Appendix A - ADS506-01-FA22 - Final Project

Team 1

12/05/2022

RMarkdown global setup

```
knitr::opts_chunk$set(fig.align = 'center')
```

Load packages

```
#library(AppliedPredictiveModeling)
#library(BioStatR)
library(car)
library(caret)
library(class)
library(corrplot)
#library(datasets)
#library(e1071)
library(forecast)
library(gridExtra)
#library(Hmisc)
library(here)
library(imputeTS)
library(lubridate)
#library(mlbench)
library(padr)
library(psych)
#library(randomForest)
#library(RANN)
library(reshape2)
#library(rpart)
#library(rpart.plot)
library(scales)
library(tidyverse)
library(timetk)
#library(tsibble)
library(tseries)
library(zoo)

set.seed(1699)
```

Create custom function to generate boxplots and descriptive statistics for continuous variables

```
box_comp <- function(xcol = c(),
                     df = NA,
                     rtn_met = TRUE,
                     grph_title = "All",
                     box = TRUE) {
  # Define function to produce formatted boxplots
  sig <- 3
  metrics_df01 <- data.frame(metric = c("",
                                        "Total N:",
                                        "Count",
                                        "NA Count",
                                        "Mean",
                                        "Median",
                                        "Standard Deviation",
                                        "Variance",
                                        "Range",
                                        "Min",
                                        "Max",
                                        "25th Percentile",
                                        "75th Percentile",
                                        "Subset w/o Outliers:",
                                        "Count",
                                        "%",
                                        "Outlier %",
                                        "NA Count",
                                        "Mean",
                                        "Median",
                                        "Standard Deviation",
                                        "Variance",
                                        "Range",
                                        "Min",
                                        "Max"
                                        ))
  for(var in xcol) {
    df_s1 <- df[, var]
    df_s1s1 <-data.frame(df_s1)
    df_s1_fit <- preProcess(df_s1s1,
                            method = c("center", "scale"))
    df_s1_trans <- predict(df_s1_fit, df_s1s1)

    # Calculate quartiles
    var_iqr_lim <- IQR(df_s1) * 1.5
    var_q1 <- quantile(df_s1, probs = c(.25))
    var_otlow <- var_q1 - var_iqr_lim
    var_q3 <- quantile(df_s1, probs = c(.75))
    var_othigh <- var_q3 + var_iqr_lim

    # Subset non-outlier data
    var_non_otlr_df01 <- subset(df, (abs(df_s1_trans) <= 3))
    #var_non_otlr_df01 <- subset(df, (df_s1 > var_otlow & df_s1 < var_othigh))
```

```r
df_s2 <- var_non_otlr_df01[, var]

# Begin calculating measures of centrality & dispersion
var_mean <- mean(df_s1, na.remove = TRUE)
var_non_otlr_df01_trunc_mean <- mean(df_s2, na.remove = TRUE)
var_med <- median(df_s1)
var_non_otlr_df01_trunc_med <- median(df_s2)
var_mode <- mode(df_s1)
var_non_otlr_df01_trunc_mode <- mode(df_s2)
var_stde <- sd(df_s1)
var_non_otlr_df01_trunc_stde <- sd(df_s2)
var_vari <- var(df_s1)
var_non_otlr_df01_trunc_vari <- var(df_s2)
var01_min <- min(df[, var])
var01_max <- max(df[, var])
var01_range <- var01_max - var01_min
var02_min <- min(var_non_otlr_df01[, var])
var02_max <- max(var_non_otlr_df01[, var])
var02_range <- var02_max - var02_min

# Configure y-axis min & max to sync graphs
plot_min <- min(var01_min, var02_min)
plot_max <- max(var01_max, var02_max)
nonoutlier_perc <- round((as.numeric(dim(var_non_otlr_df01)[1] /
↪ as.numeric(dim(df)[1]))) * 100, 1)

# Fill in metrics table
measure_val01 <- c(paste0("Variable: ", var),
                   "",
                   as.character(dim(df)[1]),
                   sum(is.na(df_s1)),
                   round(var_mean, sig),
                   round(var_med, sig),
                   round(var_stde, sig),
                   round(var_vari, sig),
                   round(var01_range, sig),
                   round(var01_min, sig),
                   round(var01_max, sig),
                   round(var_q1, sig),
                   round(var_q3, sig),
                   "",
                   as.character(dim(var_non_otlr_df01)[1]),
                   paste0(nonoutlier_perc, "%"),
                   paste0(round(100 - nonoutlier_perc, 1), "%"),
                   sum(is.na(df_s2)),
                   round(var_non_otlr_df01_trunc_mean, sig),
                   round(var_non_otlr_df01_trunc_med, sig),
                   round(var_non_otlr_df01_trunc_stde, sig),
                   round(var_non_otlr_df01_trunc_vari, sig),
                   round(var02_range, sig),
                   round(var02_min, sig),
                   round(var02_max, sig)
                   )
```

```
    var_name <- paste0("Variable: ", var)
    metrics_df01[, ncol(metrics_df01) + 1] <- measure_val01
}
  # Format boxplot titles based on number of plots
  if(box == TRUE) {
    if(length(xcol == 1)) {
      boxplot(df,
              ylab = "Parameter Values",
              main = paste0("Boxplot for ", xcol, " (", grph_title, ")"))
    }
    else {
      boxplot(df,
              ylab = "Parameter Values",
              main = paste0("Boxplot for Multiple Parameters", " (", grph_title, ")"))

    }
  }
  # Return and print metrics table(s)
  if(rtn_met == TRUE) {
    print(metrics_df01)
    return(metrics_df01)
  }
}
```

Import and merge Datasets

```
# Import 4 separate CSV files
curr_dir01 <- here("data/Ocean Water/water_quality_1990_1999_datasd.csv")
#curr_dir01
curr_dir02 <- here("data/Ocean Water/water_quality_2000_2010_datasd.csv")
#curr_dir02
curr_dir03 <- here("data/Ocean Water/water_quality_2011_2019_datasd.csv")
#curr_dir03
curr_dir04 <- here("data/Ocean Water/water_quality_2020_2021_datasd.csv")
#curr_dir04

#setwd('C:/Users/Connie/Documents/Masters Applied Data Science USD/506/Week2/Final
↪  Project/Ocean WAter')

#owt_df01a <- read_csv("water_quality_1990_1999_datasd.csv", col_types =
↪  cols(date_sample=col_date("%Y-%m-%d")))
#owt_df01b <- read_csv("water_quality_2000_2010_datasd.csv", col_types =
↪  cols(date_sample=col_date("%Y-%m-%d")))
#owt_df01c <- read_csv("water_quality_2011_2019_datasd.csv", col_types =
↪  cols(date_sample=col_date("%Y-%m-%d")))
#owt_df01d <- read_csv("water_quality_2020_2021_datasd.csv", col_types =
↪  cols(date_sample=col_date("%Y-%m-%d")))

owt_df01a <- read.csv(curr_dir01, header = TRUE, sep = ",")
owt_df01b <- read.csv(curr_dir02, header = TRUE, sep = ",")
owt_df01c <- read.csv(curr_dir03, header = TRUE, sep = ",")
```

```r
owt_df01d <- read.csv(curr_dir04, header = TRUE, sep = ",")


# Merge 4 seperate dataframes into 1
owt_df01 <- rbind(owt_df01a, owt_df01b, owt_df01c, owt_df01d)

# DF Reindex Citation:
# https://gist.github.com/makexu93/05ef0f34306d3ab6c9ca8ddcd702cee1
owt_df01 <- owt_df01[order(owt_df01$date_sample, decreasing = FALSE), ]
row.names(owt_df01) <- NULL

print(head(owt_df01, 17))
```

```
##        sample station depth_m date_sample        time project   parameter
## 1  9011158743      C5     9.0  1990-11-15                PLOO CHLOROPHYLL
## 2  9011158743      C5     9.0  1990-11-15                PLOO     DENSITY
## 3  9011158743      C5     9.0  1990-11-15                PLOO          DO
## 4  9011158743      C5     9.0  1990-11-15                PLOO          PH
## 5  9011158743      C5     9.0  1990-11-15                PLOO    SALINITY
## 6  9011158743      C5     9.0  1990-11-15                PLOO        TEMP
## 7  9011158743      C5     9.0  1990-11-15                PLOO         XMS
## 8  9011158834     I25     6.0  1990-11-15                SBOO CHLOROPHYLL
## 9  9011158834     I25     6.0  1990-11-15                SBOO     DENSITY
## 10 9011158834     I25     6.0  1990-11-15                SBOO          DO
## 11 9011158834     I25     6.0  1990-11-15                SBOO          PH
## 12 9011158834     I25     6.0  1990-11-15                SBOO    SALINITY
## 13 9011158834     I25     6.0  1990-11-15                SBOO        TEMP
## 14 9011158834     I25     6.0  1990-11-15                SBOO         XMS
## 15   KE000001      A1     1.5  1991-01-02 7:18:00 PST    PLOO      ENTERO
## 16   KE000001      A1     1.5  1991-01-02 7:18:00 PST    PLOO       FECAL
## 17  CTD000001      A1     1.5  1991-01-02 7:18:00 PST    PLOO        TEMP
##    qualifier    value      units
## 1               0.870       ug/L
## 2              23.855    sigma-t
## 3               6.550       mg/L
## 4               8.080         pH
## 5              33.617        ppt
## 6              19.430          C
## 7              44.850          %
## 8               1.270       ug/L
## 9              23.853    sigma-t
## 10              7.410       mg/L
## 11              8.180         pH
## 12             33.574        ppt
## 13             19.310          C
## 14             75.600          %
## 15         e  200.000 CFU/100 mL
## 16         > 1200.000 CFU/100 mL
## 17             14.500          C
```

```r
describe(owt_df01)
```

```
##             vars       n   mean      sd min     max   range   se
## sample         1 1236769    NaN      NA Inf    -Inf    -Inf   NA
```

```
## station        2 1236769    NaN      NA Inf    -Inf    -Inf   NA
## depth_m        3 1152608  19.38   25.07   1     116     115 0.02
## date_sample    4 1236769    NaN      NA Inf    -Inf    -Inf   NA
## time           5 1236769    NaN      NA Inf    -Inf    -Inf   NA
## project        6 1236769    NaN      NA Inf    -Inf    -Inf   NA
## parameter      7 1236769    NaN      NA Inf    -Inf    -Inf   NA
## qualifier      8 1236769    NaN      NA Inf    -Inf    -Inf   NA
## value          9 1231466 124.24 1785.21 -37 1100000 1100037 1.61
## units         10 1236769    NaN      NA Inf    -Inf    -Inf   NA
```

```
#write.csv(owt_df01, "C:/Users/acarr/Sync/Programming/Python and R/ADS Markdown
↪  Files/ADS-506 Markdown/Final Project/data/Ocean Water/ocean_df01.csv")
```

Factorize and format column types; print NA counts

```
# List of parameter values
param_lst01 <- c("CHLOROPHYLL",
                 "DENSITY",
                 "DO",
                 "ENTERO",
                 "FECAL",
                 "OG",
                 "PH",
                 "SALINITY",
                 "SUSO",
                 "TEMP",
                 "TOTAL",
                 "XMS")

# List of col names
col_lst01 <- c("sample",
               "station",
               "date_sample",
               "time",
               "project",
               "parameter",
               "qualifier",
               "units")

# Citation: https://www.geeksforgeeks.org/find-columns-and-rows-with-na-in-r-dataframe/
owt_df02 <- owt_df01
for(c in col_lst01) {
  owt_df02[, c] <- as.factor(owt_df02[, c] )
}

# Generate NA summary tables
# Citation: https://www.geeksforgeeks.org/replace-character-value-with-na-in-r/
owt_df02[owt_df02 == ""] <- NA
print(head(owt_df02, 17))
```

```
##        sample station depth_m date_sample        time project   parameter
## 1  9011158743      C5     9.0  1990-11-15        <NA>    PLOO CHLOROPHYLL
## 2  9011158743      C5     9.0  1990-11-15        <NA>    PLOO     DENSITY
## 3  9011158743      C5     9.0  1990-11-15        <NA>    PLOO          DO
```

```
## 4  9011158743      C5     9.0  1990-11-15        <NA>    PLOO          PH
## 5  9011158743      C5     9.0  1990-11-15        <NA>    PLOO    SALINITY
## 6  9011158743      C5     9.0  1990-11-15        <NA>    PLOO        TEMP
## 7  9011158743      C5     9.0  1990-11-15        <NA>    PLOO         XMS
## 8  9011158834     I25     6.0  1990-11-15        <NA>    SBOO CHLOROPHYLL
## 9  9011158834     I25     6.0  1990-11-15        <NA>    SBOO     DENSITY
## 10 9011158834     I25     6.0  1990-11-15        <NA>    SBOO          DO
## 11 9011158834     I25     6.0  1990-11-15        <NA>    SBOO          PH
## 12 9011158834     I25     6.0  1990-11-15        <NA>    SBOO    SALINITY
## 13 9011158834     I25     6.0  1990-11-15        <NA>    SBOO        TEMP
## 14 9011158834     I25     6.0  1990-11-15        <NA>    SBOO         XMS
## 15   KE000001      A1     1.5  1991-01-02 7:18:00 PST    PLOO      ENTERO
## 16   KE000001      A1     1.5  1991-01-02 7:18:00 PST    PLOO       FECAL
## 17  CTD000001      A1     1.5  1991-01-02 7:18:00 PST    PLOO        TEMP
##    qualifier    value      units
## 1       <NA>    0.870       ug/L
## 2       <NA>   23.855    sigma-t
## 3       <NA>    6.550       mg/L
## 4       <NA>    8.080         pH
## 5       <NA>   33.617        ppt
## 6       <NA>   19.430          C
## 7       <NA>   44.850          %
## 8       <NA>    1.270       ug/L
## 9       <NA>   23.853    sigma-t
## 10      <NA>    7.410       mg/L
## 11      <NA>    8.180         pH
## 12      <NA>   33.574        ppt
## 13      <NA>   19.310          C
## 14      <NA>   75.600          %
## 15         e  200.000 CFU/100 mL
## 16         > 1200.000 CFU/100 mL
## 17      <NA>   14.500          C
```

```r
owt_df02_na <- sapply(owt_df02, function(x) sum(is.na(x)))
owt_df02_notna <- sapply(owt_df02, function(x) sum(!is.na(x)))
owt_df02_tbl01 <- rbind(owt_df02_notna, owt_df02_na)
owt_df02_tbl02 <- rbind(owt_df02_tbl01, round(prop.table(owt_df02_tbl01, margin = 2), 4))
print("All parameters")
```

```
## [1] "All parameters"
```

```r
print(owt_df02_tbl02)
```

```
##                 sample station     depth_m date_sample       time project
## owt_df02_notna 1236769 1236769 1152608.000     1236769 1075929.00 1236769
## owt_df02_na          0       0   84161.000           0  160840.00       0
## owt_df02_notna       1       1       0.932           1       0.87       1
## owt_df02_na          0       0       0.068           0       0.13       0
##                parameter   qualifier        value   units
## owt_df02_notna   1236769 394867.0000 1231466.0000 1236769
## owt_df02_na            0 841902.0000    5303.0000       0
## owt_df02_notna         1      0.3193       0.9957       1
## owt_df02_na            0      0.6807       0.0043       0
```

```r
owt_df02a <- owt_df02[which(is.na(owt_df02), arr.ind=TRUE), ]
#print(head(owt_df02a, 17))

for(p in param_lst01) {
  df = owt_df02[owt_df02$parameter == p, ]
  print(head(df[which(is.na(df$value), arr.ind=TRUE), ], 17))
  df_na <- sapply(df, function(x) sum(is.na(x)))
  df_notna <- sapply(df, function(x) sum(!is.na(x)))
  df_tbl01 <- rbind(df_notna, df_na)
  df_tbl02 <- rbind(df_tbl01, round(prop.table(df_tbl01, margin = 2), 4))
  rownames(df_tbl02) <- c("Not NA n", "NA n", "Not NA %", "NA %")
  print(p)
  print(df_tbl02) # This table w/ null counts and proportions for each feature not
  ↪  displayed for space purposes
}
```

```
##            sample station depth_m date_sample time project   parameter
## 272260 1229972635     B10     1.5  1997-12-29 <NA>    PLOO CHLOROPHYLL
## 272267 1229972638     B10    42.7  1997-12-29 <NA>    PLOO CHLOROPHYLL
## 272274 1229972633     B10    61.0  1997-12-29 <NA>    PLOO CHLOROPHYLL
## 272281 1229972634     B10    79.2  1997-12-29 <NA>    PLOO CHLOROPHYLL
## 272288 1229972637     B10    97.5  1997-12-29 <NA>    PLOO CHLOROPHYLL
## 272295 1229972636     B10   115.8  1997-12-29 <NA>    PLOO CHLOROPHYLL
## 272302 1229972643     B11     1.5  1997-12-29 <NA>    PLOO CHLOROPHYLL
## 272309 1229972639     B11    42.7  1997-12-29 <NA>    PLOO CHLOROPHYLL
## 272316 1229972642     B11    61.0  1997-12-29 <NA>    PLOO CHLOROPHYLL
## 272323 1229972641     B11    79.2  1997-12-29 <NA>    PLOO CHLOROPHYLL
## 272330 1229972640     B11    88.4  1997-12-29 <NA>    PLOO CHLOROPHYLL
## 272337 1229972644     B13     1.5  1997-12-29 <NA>    PLOO CHLOROPHYLL
## 272344 1229972648     B13    42.7  1997-12-29 <NA>    PLOO CHLOROPHYLL
## 272351 1229972647     B13    61.0  1997-12-29 <NA>    PLOO CHLOROPHYLL
## 272358 1229972646     B13    79.2  1997-12-29 <NA>    PLOO CHLOROPHYLL
## 272365 1229972649     B13    97.5  1997-12-29 <NA>    PLOO CHLOROPHYLL
## 272372 1229972645     B13   115.8  1997-12-29 <NA>    PLOO CHLOROPHYLL
##        qualifier value units
## 272260      <NA>    NA  ug/L
## 272267      <NA>    NA  ug/L
## 272274      <NA>    NA  ug/L
## 272281      <NA>    NA  ug/L
## 272288      <NA>    NA  ug/L
## 272295      <NA>    NA  ug/L
## 272302      <NA>    NA  ug/L
## 272309      <NA>    NA  ug/L
## 272316      <NA>    NA  ug/L
## 272323      <NA>    NA  ug/L
## 272330      <NA>    NA  ug/L
## 272337      <NA>    NA  ug/L
## 272344      <NA>    NA  ug/L
## 272351      <NA>    NA  ug/L
## 272358      <NA>    NA  ug/L
## 272365      <NA>    NA  ug/L
## 272372      <NA>    NA  ug/L
## [1] "CHLOROPHYLL"
```

```
##          sample station depth_m date_sample       time project parameter
## Not NA n  88471   88471   88471       88471 74093.0000   88471     88471
## NA n          0       0       0           0 14378.0000       0         0
## Not NA %      1       1       1           1     0.8375       1         1
## NA %          0       0       0           0     0.1625       0         0
##          qualifier      value units
## Not NA n         0 87911.0000 88471
## NA n         88471   560.0000     0
## Not NA %         0     0.9937     1
## NA %             1     0.0063     0
##            sample station depth_m date_sample         time project parameter
## 429235 1018012132     E16     1.5  2001-10-18  8:32:00 PST    PLOO   DENSITY
## 503878  513032821      C8     1.0  2003-05-13 10:30:00 PST    PLOO   DENSITY
## 547108  601042705      C4     1.0  2004-06-01 11:37:00 PST    PLOO   DENSITY
## 720423  702082492      A6     1.0  2008-07-02  9:42:00 PST    PLOO   DENSITY
## 720433  702082490      A6    12.0  2008-07-02  9:42:00 PST    PLOO   DENSITY
## 720443  702082491      A6    18.0  2008-07-02  9:42:00 PST    PLOO   DENSITY
## 720453  702082495      A7     1.0  2008-07-02  9:05:00 PST    PLOO   DENSITY
## 720463  702082493      A7    12.0  2008-07-02  9:05:00 PST    PLOO   DENSITY
## 720473  702082494      A7    18.0  2008-07-02  9:05:00 PST    PLOO   DENSITY
## 720483  702082498      C4     1.0  2008-07-02 11:45:00 PST    PLOO   DENSITY
## 720493  702082496      C4     3.0  2008-07-02 11:45:00 PST    PLOO   DENSITY
## 720503  702082497      C4     9.0  2008-07-02 11:45:00 PST    PLOO   DENSITY
## 720513  702082501      C5     1.0  2008-07-02 11:25:00 PST    PLOO   DENSITY
## 720523  702082499      C5     3.0  2008-07-02 11:25:00 PST    PLOO   DENSITY
## 720533  702082500      C5     9.0  2008-07-02 11:25:00 PST    PLOO   DENSITY
## 720543  702082504      C6     1.0  2008-07-02 11:12:00 PST    PLOO   DENSITY
## 720553  702082502      C6     3.0  2008-07-02 11:12:00 PST    PLOO   DENSITY
##        qualifier value   units
## 429235      <NA>    NA sigma-t
## 503878      <NA>    NA sigma-t
## 547108      <NA>    NA sigma-t
## 720423      <NA>    NA sigma-t
## 720433      <NA>    NA sigma-t
## 720443      <NA>    NA sigma-t
## 720453      <NA>    NA sigma-t
## 720463      <NA>    NA sigma-t
## 720473      <NA>    NA sigma-t
## 720483      <NA>    NA sigma-t
## 720493      <NA>    NA sigma-t
## 720503      <NA>    NA sigma-t
## 720513      <NA>    NA sigma-t
## 720523      <NA>    NA sigma-t
## 720533      <NA>    NA sigma-t
## 720543      <NA>    NA sigma-t
## 720553      <NA>    NA sigma-t
## [1] "DENSITY"
##          sample station depth_m date_sample       time project parameter
## Not NA n  88317   88317   88317       88317 73999.0000   88317     88317
## NA n          0       0       0           0 14318.0000       0         0
## Not NA %      1       1       1           1     0.8379       1         1
## NA %          0       0       0           0     0.1621       0         0
##          qualifier      value units
## Not NA n         0 88256.0000 88317
```

```
## NA n         88317    61.0000     0
## Not NA %         0     0.9993     1
## NA %             1     0.0007     0
##            sample station depth_m date_sample         time project parameter
## 82185   CTD014940     A11    42.7  1993-05-06 10:45:00 PST    PLOO        DO
## 168703 1024942994      A1     1.5  1994-10-24  9:10:00 PST    PLOO        DO
## 168713 1024942995      A1     3.0  1994-10-24  9:10:00 PST    PLOO        DO
## 168723 1024942996      A1     6.1  1994-10-24  9:10:00 PST    PLOO        DO
## 168733 1024942997      A1    12.2  1994-10-24  9:10:00 PST    PLOO        DO
## 168734 1024942998      A1    12.2  1994-10-24  9:10:00 PST    PLOO        DO
## 168748 1024942999      A1    18.3  1994-10-24  9:10:00 PST    PLOO        DO
## 237009  909962654      B2     1.5  1996-09-09 12:11:00 PST    PLOO        DO
## 237017  909962655      B2    12.2  1996-09-09 12:11:00 PST    PLOO        DO
## 237025  909962656      B2    18.3  1996-09-09 12:11:00 PST    PLOO        DO
## 369865  713002413      A1     1.5  2000-07-13 11:06:00 PST    PLOO        DO
## 369878  713002414      A1    12.2  2000-07-13 11:06:00 PST    PLOO        DO
## 369889  713002415      A1    18.3  2000-07-13 11:06:00 PST    PLOO        DO
## 373128  816002467      A7     1.5  2000-08-16  8:49:00 PST    PLOO        DO
## 373140  816002468      A7    12.2  2000-08-16  8:49:00 PST    PLOO        DO
## 373151  816002469      A7    18.3  2000-08-16  8:49:00 PST    PLOO        DO
## 375761  905002505      I6    27.4  2000-09-05 10:41:00 PST    SBOO        DO
##        qualifier value units
## 82185       <NA>    NA  mg/L
## 168703      <NA>    NA  mg/L
## 168713      <NA>    NA  mg/L
## 168723      <NA>    NA  mg/L
## 168733      <NA>    NA  mg/L
## 168734      <NA>    NA  mg/L
## 168748      <NA>    NA  mg/L
## 237009      <NA>    NA  mg/L
## 237017      <NA>    NA  mg/L
## 237025      <NA>    NA  mg/L
## 369865      <NA>    NA  mg/L
## 369878      <NA>    NA  mg/L
## 369889      <NA>    NA  mg/L
## 373128      <NA>    NA  mg/L
## 373140      <NA>    NA  mg/L
## 373151      <NA>    NA  mg/L
## 375761      <NA>    NA  mg/L
## [1] "DO"
##          sample station depth_m date_sample       time project parameter
## Not NA n 109542  109542  109542      109542 83392.0000  109542    109542
## NA n          0       0       0           0 26150.0000       0         0
## Not NA %      1       1       1           1     0.7613       1         1
## NA %          0       0       0           0     0.2387       0         0
##          qualifier      value  units
## Not NA n         0 109437.000 109542
## NA n        109542    105.000      0
## Not NA %         0      0.999      1
## NA %             1      0.001      0
##            sample station depth_m date_sample        time project parameter
## 25057    MO001828      A2     1.0  1991-10-09 8:27:00 PST    PLOO    ENTERO
## 81650    SH000903      D5      NA  1993-05-04        <NA>    PLOO    ENTERO
## 103629 1208931380      A2     3.0  1993-12-08 8:20:00 PST    PLOO    ENTERO
```

```
## 103642 1208931381      A2     6.1  1993-12-08 8:20:00 PST    PLOO    ENTERO
## 103655 1208931382      A2    12.2  1993-12-08 8:20:00 PST    PLOO    ENTERO
## 103668 1208931383      A2    18.3  1993-12-08 8:20:00 PST    PLOO    ENTERO
## 103701 1208931385      A2    30.5  1993-12-08 8:20:00 PST    PLOO    ENTERO
## 103714 1208931386      A2    36.6  1993-12-08 8:20:00 PST    PLOO    ENTERO
## 103727 1208931387      A2    42.7  1993-12-08 8:20:00 PST    PLOO    ENTERO
## 103740 1208931388      A2    48.8  1993-12-08 8:20:00 PST    PLOO    ENTERO
## 103753 1208931389      A2    54.9  1993-12-08 8:20:00 PST    PLOO    ENTERO
## 103812 1208931392      A3     3.0  1993-12-08 9:49:00 PST    PLOO    ENTERO
## 103825 1208931393      A3     6.1  1993-12-08 9:49:00 PST    PLOO    ENTERO
## 103838 1208931394      A3    12.2  1993-12-08 9:49:00 PST    PLOO    ENTERO
## 103851 1208931395      A3    18.3  1993-12-08 9:49:00 PST    PLOO    ENTERO
## 103882 1208931397      A3    30.5  1993-12-08 9:49:00 PST    PLOO    ENTERO
## 103895 1208931398      A3    36.6  1993-12-08 9:49:00 PST    PLOO    ENTERO
##        qualifier value      units
## 25057          e    NA CFU/100 mL
## 81650       <NA>    NA CFU/100 mL
## 103629      <NA>    NA CFU/100 mL
## 103642      <NA>    NA CFU/100 mL
## 103655      <NA>    NA CFU/100 mL
## 103668      <NA>    NA CFU/100 mL
## 103701      <NA>    NA CFU/100 mL
## 103714      <NA>    NA CFU/100 mL
## 103727      <NA>    NA CFU/100 mL
## 103740      <NA>    NA CFU/100 mL
## 103753      <NA>    NA CFU/100 mL
## 103812      <NA>    NA CFU/100 mL
## 103825      <NA>    NA CFU/100 mL
## 103838      <NA>    NA CFU/100 mL
## 103851      <NA>    NA CFU/100 mL
## 103882      <NA>    NA CFU/100 mL
## 103895      <NA>    NA CFU/100 mL
## [1] "ENTERO"
##          sample station     depth_m date_sample        time project parameter
## Not NA n 144341  144341 116186.0000      144341 144012.0000  144341    144341
## NA n          0       0  28155.0000           0    329.0000       0         0
## Not NA %      1       1      0.8049           1      0.9977       1         1
## NA %          0       0      0.1951           0      0.0023       0         0
##           qualifier       value  units
## Not NA n 136251.000 143075.0000 144341
## NA n       8090.000   1266.0000      0
## Not NA %      0.944      0.9912      1
## NA %          0.056      0.0088      0
##            sample station depth_m date_sample        time project parameter
## 39760    MO003378      B3    61.0  1992-03-04 9:23:00 PST    PLOO     FECAL
## 73538    MO002093      A4    79.2  1993-02-03 9:15:00 PST    PLOO     FECAL
## 81651    SH000903      D5      NA  1993-05-04        <NA>    PLOO     FECAL
## 82671    SH001257      D7      NA  1993-05-11 9:43:00 PST    PLOO     FECAL
## 103630 1208931380      A2     3.0  1993-12-08 8:20:00 PST    PLOO     FECAL
## 103643 1208931381      A2     6.1  1993-12-08 8:20:00 PST    PLOO     FECAL
## 103656 1208931382      A2    12.2  1993-12-08 8:20:00 PST    PLOO     FECAL
## 103669 1208931383      A2    18.3  1993-12-08 8:20:00 PST    PLOO     FECAL
## 103702 1208931385      A2    30.5  1993-12-08 8:20:00 PST    PLOO     FECAL
## 103715 1208931386      A2    36.6  1993-12-08 8:20:00 PST    PLOO     FECAL
```

```
## 103728 1208931387      A2    42.7  1993-12-08 8:20:00 PST    PLOO     FECAL
## 103741 1208931388      A2    48.8  1993-12-08 8:20:00 PST    PLOO     FECAL
## 103754 1208931389      A2    54.9  1993-12-08 8:20:00 PST    PLOO     FECAL
## 103813 1208931392      A3     3.0  1993-12-08 9:49:00 PST    PLOO     FECAL
## 103826 1208931393      A3     6.1  1993-12-08 9:49:00 PST    PLOO     FECAL
## 103839 1208931394      A3    12.2  1993-12-08 9:49:00 PST    PLOO     FECAL
## 103852 1208931395      A3    18.3  1993-12-08 9:49:00 PST    PLOO     FECAL
##        qualifier value      units
## 39760          <    NA CFU/100 mL
## 73538          <    NA CFU/100 mL
## 81651       <NA>    NA CFU/100 mL
## 82671       <NA>    NA CFU/100 mL
## 103630      <NA>    NA CFU/100 mL
## 103643      <NA>    NA CFU/100 mL
## 103656      <NA>    NA CFU/100 mL
## 103669      <NA>    NA CFU/100 mL
## 103702      <NA>    NA CFU/100 mL
## 103715      <NA>    NA CFU/100 mL
## 103728      <NA>    NA CFU/100 mL
## 103741      <NA>    NA CFU/100 mL
## 103754      <NA>    NA CFU/100 mL
## 103813      <NA>    NA CFU/100 mL
## 103826      <NA>    NA CFU/100 mL
## 103839      <NA>    NA CFU/100 mL
## 103852      <NA>    NA CFU/100 mL
## [1] "FECAL"
##          sample station     depth_m date_sample        time project parameter
## Not NA n 137649  137649 109633.0000      137649 137322.0000  137649    137649
## NA n          0       0  28016.0000           0    327.0000       0         0
## Not NA %      1       1      0.7965           1      0.9976       1         1
## NA %          0       0      0.2035           0      0.0024       0         0
##            qualifier      value  units
## Not NA n 127994.0000 136405.000 137649
## NA n       9655.0000   1244.000      0
## Not NA %      0.9299      0.991      1
## NA %          0.0701      0.009      0
##           sample station depth_m date_sample         time project parameter
## 112401 112941961      A1    12.2  1994-01-12  8:36:00 PST    PLOO        OG
## 125289 309941665      A4    79.2  1994-03-09 10:06:00 PST    PLOO        OG
## 136304 503941704      B5     1.5  1994-05-03 10:24:00 PST    PLOO        OG
## 136346 503941705      B5    24.4  1994-05-03 10:24:00 PST    PLOO        OG
## 136396 503941706      B5    61.0  1994-05-03 10:24:00 PST    PLOO        OG
## 136772 504941833      A2    24.4  1994-05-04  8:02:00 PST    PLOO        OG
## 137186 504941844      A6     1.5  1994-05-04  9:17:00 PST    PLOO        OG
## 137212 504941845      A6    12.2  1994-05-04  9:17:00 PST    PLOO        OG
## 137213 504941846      A6    12.2  1994-05-04  9:17:00 PST    PLOO        OG
## 137223 504941847      A6    18.3  1994-05-04  9:17:00 PST    PLOO        OG
## 137485 505941970      A7     1.5  1994-05-05 10:19:00 PST    PLOO        OG
## 137511 505941971      A7    12.2  1994-05-05 10:19:00 PST    PLOO        OG
## 137512 505941972      A7    12.2  1994-05-05 10:19:00 PST    PLOO        OG
## 137522 505941973      A7    18.3  1994-05-05 10:19:00 PST    PLOO        OG
## 137532 505941974      B1     1.5  1994-05-05  7:50:00 PST    PLOO        OG
## 137574 505941975      B1    24.4  1994-05-05  7:50:00 PST    PLOO        OG
## 137575 505941976      B1    24.4  1994-05-05  7:50:00 PST    PLOO        OG
```

```
##        qualifier value units
## 112401      <NA>    NA  mg/L
## 125289      <NA>    NA  mg/L
## 136304      <NA>    NA  mg/L
## 136346      <NA>    NA  mg/L
## 136396      <NA>    NA  mg/L
## 136772      <NA>    NA  mg/L
## 137186      <NA>    NA  mg/L
## 137212      <NA>    NA  mg/L
## 137213      <NA>    NA  mg/L
## 137223      <NA>    NA  mg/L
## 137485      <NA>    NA  mg/L
## 137511      <NA>    NA  mg/L
## 137512      <NA>    NA  mg/L
## 137522      <NA>    NA  mg/L
## 137532      <NA>    NA  mg/L
## 137574      <NA>    NA  mg/L
## 137575      <NA>    NA  mg/L
## [1] "OG"
##          sample station depth_m date_sample      time project parameter
## Not NA n   7944    7944    7944        7944 7940.0000    7944      7944
## NA n          0       0       0           0    4.0000       0         0
## Not NA %      1       1       1           1    0.9995       1         1
## NA %          0       0       0           0    0.0005       0         0
##          qualifier     value units
## Not NA n 7673.0000 7922.0000  7944
## NA n      271.0000   22.0000     0
## Not NA %    0.9659    0.9972     1
## NA %        0.0341    0.0028     0
##            sample station depth_m date_sample         time project parameter
## 168706 1024942994      A1     1.5  1994-10-24  9:10:00 PST    PLOO        PH
## 168716 1024942995      A1     3.0  1994-10-24  9:10:00 PST    PLOO        PH
## 168726 1024942996      A1     6.1  1994-10-24  9:10:00 PST    PLOO        PH
## 168737 1024942997      A1    12.2  1994-10-24  9:10:00 PST    PLOO        PH
## 168738 1024942998      A1    12.2  1994-10-24  9:10:00 PST    PLOO        PH
## 168751 1024942999      A1    18.3  1994-10-24  9:10:00 PST    PLOO        PH
## 332755  923992590      A1     1.5  1999-09-23  7:40:00 PST    PLOO        PH
## 332767  923992591      A1    12.2  1999-09-23  7:40:00 PST    PLOO        PH
## 332778  923992592      A1    18.3  1999-09-23  7:40:00 PST    PLOO        PH
## 332799  923992593      A6     1.5  1999-09-23  8:47:00 PST    PLOO        PH
## 332810  923992594      A6    12.2  1999-09-23  8:47:00 PST    PLOO        PH
## 332821  923992595      A6    18.3  1999-09-23  8:47:00 PST    PLOO        PH
## 332833  923992596      A7     1.5  1999-09-23  7:57:00 PST    PLOO        PH
## 332844  923992597      A7    12.2  1999-09-23  7:57:00 PST    PLOO        PH
## 332855  923992598      A7    18.3  1999-09-23  7:57:00 PST    PLOO        PH
## 332866  923992599      C4     1.5  1999-09-23 10:24:00 PST    PLOO        PH
## 332877  923992600      C4     3.0  1999-09-23 10:24:00 PST    PLOO        PH
##        qualifier value units
## 168706      <NA>    NA    pH
## 168716      <NA>    NA    pH
## 168726      <NA>    NA    pH
## 168737      <NA>    NA    pH
## 168738      <NA>    NA    pH
## 168751      <NA>    NA    pH
```

```
## 332755      <NA>    NA    pH
## 332767      <NA>    NA    pH
## 332778      <NA>    NA    pH
## 332799      <NA>    NA    pH
## 332810      <NA>    NA    pH
## 332821      <NA>    NA    pH
## 332833      <NA>    NA    pH
## 332844      <NA>    NA    pH
## 332855      <NA>    NA    pH
## 332866      <NA>    NA    pH
## 332877      <NA>    NA    pH
## [1] "PH"
##          sample station depth_m date_sample       time project parameter
## Not NA n 107818  107818  107818      107818 81668.0000  107818    107818
## NA n          0       0       0           0 26150.0000       0         0
## Not NA %      1       1       1           1     0.7575       1         1
## NA %          0       0       0           0     0.2425       0         0
##          qualifier       value  units
## Not NA n         0 107564.0000 107818
## NA n        107818    254.0000      0
## Not NA %         0      0.9976      1
## NA %             1      0.0024      0
##            sample station depth_m date_sample         time project parameter
## 82188   CTD014940     A11    42.7  1993-05-06 10:45:00 PST    PLOO  SALINITY
## 168707 1024942994      A1     1.5  1994-10-24  9:10:00 PST    PLOO  SALINITY
## 168717 1024942995      A1     3.0  1994-10-24  9:10:00 PST    PLOO  SALINITY
## 168727 1024942996      A1     6.1  1994-10-24  9:10:00 PST    PLOO  SALINITY
## 168739 1024942997      A1    12.2  1994-10-24  9:10:00 PST    PLOO  SALINITY
## 168740 1024942998      A1    12.2  1994-10-24  9:10:00 PST    PLOO  SALINITY
## 168752 1024942999      A1    18.3  1994-10-24  9:10:00 PST    PLOO  SALINITY
## 369870  713002413      A1     1.5  2000-07-13 11:06:00 PST    PLOO  SALINITY
## 369882  713002414      A1    12.2  2000-07-13 11:06:00 PST    PLOO  SALINITY
## 369893  713002415      A1    18.3  2000-07-13 11:06:00 PST    PLOO  SALINITY
## 373133  816002467      A7     1.5  2000-08-16  8:49:00 PST    PLOO  SALINITY
## 373144  816002468      A7    12.2  2000-08-16  8:49:00 PST    PLOO  SALINITY
## 373155  816002469      A7    18.3  2000-08-16  8:49:00 PST    PLOO  SALINITY
## 429241 1018012132     E16     1.5  2001-10-18  8:32:00 PST    PLOO  SALINITY
## 468131  813022786      C6     6.0  2002-08-13 11:10:00 PST    PLOO  SALINITY
## 503883  513032821      C8     1.0  2003-05-13 10:30:00 PST    PLOO  SALINITY
## 547113  601042705      C4     1.0  2004-06-01 11:37:00 PST    PLOO  SALINITY
##        qualifier value units
## 82188       <NA>    NA   ppt
## 168707      <NA>    NA   ppt
## 168717      <NA>    NA   ppt
## 168727      <NA>    NA   ppt
## 168739      <NA>    NA   ppt
## 168740      <NA>    NA   ppt
## 168752      <NA>    NA   ppt
## 369870      <NA>    NA   ppt
## 369882      <NA>    NA   ppt
## 369893      <NA>    NA   ppt
## 373133      <NA>    NA   ppt
## 373144      <NA>    NA   ppt
## 373155      <NA>    NA   ppt
```

```
## 429241      <NA>    NA   ppt
## 468131      <NA>    NA   ppt
## 503883      <NA>    NA   ppt
## 547113      <NA>    NA   ppt
## [1] "SALINITY"
##          sample station depth_m date_sample       time project parameter
## Not NA n 109492  109492  109492      109492 83351.0000  109492    109492
## NA n          0       0       0           0 26141.0000       0         0
## Not NA %      1       1       1           1     0.7613       1         1
## NA %          0       0       0           0     0.2387       0         0
##          qualifier       value  units
## Not NA n         0 109318.0000 109492
## NA n        109492    174.0000      0
## Not NA %         0      0.9984      1
## NA %             1      0.0016      0
##            sample station depth_m date_sample         time project parameter
## 182188  119951890      B1    61.0  1995-01-19  7:25:00 PST    PLOO      SUSO
## 197840  413951394      B9    97.5  1995-04-13 11:32:00 PST    PLOO      SUSO
## 236137  821961617      B9     1.5  1996-08-21  8:23:00 PST    PLOO      SUSO
## 236146  821961618      B9    42.7  1996-08-21  8:23:00 PST    PLOO      SUSO
## 236171  821961619      B9    97.5  1996-08-21  8:23:00 PST    PLOO      SUSO
## 236208  821961620     E10     1.5  1996-08-21 10:58:00 PST    PLOO      SUSO
## 236217  821961621     E10    42.7  1996-08-21 10:58:00 PST    PLOO      SUSO
## 236242  821961622     E10    88.4  1996-08-21 10:58:00 PST    PLOO      SUSO
## 237106  910961040      A1    12.2  1996-09-10  7:23:00 PST    PLOO      SUSO
## 237115  910961041      A1    18.3  1996-09-10  7:23:00 PST    PLOO      SUSO
## 237125  910961042      A6     1.5  1996-09-10  8:45:00 PST    PLOO      SUSO
## 237143  910961044      A6    18.3  1996-09-10  8:45:00 PST    PLOO      SUSO
## 237153  910961045      A7     1.5  1996-09-10  8:13:00 PST    PLOO      SUSO
## 237162  910961046      A7    12.2  1996-09-10  8:13:00 PST    PLOO      SUSO
## 262334  814971868      A6    18.3  1997-08-14  9:00:00 PST    PLOO      SUSO
## 267067 1015971437      E5    42.7  1997-10-15 12:28:00 PST    PLOO      SUSO
## 278347  311981070     B12     1.5  1998-03-11  7:48:00 PST    PLOO      SUSO
##        qualifier value units
## 182188      <NA>    NA  mg/L
## 197840      <NA>    NA  mg/L
## 236137      <NA>    NA  mg/L
## 236146      <NA>    NA  mg/L
## 236171      <NA>    NA  mg/L
## 236208      <NA>    NA  mg/L
## 236217      <NA>    NA  mg/L
## 236242      <NA>    NA  mg/L
## 237106      <NA>    NA  mg/L
## 237115      <NA>    NA  mg/L
## 237125      <NA>    NA  mg/L
## 237143      <NA>    NA  mg/L
## 237153      <NA>    NA  mg/L
## 237162      <NA>    NA  mg/L
## 262334      <NA>    NA  mg/L
## 267067      <NA>    NA  mg/L
## 278347      <NA>    NA  mg/L
## [1] "SUSO"
##          sample station depth_m date_sample       time project parameter
## Not NA n  27543   27543   27543       27543 27538.0000   27543     27543
```

```
## NA n          0       0       0           0     5.0000       0         0
## Not NA %      1       1       1           1     0.9998       1         1
## NA %          0       0       0           0     0.0002       0         0
##           qualifier     value units
## Not NA n  1290.0000 27515.000 27543
## NA n     26253.0000    28.000     0
## Not NA %     0.0468     0.999     1
## NA %         0.9532     0.001     0
##          sample station depth_m date_sample         time project parameter
## 81483 CTD013369      K4    18.3  1993-05-03  7:07:00 PST    PLOO      TEMP
## 82189 CTD014940     A11    42.7  1993-05-06 10:45:00 PST    PLOO      TEMP
## 82454 CTD013374      K4    18.3  1993-05-06  8:52:00 PST    PLOO      TEMP
## 82871 CTD013384      K4    18.3  1993-05-12  7:36:00 PST    PLOO      TEMP
## 83293 CTD008245      C6     1.5  1993-05-19 12:10:00 PST    PLOO      TEMP
## 83297 CTD008246      C6     3.0  1993-05-19 12:10:00 PST    PLOO      TEMP
## 83301 CTD008247      C6     6.1  1993-05-19 12:10:00 PST    PLOO      TEMP
## 83495 CTD013399      K4    18.3  1993-05-20  7:20:00 PST    PLOO      TEMP
## 83500 CTD008251      C6     1.5  1993-05-21 12:58:00 PST    PLOO      TEMP
## 83504 CTD008252      C6     3.0  1993-05-21 12:58:00 PST    PLOO      TEMP
## 83508 CTD008253      C6     6.1  1993-05-21 12:58:00 PST    PLOO      TEMP
## 83562 CTD004913      A7     1.5  1993-05-24  8:31:00 PST    PLOO      TEMP
## 83567 CTD004914      A7     3.0  1993-05-24  8:31:00 PST    PLOO      TEMP
## 83572 CTD004915      A7     6.1  1993-05-24  8:31:00 PST    PLOO      TEMP
## 83577 CTD004916      A7    12.2  1993-05-24  8:31:00 PST    PLOO      TEMP
## 83582 CTD004917      A7    18.3  1993-05-24  8:31:00 PST    PLOO      TEMP
## 83652 CTD009898      C7    18.3  1993-05-24  9:12:00 PST    PLOO      TEMP
##       qualifier value units
## 81483      <NA>    NA     C
## 82189      <NA>    NA     C
## 82454      <NA>    NA     C
## 82871      <NA>    NA     C
## 83293      <NA>    NA     C
## 83297      <NA>    NA     C
## 83301      <NA>    NA     C
## 83495      <NA>    NA     C
## 83500      <NA>    NA     C
## 83504      <NA>    NA     C
## 83508      <NA>    NA     C
## 83562      <NA>    NA     C
## 83567      <NA>    NA     C
## 83572      <NA>    NA     C
## 83577      <NA>    NA     C
## 83582      <NA>    NA     C
## 83652      <NA>    NA     C
## [1] "TEMP"
##          sample station depth_m date_sample        time project parameter
## Not NA n 139066  139066  139066      139066 112709.0000  139066    139066
## NA n          0       0       0           0  26357.0000       0         0
## Not NA %      1       1       1           1      0.8105       1         1
## NA %          0       0       0           0      0.1895       0         0
##          qualifier       value  units
## Not NA n         0 139046.0000 139066
## NA n        139066     20.0000      0
## Not NA %         0      0.9999      1
```

```
## NA %             1      0.0001      0
##            sample station depth_m date_sample        time project parameter
## 81652    SH000903      D5      NA  1993-05-04        <NA>    PLOO     TOTAL
## 82672    SH001257      D7      NA  1993-05-11 9:43:00 PST    PLOO     TOTAL
## 101335 1124931032      C6     1.5  1993-11-24 8:23:00 PST    PLOO     TOTAL
## 103637 1208931380      A2     3.0  1993-12-08 8:20:00 PST    PLOO     TOTAL
## 103650 1208931381      A2     6.1  1993-12-08 8:20:00 PST    PLOO     TOTAL
## 103663 1208931382      A2    12.2  1993-12-08 8:20:00 PST    PLOO     TOTAL
## 103676 1208931383      A2    18.3  1993-12-08 8:20:00 PST    PLOO     TOTAL
## 103709 1208931385      A2    30.5  1993-12-08 8:20:00 PST    PLOO     TOTAL
## 103722 1208931386      A2    36.6  1993-12-08 8:20:00 PST    PLOO     TOTAL
## 103735 1208931387      A2    42.7  1993-12-08 8:20:00 PST    PLOO     TOTAL
## 103748 1208931388      A2    48.8  1993-12-08 8:20:00 PST    PLOO     TOTAL
## 103761 1208931389      A2    54.9  1993-12-08 8:20:00 PST    PLOO     TOTAL
## 103820 1208931392      A3     3.0  1993-12-08 9:49:00 PST    PLOO     TOTAL
## 103833 1208931393      A3     6.1  1993-12-08 9:49:00 PST    PLOO     TOTAL
## 103846 1208931394      A3    12.2  1993-12-08 9:49:00 PST    PLOO     TOTAL
## 103859 1208931395      A3    18.3  1993-12-08 9:49:00 PST    PLOO     TOTAL
## 103890 1208931397      A3    30.5  1993-12-08 9:49:00 PST    PLOO     TOTAL
##        qualifier value      units
## 81652       <NA>    NA CFU/100 mL
## 82672       <NA>    NA CFU/100 mL
## 101335      <NA>    NA CFU/100 mL
## 103637      <NA>    NA CFU/100 mL
## 103650      <NA>    NA CFU/100 mL
## 103663      <NA>    NA CFU/100 mL
## 103676      <NA>    NA CFU/100 mL
## 103709      <NA>    NA CFU/100 mL
## 103722      <NA>    NA CFU/100 mL
## 103735      <NA>    NA CFU/100 mL
## 103748      <NA>    NA CFU/100 mL
## 103761      <NA>    NA CFU/100 mL
## 103820      <NA>    NA CFU/100 mL
## 103833      <NA>    NA CFU/100 mL
## 103846      <NA>    NA CFU/100 mL
## 103859      <NA>    NA CFU/100 mL
## 103890      <NA>    NA CFU/100 mL
## [1] "TOTAL"
##          sample station     depth_m date_sample        time project parameter
## Not NA n 137584  137584 109594.0000      137584 137257.0000  137584    137584
## NA n          0       0  27990.0000           0    327.0000       0         0
## Not NA %      1       1      0.7966           1      0.9976       1         1
## NA %          0       0      0.2034           0      0.0024       0         0
##            qualifier       value  units
## Not NA n 121659.0000 136141.0000 137584
## NA n      15925.0000   1443.0000      0
## Not NA %      0.8843      0.9895      1
## NA %          0.1157      0.0105      0
##           sample station depth_m date_sample         time project parameter
## 81485  CTD013369      K4    18.3  1993-05-03  7:07:00 PST    PLOO       XMS
## 82191  CTD014940     A11    42.7  1993-05-06 10:45:00 PST    PLOO       XMS
## 82456  CTD013374      K4    18.3  1993-05-06  8:52:00 PST    PLOO       XMS
## 82873  CTD013384      K4    18.3  1993-05-12  7:36:00 PST    PLOO       XMS
## 83497  CTD013399      K4    18.3  1993-05-20  7:20:00 PST    PLOO       XMS
```

```
## 83564  CTD004913      A7     1.5  1993-05-24  8:31:00 PST    PLOO       XMS
## 83569  CTD004914      A7     3.0  1993-05-24  8:31:00 PST    PLOO       XMS
## 83574  CTD004915      A7     6.1  1993-05-24  8:31:00 PST    PLOO       XMS
## 83579  CTD004916      A7    12.2  1993-05-24  8:31:00 PST    PLOO       XMS
## 83584  CTD004917      A7    18.3  1993-05-24  8:31:00 PST    PLOO       XMS
## 83654  CTD009898      C7    18.3  1993-05-24  9:12:00 PST    PLOO       XMS
## 283998 526982378     E17    97.5  1998-05-26         <NA>    PLOO       XMS
## 286055 618982765     B10   115.8  1998-06-18         <NA>    PLOO       XMS
## 286090 618982769     B11    88.4  1998-06-18         <NA>    PLOO       XMS
## 286307 618982818     E17    97.5  1998-06-18         <NA>    PLOO       XMS
## 286342 618982825     E19    88.4  1998-06-18         <NA>    PLOO       XMS
## 291432 827982068     E24   115.8  1998-08-27         <NA>    PLOO       XMS
##        qualifier value units
## 81485       <NA>    NA     %
## 82191       <NA>    NA     %
## 82456       <NA>    NA     %
## 82873       <NA>    NA     %
## 83497       <NA>    NA     %
## 83564       <NA>    NA     %
## 83569       <NA>    NA     %
## 83574       <NA>    NA     %
## 83579       <NA>    NA     %
## 83584       <NA>    NA     %
## 83654       <NA>    NA     %
## 283998      <NA>    NA     %
## 286055      <NA>    NA     %
## 286090      <NA>    NA     %
## 286307      <NA>    NA     %
## 286342      <NA>    NA     %
## 291432      <NA>    NA     %
## [1] "XMS"
##          sample station depth_m date_sample        time project parameter
## Not NA n 139002  139002  139002      139002 112648.0000  139002    139002
## NA n          0       0       0           0  26354.0000       0         0
## Not NA %      1       1       1           1      0.8104       1         1
## NA %          0       0       0           0      0.1896       0         0
##          qualifier       value  units
## Not NA n         0 138876.0000 139002
## NA n        139002    126.0000      0
## Not NA %         0      0.9991      1
## NA %             1      0.0009      0
```

```
# Display value summaries
# Citation: Dave Hurst
params <- owt_df02 %>%
  mutate(unit_def = paste(parameter, qualifier, units)) %>%
  count(unit_def)
print(params)
```

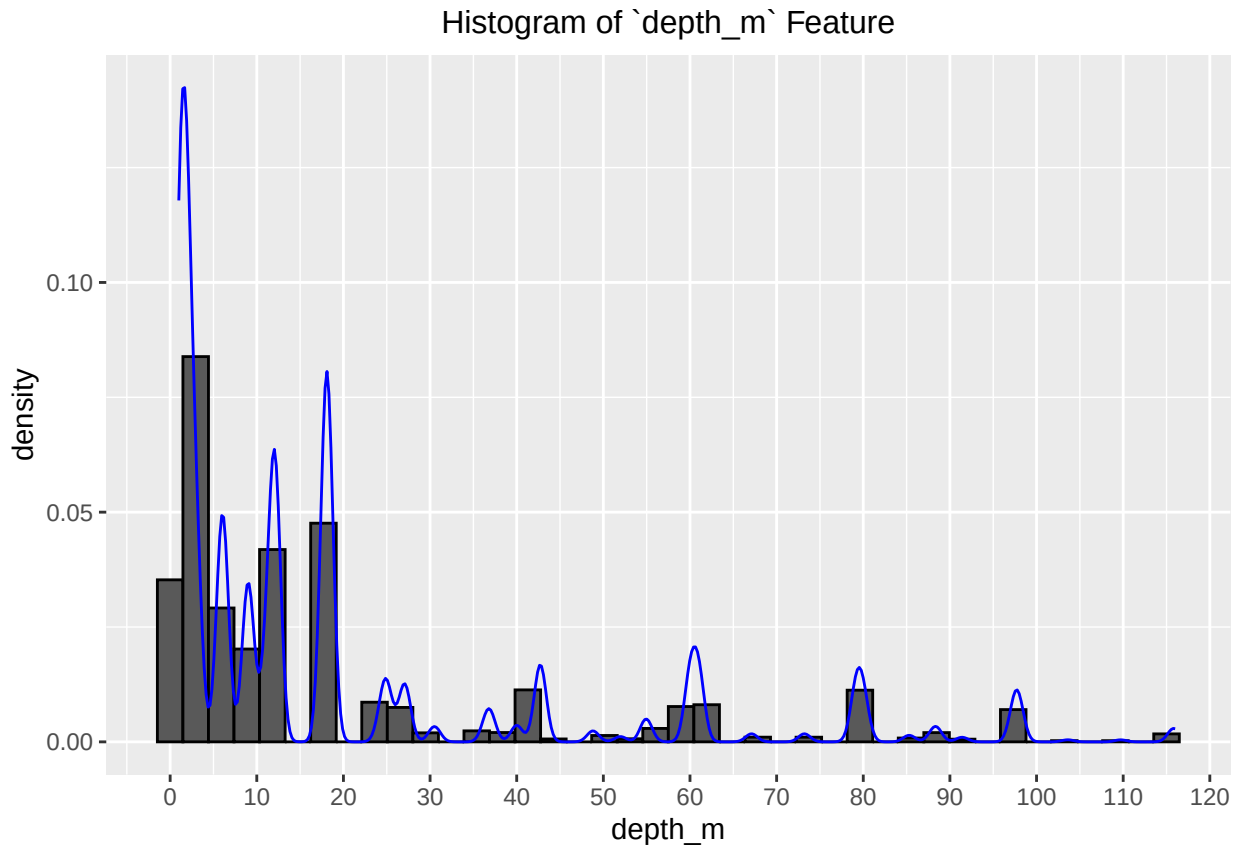
```
##                unit_def      n
## 1   CHLOROPHYLL NA ug/L  88471
## 2    DENSITY NA sigma-t  88317
## 3            DO NA mg/L 109542
## 4   ENTERO < CFU/100 mL  95848
```

```
## 5   ENTERO > CFU/100 mL    452
## 6   ENTERO e CFU/100 mL  39766
## 7  ENTERO LA CFU/100 mL     23
## 8  ENTERO NA CFU/100 mL   8090
## 9  ENTERO ND CFU/100 mL      1
## 10 ENTERO NR CFU/100 mL      1
## 11 ENTERO NS CFU/100 mL    160
## 12   FECAL < CFU/100 mL  85819
## 13   FECAL > CFU/100 mL    746
## 14   FECAL e CFU/100 mL  41255
## 15  FECAL LA CFU/100 mL      8
## 16  FECAL NA CFU/100 mL   9655
## 17  FECAL ND CFU/100 mL      1
## 18  FECAL NR CFU/100 mL      4
## 19  FECAL NS CFU/100 mL    161
## 20            OG < mg/L   7673
## 21           OG NA mg/L    271
## 22             PH NA pH 107818
## 23      SALINITY NA ppt 109492
## 24          SUSO < mg/L   1290
## 25         SUSO NA mg/L  26253
## 26            TEMP NA C 139066
## 27   TOTAL < CFU/100 mL  66655
## 28   TOTAL > CFU/100 mL   2844
## 29  TOTAL >= CFU/100 mL      3
## 30   TOTAL e CFU/100 mL  51924
## 31  TOTAL LA CFU/100 mL     14
## 32  TOTAL NA CFU/100 mL  15925
## 33  TOTAL ND CFU/100 mL     54
## 34  TOTAL NR CFU/100 mL      4
## 35  TOTAL NS CFU/100 mL    161
## 36             XMS NA % 139002
```

Bin `depth_m` variable

```r
owt_df02$date_sample <- as.Date(owt_df02$date_sample, "%Y-%m-%d")

# Create bins for depth_m values
depth_lvls01 <- c("[0,8)",
                  "[8,33)",
                  "[33,47)",
                  "[47,70)",
                  "[70,90)",
                  "[90,112)",
                  "[112,120]",
                  "Unknown")

# Plot distribution of depth_m values
# Plot Formatting Citation:
#
↪  https://community.rstudio.com/t/ggplot-x-axis-y-axis-ticks-labels-breaks-and-limits/119123/2
ggplot(owt_df02, aes(x = depth_m)) +
  geom_histogram(color = "black", bins = 40, aes(y = stat(density))) +
```

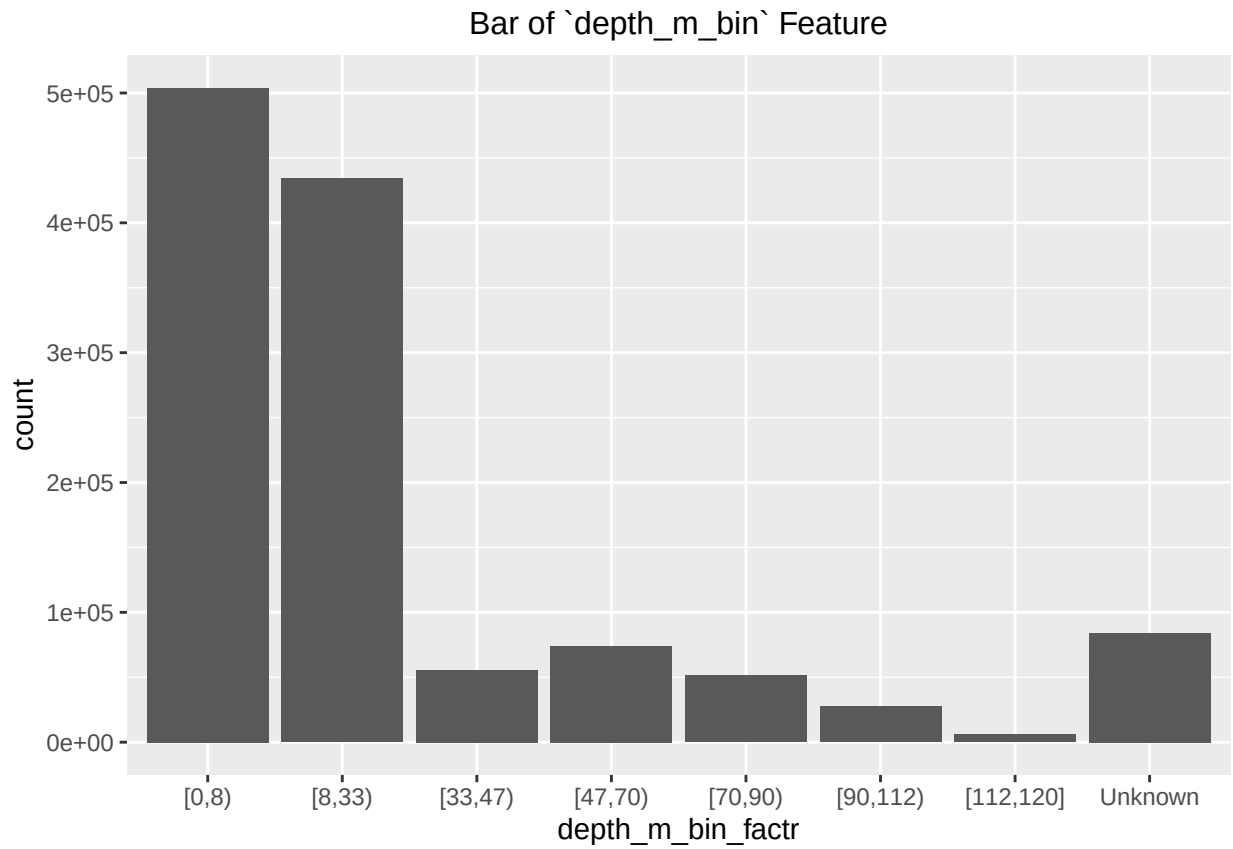
```
  geom_density(col = "blue") +
  labs(title = "Histogram of `depth_m` Feature") +
  scale_x_continuous(breaks=seq(0,120,10)) +
  theme(plot.title = element_text(hjust = 0.5, size = 12))
```




```
# Create new column with bins
# Add Columns Using mutate() Citation:
#
↪  https://www.marsja.se/r-add-column-to-dataframe-based-on-other-columns-conditions-dplyr/
owt_df02 <- mutate(owt_df02, depth_m_bin = case_when(depth_m < 8 ~ "[0,8)",
                                                     depth_m < 33 ~ "[8,33)",
                                                     depth_m < 47 ~ "[33,47)",
                                                     depth_m < 70 ~ "[47,70)",
                                                     depth_m < 90 ~ "[70,90)",
                                                     depth_m < 112 ~ "[90,112)",
                                                     depth_m >= 112 ~ "[112,120]"))

# Replace NAs with "Unknown"
# Citation: https://statisticsglobe.com/r-replace-na-with-0/
owt_df02$depth_m_bin <- replace_na(owt_df02$depth_m_bin, "Unknown")

# Sort Bars Citation:
# https://www.statology.org/order-bars-ggplot2-bar-chart/
owt_df02$depth_m_bin_factr = factor(owt_df02$depth_m_bin, levels = depth_lvls01)
print(head(owt_df02, 17))
```

```
##        sample station depth_m date_sample        time project   parameter
## 1  9011158743      C5     9.0  1990-11-15        <NA>    PLOO CHLOROPHYLL
## 2  9011158743      C5     9.0  1990-11-15        <NA>    PLOO     DENSITY
## 3  9011158743      C5     9.0  1990-11-15        <NA>    PLOO          DO
## 4  9011158743      C5     9.0  1990-11-15        <NA>    PLOO          PH
## 5  9011158743      C5     9.0  1990-11-15        <NA>    PLOO    SALINITY
## 6  9011158743      C5     9.0  1990-11-15        <NA>    PLOO        TEMP
## 7  9011158743      C5     9.0  1990-11-15        <NA>    PLOO         XMS
## 8  9011158834     I25     6.0  1990-11-15        <NA>    SBOO CHLOROPHYLL
## 9  9011158834     I25     6.0  1990-11-15        <NA>    SBOO     DENSITY
## 10 9011158834     I25     6.0  1990-11-15        <NA>    SBOO          DO
## 11 9011158834     I25     6.0  1990-11-15        <NA>    SBOO          PH
## 12 9011158834     I25     6.0  1990-11-15        <NA>    SBOO    SALINITY
## 13 9011158834     I25     6.0  1990-11-15        <NA>    SBOO        TEMP
## 14 9011158834     I25     6.0  1990-11-15        <NA>    SBOO         XMS
## 15   KE000001      A1     1.5  1991-01-02 7:18:00 PST    PLOO      ENTERO
## 16   KE000001      A1     1.5  1991-01-02 7:18:00 PST    PLOO       FECAL
## 17  CTD000001      A1     1.5  1991-01-02 7:18:00 PST    PLOO        TEMP
##    qualifier    value      units depth_m_bin depth_m_bin_factr
## 1       <NA>    0.870       ug/L      [8,33)            [8,33)
## 2       <NA>   23.855    sigma-t      [8,33)            [8,33)
## 3       <NA>    6.550       mg/L      [8,33)            [8,33)
## 4       <NA>    8.080         pH      [8,33)            [8,33)
## 5       <NA>   33.617        ppt      [8,33)            [8,33)
## 6       <NA>   19.430          C      [8,33)            [8,33)
## 7       <NA>   44.850          %      [8,33)            [8,33)
## 8       <NA>    1.270       ug/L       [0,8)             [0,8)
## 9       <NA>   23.853    sigma-t       [0,8)             [0,8)
## 10      <NA>    7.410       mg/L       [0,8)             [0,8)
## 11      <NA>    8.180         pH       [0,8)             [0,8)
## 12      <NA>   33.574        ppt       [0,8)             [0,8)
## 13      <NA>   19.310          C       [0,8)             [0,8)
## 14      <NA>   75.600          %       [0,8)             [0,8)
## 15         e  200.000 CFU/100 mL       [0,8)             [0,8)
## 16         > 1200.000 CFU/100 mL       [0,8)             [0,8)
## 17      <NA>   14.500          C       [0,8)             [0,8)
```

```r
# Display transformed bar chart
ggplot(owt_df02, aes(x = depth_m_bin_factr)) +
  geom_bar() +
  labs(title = "Bar of `depth_m_bin` Feature") +
  theme(plot.title = element_text(hjust = 0.5, size = 12))
```



Perform several aggregations on the data for performing EDA at multiple levels

```
# Display aggregations by different features
owt_df02_gb01 <- owt_df02 %>%
  group_by(station) %>%
  summarise(Count = n())

print(owt_df02_gb01[owt_df02_gb01$Count == min(owt_df02_gb01$Count), ])
```

```
## # A tibble: 2 x 2
##   station Count
##   <fct>   <int>
## 1 A15        30
## 2 A16        30
```

```
print(owt_df02_gb01[owt_df02_gb01$Count == max(owt_df02_gb01$Count), ])
```

```
## # A tibble: 1 x 2
##   station Count
##   <fct>   <int>
## 1 A1      55217
```

```
owt_df02_gb02 <- owt_df02 %>%
  group_by(project) %>%
  summarise(Count = n())
```

```r
owt_df02_gb03 <- owt_df02 %>%
  group_by(date_sample) %>%
  summarise(Count = n())

# Main DF1
owt_df02_gb04 <- owt_df02 %>%
  group_by(date_sample, parameter) %>%
  summarise(Avg = mean(value, na.remove = TRUE))
```

```
## `summarise()` has grouped output by 'date_sample'. You can override using the
## `.groups` argument.
```

```r
owt_df02_gb05 <- owt_df02 %>%
  group_by(parameter) %>%
  summarise(Count = n())

owt_df02_gb06 <- owt_df02 %>%
  group_by(depth_m) %>%
  summarise(Count = n())

# Main DF3
owt_df02_gb07 <- owt_df02 %>%
  group_by(date_sample, project, depth_m_bin, parameter) %>%
  summarise(Avg = mean(value, na.remove = TRUE))
```

```
## `summarise()` has grouped output by 'date_sample', 'project', 'depth_m_bin'.
## You can override using the `.groups` argument.
```

```r
owt_df02_gb08 <- owt_df02 %>%
  group_by(depth_m_bin) %>%
  summarise(Count = n())

# Main DF2
owt_df02_gb09 <- owt_df02 %>%
  group_by(date_sample, project, parameter) %>%
  summarise(Avg = mean(value, na.remove = TRUE))
```

```
## `summarise()` has grouped output by 'date_sample', 'project'. You can override
## using the `.groups` argument.
```

```r
print(owt_df02_gb01)
```

```
## # A tibble: 157 x 2
##    station Count
##    <fct>   <int>
##  1 A1      55217
##  2 A10      5852
##  3 A11      6602
##  4 A12      5812
##  5 A13      6599
##  6 A14      5886
##  7 A15        30
##  8 A16        30
##  9 A17      2961
## 10 A2       7572
```

```
## # ... with 147 more rows
```

```
print(dim(owt_df02_gb01))
```

```
## [1] 157   2
```

```
print(owt_df02_gb02)
```

```
## # A tibble: 2 x 2
##   project  Count
##   <fct>    <int>
## 1 PLOO    805915
## 2 SBOO    430854
```

```
print(dim(owt_df02_gb02))
```

```
## [1] 2 2
```

```
print(head(owt_df02_gb03, 17))
```

```
## # A tibble: 17 x 2
##    date_sample Count
##    <date>      <int>
##  1 1990-11-15     14
##  2 1991-01-02    195
##  3 1991-01-03    195
##  4 1991-01-07    190
##  5 1991-01-08    181
##  6 1991-01-09    577
##  7 1991-01-10    200
##  8 1991-01-11    174
##  9 1991-01-14    195
## 10 1991-01-16    195
## 11 1991-01-22    194
## 12 1991-01-23    221
## 13 1991-01-28    189
## 14 1991-01-30    195
## 15 1991-02-04    222
## 16 1991-02-06    195
## 17 1991-02-11    195
```

```
print(dim(owt_df02_gb03))
```

```
## [1] 5580    2
```

```
print(head(owt_df02_gb04, 17))
```

```
## # A tibble: 17 x 3
## # Groups:   date_sample [3]
##    date_sample parameter      Avg
##    <date>      <fct>        <dbl>
##  1 1990-11-15  CHLOROPHYLL   1.07
##  2 1990-11-15  DENSITY      23.9
##  3 1990-11-15  DO            6.98
##  4 1990-11-15  PH            8.13
##  5 1990-11-15  SALINITY     33.6
##  6 1990-11-15  TEMP         19.4
```

```
##  7 1990-11-15  XMS          60.2
##  8 1991-01-02  ENTERO       32.1
##  9 1991-01-02  FECAL       126.
## 10 1991-01-02  TEMP         14.5
## 11 1991-01-02  TOTAL       442.
## 12 1991-01-02  XMS          80.0
## 13 1991-01-03  ENTERO       18.7
## 14 1991-01-03  FECAL        51.3
## 15 1991-01-03  TEMP         14.4
## 16 1991-01-03  TOTAL       181.
## 17 1991-01-03  XMS          83.9
```

```
print(dim(owt_df02_gb04))
```

```
## [1] 36811     3
```

```
print(owt_df02_gb05)
```

```
## # A tibble: 12 x 2
##    parameter    Count
##    <fct>        <int>
##  1 CHLOROPHYLL  88471
##  2 DENSITY      88317
##  3 DO          109542
##  4 ENTERO      144341
##  5 FECAL       137649
##  6 OG            7944
##  7 PH          107818
##  8 SALINITY    109492
##  9 SUSO         27543
## 10 TEMP        139066
## 11 TOTAL       137584
## 12 XMS         139002
```

```
print(dim(owt_df02_gb05))
```

```
## [1] 12  2
```

```
print(owt_df02_gb06)
```

```
## # A tibble: 51 x 2
##    depth_m  Count
##      <dbl>  <int>
##  1     1   119858
##  2     1.5  93937
##  3     2   120007
##  4     3    71058
##  5     6    55762
##  6     6.1  43265
##  7     9    65616
##  8     9.1   3052
##  9    11    23069
## 10    12    80308
## # ... with 41 more rows
```

```r
print(dim(owt_df02_gb06))
```

```
## [1] 51  2
```

```r
print(head(owt_df02_gb07, 17))
```

```
## # A tibble: 17 x 5
## # Groups:   date_sample, project, depth_m_bin [3]
##    date_sample project depth_m_bin parameter      Avg
##    <date>      <fct>   <chr>       <fct>        <dbl>
##  1 1990-11-15  PLOO    [8,33)      CHLOROPHYLL   0.87
##  2 1990-11-15  PLOO    [8,33)      DENSITY      23.9
##  3 1990-11-15  PLOO    [8,33)      DO            6.55
##  4 1990-11-15  PLOO    [8,33)      PH            8.08
##  5 1990-11-15  PLOO    [8,33)      SALINITY     33.6
##  6 1990-11-15  PLOO    [8,33)      TEMP         19.4
##  7 1990-11-15  PLOO    [8,33)      XMS          44.8
##  8 1990-11-15  SBOO    [0,8)       CHLOROPHYLL   1.27
##  9 1990-11-15  SBOO    [0,8)       DENSITY      23.9
## 10 1990-11-15  SBOO    [0,8)       DO            7.41
## 11 1990-11-15  SBOO    [0,8)       PH            8.18
## 12 1990-11-15  SBOO    [0,8)       SALINITY     33.6
## 13 1990-11-15  SBOO    [0,8)       TEMP         19.3
## 14 1990-11-15  SBOO    [0,8)       XMS          75.6
## 15 1991-01-02  PLOO    [0,8)       ENTERO       34.1
## 16 1991-01-02  PLOO    [0,8)       FECAL       135.
## 17 1991-01-02  PLOO    [0,8)       TEMP         14.6
```

```r
print(dim(owt_df02_gb07))
```

```
## [1] 121286      5
```

```r
print(owt_df02_gb08)
```

```
## # A tibble: 8 x 2
##   depth_m_bin  Count
##   <chr>        <int>
## 1 [0,8)       503887
## 2 [112,120]     5908
## 3 [33,47)      55629
## 4 [47,70)      74036
## 5 [70,90)      51358
## 6 [8,33)      434169
## 7 [90,112)     27621
## 8 Unknown      84161
```

```r
print(dim(owt_df02_gb08))
```

```
## [1] 8 2
```

```r
print(head(owt_df02_gb09, 17))
```

```
## # A tibble: 17 x 4
## # Groups:   date_sample, project [3]
##    date_sample project parameter      Avg
##    <date>      <fct>   <fct>        <dbl>
```

```
##  1 1990-11-15  PLOO    CHLOROPHYLL   0.87
##  2 1990-11-15  PLOO    DENSITY      23.9
##  3 1990-11-15  PLOO    DO            6.55
##  4 1990-11-15  PLOO    PH            8.08
##  5 1990-11-15  PLOO    SALINITY     33.6
##  6 1990-11-15  PLOO    TEMP         19.4
##  7 1990-11-15  PLOO    XMS          44.8
##  8 1990-11-15  SBOO    CHLOROPHYLL   1.27
##  9 1990-11-15  SBOO    DENSITY      23.9
## 10 1990-11-15  SBOO    DO            7.41
## 11 1990-11-15  SBOO    PH            8.18
## 12 1990-11-15  SBOO    SALINITY     33.6
## 13 1990-11-15  SBOO    TEMP         19.3
## 14 1990-11-15  SBOO    XMS          75.6
## 15 1991-01-02  PLOO    ENTERO       32.1
## 16 1991-01-02  PLOO    FECAL       126.
## 17 1991-01-02  PLOO    TEMP         14.5
```

```
print(dim(owt_df02_gb09))
```

```
## [1] 48395     4
```

Create custom function to perform df mutation/casting and boxplot display

```
ts_eda <- function(ts_df = NA,
                   form_lead = c(),
                   form_cast = c(),
                   param_lst = c(),
                   l1_col = c(),
                   l1_param = c(),
                   l2_col = c(),
                   l2_param = c(),
                   rtn_met = TRUE,
                   grph_title = "All",
                   box = TRUE,
                   week_agg = FALSE,
                   out_rm = FALSE) {
  # Define function to dcast, print boxplot, and print desc stats for each parameter
  dcast_form <- as.formula(paste(paste(form_lead, collapse = "+"), form_cast, sep = "~"))
  #print(dcast_form)
  #print(head(ts_df))

  counter <- 1
  # Loop to dcast parameters to cols
  for(p in param_lst) {
    #sym_param <- sym(p)
    #print(sym_param)
    param_df <- ts_df[ts_df[, form_cast] == p, ]
    param_df <- param_df %>%
      drop_na()
    #print(param_df)

    #_____________________________________________________________________________
    # If keyword set to TRUE, convert daily TS data to weekly
```

```r
if(week_agg == TRUE) {
  param_df02a <- param_df
  param_df02a$week <- isoweek(param_df02a$date_sample)
  # Citation: https://lubridate.tidyverse.org/reference/round_date.html
  param_df02a$week_end <- ceiling_date(param_df02a$date_sample,
                                       unit = "week",
                                       week_start = getOption("lubridate.week.start",
                                       ↪  1))
  #print(head(param_df02a, 17)
  param_df$date_sample <- param_df02a$week_end
}

# Citation: https://www.datasciencemadesimple.com/melting-casting-r/
param_df_cast <- dcast(param_df, dcast_form, mean)
#print(head(param_df_cast, 17))

#_____________________________________________________________________________
# If keyword set to TRUE, remove outliers
if(out_rm == TRUE) {
  #ts_df_mrgd01c <- na.omit(param_df_cast)
  #print(head(ts_df_mrgd01c, 17))
  #print(dim(ts_df_mrgd01c))
  ts_df_mrgd01c_s1 <- subset(x = param_df_cast, select = p)
  ts_df_mrgd01c_s1_fit <- preProcess(ts_df_mrgd01c_s1,
                                     method = c("center", "scale"))
  ts_df_mrgd01c_s1_trans <- predict(ts_df_mrgd01c_s1_fit,
                                    ts_df_mrgd01c_s1)

  # Subset non-outlier data
  print(dim(param_df_cast))
  param_df_cast <- subset(param_df_cast,
                              (abs(ts_df_mrgd01c_s1_trans) <= 3))
  dfs1b <- param_df_cast[, p]
  #print(head(param_df_cast, 17))
}

# For first item in vector, no merge is needed
if(counter  == 1) {
  ts_df_mrgd <- param_df_cast
}
# For 2-n items in vector, merge dataframes iteratively
else {
  # Merge individual casted parameter df's into 1 df
  # Citation: https://www.geeksforgeeks.org/joining-of-dataframes-in-r-programming/
  ts_df_mrgd <- merge(x = ts_df_mrgd,
                      y = param_df_cast,
                      by = form_lead,
                      all = TRUE)
}

# Run custom function to ID outliers and generate boxplot
#ts_df_mrgd01a <- subset(x = ts_df_mrgd, select = num_var_lst01)
ts_df_mrgd01a <- na.omit(param_df_cast)
```

```
  #print(head(ts_df_mrgd01a, 17))
  #print(dim(ts_df_mrgd01a))
  dfs1 <- subset(x = ts_df_mrgd01a, select = p)
  dfs1a <- dfs1
  #print(head(dfs1a, 17))

  dfs1a$Groups <- as.factor(grph_title)
  box_comp(xcol = p,
           df = dfs1,
           rtn_met = rtn_met,
           box = box)
  #dfs_lst <- list(dfs1)
  #print(dfs_lst)

  #_____________________________________________________________________________
  # Create subplots based on additional agg layers
  #print(paste0("L2 length = ", length(l2_param)))
  if(length(l2_param) == 0) {
    for(l1 in l1_param) {
      ts_df_mrgd_chl_dmb1 <- ts_df_mrgd01a[(ts_df_mrgd01a[, l1_col] == l1), ]

      # Run custom function to ID outliers and generate boxplot
      #print(head(ts_df_mrgd_chl_dmb1))
      # Citation: https://www.geeksforgeeks.org/handling-errors-in-r-programming/
      dfs2 <- subset(x = ts_df_mrgd_chl_dmb1, select = p)
      dfs2a <- dfs2



      try(dfs2a$Groups <- as.factor(l1))
      try(box_comp(xcol = p,
                   df = dfs2,
                   rtn_met = rtn_met,
                   grph_title = l1,
                   box = box),
          silent = TRUE)
      dfs1a <- rbind(dfs1a, dfs2a)
    }
  }
  else {
    for(l1 in l1_param) {
      for(l2 in l2_param) {
        ts_df_mrgd_chl_dmb1 <- ts_df_mrgd01a[(ts_df_mrgd01a[, l1_col] == l1) &
↪ (ts_df_mrgd01a[, l2_col] == l2), ]

        # Run custom function to ID outliers and generate boxplot
        #print(head(ts_df_mrgd_chl_dmb1))
        # Citation: https://www.geeksforgeeks.org/handling-errors-in-r-programming/
        dfs3 <- subset(x = ts_df_mrgd_chl_dmb1, select = p)
        dfs3a <- dfs3
```

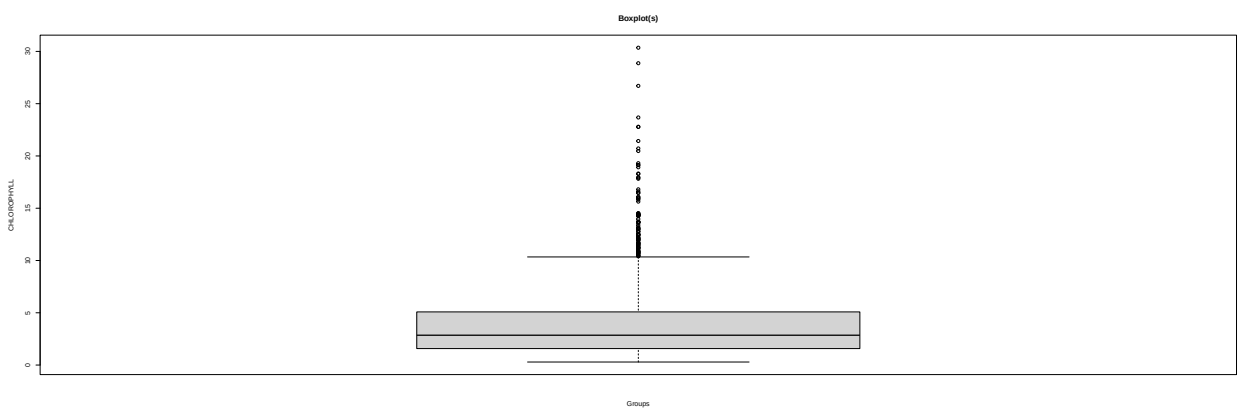
```
          try(dfs3a$Groups <- as.factor(paste0(l1, ": ", l2)))
          try(box_comp(xcol = p,
                       df = dfs3,
                       rtn_met = rtn_met,
                       grph_title = paste0(l1, ": ", l2),
                       box = box),
              silent = TRUE)
          dfs1a <- rbind(dfs1a, dfs3a)
        }
      }
    }
    #_____________________________________________________________________
    #print(dim(dfs1a))
    #print(head(dfs1a, 17))
    bx_form <- as.formula(paste(p, "Groups", sep = "~"))
    #print(bx_form)
    #dfs1a$box_factr = factor(owt_df02$depth_m_bin, levels = depth_lvls01)
    #print(head(dfs1a, 17))
    boxplot(bx_form,
            dfs1a,
            main = "Boxplot(s)")

    counter <- counter + 1
  }
  print(head(ts_df_mrgd, 17))
  print(describe(ts_df_mrgd))

  # Display summary of NA count
  ts_df_na <- sapply(ts_df, function(x) sum(is.na(x)))
  ts_df_notna <- sapply(ts_df, function(x) sum(!is.na(x)))
  ts_df_tbl01 <- rbind(ts_df_notna, ts_df_na)
  ts_df_tbl02 <- rbind(ts_df_tbl01, round(prop.table(ts_df_tbl01, margin = 2), 4))
  rownames(ts_df_tbl02) <- c("Not NA n", "NA n", "Not NA %", "NA %")
  print(ts_df_tbl02) # This table w/ null counts and proportions for each feature not
  ↪  displayed for space purposes
  return(ts_df_mrgd)
}
```

Run custom function on data aggregated by `date_sample` and `parameter`

```
param_lst02 <- c("CHLOROPHYLL",
                 "DENSITY",
                 "DO",
                 "ENTERO",
                 "FECAL",
                 "OG",
                 "PH",
                 "SALINITY",
                 "SUSO",
                 "TEMP",
                 "XMS")
```

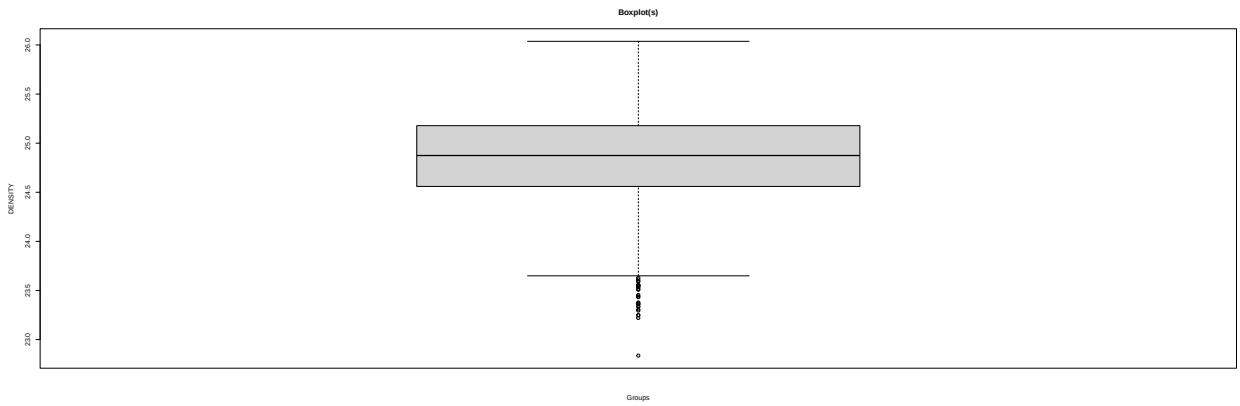
```r
owt_df02_gb04_mrgd = ts_eda(ts_df = owt_df02_gb04,
                            form_lead = "date_sample",
                            form_cast = "parameter",
                            param_lst = param_lst02,
                            rtn_met = TRUE,
                            box = FALSE,
                            week_agg = FALSE
                            )
```

```
##                  metric                    V2
## 1                       Variable: CHLOROPHYLL
## 2              Total N:
## 3                 Count                  2092
## 4              NA Count                     0
## 5                  Mean                  3.91
## 6                Median                 2.853
## 7    Standard Deviation                 3.411
## 8              Variance                11.633
## 9                 Range                30.064
## 10                  Min                  0.29
## 11                  Max                30.353
## 12      25th Percentile                 1.576
## 13      75th Percentile                 5.083
## 14 Subset w/o Outliers:
## 15                Count                  2050
## 16                    %                   98%
## 17            Outlier %                    2%
## 18             NA Count                     0
## 19                 Mean                 3.626
## 20               Median                 2.791
## 21   Standard Deviation                  2.74
## 22             Variance                 7.507
## 23                Range                13.676
## 24                  Min                  0.29
## 25                  Max                13.965
```



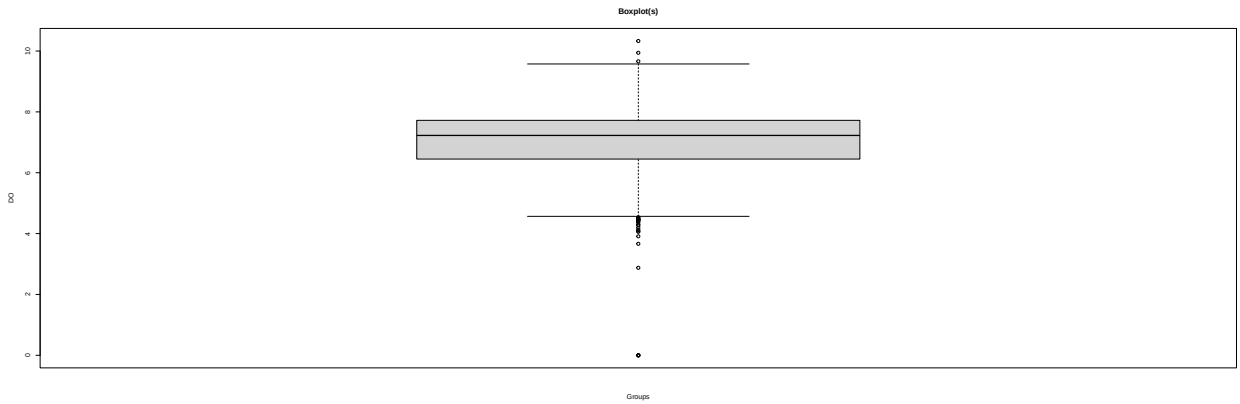

```
##                  metric                 V2
## 1                       Variable: DENSITY
## 2              Total N:
## 3                 Count               2246
```

```
## 4              NA Count                0
## 5                  Mean            24.85
## 6                Median           24.874
## 7    Standard Deviation            0.466
## 8              Variance            0.217
## 9                 Range              3.2
## 10                  Min           22.837
## 11                  Max           26.037
## 12      25th Percentile            24.56
## 13      75th Percentile           25.178
## 14 Subset w/o Outliers:
## 15                Count             2232
## 16                    %            99.4%
## 17            Outlier %             0.6%
## 18             NA Count                0
## 19                 Mean            24.86
## 20               Median           24.877
## 21   Standard Deviation            0.451
## 22             Variance            0.203
## 23                Range            2.583
## 24                  Min           23.454
## 25                  Max           26.037
```

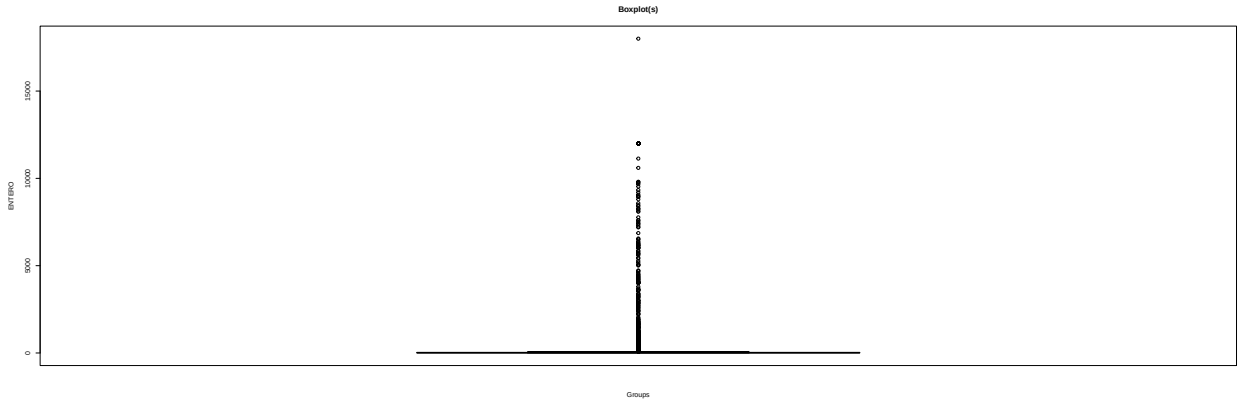



```
##                  metric           V2
## 1                       Variable: DO
## 2              Total N:
## 3                 Count         2504
## 4              NA Count            0
## 5                  Mean        7.041
## 6                Median        7.226
## 7    Standard Deviation         0.99
## 8              Variance         0.98
## 9                 Range       10.329
## 10                  Min            0
## 11                  Max       10.329
## 12      25th Percentile        6.451
## 13      75th Percentile        7.722
## 14 Subset w/o Outliers:
## 15                Count         2494
## 16                    %        99.6%
## 17            Outlier %         0.4%
```

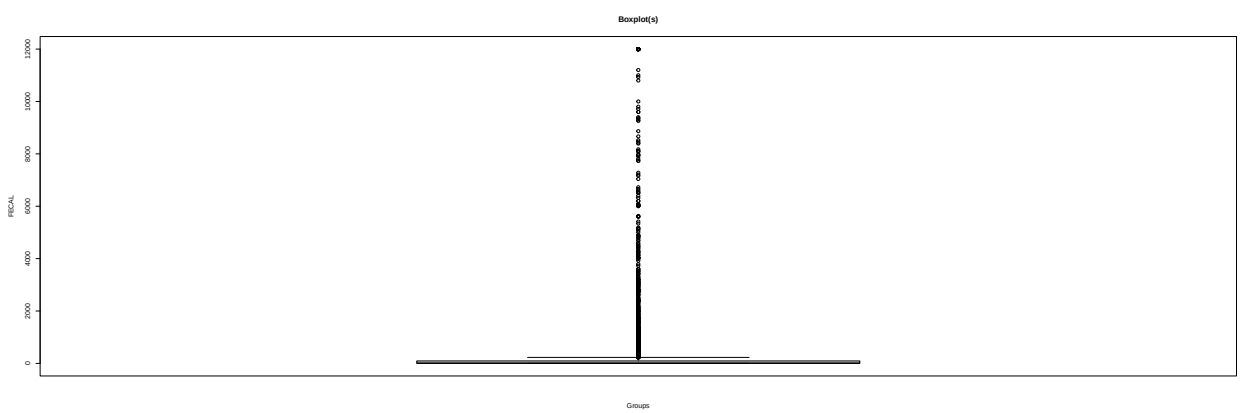
```
## 18             NA Count            0
## 19                 Mean        7.057
## 20               Median        7.232
## 21   Standard Deviation        0.937
## 22             Variance        0.877
## 23                Range        5.822
## 24                  Min         4.12
## 25                  Max        9.942
```



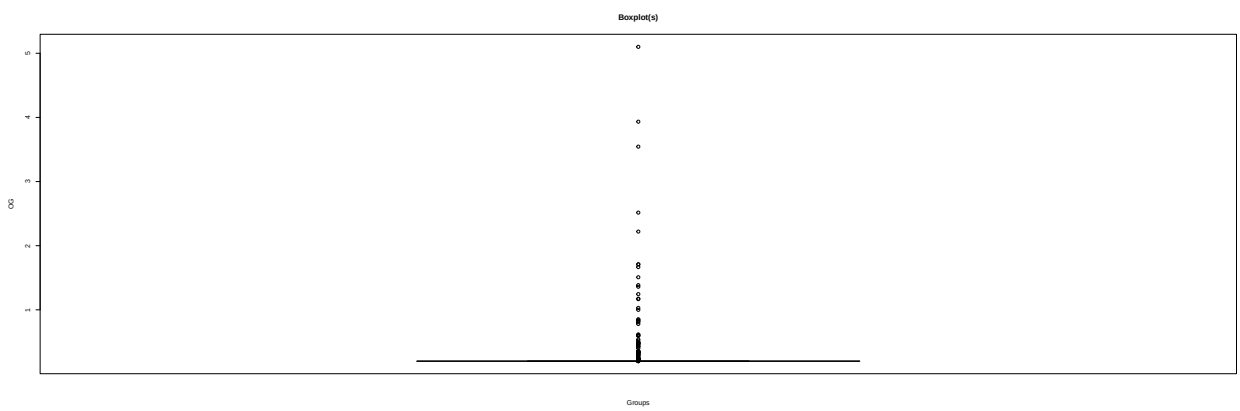

```
##                  metric               V2
## 1                       Variable: ENTERO
## 2             Total N:
## 3                Count             5197
## 4             NA Count                0
## 5                 Mean          284.213
## 6               Median            7.333
## 7   Standard Deviation         1325.881
## 8             Variance      1757960.571
## 9                Range            18000
## 10                 Min                0
## 11                 Max            18000
## 12      25th Percentile             2.75
## 13      75th Percentile           35.455
## 14 Subset w/o Outliers:
## 15               Count             5090
## 16                   %            97.9%
## 17           Outlier %             2.1%
## 18            NA Count                0
## 19                Mean          112.006
## 20              Median                7
## 21   Standard Deviation          417.536
## 22            Variance       174336.299
## 23               Range         4233.333
## 24                 Min                0
## 25                 Max         4233.333
```




```
##                  metric              V2
## 1                       Variable: FECAL
## 2             Total N:
## 3                Count            5078
## 4             NA Count               0
## 5                 Mean         409.934
## 6               Median          10.564
## 7    Standard Deviation        1513.552
## 8             Variance     2290838.653
## 9                Range           12000
## 10                 Min               0
## 11                 Max           12000
## 12      25th Percentile           3.404
## 13      75th Percentile          94.095
## 14 Subset w/o Outliers:
## 15               Count            4965
## 16                   %           97.8%
## 17            Outlier %            2.2%
## 18            NA Count               0
## 19                Mean         208.248
## 20              Median              10
## 21   Standard Deviation         600.094
## 22            Variance      360113.198
## 23               Range            4900
## 24                 Min               0
## 25                 Max            4900
```

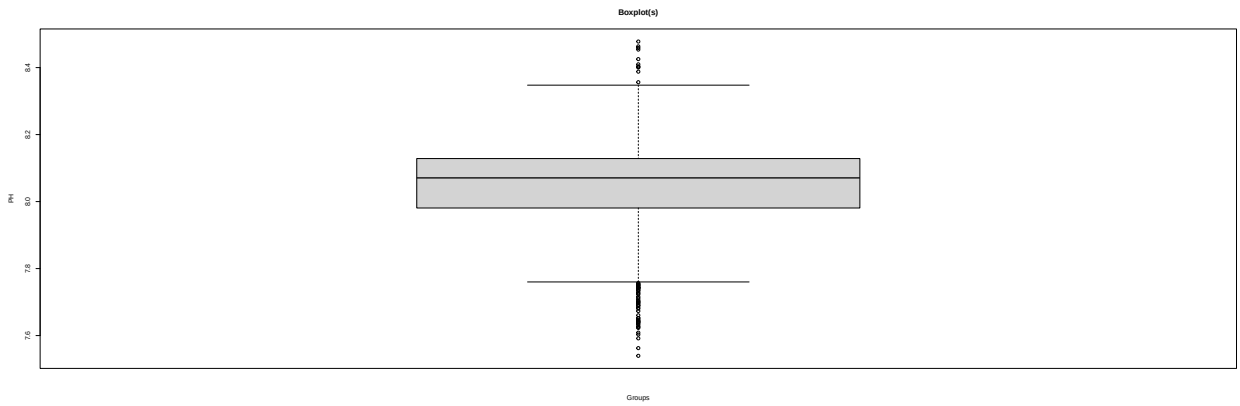


```
##                  metric           V2
## 1                       Variable: OG
## 2              Total N:
## 3                 Count          937
## 4              NA Count            0
## 5                  Mean        0.244
## 6                Median          0.2
## 7    Standard Deviation        0.286
## 8              Variance        0.082
## 9                 Range          4.9
## 10                  Min          0.2
## 11                  Max          5.1
## 12      25th Percentile          0.2
## 13      75th Percentile          0.2
## 14 Subset w/o Outliers:
## 15                Count          923
## 16                    %        98.5%
## 17            Outlier %         1.5%
## 18             NA Count            0
## 19                 Mean        0.215
## 20               Median          0.2
## 21   Standard Deviation        0.078
## 22             Variance        0.006
## 23                Range         0.83
## 24                  Min          0.2
## 25                  Max         1.03
```

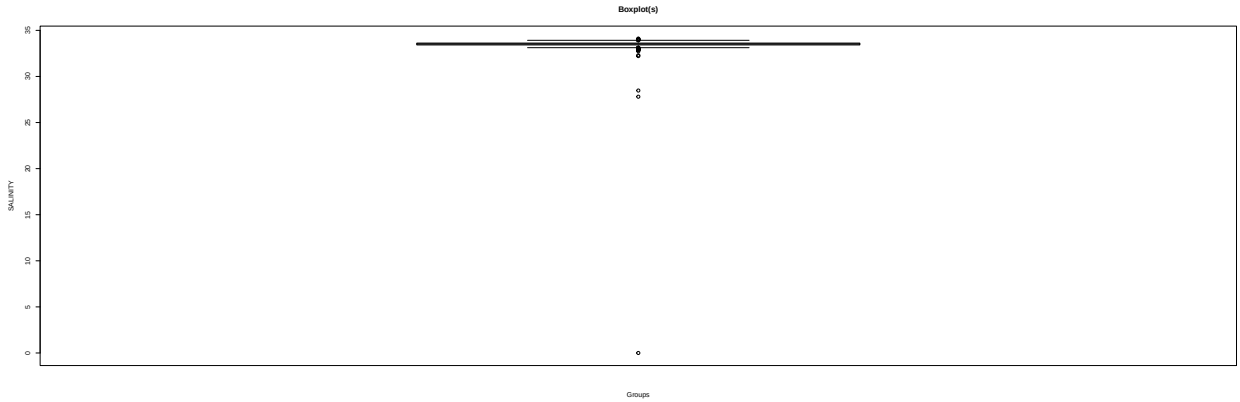



```
##                  metric           V2
## 1                       Variable: PH
## 2              Total N:
## 3                 Count         2469
## 4              NA Count            0
## 5                  Mean         8.05
## 6                Median        8.071
## 7    Standard Deviation        0.117
## 8              Variance        0.014
## 9                 Range        0.938
## 10                  Min         7.54
## 11                  Max        8.478
## 12      25th Percentile        7.981
## 13      75th Percentile        8.128
```

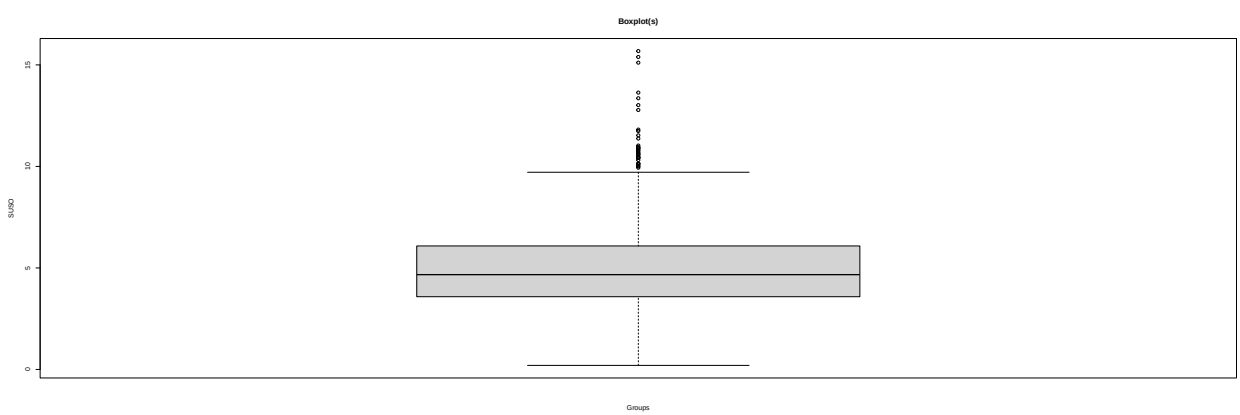
```
## 14 Subset w/o Outliers:
## 15                Count         2435
## 16                    %        98.6%
## 17            Outlier %         1.4%
## 18             NA Count            0
## 19                 Mean        8.053
## 20               Median        8.071
## 21   Standard Deviation        0.108
## 22             Variance        0.012
## 23                Range        0.702
## 24                  Min          7.7
## 25                  Max        8.402
```



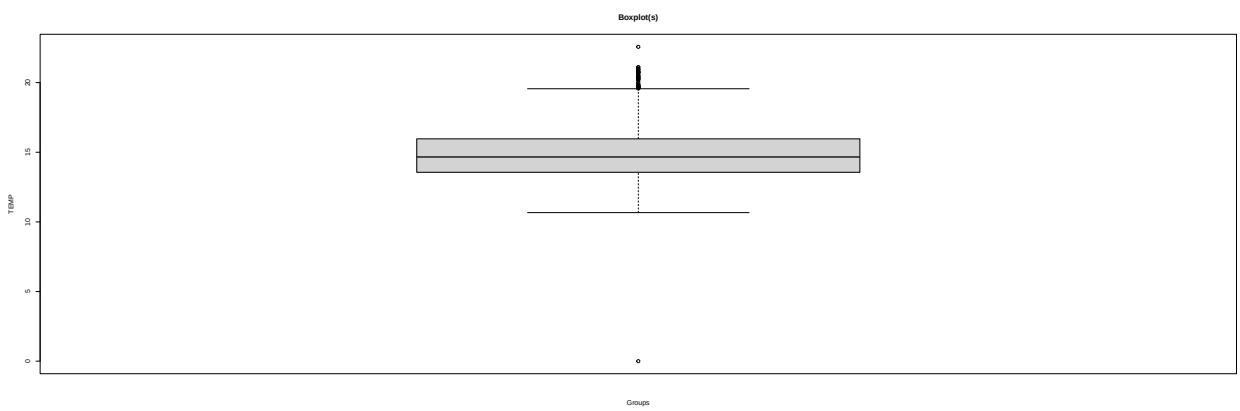

```
##                  metric                 V2
## 1                       Variable: SALINITY
## 2              Total N:
## 3                 Count               2505
## 4              NA Count                  0
## 5                  Mean             33.502
## 6                Median             33.527
## 7    Standard Deviation              0.706
## 8              Variance              0.499
## 9                 Range             34.098
## 10                  Min                  0
## 11                  Max             34.098
## 12      25th Percentile             33.418
## 13      75th Percentile              33.62
## 14 Subset w/o Outliers:
## 15                Count               2502
## 16                    %              99.9%
## 17            Outlier %               0.1%
## 18             NA Count                  0
## 19                 Mean             33.519
## 20               Median             33.527
## 21   Standard Deviation              0.165
## 22             Variance              0.027
## 23                Range              1.888
## 24                  Min              32.21
## 25                  Max             34.098
```




```
##                  metric             V2
## 1                       Variable: SUSO
## 2             Total N:
## 3                Count            976
## 4             NA Count              0
## 5                 Mean          4.993
## 6               Median           4.67
## 7    Standard Deviation          2.164
## 8             Variance          4.681
## 9                Range          15.48
## 10                 Min            0.2
## 11                 Max          15.68
## 12      25th Percentile          3.583
## 13      75th Percentile          6.083
## 14 Subset w/o Outliers:
## 15               Count            966
## 16                   %            99%
## 17           Outlier %             1%
## 18            NA Count              0
## 19                Mean          4.906
## 20              Median          4.639
## 21   Standard Deviation          1.991
## 22            Variance          3.966
## 23               Range         11.172
## 24                 Min            0.2
## 25                 Max         11.372
```

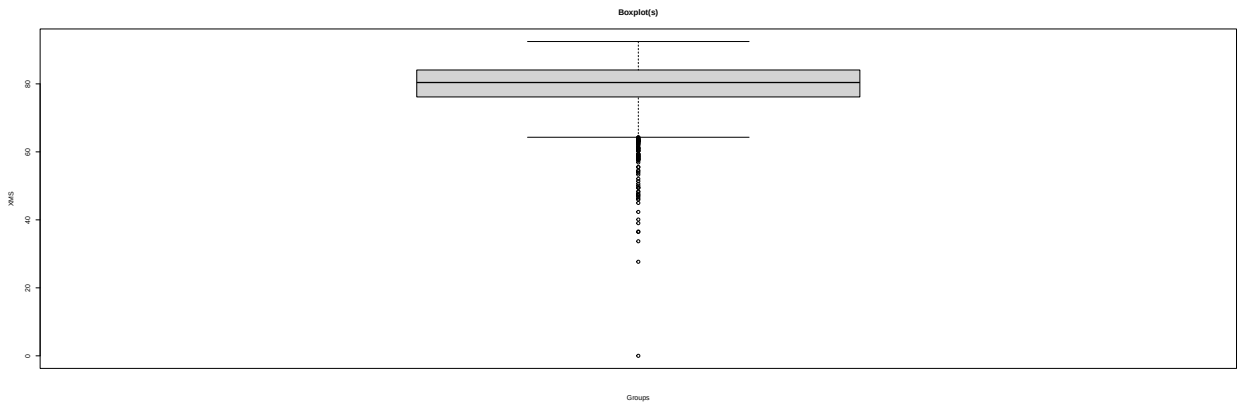


```
##                  metric             V2
## 1                       Variable: TEMP
## 2              Total N:
## 3                 Count           3373
## 4              NA Count              0
## 5                  Mean         14.843
## 6                Median         14.661
## 7    Standard Deviation          1.879
## 8              Variance           3.53
## 9                 Range         22.568
## 10                  Min              0
## 11                  Max         22.568
## 12      25th Percentile         13.561
## 13      75th Percentile         15.964
## 14 Subset w/o Outliers:
## 15                Count           3357
## 16                    %          99.5%
## 17            Outlier %           0.5%
## 18             NA Count              0
## 19                 Mean          14.82
## 20               Median          14.65
## 21   Standard Deviation          1.821
## 22             Variance          3.315
## 23                Range          9.794
## 24                  Min         10.666
## 25                  Max          20.46
```




```
##                  metric             V2
## 1                       Variable: XMS
## 2              Total N:
## 3                 Count           3344
## 4              NA Count              0
## 5                  Mean         79.402
## 6                Median           80.4
## 7    Standard Deviation          6.979
## 8              Variance         48.713
## 9                 Range         92.456
## 10                  Min              0
## 11                  Max         92.456
## 12      25th Percentile         76.156
## 13      75th Percentile         84.084
```

```
## 14 Subset w/o Outliers:
## 15                Count          3302
## 16                    %         98.7%
## 17            Outlier %          1.3%
## 18             NA Count             0
## 19                 Mean        79.791
## 20               Median        80.486
## 21   Standard Deviation         5.988
## 22             Variance        35.857
## 23                Range         33.88
## 24                  Min        58.577
## 25                  Max        92.456
```



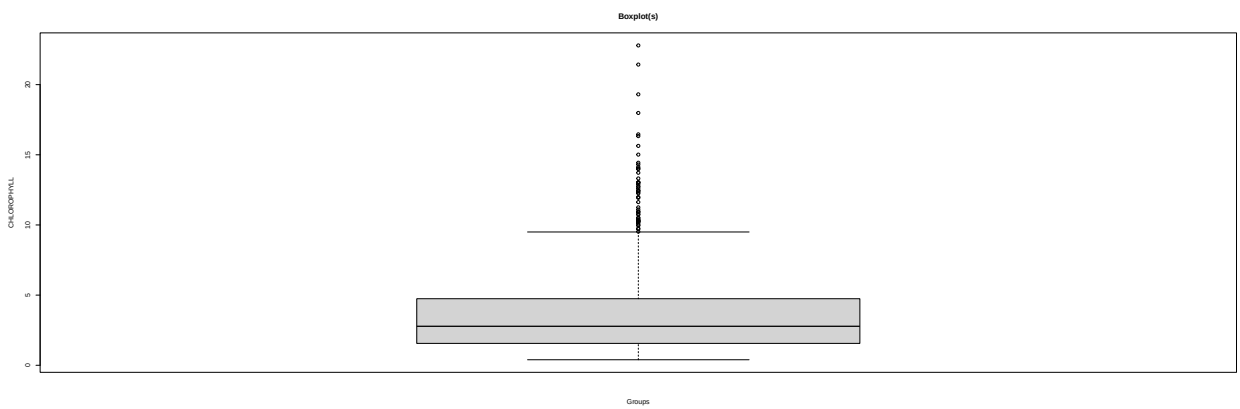

```
##    date_sample CHLOROPHYLL DENSITY      DO    ENTERO     FECAL OG    PH
## 1   1990-11-15        1.07  23.854 6.98000        NA        NA NA 8.130
## 2   1991-01-02          NA      NA      NA  32.05128 125.64103 NA    NA
## 3   1991-01-03          NA      NA      NA  18.71795  51.28205 NA    NA
## 4   1991-01-07          NA      NA      NA 106.15385  80.76923 NA    NA
## 5   1991-01-08          NA      NA      NA  40.00000  40.55556 NA    NA
## 6   1991-01-09          NA      NA 5.47625  20.33898  40.50847 NA 8.195
## 7   1991-01-10          NA      NA 5.50000  40.22727  78.18182 NA    NA
## 8   1991-01-11          NA      NA 5.36000  83.92857 446.07143 NA    NA
## 9   1991-01-14          NA      NA      NA  33.84615  95.64103 NA    NA
## 10  1991-01-16          NA      NA      NA  12.56410  23.58974 NA    NA
## 11  1991-01-22          NA      NA      NA  20.51282  31.02564 NA    NA
## 12  1991-01-23          NA      NA      NA  43.12500 108.54167 NA    NA
## 13  1991-01-28          NA      NA      NA 183.07692 427.69231 NA    NA
## 14  1991-01-30          NA      NA      NA 125.38462 429.48718 NA    NA
## 15  1991-02-04          NA      NA      NA  16.29167  16.75000 NA    NA
## 16  1991-02-06          NA      NA      NA  17.38462  12.51282 NA    NA
## 17  1991-02-11          NA      NA      NA  51.89744  55.43590 NA    NA
##    SALINITY SUSO     TEMP      XMS
## 1  33.59550   NA 19.37000 60.22500
## 2        NA   NA 14.50769 80.02564
## 3        NA   NA 14.39231 83.89744
## 4        NA   NA 14.54103 78.97436
## 5        NA   NA 13.43000 80.20000
## 6  33.51938   NA 14.26889 86.21111
## 7  33.49300   NA 13.75000 80.45833
## 8  33.49100   NA 14.38400 84.40000
## 9        NA   NA 14.51282 72.02564
```

```
## 10       NA   NA 14.57692 68.35897
## 11       NA   NA 14.50769 76.51282
## 12       NA   NA 14.06923 78.71053
## 13       NA   NA 14.29487 82.43590
## 14       NA   NA 14.17436 81.23077
## 15       NA   NA 14.46154 72.12821
## 16       NA   NA 14.46154 69.53846
## 17       NA   NA 13.82564 79.23077
##             vars    n   mean      sd median trimmed   mad   min      max
## date_sample    1 5450    NaN      NA     NA     NaN    NA   Inf     -Inf
## CHLOROPHYLL    2 2092   3.91    3.41   2.85    3.33  2.28  0.29    30.35
## DENSITY        3 2246  24.85    0.47  24.87   24.87  0.46 22.84    26.04
## DO             4 2504   7.04    0.99   7.23    7.11  0.86  0.00    10.33
## ENTERO         5 5197 284.21 1325.88   7.33   25.74  7.91  0.00 18000.00
## FECAL          6 5078 409.93 1513.55  10.56   69.45 12.57  0.00 12000.00
## OG             7  937   0.24    0.29   0.20    0.20  0.00  0.20     5.10
## PH             8 2469   8.05    0.12   8.07    8.06  0.10  7.54     8.48
## SALINITY       9 2505  33.50    0.71  33.53   33.52  0.15  0.00    34.10
## SUSO          10  976   4.99    2.16   4.67    4.80  1.80  0.20    15.68
## TEMP          11 3373  14.84    1.88  14.66   14.75  1.78  0.00    22.57
## XMS           12 3344  79.40    6.98  80.40   80.08  5.76  0.00    92.46
##                range   skew kurtosis    se
## date_sample     -Inf     NA       NA    NA
## CHLOROPHYLL    30.06   2.25     7.84  0.07
## DENSITY         3.20  -0.42     0.25  0.01
## DO             10.33  -1.05     3.72  0.02
## ENTERO      18000.00   6.95    53.47 18.39
## FECAL       12000.00   5.81    36.94 21.24
## OG              4.90  10.89   144.21  0.01
## PH              0.94  -0.66     1.32  0.00
## SALINITY       34.10 -42.97  2021.03  0.01
## SUSO           15.48   1.09     2.23  0.07
## TEMP           22.57   0.35     1.15  0.03
## XMS            92.46  -1.86     9.43  0.12
##          date_sample parameter       Avg
## Not NA n       36811     36811 35669.000
## NA n               0         0  1142.000
## Not NA %           1         1     0.969
## NA %               0         0     0.031
```

```
owt_df02_gb04_wkly = ts_eda(ts_df = owt_df02_gb04,
                            form_lead = "date_sample",
                            form_cast = "parameter",
                            param_lst = param_lst02,
                            rtn_met = TRUE,
                            box = FALSE,
                            week_agg = TRUE
                            )
```

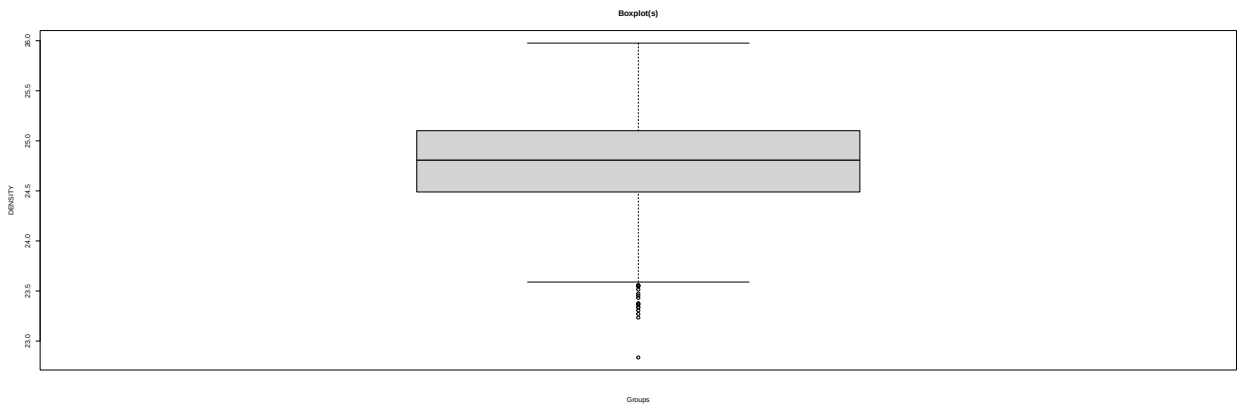
```
##                  metric                    V2
## 1                       Variable: CHLOROPHYLL
## 2              Total N:
## 3                 Count                  1071
## 4              NA Count                     0
```

```
## 5                  Mean                 3.664
## 6                Median                 2.778
## 7    Standard Deviation                  2.98
## 8              Variance                 8.879
## 9                 Range                22.399
## 10                  Min                 0.393
## 11                  Max                22.792
## 12      25th Percentile                  1.56
## 13      75th Percentile                 4.744
## 14 Subset w/o Outliers:
## 15                Count                  1049
## 16                    %                 97.9%
## 17            Outlier %                  2.1%
## 18             NA Count                     0
## 19                 Mean                 3.423
## 20               Median                 2.726
## 21   Standard Deviation                 2.465
## 22             Variance                 6.074
## 23                Range                12.205
## 24                  Min                 0.393
## 25                  Max                12.599
```

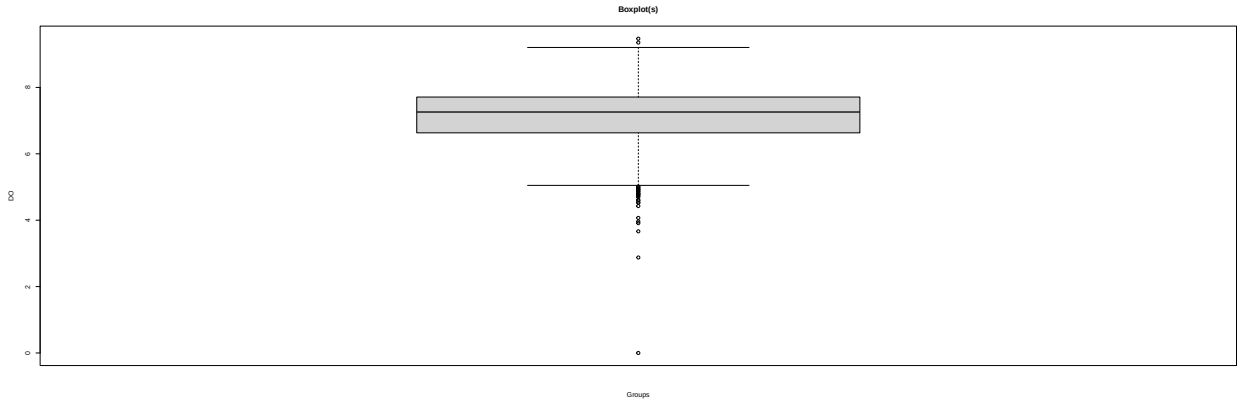



```
##                  metric                 V2
## 1                       Variable: DENSITY
## 2              Total N:
## 3                 Count               1098
## 4              NA Count                  0
## 5                  Mean              24.78
## 6                Median             24.807
## 7    Standard Deviation              0.467
## 8              Variance              0.218
## 9                 Range              3.139
## 10                  Min             22.837
## 11                  Max             25.976
## 12      25th Percentile             24.489
## 13      75th Percentile               25.1
## 14 Subset w/o Outliers:
## 15                Count               1089
## 16                    %              99.2%
## 17            Outlier %               0.8%
## 18             NA Count                  0
```

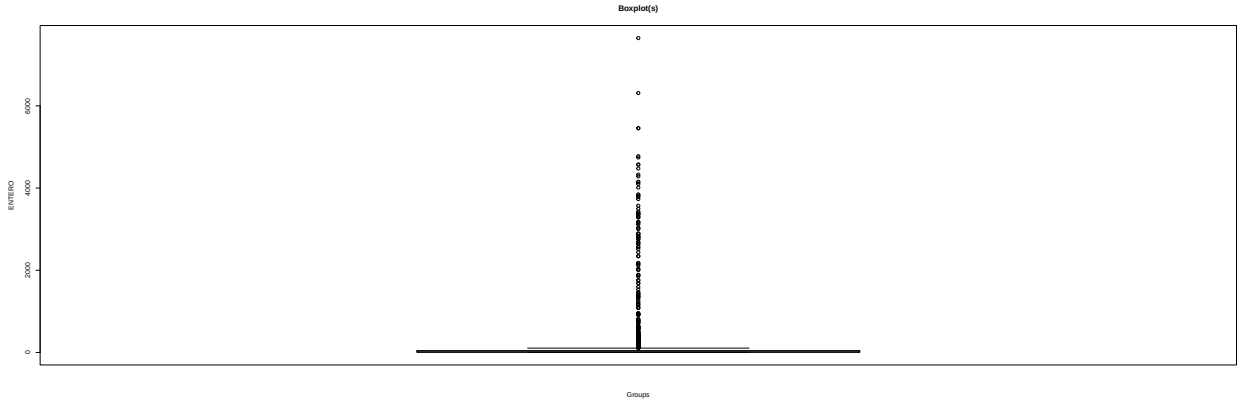
```
## 19                 Mean           24.793
## 20               Median           24.812
## 21   Standard Deviation            0.448
## 22             Variance            0.201
## 23                Range            2.545
## 24                  Min           23.431
## 25                  Max           25.976
```



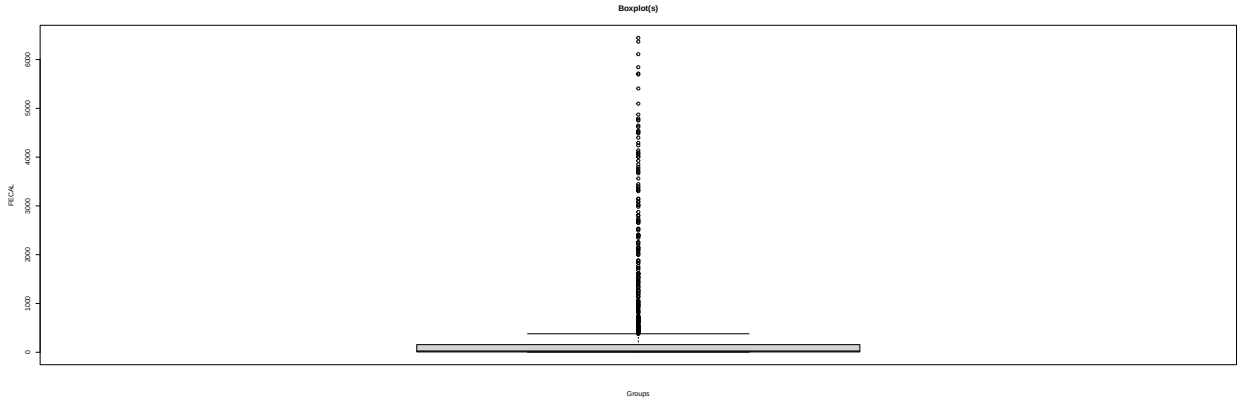

```
##                  metric           V2
## 1                       Variable: DO
## 2              Total N:
## 3                 Count         1203
## 4              NA Count            0
## 5                  Mean        7.102
## 6                Median        7.259
## 7    Standard Deviation        0.876
## 8              Variance        0.767
## 9                 Range        9.468
## 10                  Min            0
## 11                  Max        9.468
## 12      25th Percentile        6.632
## 13      75th Percentile         7.71
## 14 Subset w/o Outliers:
## 15                Count         1196
## 16                    %        99.4%
## 17            Outlier %         0.6%
## 18             NA Count            0
## 19                 Mean        7.125
## 20               Median        7.265
## 21   Standard Deviation        0.821
## 22             Variance        0.674
## 23                Range        4.942
## 24                  Min        4.527
## 25                  Max        9.468
```




```
##                  metric                V2
## 1                       Variable: ENTERO
## 2              Total N:
## 3                 Count             1614
## 4              NA Count                0
## 5                  Mean          214.198
## 6                Median           12.258
## 7    Standard Deviation          718.919
## 8              Variance        516845.04
## 9                 Range         7646.278
## 10                  Min                2
## 11                  Max         7648.278
## 12      25th Percentile            5.434
## 13      75th Percentile           45.567
## 14 Subset w/o Outliers:
## 15                Count             1557
## 16                    %            96.5%
## 17            Outlier %             3.5%
## 18             NA Count                0
## 19                 Mean           91.784
## 20               Median           11.698
## 21   Standard Deviation           275.13
## 22             Variance        75696.459
## 23                Range         2344.566
## 24                  Min                2
## 25                  Max         2346.566
```

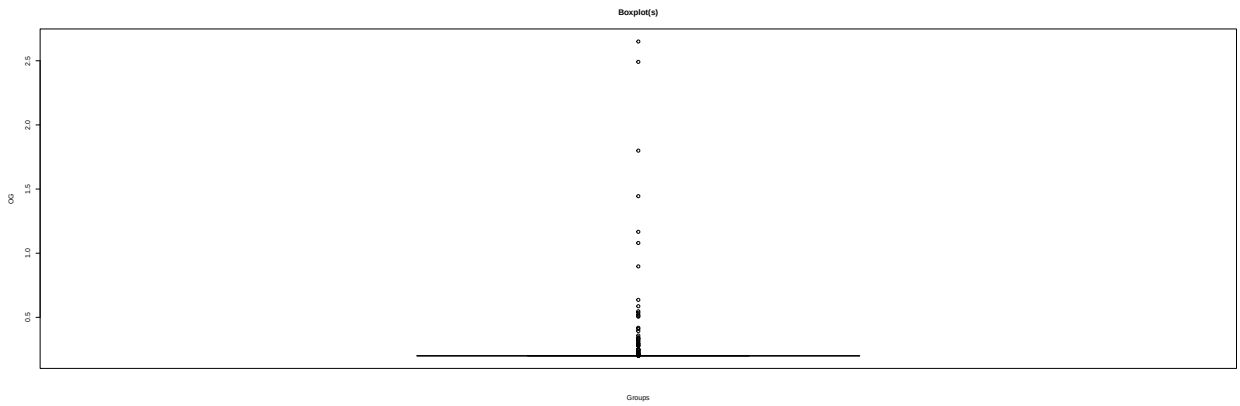


```
##                  metric              V2
## 1                       Variable: FECAL
## 2              Total N:
## 3                 Count            1614
## 4              NA Count               0
## 5                  Mean         304.597
## 6                Median          23.303
## 7    Standard Deviation          826.25
## 8              Variance      682689.747
## 9                 Range         6443.07
## 10                  Min               2
## 11                  Max         6445.07
## 12      25th Percentile           6.236
## 13      75th Percentile         156.176
## 14 Subset w/o Outliers:
## 15                Count            1562
## 16                    %           96.8%
## 17            Outlier %            3.2%
## 18             NA Count               0
## 19                 Mean         177.977
## 20               Median          20.506
## 21   Standard Deviation         421.323
## 22             Variance       177512.97
## 23                Range        2737.584
## 24                  Min               2
## 25                  Max        2739.584
```

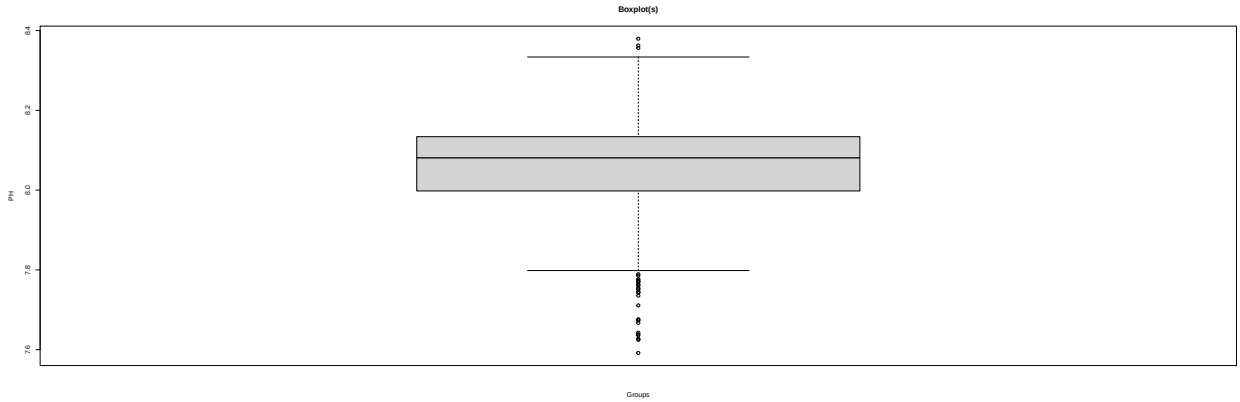



```
##                  metric           V2
## 1                       Variable: OG
## 2              Total N:
## 3                 Count          351
## 4              NA Count            0
## 5                  Mean        0.244
## 6                Median          0.2
## 7    Standard Deviation        0.227
## 8              Variance        0.052
## 9                 Range         2.45
## 10                  Min          0.2
## 11                  Max         2.65
## 12      25th Percentile          0.2
## 13      75th Percentile          0.2
```

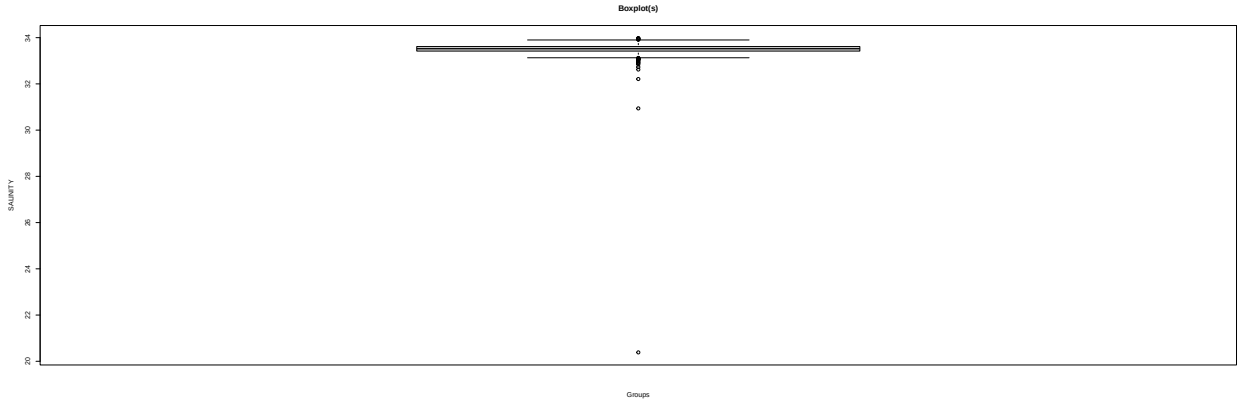
```
## 14 Subset w/o Outliers:
## 15                Count          345
## 16                    %        98.3%
## 17            Outlier %         1.7%
## 18             NA Count            0
## 19                 Mean        0.218
## 20               Median          0.2
## 21   Standard Deviation        0.068
## 22             Variance        0.005
## 23                Range        0.697
## 24                  Min          0.2
## 25                  Max        0.897
```



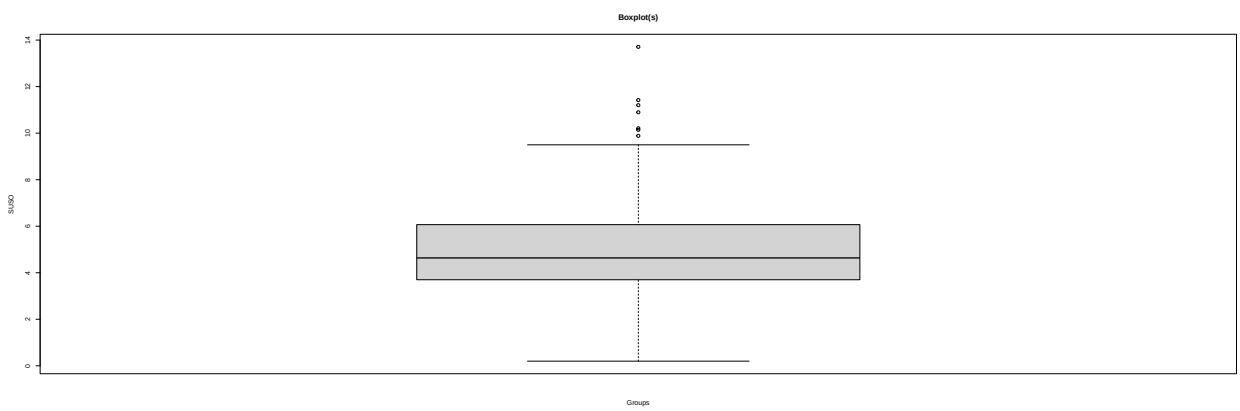

```
##                  metric           V2
## 1                       Variable: PH
## 2              Total N:
## 3                 Count         1205
## 4              NA Count            0
## 5                  Mean        8.062
## 6                Median        8.081
## 7    Standard Deviation         0.11
## 8              Variance        0.012
## 9                 Range        0.788
## 10                  Min        7.592
## 11                  Max         8.38
## 12      25th Percentile        7.998
## 13      75th Percentile        8.134
## 14 Subset w/o Outliers:
## 15                Count         1193
## 16                    %          99%
## 17            Outlier %           1%
## 18             NA Count            0
## 19                 Mean        8.066
## 20               Median        8.082
## 21   Standard Deviation        0.102
## 22             Variance         0.01
## 23                Range        0.644
## 24                  Min        7.735
## 25                  Max         8.38
```




```
##                 metric                V2
## 1                      Variable: SALINITY
## 2             Total N:
## 3                Count              1198
## 4             NA Count                 0
## 5                 Mean            33.501
## 6               Median            33.521
## 7    Standard Deviation              0.42
## 8             Variance             0.177
## 9                Range            13.596
## 10                 Min            20.385
## 11                 Max            33.981
## 12      25th Percentile            33.418
## 13      75th Percentile            33.615
## 14 Subset w/o Outliers:
## 15               Count              1195
## 16                   %             99.7%
## 17           Outlier %              0.3%
## 18            NA Count                 0
## 19                Mean            33.516
## 20              Median            33.522
## 21   Standard Deviation             0.161
## 22            Variance             0.026
## 23               Range              1.36
## 24                 Min            32.621
## 25                 Max            33.981
```

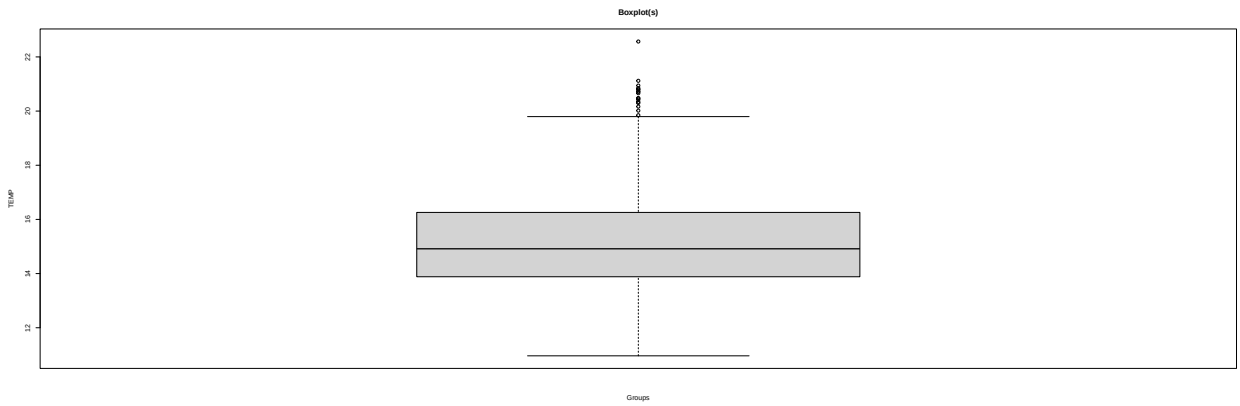


```
##                  metric             V2
## 1                       Variable: SUSO
## 2              Total N:
## 3                 Count            367
## 4              NA Count              0
## 5                  Mean          4.914
## 6                Median          4.637
## 7    Standard Deviation           1.85
## 8              Variance          3.424
## 9                 Range         13.509
## 10                  Min            0.2
## 11                  Max         13.709
## 12      25th Percentile          3.699
## 13      75th Percentile          6.067
## 14 Subset w/o Outliers:
## 15                Count            363
## 16                    %          98.9%
## 17            Outlier %           1.1%
## 18             NA Count              0
## 19                 Mean          4.838
## 20               Median          4.611
## 21   Standard Deviation          1.708
## 22             Variance          2.918
## 23                Range         10.009
## 24                  Min            0.2
## 25                  Max         10.209
```

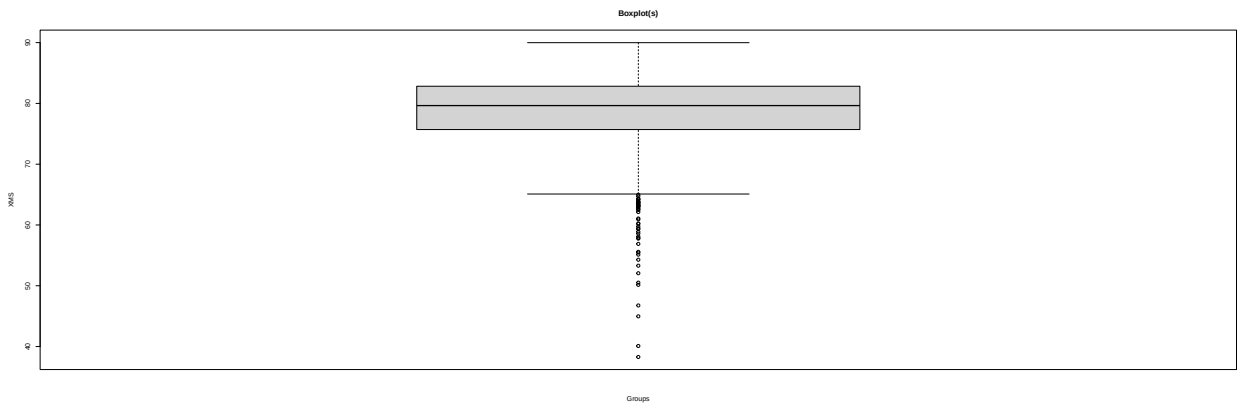



```
##                  metric             V2
## 1                       Variable: TEMP
## 2              Total N:
## 3                 Count           1547
## 4              NA Count              0
## 5                  Mean         15.145
## 6                Median         14.915
## 7    Standard Deviation          1.783
## 8              Variance          3.179
## 9                 Range         11.605
## 10                  Min         10.963
## 11                  Max         22.568
## 12      25th Percentile         13.883
## 13      75th Percentile         16.258
```

```
## 14 Subset w/o Outliers:
## 15                Count           1538
## 16                    %          99.4%
## 17            Outlier %           0.6%
## 18             NA Count              0
## 19                 Mean          15.11
## 20               Median         14.897
## 21   Standard Deviation           1.73
## 22             Variance          2.992
## 23                Range           9.52
## 24                  Min         10.963
## 25                  Max         20.483
```




```
##                  metric            V2
## 1                      Variable: XMS
## 2              Total N:
## 3                 Count          1540
## 4              NA Count             0
## 5                  Mean        78.614
## 6                Median        79.642
## 7    Standard Deviation         6.152
## 8              Variance        37.845
## 9                 Range        51.708
## 10                  Min        38.282
## 11                  Max         89.99
## 12      25th Percentile        75.699
## 13      75th Percentile        82.824
## 14 Subset w/o Outliers:
## 15                Count          1519
## 16                    %         98.6%
## 17            Outlier %          1.4%
## 18             NA Count             0
## 19                 Mean        78.961
## 20               Median        79.742
## 21   Standard Deviation         5.384
## 22             Variance        28.987
## 23                Range        29.778
## 24                  Min        60.212
## 25                  Max         89.99
```



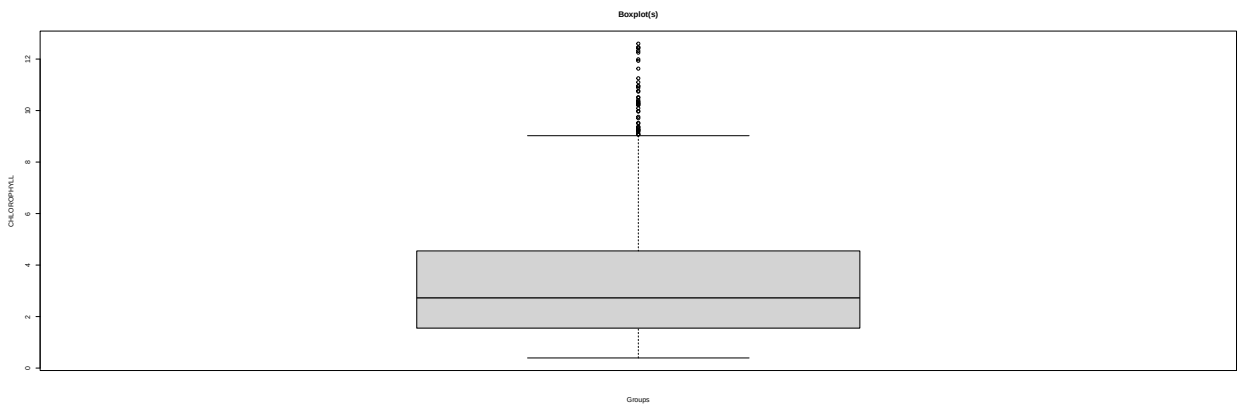

```
##    date_sample CHLOROPHYLL DENSITY       DO      ENTERO     FECAL OG       PH
## 1   1990-11-19        1.07  23.854 6.980000          NA        NA NA 8.130000
## 2   1991-01-07          NA      NA       NA   25.384615  88.46154 NA       NA
## 3   1991-01-14          NA      NA 5.445417   58.129735 137.21730 NA 8.195000
## 4   1991-01-21          NA      NA       NA   23.205128  59.61538 NA       NA
## 5   1991-01-28          NA      NA       NA   31.818910  69.78365 NA       NA
## 6   1991-02-04          NA      NA       NA  154.230769 428.58974 NA       NA
## 7   1991-02-11          NA      NA       NA   16.838141  14.63141 NA       NA
## 8   1991-02-18          NA      NA 5.597500   45.317879 112.33029 NA 8.173333
## 9   1991-02-25          NA      NA       NA    9.083333  16.10737 NA       NA
## 10  1991-03-04          NA      NA       NA   16.512821  15.05128 NA       NA
## 11  1991-03-11          NA      NA 4.808333   43.496041 247.95270 NA 8.201667
## 12  1991-03-18          NA      NA       NA   32.542347 179.98990 NA       NA
## 13  1991-03-25          NA      NA       NA 1370.111538 517.44812 NA       NA
## 14  1991-04-01          NA      NA       NA   15.025641  33.15385 NA       NA
## 15  1991-04-08          NA      NA       NA   38.837607 136.90598 NA       NA
## 16  1991-04-15          NA      NA 4.730833   43.944524 190.35018 NA 8.138333
## 17  1991-04-22          NA      NA       NA   24.313390  77.44160 NA       NA
##    SALINITY SUSO     TEMP      XMS
## 1  33.59550   NA 19.37000 60.22500
## 2        NA   NA 14.45000 81.96154
## 3  33.50113   NA 14.07478 82.04876
## 4        NA   NA 14.54487 70.19231
## 5        NA   NA 14.28846 77.61167
## 6        NA   NA 14.23462 81.83333
## 7        NA   NA 14.46154 70.83333
## 8  33.51717   NA 14.00639 79.30243
## 9        NA   NA 14.05769 79.71518
## 10       NA   NA 14.24231 82.44872
## 11 33.48729   NA 13.93447 70.49667
## 12       NA   NA 12.97995 68.95260
## 13       NA   NA 13.11026 69.92308
## 14       NA   NA 13.46667 75.12719
## 15       NA   NA 13.19487 81.09818
## 16 33.55379   NA 13.33149 71.94475
## 17       NA   NA 12.97949 74.71053
##             vars    n   mean     sd median trimmed   mad   min     max   range
## date_sample    1 1616    NaN     NA     NA     NaN    NA   Inf    -Inf    -Inf
## CHLOROPHYLL    2 1071   3.66   2.98   2.78    3.16  2.07  0.39   22.79   22.40
## DENSITY        3 1098  24.78   0.47  24.81   24.80  0.45 22.84   25.98    3.14
```

```
## DO             4 1203   7.10   0.88   7.26    7.18  0.74  0.00    9.47    9.47
## ENTERO         5 1614 214.20 718.92  12.26   35.21 13.56  2.00 7648.28 7646.28
## FECAL          6 1614 304.60 826.25  23.30   86.48 29.92  2.00 6445.07 6443.07
## OG             7  351   0.24   0.23   0.20    0.20  0.00  0.20    2.65    2.45
## PH             8 1205   8.06   0.11   8.08    8.07  0.10  7.59    8.38    0.79
## SALINITY       9 1198  33.50   0.42  33.52   33.52  0.15 20.38   33.98   13.60
## SUSO          10  367   4.91   1.85   4.64    4.81  1.61  0.20   13.71   13.51
## TEMP          11 1547  15.14   1.78  14.92   15.04  1.75 10.96   22.57   11.61
## XMS           12 1540  78.61   6.15  79.64   79.25  5.14 38.28   89.99   51.71
##               skew kurtosis    se
## date_sample     NA       NA    NA
## CHLOROPHYLL   1.97     5.38  0.09
## DENSITY      -0.45     0.37  0.01
## DO           -1.19     4.14  0.03
## ENTERO        4.84    26.56 17.89
## FECAL         4.13    18.61 20.57
## OG            7.92    70.11  0.01
## PH           -0.84     1.63  0.00
## SALINITY    -25.63   791.34  0.01
## SUSO          0.79     1.80  0.10
## TEMP          0.59     0.20  0.05
## XMS          -1.47     4.30  0.16
##          date_sample parameter       Avg
## Not NA n       36811     36811 35669.000
## NA n               0         0  1142.000
## Not NA %           1         1     0.969
## NA %               0         0     0.031
```

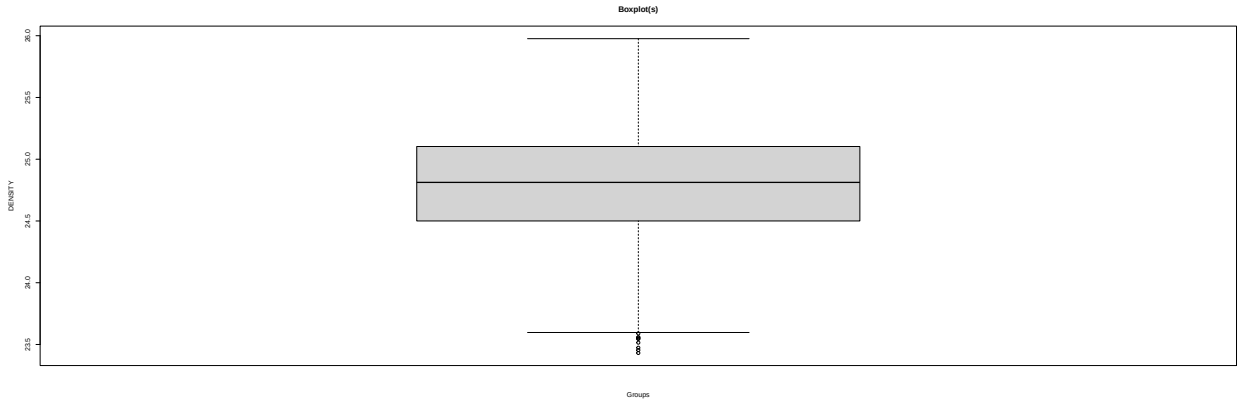
```
owt_df02_gb04_wkly02 = ts_eda(ts_df = owt_df02_gb04,
                              form_lead = "date_sample",
                              form_cast = "parameter",
                              param_lst = param_lst02,
                              rtn_met = TRUE,
                              box = FALSE,
                              week_agg = TRUE,
                              out_rm = TRUE
                              )
```

```
## [1] 1071    2
##                  metric                    V2
## 1                       Variable: CHLOROPHYLL
## 2              Total N:
## 3                 Count                  1049
## 4              NA Count                     0
## 5                  Mean                 3.423
## 6                Median                 2.726
## 7    Standard Deviation                 2.465
## 8              Variance                 6.074
## 9                 Range                12.205
## 10                  Min                 0.393
## 11                  Max                12.599
## 12      25th Percentile                 1.552
## 13      75th Percentile                  4.55
## 14 Subset w/o Outliers:
```

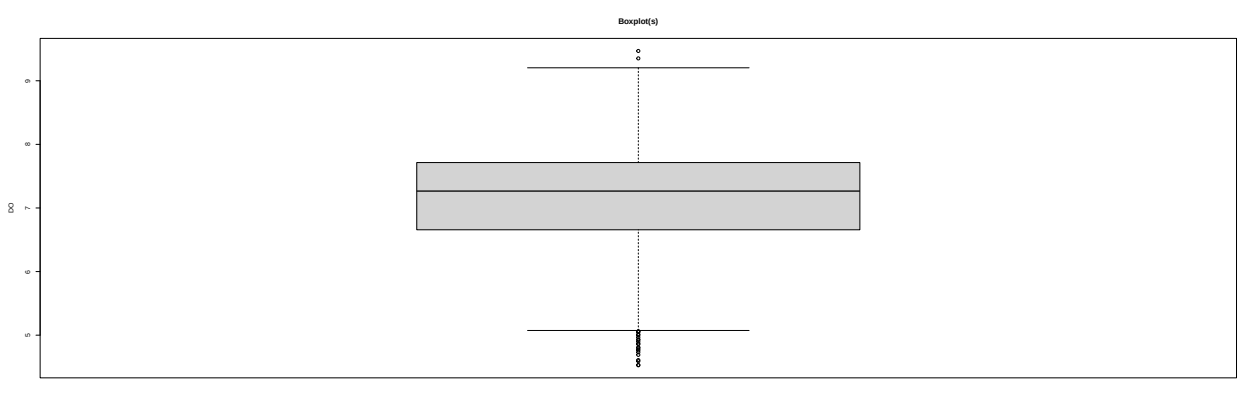
```
## 15                Count                  1035
## 16                    %                 98.7%
## 17            Outlier %                  1.3%
## 18             NA Count                     0
## 19                 Mean                  3.31
## 20               Median                 2.699
## 21   Standard Deviation                 2.278
## 22             Variance                 5.188
## 23                Range                10.373
## 24                  Min                 0.393
## 25                  Max                10.767
```



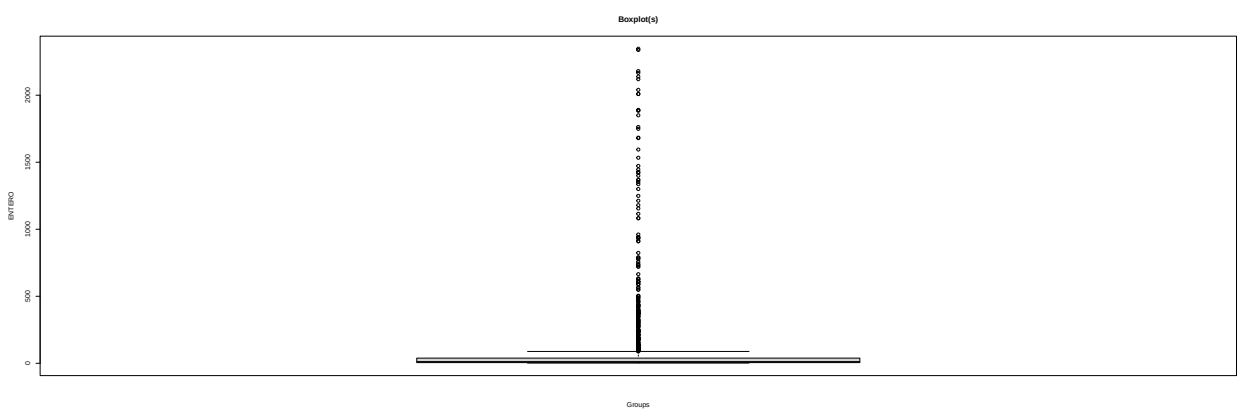

```
## [1] 1098    2
##                  metric                V2
## 1                       Variable: DENSITY
## 2             Total N:
## 3                Count              1089
## 4             NA Count                 0
## 5                 Mean            24.793
## 6               Median            24.812
## 7    Standard Deviation             0.448
## 8             Variance             0.201
## 9                Range             2.545
## 10                 Min            23.431
## 11                 Max            25.976
## 12      25th Percentile              24.5
## 13      75th Percentile            25.103
## 14 Subset w/o Outliers:
## 15                Count              1088
## 16                    %             99.9%
## 17            Outlier %              0.1%
## 18             NA Count                 0
## 19                 Mean            24.794
## 20               Median            24.813
## 21   Standard Deviation             0.446
## 22             Variance             0.199
## 23                Range             2.522
## 24                 Min            23.454
## 25                 Max            25.976
```




```
## [1] 1203    2
##                  metric           V2
## 1                       Variable: DO
## 2              Total N:
## 3                 Count         1196
## 4              NA Count            0
## 5                  Mean        7.125
## 6                Median        7.265
## 7    Standard Deviation        0.821
## 8              Variance        0.674
## 9                 Range        4.942
## 10                  Min        4.527
## 11                  Max        9.468
## 12      25th Percentile        6.657
## 13      75th Percentile        7.714
## 14 Subset w/o Outliers:
## 15                Count         1192
## 16                    %        99.7%
## 17            Outlier %         0.3%
## 18             NA Count            0
## 19                 Mean        7.133
## 20               Median        7.267
## 21   Standard Deviation        0.809
## 22             Variance        0.654
## 23                Range        4.778
## 24                  Min         4.69
## 25                  Max        9.468
```

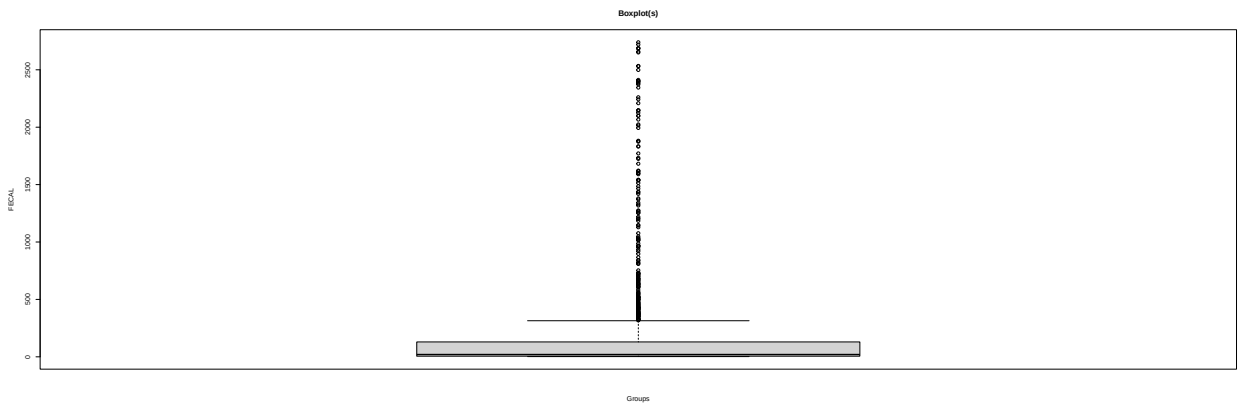


```
## [1] 1614    2
##                  metric               V2
## 1                       Variable: ENTERO
## 2              Total N:
## 3                 Count             1557
## 4              NA Count                0
## 5                  Mean           91.784
## 6                Median           11.698
## 7    Standard Deviation           275.13
## 8              Variance        75696.459
## 9                 Range         2344.566
## 10                  Min                2
## 11                  Max         2346.566
## 12      25th Percentile            5.128
## 13      75th Percentile           38.694
## 14 Subset w/o Outliers:
## 15                Count             1516
## 16                    %            97.4%
## 17            Outlier %             2.6%
## 18             NA Count                0
## 19                 Mean           52.359
## 20               Median           11.146
## 21   Standard Deviation          118.074
## 22             Variance        13941.503
## 23                Range          909.627
## 24                  Min                2
## 25                  Max          911.627
```



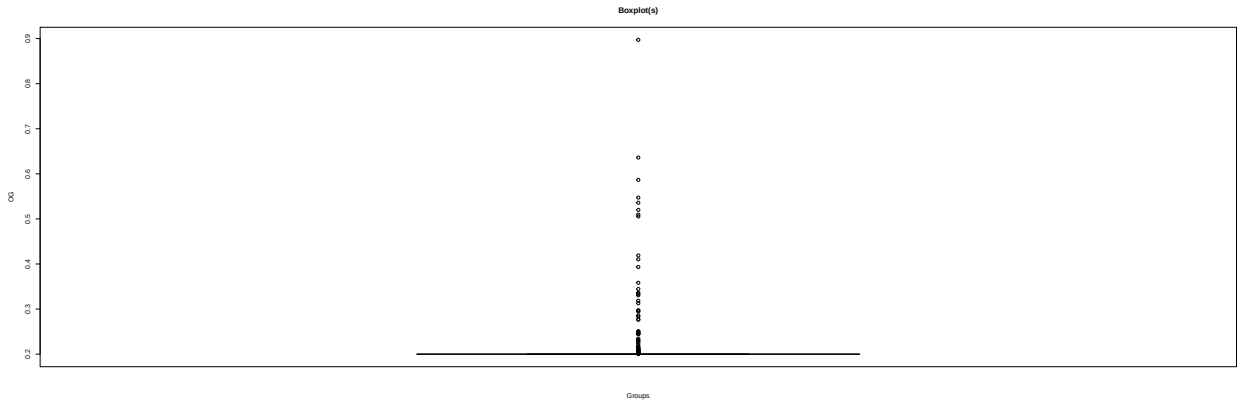

```
## [1] 1614    2
##                  metric               V2
## 1                       Variable: FECAL
## 2              Total N:
## 3                 Count             1562
## 4              NA Count                0
## 5                  Mean         177.977
## 6                Median          20.506
## 7    Standard Deviation         421.323
## 8              Variance       177512.97
## 9                 Range        2737.584
## 10                  Min                2
## 11                  Max        2739.584
```

```
## 12      25th Percentile          6.048
## 13      75th Percentile        129.582
## 14 Subset w/o Outliers:
## 15                Count           1509
## 16                    %          96.6%
## 17            Outlier %           3.4%
## 18             NA Count              0
## 19                 Mean        111.629
## 20               Median         18.395
## 21   Standard Deviation         219.97
## 22             Variance      48386.762
## 23                Range       1436.388
## 24                  Min              2
## 25                  Max       1438.388
```

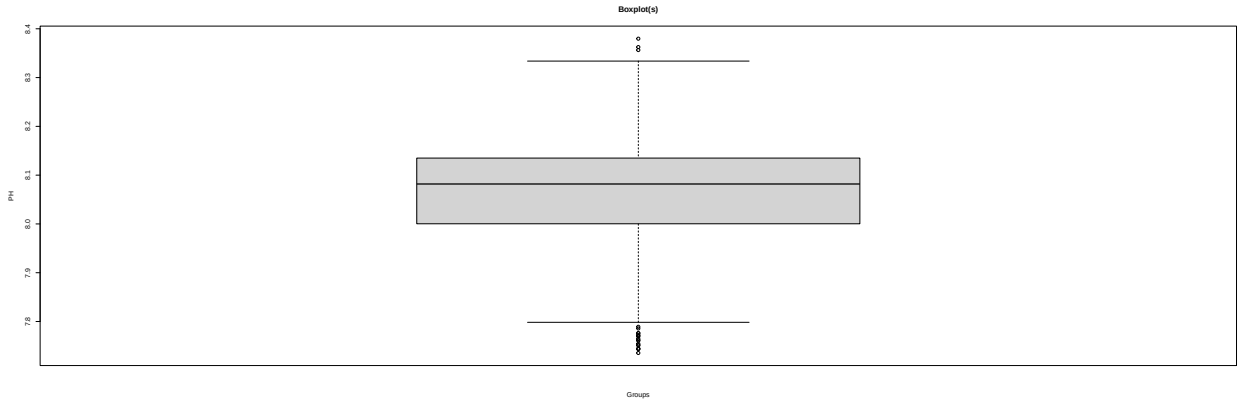



```
## [1] 351   2
##                  metric          V2
## 1                       Variable: OG
## 2              Total N:
## 3                 Count         345
## 4              NA Count           0
## 5                  Mean       0.218
## 6                Median         0.2
## 7    Standard Deviation       0.068
## 8              Variance       0.005
## 9                 Range       0.697
## 10                  Min         0.2
## 11                  Max       0.897
## 12      25th Percentile         0.2
## 13      75th Percentile         0.2
## 14 Subset w/o Outliers:
## 15                Count         337
## 16                    %       97.7%
## 17            Outlier %        2.3%
## 18             NA Count           0
## 19                 Mean       0.209
## 20               Median         0.2
## 21   Standard Deviation        0.03
## 22             Variance       0.001
## 23                Range       0.219
## 24                  Min         0.2
```

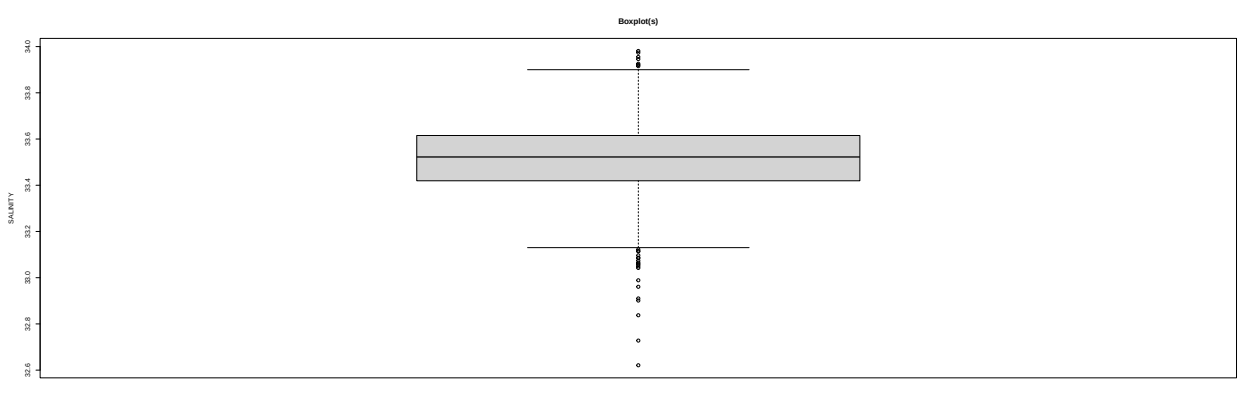
```
## 25                  Max        0.419
```



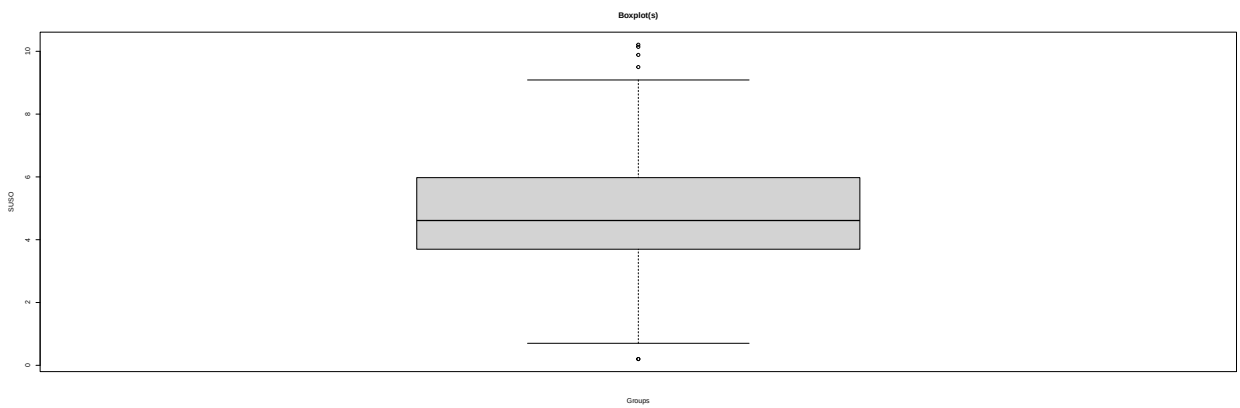

```
## [1] 1205    2
##                  metric           V2
## 1                       Variable: PH
## 2              Total N:
## 3                 Count         1193
## 4              NA Count            0
## 5                  Mean        8.066
## 6                Median        8.082
## 7    Standard Deviation        0.102
## 8              Variance         0.01
## 9                 Range        0.644
## 10                  Min        7.735
## 11                  Max         8.38
## 12      25th Percentile            8
## 13      75th Percentile        8.135
## 14 Subset w/o Outliers:
## 15                Count         1185
## 16                    %        99.3%
## 17            Outlier %         0.7%
## 18             NA Count            0
## 19                 Mean        8.068
## 20               Median        8.082
## 21   Standard Deviation        0.099
## 22             Variance         0.01
## 23                Range        0.602
## 24                  Min        7.761
## 25                  Max        8.363
```




```
## [1] 1198    2
##                  metric                 V2
## 1                       Variable: SALINITY
## 2              Total N:
## 3                 Count               1195
## 4              NA Count                  0
## 5                  Mean             33.516
## 6                Median             33.522
## 7    Standard Deviation              0.161
## 8              Variance              0.026
## 9                 Range               1.36
## 10                  Min             32.621
## 11                  Max             33.981
## 12      25th Percentile             33.419
## 13      75th Percentile             33.615
## 14 Subset w/o Outliers:
## 15                Count               1188
## 16                    %              99.4%
## 17            Outlier %               0.6%
## 18             NA Count                  0
## 19                 Mean              33.52
## 20               Median             33.523
## 21   Standard Deviation              0.152
## 22             Variance              0.023
## 23                Range              0.939
## 24                  Min             33.042
## 25                  Max             33.981
```

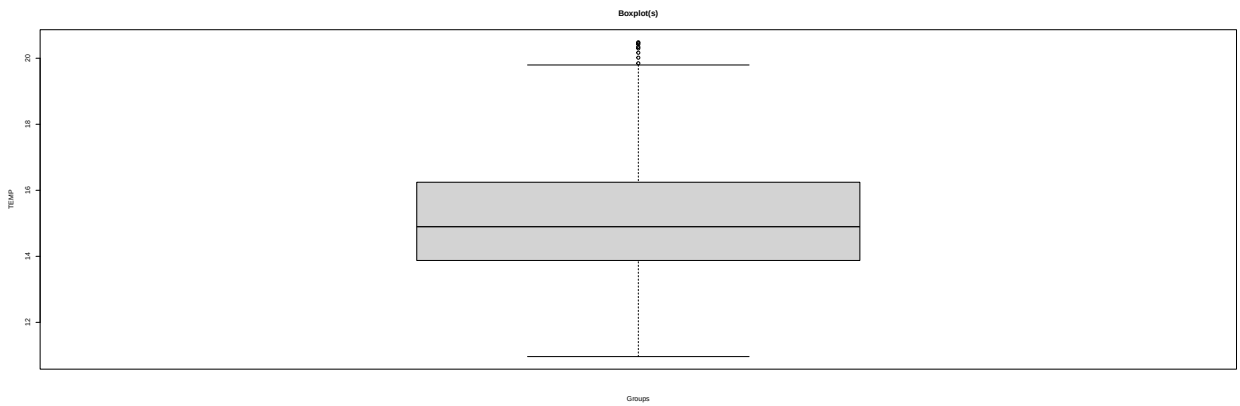


```
## [1] 367   2
##                  metric             V2
## 1                       Variable: SUSO
## 2              Total N:
## 3                 Count            363
## 4              NA Count              0
## 5                  Mean          4.838
## 6                Median          4.611
## 7    Standard Deviation          1.708
## 8              Variance          2.918
## 9                 Range         10.009
## 10                  Min            0.2
## 11                  Max         10.209
## 12      25th Percentile          3.697
## 13      75th Percentile          5.977
## 14 Subset w/o Outliers:
## 15                Count            361
## 16                    %          99.4%
## 17            Outlier %           0.6%
## 18             NA Count              0
## 19                 Mean          4.808
## 20               Median          4.607
## 21   Standard Deviation          1.666
## 22             Variance          2.775
## 23                Range          9.685
## 24                  Min            0.2
## 25                  Max          9.885
```



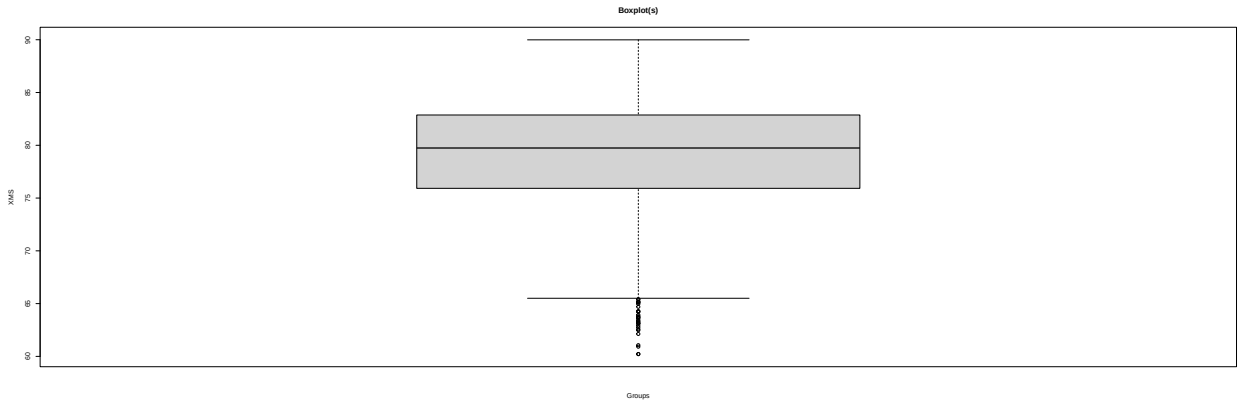

```
## [1] 1547    2
##                  metric             V2
## 1                       Variable: TEMP
## 2              Total N:
## 3                 Count           1538
## 4              NA Count              0
## 5                  Mean          15.11
## 6                Median         14.897
## 7    Standard Deviation           1.73
## 8              Variance          2.992
## 9                 Range           9.52
## 10                  Min         10.963
## 11                  Max         20.483
```

```
## 12      25th Percentile         13.876
## 13      75th Percentile         16.244
## 14 Subset w/o Outliers:
## 15                Count           1534
## 16                    %          99.7%
## 17            Outlier %           0.3%
## 18             NA Count              0
## 19                 Mean         15.097
## 20               Median         14.893
## 21   Standard Deviation          1.711
## 22             Variance          2.926
## 23                Range          9.335
## 24                  Min         10.963
## 25                  Max         20.298
```




```
## [1] 1540    2
##                  metric            V2
## 1                       Variable: XMS
## 2              Total N:
## 3                 Count          1519
## 4              NA Count             0
## 5                  Mean        78.961
## 6                Median        79.742
## 7    Standard Deviation         5.384
## 8              Variance        28.987
## 9                 Range        29.778
## 10                  Min        60.212
## 11                  Max         89.99
## 12      25th Percentile        75.922
## 13      75th Percentile         82.87
## 14 Subset w/o Outliers:
## 15                Count          1511
## 16                    %         99.5%
## 17            Outlier %          0.5%
## 18             NA Count             0
## 19                 Mean        79.053
## 20               Median         79.78
## 21   Standard Deviation         5.246
## 22             Variance         27.52
## 23                Range        27.089
## 24                  Min        62.901
```

```
## 25                  Max         89.99
```

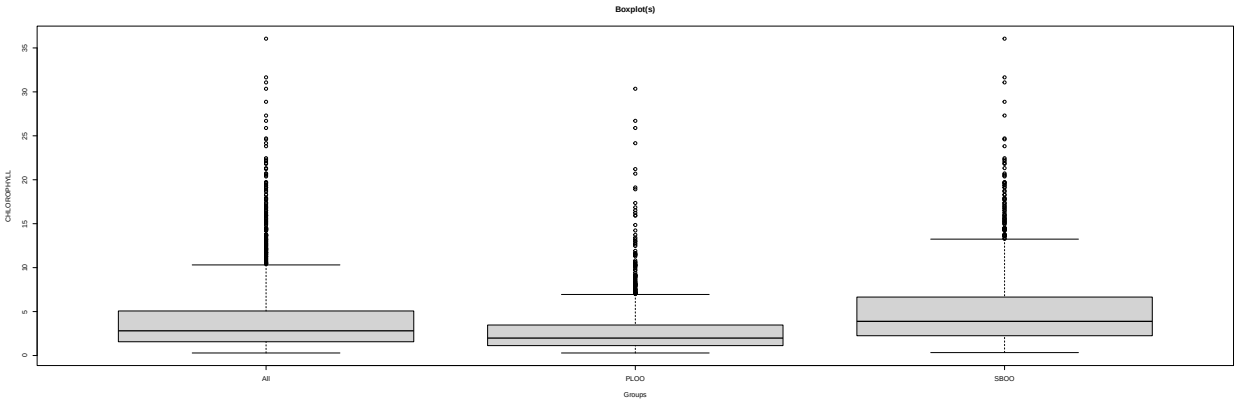


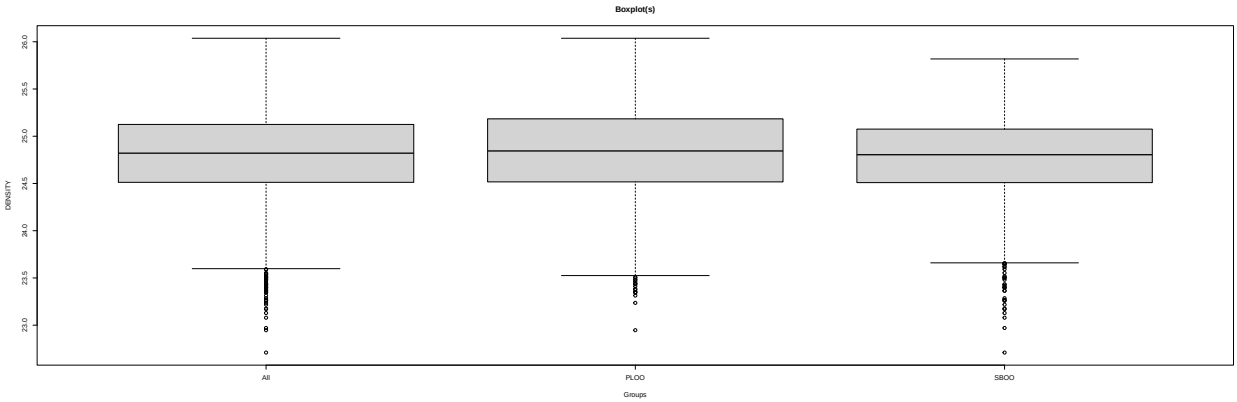

```
##    date_sample CHLOROPHYLL DENSITY       DO      ENTERO     FECAL OG       PH
## 1   1990-11-19        1.07  23.854 6.980000          NA        NA NA 8.130000
## 2   1991-01-07          NA      NA       NA   25.384615  88.46154 NA       NA
## 3   1991-01-14          NA      NA 5.445417   58.129735 137.21730 NA 8.195000
## 4   1991-01-21          NA      NA       NA   23.205128  59.61538 NA       NA
## 5   1991-01-28          NA      NA       NA   31.818910  69.78365 NA       NA
## 6   1991-02-04          NA      NA       NA  154.230769 428.58974 NA       NA
## 7   1991-02-11          NA      NA       NA   16.838141  14.63141 NA       NA
## 8   1991-02-18          NA      NA 5.597500   45.317879 112.33029 NA 8.173333
## 9   1991-02-25          NA      NA       NA    9.083333  16.10737 NA       NA
## 10  1991-03-04          NA      NA       NA   16.512821  15.05128 NA       NA
## 11  1991-03-11          NA      NA 4.808333   43.496041 247.95270 NA 8.201667
## 12  1991-03-18          NA      NA       NA   32.542347 179.98990 NA       NA
## 13  1991-03-25          NA      NA       NA 1370.111538 517.44812 NA       NA
## 14  1991-04-01          NA      NA       NA   15.025641  33.15385 NA       NA
## 15  1991-04-08          NA      NA       NA   38.837607 136.90598 NA       NA
## 16  1991-04-15          NA      NA 4.730833   43.944524 190.35018 NA 8.138333
## 17  1991-04-22          NA      NA       NA   24.313390  77.44160 NA       NA
##    SALINITY SUSO     TEMP      XMS
## 1  33.59550   NA 19.37000 60.22500
## 2        NA   NA 14.45000 81.96154
## 3  33.50113   NA 14.07478 82.04876
## 4        NA   NA 14.54487 70.19231
## 5        NA   NA 14.28846 77.61167
## 6        NA   NA 14.23462 81.83333
## 7        NA   NA 14.46154 70.83333
## 8  33.51717   NA 14.00639 79.30243
## 9        NA   NA 14.05769 79.71518
## 10       NA   NA 14.24231 82.44872
## 11 33.48729   NA 13.93447 70.49667
## 12       NA   NA 12.97995 68.95260
## 13       NA   NA 13.11026 69.92308
## 14       NA   NA 13.46667 75.12719
## 15       NA   NA 13.19487 81.09818
## 16 33.55379   NA 13.33149 71.94475
## 17       NA   NA 12.97949 74.71053
##             vars    n   mean     sd median trimmed   mad   min     max   range
## date_sample    1 1615    NaN     NA     NA     NaN    NA   Inf    -Inf    -Inf
## CHLOROPHYLL    2 1049   3.42   2.46   2.73    3.06  1.98  0.39   12.60   12.21
```

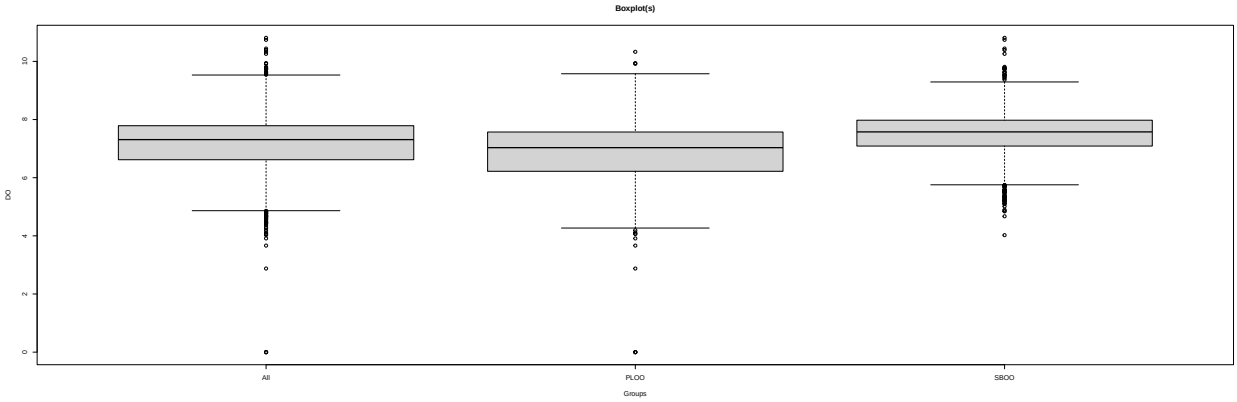
```
## DENSITY        3 1089  24.79   0.45  24.81   24.81  0.44 23.43   25.98    2.54
## DO             4 1196   7.12   0.82   7.27    7.19  0.74  4.53    9.47    4.94
## ENTERO         5 1557  91.78 275.13  11.70   25.40 12.59  2.00 2346.57 2344.57
## FECAL          6 1562 177.98 421.32  20.51   68.76 25.72  2.00 2739.58 2737.58
## OG             7  345   0.22   0.07   0.20    0.20  0.00  0.20    0.90    0.70
## PH             8 1193   8.07   0.10   8.08    8.07  0.09  7.74    8.38    0.64
## SALINITY       9 1195  33.52   0.16  33.52   33.52  0.15 32.62   33.98    1.36
## SUSO          10  363   4.84   1.71   4.61    4.78  1.57  0.20   10.21   10.01
## TEMP          11 1538  15.11   1.73  14.90   15.02  1.73 10.96   20.48    9.52
## XMS           12 1519  78.96   5.38  79.74   79.38  5.05 60.21   89.99   29.78
##              skew kurtosis    se
## date_sample    NA       NA    NA
## CHLOROPHYLL  1.30     1.35  0.08
## DENSITY     -0.27    -0.11  0.01
## DO          -0.65     0.23  0.02
## ENTERO       5.13    29.25  6.97
## FECAL        3.79    15.29 10.66
## OG           5.74    40.06  0.00
## PH          -0.50     0.51  0.00
## SALINITY    -0.54     1.78  0.00
## SUSO         0.37     0.29  0.09
## TEMP         0.48    -0.16  0.04
## XMS         -0.73     0.33  0.14
##          date_sample parameter       Avg
## Not NA n       36811     36811 35669.000
## NA n               0         0  1142.000
## Not NA %           1         1     0.969
## NA %               0         0     0.031
```

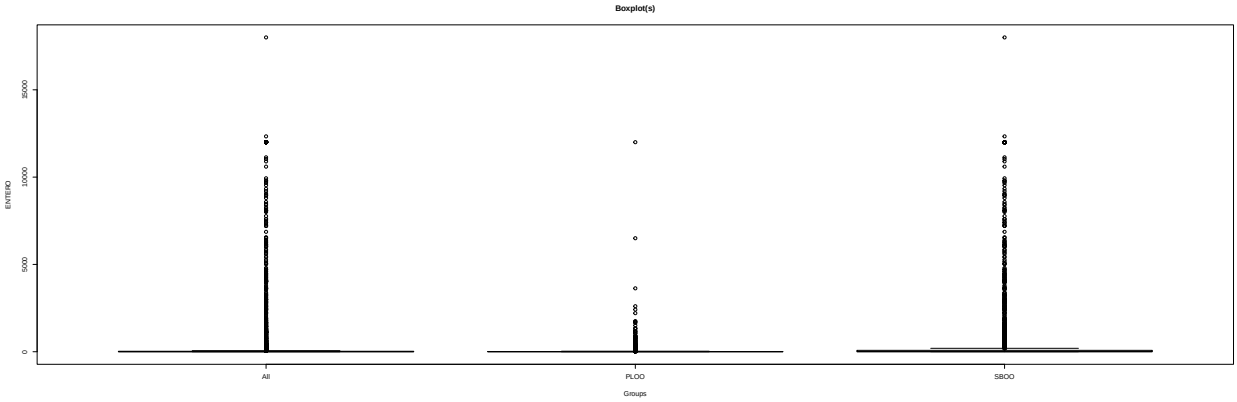
Run custom function on data aggregated by `date_sample`, `project` and `parameter`

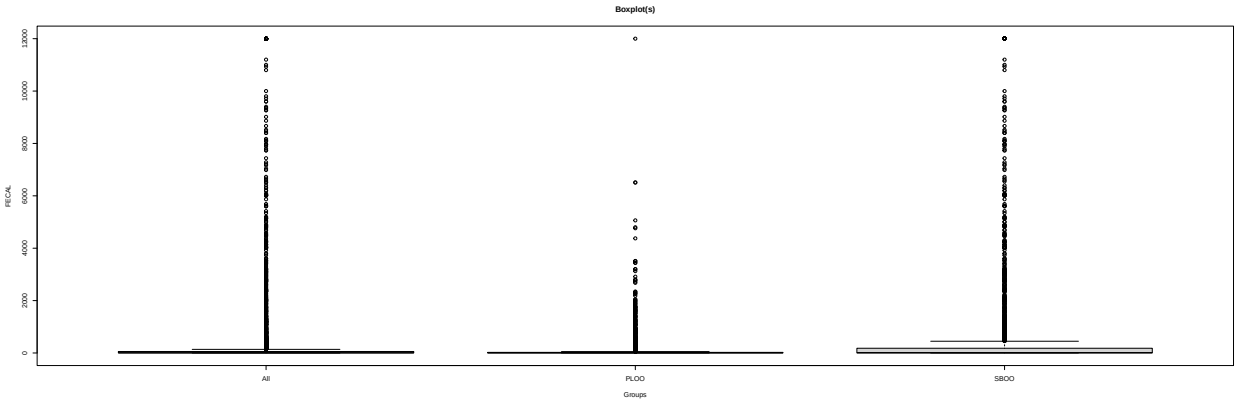
```
owt_df02_gb09_mrgd = ts_eda(ts_df = owt_df02_gb09,
                            form_lead = c("date_sample", "project"),
                            form_cast = "parameter",
                            param_lst = param_lst02,
                            l1_col = c("project"),
                            l1_param = c("PLOO", "SBOO"),
                            rtn_met = FALSE,
                            box = FALSE,
                            week_agg = FALSE
                            )
```

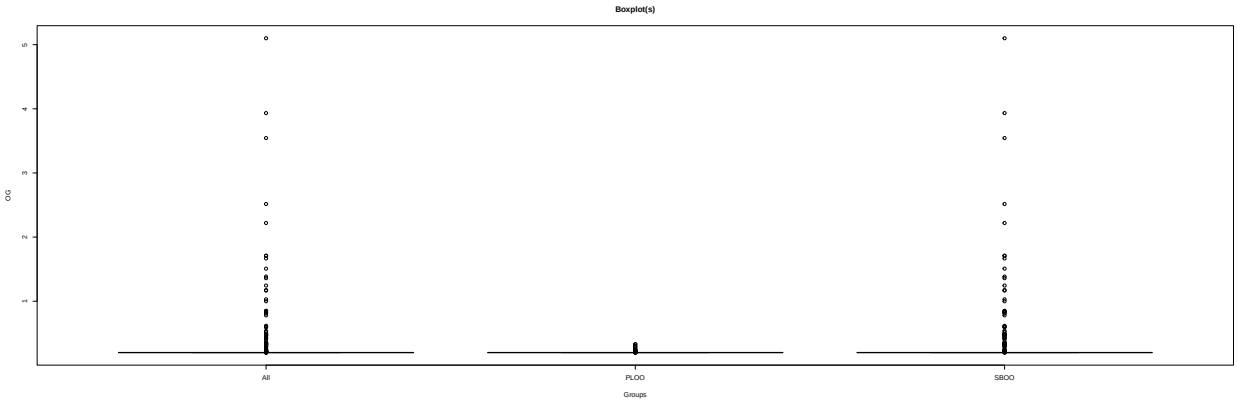

Boxplot(s)
CHLOROPHYLL
0
5
10
15
20
25
30
35
All
PLOO
SBOO
Groups

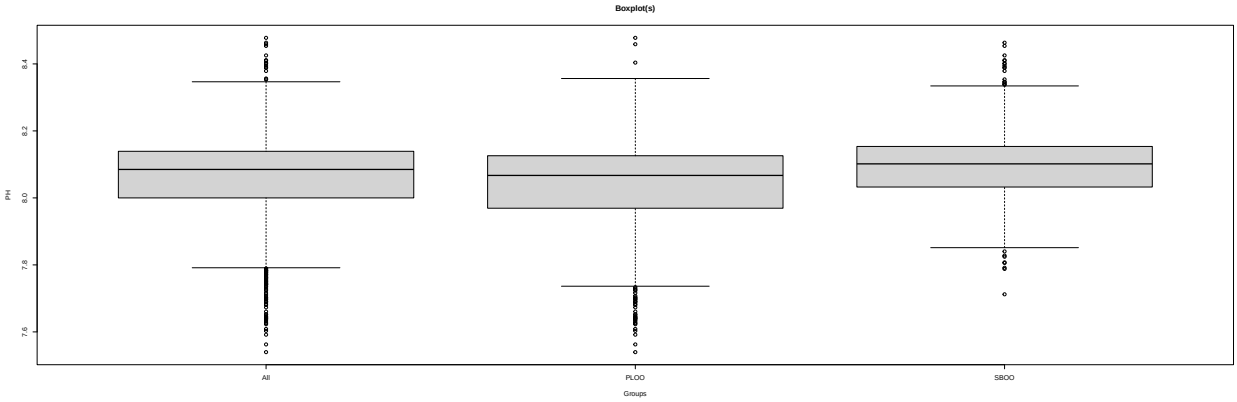

Boxplot(s)
DENSITY
23.0
23.5
24.0
24.5
25.0
25.5
26.0
All
PLOO
SBOO
Groups

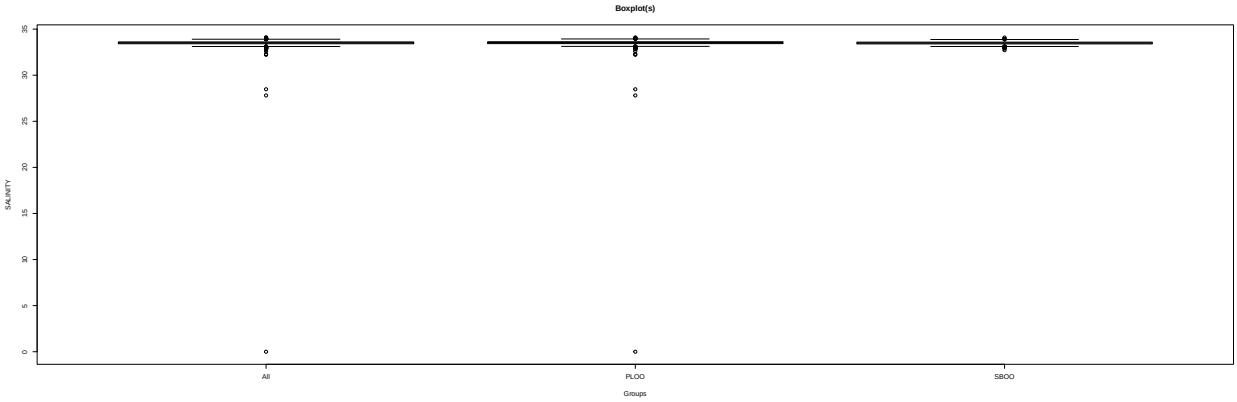

Boxplot(s)
DO
0
2
4
6
8
10
All
PLOO
SBOO
Groups

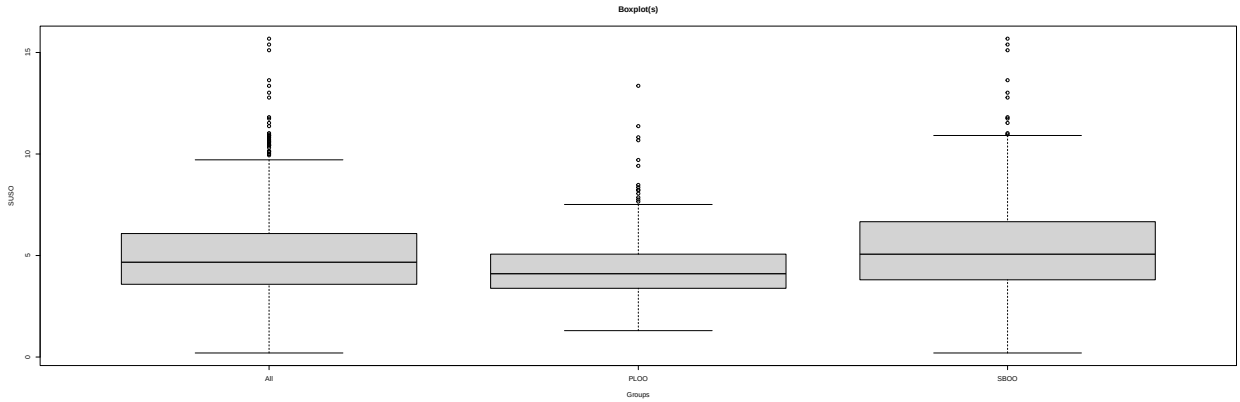

Boxplot(s)
ENTERO
0
5000
10000
15000
All
PLOO
SBOO
Groups

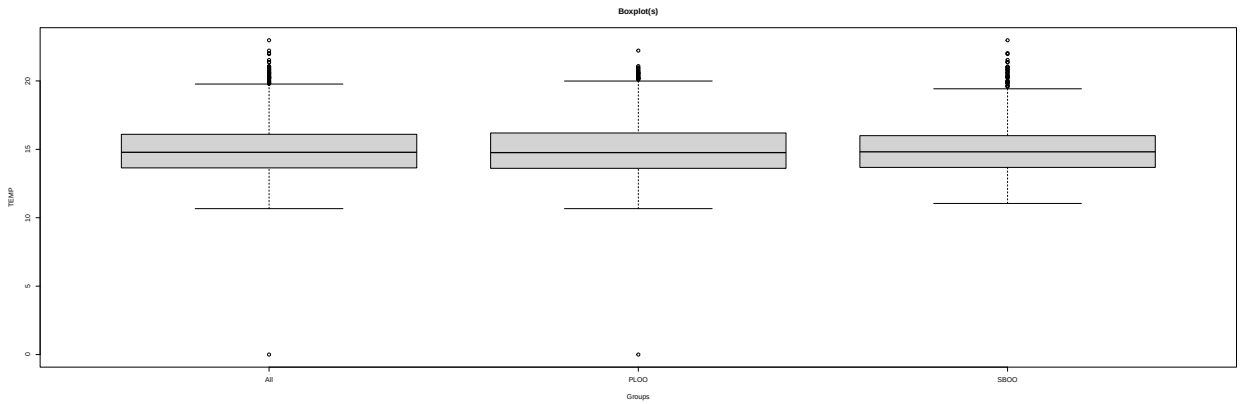

Boxplot(s)
FECAL
0
2000
4000
6000
8000
10000
12000
All
PLOO
SBOO
Groups

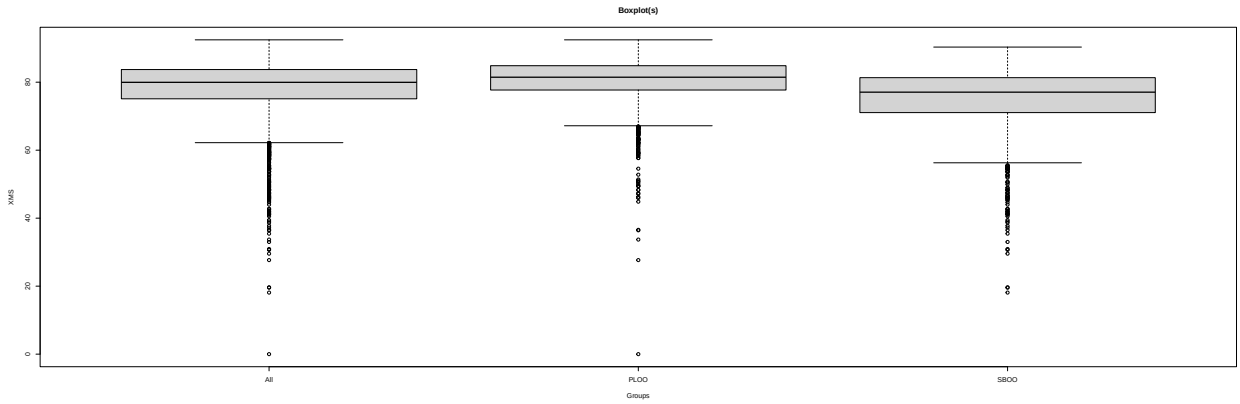

Boxplot(s)
OG
1
2
3
4
5
All
PLOO
SBOO
Groups


Boxplot(s)
PH
7.6
7.8
8.0
8.2
8.4
All
PLOO
SBOO
Groups


Boxplot(s)
SALINITY
0
5
10
15
20
25
30
35
All
PLOO
SBOO
Groups





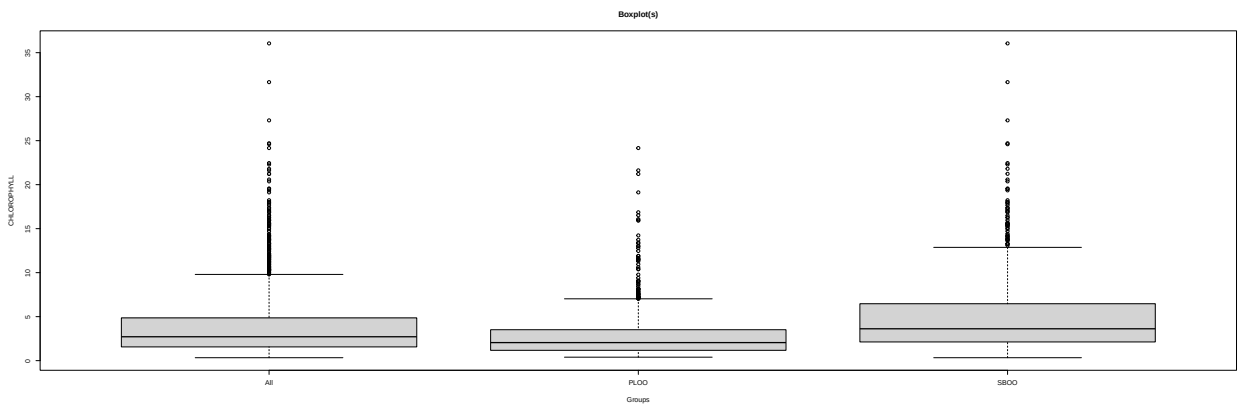


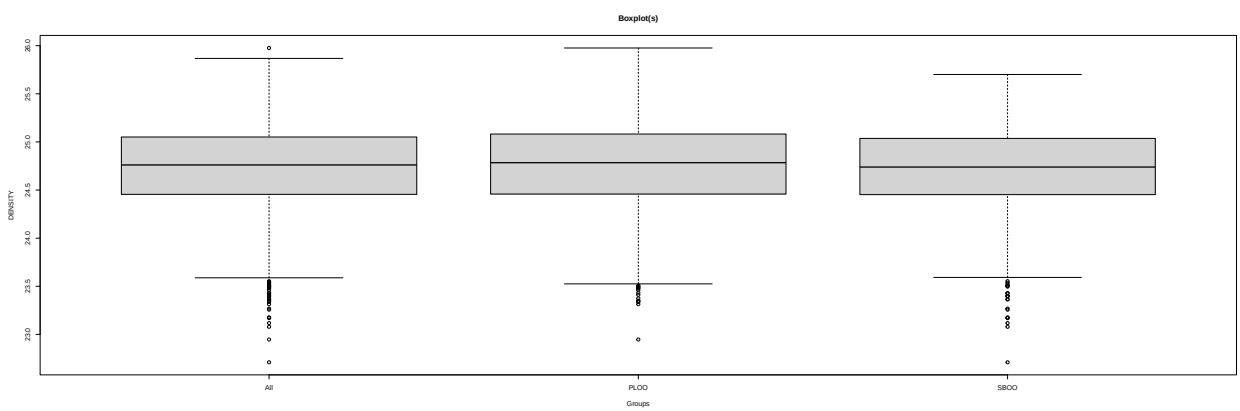

```
##    date_sample project CHLOROPHYLL DENSITY      DO    ENTERO     FECAL OG    PH
## 1   1990-11-15    PLOO        0.87  23.855 6.55000        NA        NA NA 8.080
## 2   1990-11-15    SBOO        1.27  23.853 7.41000        NA        NA NA 8.180
## 3   1991-01-02    PLOO          NA      NA      NA  32.05128 125.64103 NA    NA
## 4   1991-01-03    PLOO          NA      NA      NA  18.71795  51.28205 NA    NA
## 5   1991-01-07    PLOO          NA      NA      NA 106.15385  80.76923 NA    NA
## 6   1991-01-08    PLOO          NA      NA      NA  40.00000  40.55556 NA    NA
## 7   1991-01-09    PLOO          NA      NA 5.47625  20.33898  40.50847 NA 8.195
## 8   1991-01-10    PLOO          NA      NA 5.50000  40.22727  78.18182 NA    NA
## 9   1991-01-11    PLOO          NA      NA 5.36000  83.92857 446.07143 NA    NA
## 10  1991-01-14    PLOO          NA      NA      NA  33.84615  95.64103 NA    NA
## 11  1991-01-16    PLOO          NA      NA      NA  12.56410  23.58974 NA    NA
## 12  1991-01-22    PLOO          NA      NA      NA  20.51282  31.02564 NA    NA
```

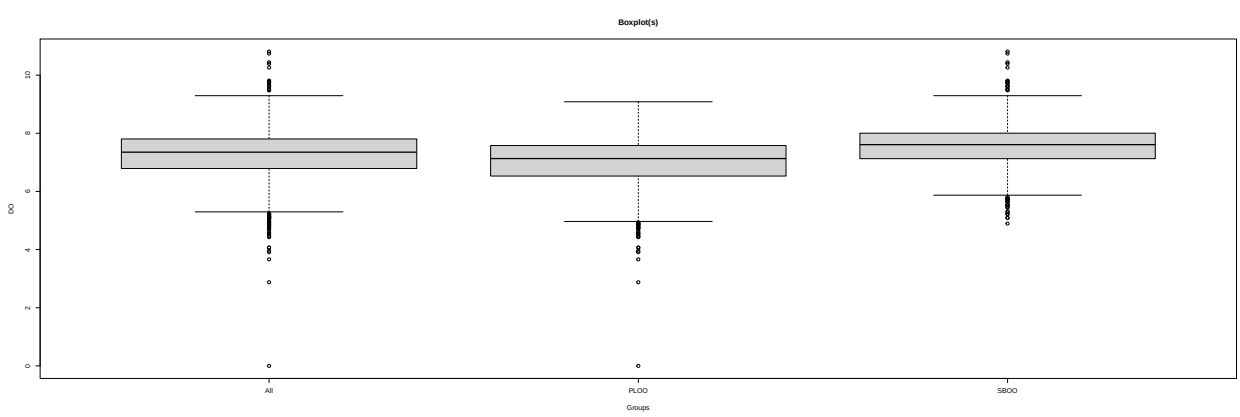
```
## 13  1991-01-23    PLOO          NA      NA      NA  43.12500 108.54167 NA    NA
## 14  1991-01-28    PLOO          NA      NA      NA 183.07692 427.69231 NA    NA
## 15  1991-01-30    PLOO          NA      NA      NA 125.38462 429.48718 NA    NA
## 16  1991-02-04    PLOO          NA      NA      NA  16.29167  16.75000 NA    NA
## 17  1991-02-06    PLOO          NA      NA      NA  17.38462  12.51282 NA    NA
##    SALINITY SUSO     TEMP      XMS
## 1  33.61700   NA 19.43000 44.85000
## 2  33.57400   NA 19.31000 75.60000
## 3        NA   NA 14.50769 80.02564
## 4        NA   NA 14.39231 83.89744
## 5        NA   NA 14.54103 78.97436
## 6        NA   NA 13.43000 80.20000
## 7  33.51938   NA 14.26889 86.21111
## 8  33.49300   NA 13.75000 80.45833
## 9  33.49100   NA 14.38400 84.40000
## 10       NA   NA 14.51282 72.02564
## 11       NA   NA 14.57692 68.35897
## 12       NA   NA 14.50769 76.51282
## 13       NA   NA 14.06923 78.71053
## 14       NA   NA 14.29487 82.43590
## 15       NA   NA 14.17436 81.23077
## 16       NA   NA 14.46154 72.12821
## 17       NA   NA 14.46154 69.53846
##             vars    n   mean      sd median trimmed  mad   min      max
## date_sample    1 7037    NaN      NA     NA     NaN   NA   Inf     -Inf
## project*       2 7037   1.43    0.50   1.00    1.42 0.00  1.00     2.00
## CHLOROPHYLL    3 3023   4.01    3.81   2.81    3.31 2.27  0.29    36.05
## DENSITY        4 3177  24.79    0.47  24.82   24.81 0.45 22.71    26.04
## DO             5 3434   7.15    0.97   7.31    7.22 0.82  0.00    10.81
## ENTERO         6 6776 253.64 1249.91   5.27   18.53 4.84  0.00 18000.00
## FECAL          7 6594 355.65 1401.82   7.07   48.93 7.51  0.00 12000.00
## OG             8  937   0.24    0.29   0.20    0.20 0.00  0.20     5.10
## PH             9 3396   8.07    0.11   8.08    8.07 0.10  7.54     8.48
## SALINITY      10 3434  33.50    0.61  33.52   33.51 0.15  0.00    34.10
## SUSO          11  977   4.99    2.16   4.67    4.80 1.80  0.20    15.68
## TEMP          12 4524  14.97    1.91  14.78   14.87 1.80  0.00    22.97
## XMS           13 4494  78.31    8.29  79.96   79.37 6.18  0.00    92.46
##                range   skew kurtosis    se
## date_sample     -Inf     NA       NA    NA
## project*        1.00   0.26    -1.93  0.01
## CHLOROPHYLL    35.76   2.56     9.61  0.07
## DENSITY         3.33  -0.46     0.38  0.01
## DO             10.81  -0.89     3.49  0.02
## ENTERO      18000.00   7.41    61.01 15.18
## FECAL       12000.00   6.25    43.27 17.26
## OG              4.90  10.89   144.21  0.01
## PH              0.94  -0.67     1.45  0.00
## SALINITY       34.10 -48.98  2674.00  0.01
## SUSO           15.48   1.09     2.23  0.07
## TEMP           22.97   0.43     0.95  0.03
## XMS            92.46  -2.00     7.54  0.12
##          date_sample project parameter        Avg
## Not NA n       48395   48395     48395 47222.0000
## NA n               0       0         0  1173.0000
```

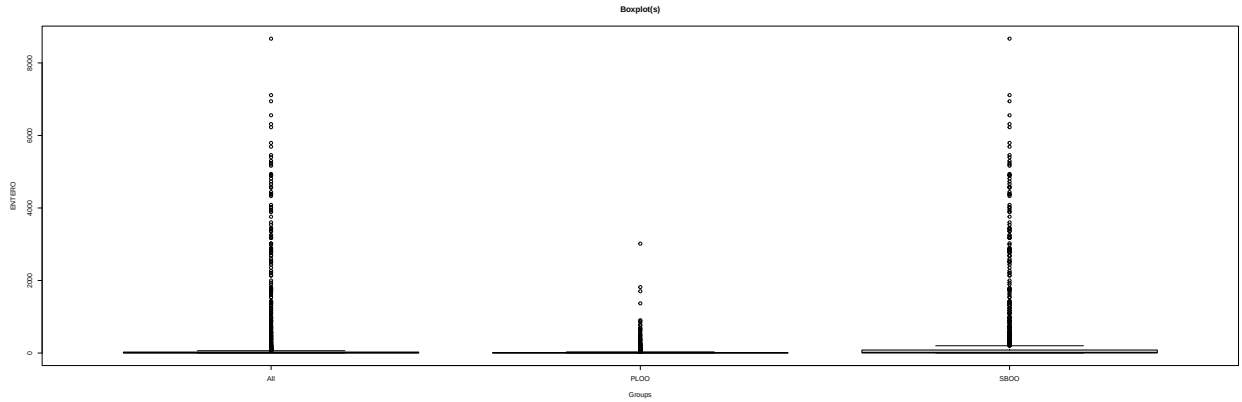
```
## Not NA %          1       1         1     0.9758
## NA %              0       0         0     0.0242
```

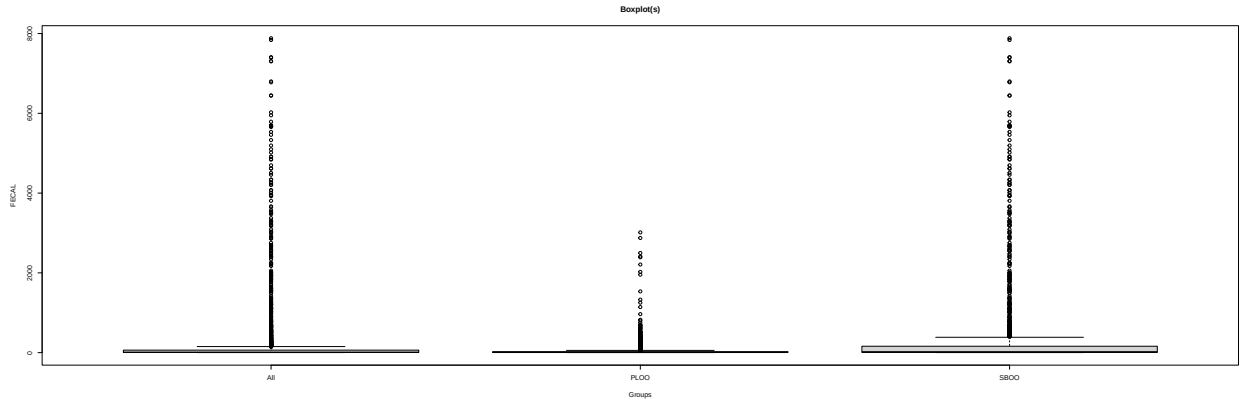
```
owt_df02_gb09_wkly = ts_eda(ts_df = owt_df02_gb09,
                            form_lead = c("date_sample", "project"),
                            form_cast = "parameter",
                            param_lst = param_lst02,
                            l1_col = c("project"),
                            l1_param = c("PLOO", "SBOO"),
                            rtn_met = FALSE,
                            box = FALSE,
                            week_agg = TRUE
                            )
```

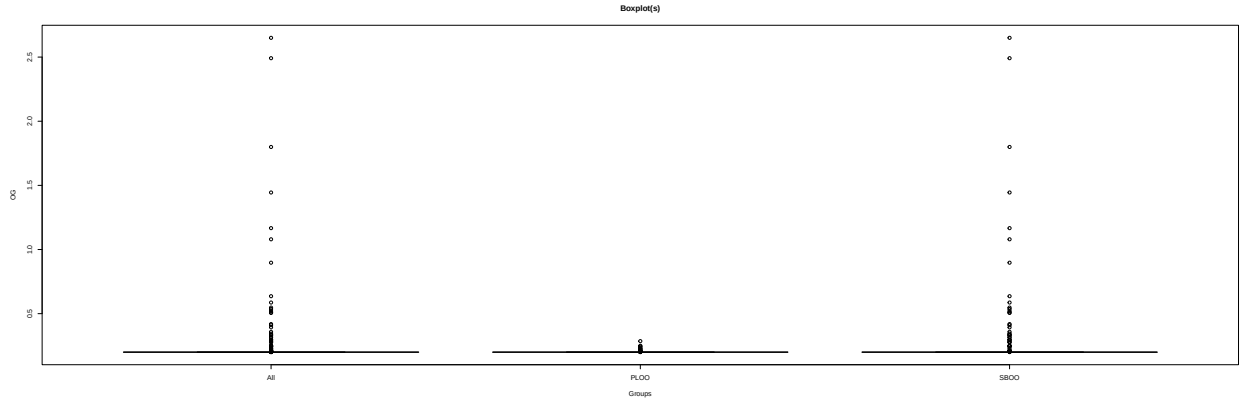


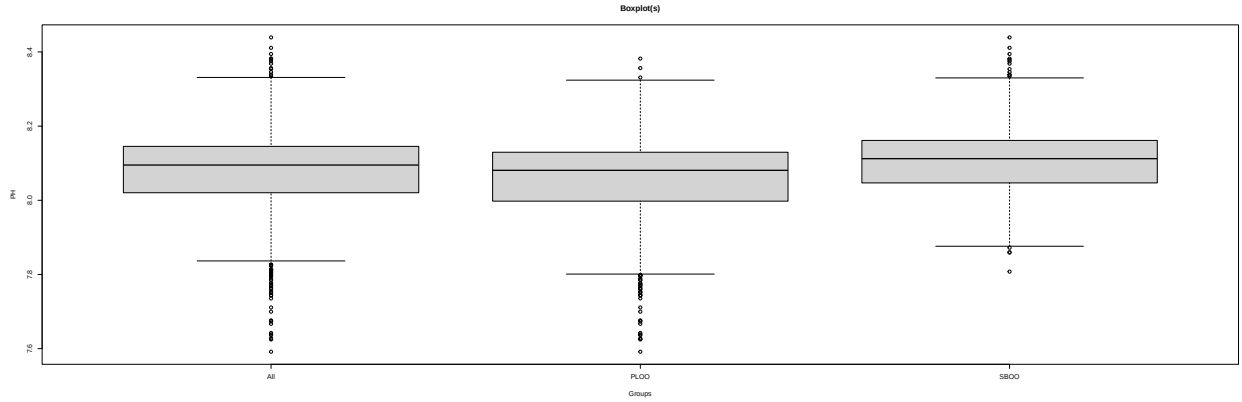


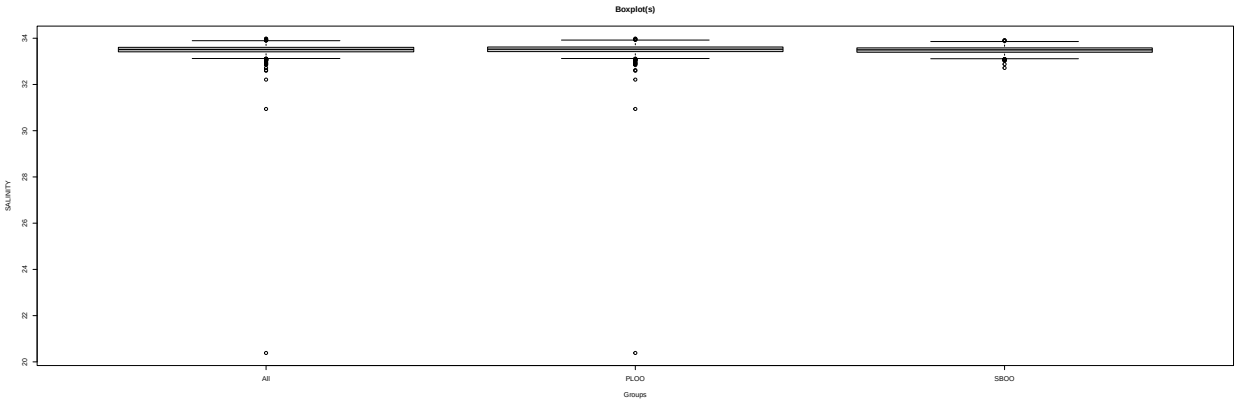


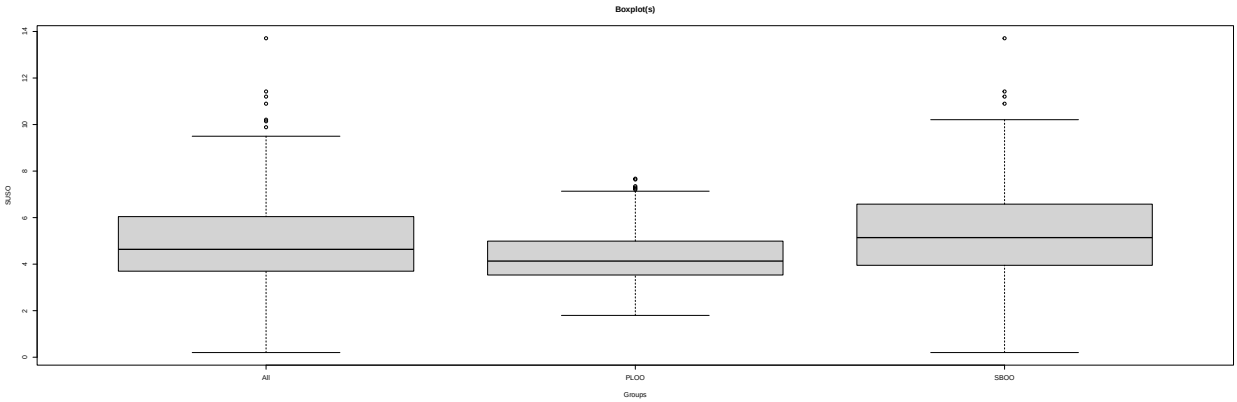

Boxplot(s)
ENTERO
0
2000
4000
6000
8000
All
PLOO
SBOO
Groups

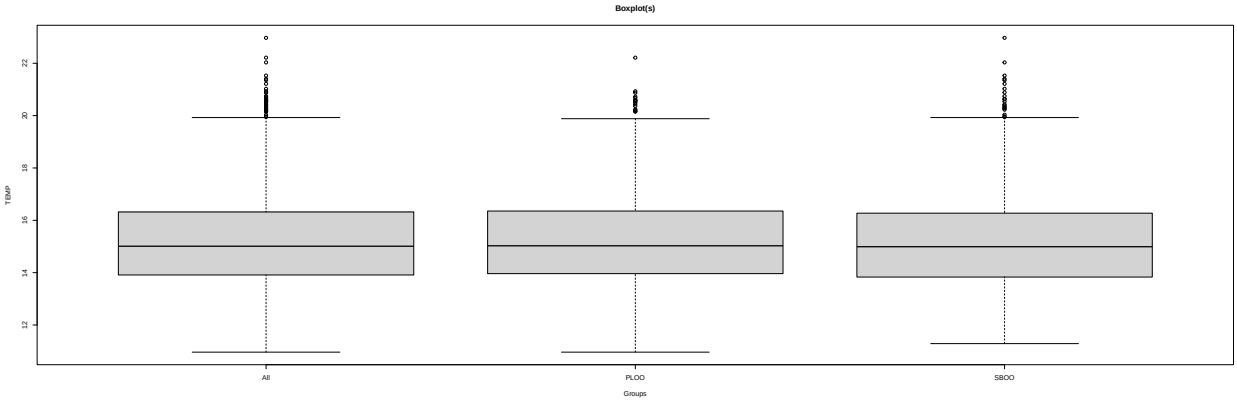

Boxplot(s)
FECAL
0
2000
4000
6000
8000
All
PLOO
SBOO
Groups

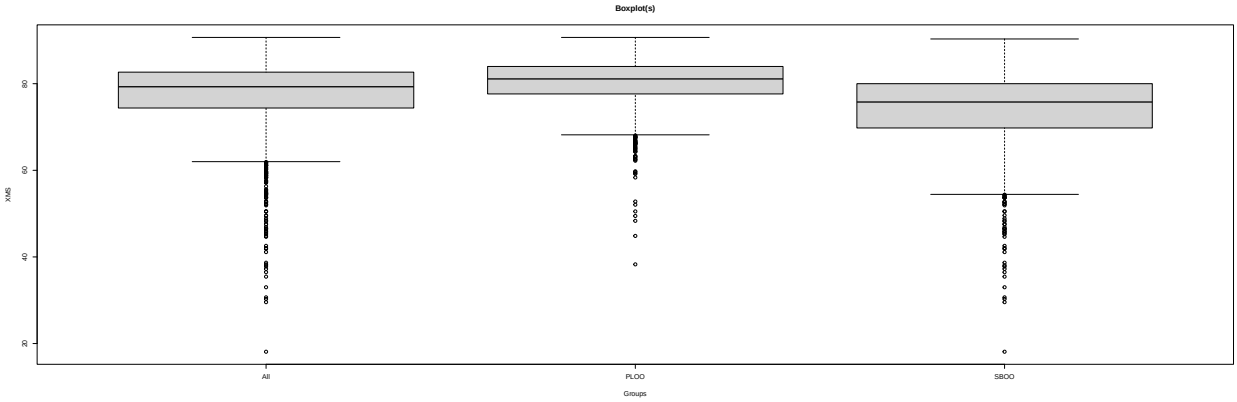

Boxplot(s)
OG
0.5
1.0
1.5
2.0
2.5
All
PLOO
SBOO
Groups


Boxplot(s)
PH
7.6
7.8
8.0
8.2
8.4
All
PLOO
SBOO
Groups


Boxplot(s)
SALINITY
20
22
24
26
28
30
32
34
All
PLOO
SBOO
Groups


Boxplot(s)
SUSO
0
2
4
6
8
10
12
14
All
PLOO
SBOO
Groups


Boxplot(s)
TBMP
12
14
16
18
20
22
All
PLOO
SBOO
Groups

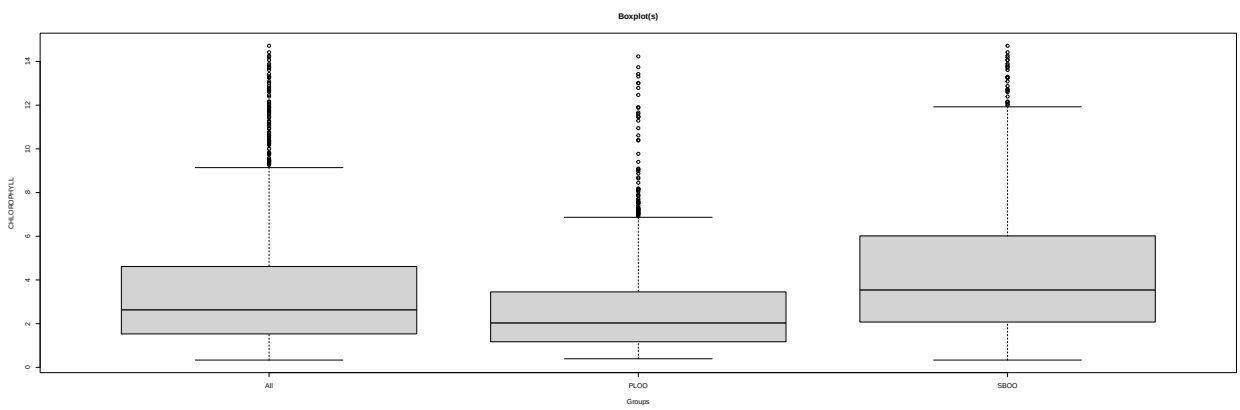

Boxplot(s)
XMS
20
40
60
80
All
PLOO
SBOO
Groups

```
##    date_sample project CHLOROPHYLL DENSITY       DO      ENTERO     FECAL OG
## 1   1990-11-19    PL00        0.87  23.855 6.550000          NA        NA NA
## 2   1990-11-19    SB00        1.27  23.853 7.410000          NA        NA NA
## 3   1991-01-07    PL00          NA      NA       NA   25.384615  88.46154 NA
## 4   1991-01-14    PL00          NA      NA 5.445417   58.129735 137.21730 NA
## 5   1991-01-21    PL00          NA      NA       NA   23.205128  59.61538 NA
## 6   1991-01-28    PL00          NA      NA       NA   31.818910  69.78365 NA
## 7   1991-02-04    PL00          NA      NA       NA  154.230769 428.58974 NA
## 8   1991-02-11    PL00          NA      NA       NA   16.838141  14.63141 NA
## 9   1991-02-18    PL00          NA      NA 5.597500   45.317879 112.33029 NA
## 10  1991-02-25    PL00          NA      NA       NA    9.083333  16.10737 NA
## 11  1991-03-04    PL00          NA      NA       NA   16.512821  15.05128 NA
## 12  1991-03-11    PL00          NA      NA 4.808333   43.496041 247.95270 NA
## 13  1991-03-18    PL00          NA      NA       NA   32.542347 179.98990 NA
## 14  1991-03-25    PL00          NA      NA       NA 1370.111538 517.44812 NA
## 15  1991-04-01    PL00          NA      NA       NA   15.025641  33.15385 NA
## 16  1991-04-08    PL00          NA      NA       NA   38.837607 136.90598 NA
## 17  1991-04-15    PL00          NA      NA 4.730833   43.944524 190.35018 NA
##          PH SALINITY SUSO     TEMP      XMS
## 1  8.080000 33.61700   NA 19.43000 44.85000
## 2  8.180000 33.57400   NA 19.31000 75.60000
## 3        NA       NA   NA 14.45000 81.96154
## 4  8.195000 33.50113   NA 14.07478 82.04876
## 5        NA       NA   NA 14.54487 70.19231
## 6        NA       NA   NA 14.28846 77.61167
## 7        NA       NA   NA 14.23462 81.83333
## 8        NA       NA   NA 14.46154 70.83333
## 9  8.173333 33.51717   NA 14.00639 79.30243
## 10       NA       NA   NA 14.05769 79.71518
## 11       NA       NA   NA 14.24231 82.44872
## 12 8.201667 33.48729   NA 13.93447 70.49667
## 13       NA       NA   NA 12.97995 68.95260
## 14       NA       NA   NA 13.11026 69.92308
## 15       NA       NA   NA 13.46667 75.12719
## 16       NA       NA   NA 13.19487 81.09818
## 17 8.138333 33.55379   NA 13.33149 71.94475
##             vars    n   mean     sd median trimmed   mad   min     max   range
## date_sample    1 2802    NaN     NA     NA     NaN    NA   Inf    -Inf    -Inf
## project*       2 2802   1.43   0.49   1.00    1.41  0.00  1.00    2.00    1.00
## CHLOROPHYLL    3 1967   3.89   3.68   2.71    3.19  2.09  0.33   36.05   35.72
## DENSITY        4 2000  24.73   0.47  24.76   24.75  0.44 22.71   25.98    3.27
## DO             5 2101   7.24   0.87   7.35    7.29  0.75  0.00   10.81   10.81
## ENTERO         6 2786 169.27 699.74   7.58   17.88  7.65  2.00 8668.00 8666.00
## FECAL          7 2786 233.75 815.20   9.45   42.01 10.37  2.00 7881.92 7879.92
## OG             8  351   0.24   0.23   0.20    0.20  0.00  0.20    2.65    2.45
## PH             9 2105   8.08   0.10   8.10    8.09  0.09  7.59    8.44    0.85
## SALINITY      10 2097  33.50   0.33  33.51   33.51  0.14 20.38   33.98   13.60
## SUSO          11  369   4.91   1.85   4.64    4.80  1.61  0.20   13.71   13.51
## TEMP          12 2616  15.22   1.83  15.01   15.11  1.77 10.96   22.97   12.01
## XMS           13 2606  77.43   8.03  79.29   78.55  5.84 18.11   90.68   72.57
##               skew kurtosis    se
## date_sample     NA       NA    NA
## project*      0.30    -1.91  0.01
## CHLOROPHYLL   2.63    10.24  0.08
```

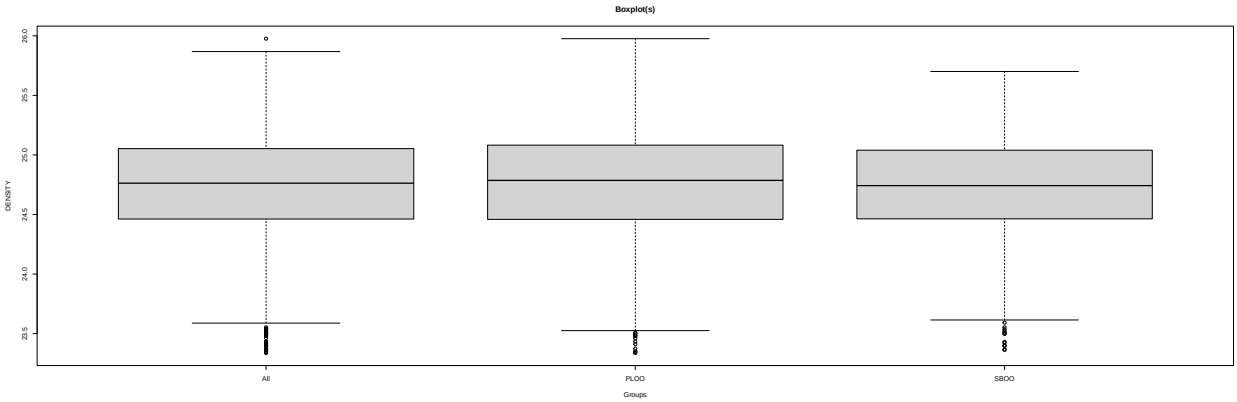
```
## DENSITY      -0.47     0.46  0.01
## DO           -0.76     3.34  0.02
## ENTERO        6.11    42.36 13.26
## FECAL         5.43    33.41 15.44
## OG            7.92    70.11  0.01
## PH           -0.71     1.79  0.00
## SALINITY    -29.25  1137.46  0.01
## SUSO          0.79     1.80  0.10
## TEMP          0.61     0.27  0.04
## XMS          -1.91     5.85  0.16
##          date_sample project parameter        Avg
## Not NA n       48395   48395     48395 47222.0000
## NA n               0       0         0  1173.0000
## Not NA %           1       1         1     0.9758
## NA %               0       0         0     0.0242
```

```
owt_df02_gb09_wkly02 = ts_eda(ts_df = owt_df02_gb09,
                              form_lead = c("date_sample", "project"),
                              form_cast = "parameter",
                              param_lst = param_lst02,
                              l1_col = c("project"),
                              l1_param = c("PLOO", "SBOO"),
                              rtn_met = FALSE,
                              box = FALSE,
                              week_agg = TRUE,
                              out_rm = TRUE
                              )
```

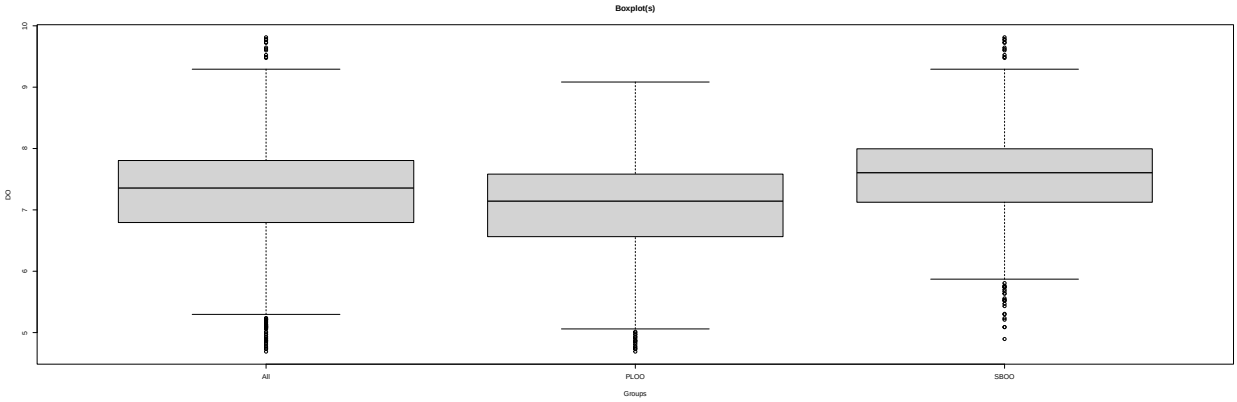
```
## [1] 1967    3
```



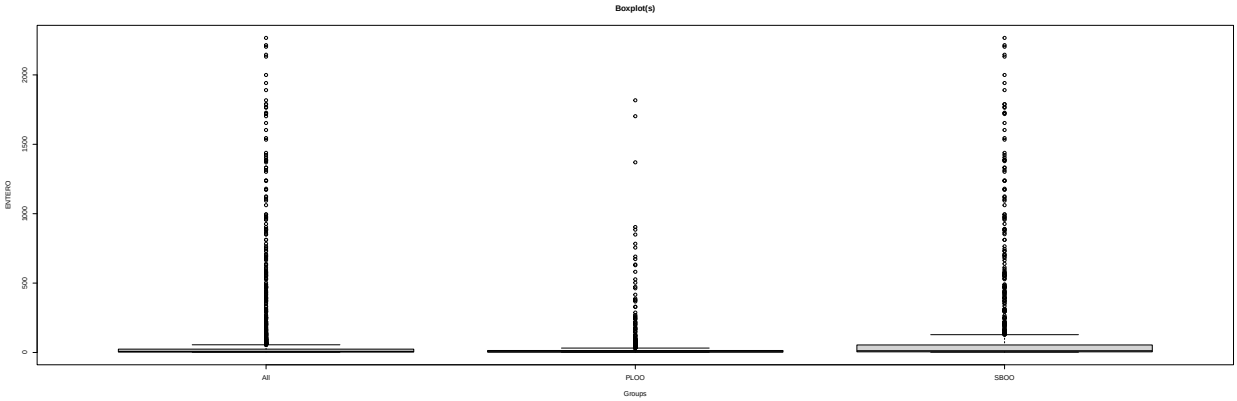

```
## [1] 2000    3
```



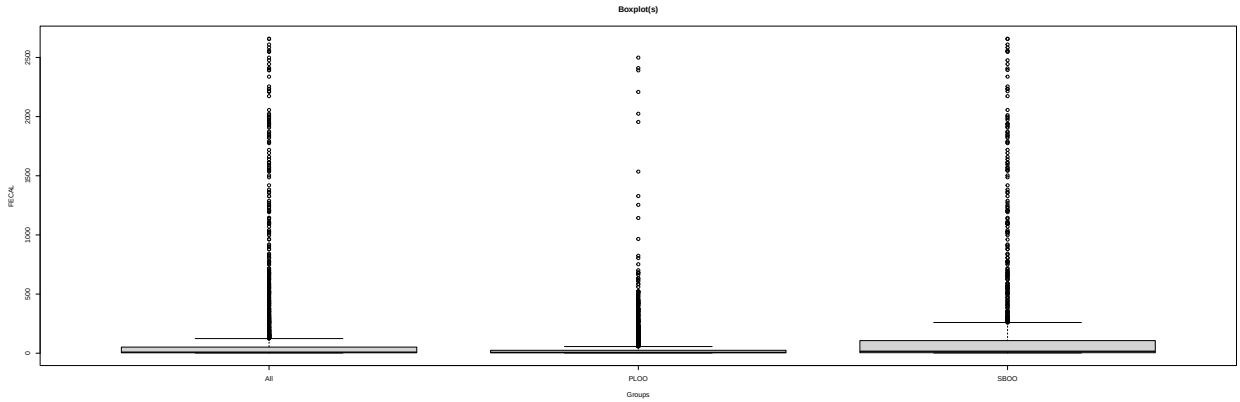

```
## [1] 2101    3
```



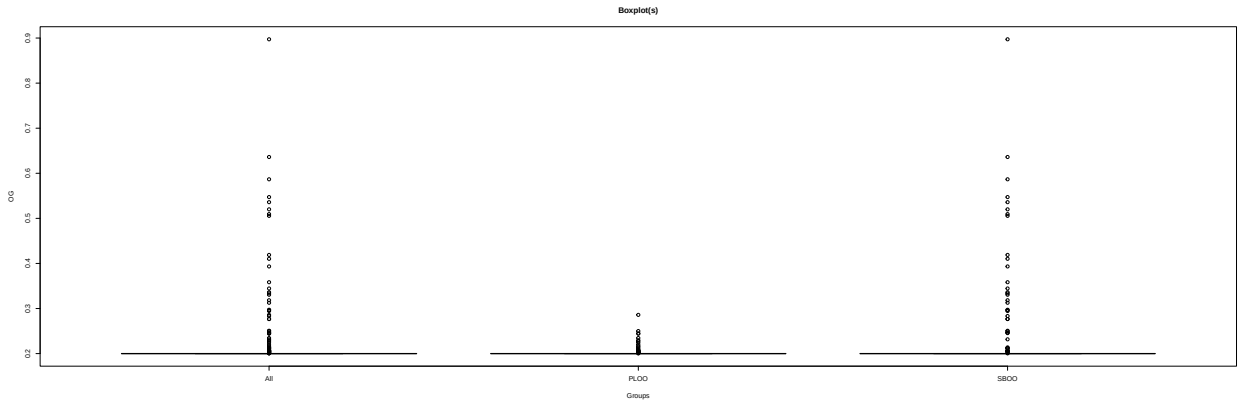

```
## [1] 2786    3
```



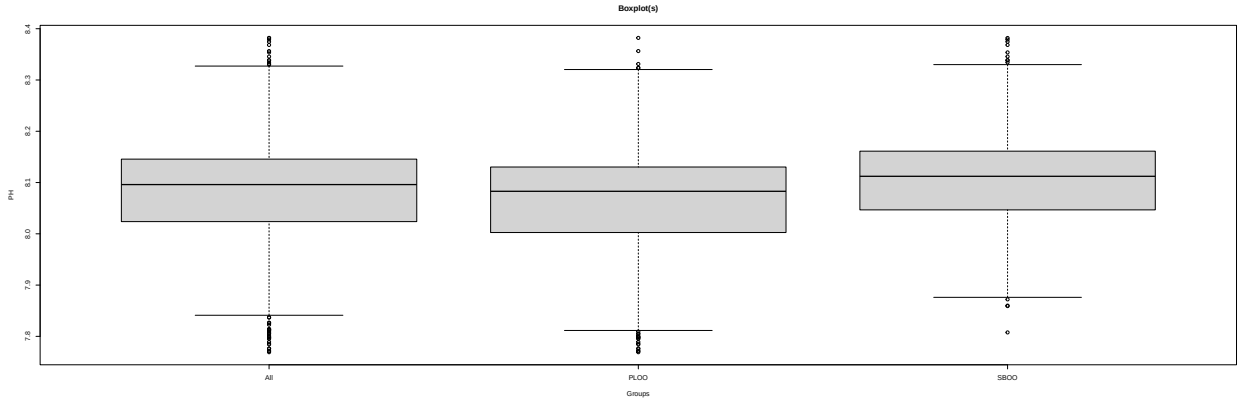

```
## [1] 2786    3
```



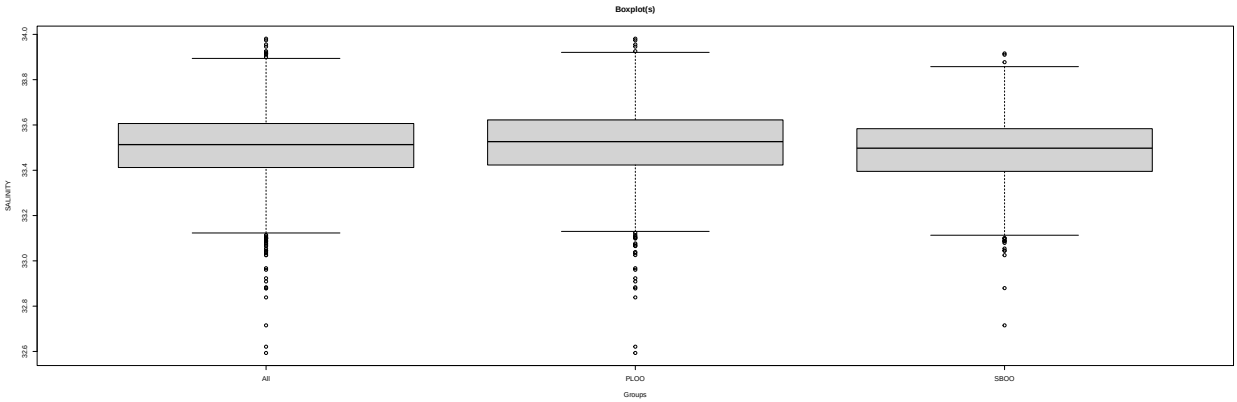

```
## [1] 351   3
```



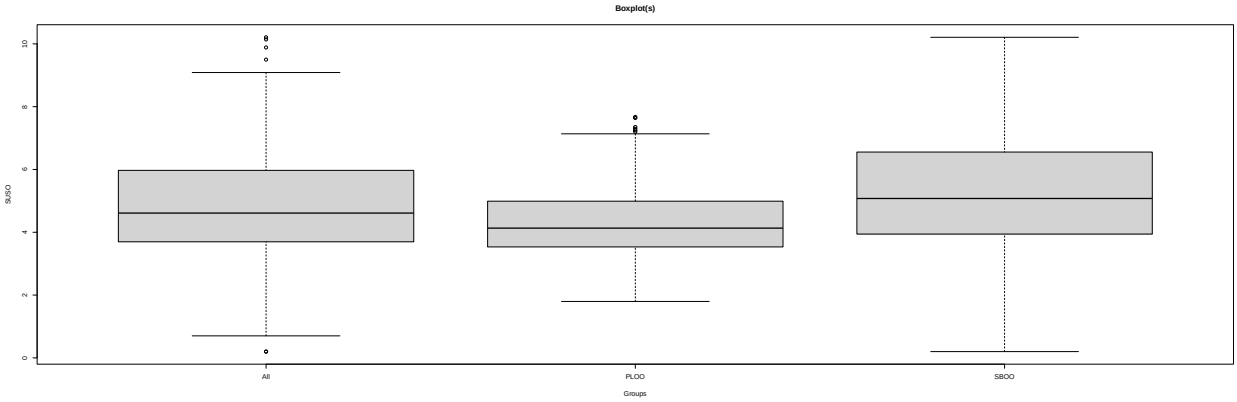

```
## [1] 2105    3
```



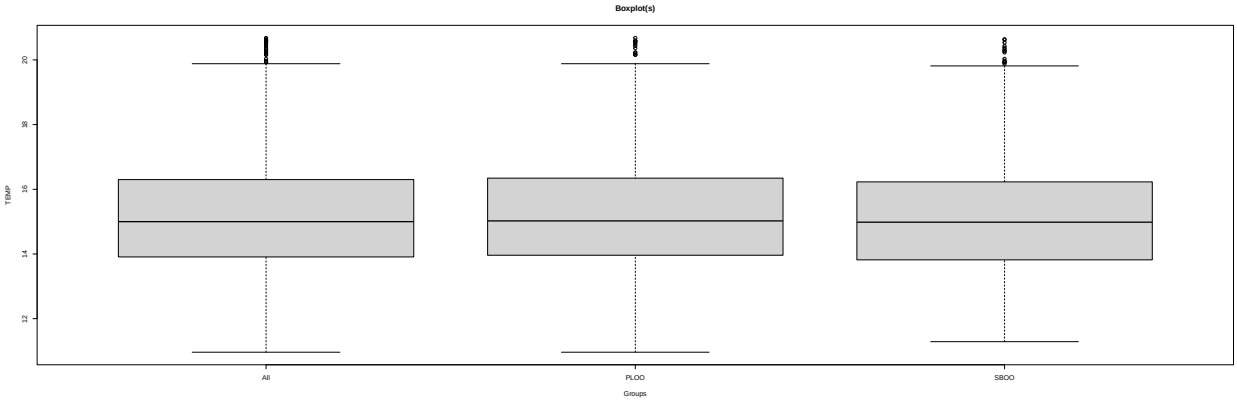

```
## [1] 2097    3
```



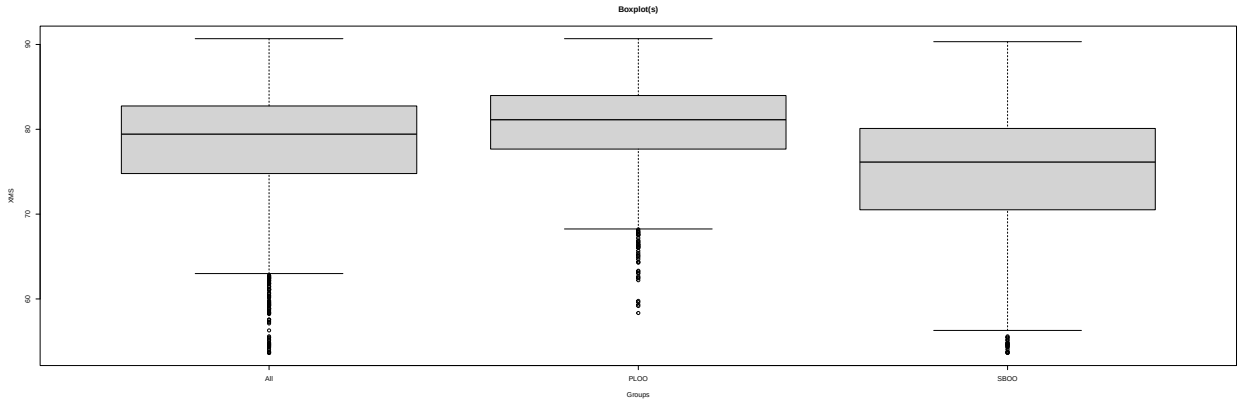

```
## [1] 369   3
```




```
## [1] 2616    3
```




```
## [1] 2606    3
```




```
##    date_sample project CHLOROPHYLL DENSITY       DO      ENTERO     FECAL OG
## 1   1990-11-19    PLOO        0.87  23.855 6.550000          NA        NA NA
## 2   1990-11-19    SBOO        1.27  23.853 7.410000          NA        NA NA
## 3   1991-01-07    PLOO          NA      NA       NA   25.384615  88.46154 NA
## 4   1991-01-14    PLOO          NA      NA 5.445417   58.129735 137.21730 NA
## 5   1991-01-21    PLOO          NA      NA       NA   23.205128  59.61538 NA
## 6   1991-01-28    PLOO          NA      NA       NA   31.818910  69.78365 NA
## 7   1991-02-04    PLOO          NA      NA       NA  154.230769 428.58974 NA
## 8   1991-02-11    PLOO          NA      NA       NA   16.838141  14.63141 NA
## 9   1991-02-18    PLOO          NA      NA 5.597500   45.317879 112.33029 NA
## 10  1991-02-25    PLOO          NA      NA       NA    9.083333  16.10737 NA
## 11  1991-03-04    PLOO          NA      NA       NA   16.512821  15.05128 NA
## 12  1991-03-11    PLOO          NA      NA 4.808333   43.496041 247.95270 NA
## 13  1991-03-18    PLOO          NA      NA       NA   32.542347 179.98990 NA
## 14  1991-03-25    PLOO          NA      NA       NA 1370.111538 517.44812 NA
## 15  1991-04-01    PLOO          NA      NA       NA   15.025641  33.15385 NA
## 16  1991-04-08    PLOO          NA      NA       NA   38.837607 136.90598 NA
## 17  1991-04-15    PLOO          NA      NA 4.730833   43.944524 190.35018 NA
##          PH SALINITY SUSO     TEMP      XMS
## 1  8.080000 33.61700   NA 19.43000       NA
## 2  8.180000 33.57400   NA 19.31000 75.60000
## 3        NA       NA   NA 14.45000 81.96154
## 4  8.195000 33.50113   NA 14.07478 82.04876
## 5        NA       NA   NA 14.54487 70.19231
## 6        NA       NA   NA 14.28846 77.61167
## 7        NA       NA   NA 14.23462 81.83333
## 8        NA       NA   NA 14.46154 70.83333
## 9  8.173333 33.51717   NA 14.00639 79.30243
## 10       NA       NA   NA 14.05769 79.71518
## 11       NA       NA   NA 14.24231 82.44872
## 12 8.201667 33.48729   NA 13.93447 70.49667
## 13       NA       NA   NA 12.97995 68.95260
## 14       NA       NA   NA 13.11026 69.92308
## 15       NA       NA   NA 13.46667 75.12719
## 16       NA       NA   NA 13.19487 81.09818
## 17 8.138333 33.55379   NA 13.33149 71.94475
##             vars    n   mean     sd median trimmed  mad   min     max   range
## date_sample    1 2799    NaN     NA     NA     NaN   NA   Inf    -Inf    -Inf
## project*       2 2799   1.43   0.49   1.00    1.41 0.00  1.00    2.00    1.00
## CHLOROPHYLL    3 1919   3.51   2.75   2.63    3.06 1.98  0.33   14.72   14.38
```

```
## DENSITY        4 1990  24.74   0.46  24.76   24.76 0.44 23.34   25.98    2.64
## DO             5 2082   7.26   0.81   7.36    7.30 0.74  4.69    9.81    5.12
## ENTERO         6 2713  66.28 228.34   7.25   14.79 7.15  2.00 2266.55 2264.55
## FECAL          7 2711 115.89 335.46   8.89   33.22 9.50  2.00 2658.87 2656.87
## OG             8  345   0.22   0.07   0.20    0.20 0.00  0.20    0.90    0.70
## PH             9 2079   8.08   0.10   8.10    8.09 0.09  7.77    8.38    0.61
## SALINITY      10 2094  33.50   0.16  33.51   33.51 0.14 32.59   33.98    1.39
## SUSO          11  365   4.83   1.71   4.61    4.77 1.57  0.20   10.21   10.01
## TEMP          12 2603  15.19   1.78  15.00   15.10 1.76 10.96   20.68    9.72
## XMS           13 2560  78.03   6.67  79.43   78.77 5.69 53.63   90.68   37.05
##              skew kurtosis   se
## date_sample    NA       NA   NA
## project*     0.30    -1.91 0.01
## CHLOROPHYLL  1.53     2.20 0.06
## DENSITY     -0.34     0.08 0.01
## DO          -0.46     0.44 0.02
## ENTERO       5.78    37.71 4.38
## FECAL        4.74    24.82 6.44
## OG           5.74    40.06 0.00
## PH          -0.36     0.45 0.00
## SALINITY    -0.53     1.74 0.00
## SUSO         0.37     0.30 0.09
## TEMP         0.50    -0.07 0.03
## XMS         -1.07     1.10 0.13
##          date_sample project parameter        Avg
## Not NA n       48395   48395     48395 47222.0000
## NA n               0       0         0  1173.0000
## Not NA %           1       1         1     0.9758
## NA %               0       0         0     0.0242
```

```
owt_df02_gb09_wkly03 <- owt_df02_gb09_wkly
print(head(owt_df02_gb09_wkly03, 17))
```

```
##    date_sample project CHLOROPHYLL DENSITY       DO      ENTERO     FECAL OG
## 1   1990-11-19    PLOO        0.87  23.855 6.550000          NA        NA NA
## 2   1990-11-19    SBOO        1.27  23.853 7.410000          NA        NA NA
## 3   1991-01-07    PLOO          NA      NA       NA   25.384615  88.46154 NA
## 4   1991-01-14    PLOO          NA      NA 5.445417   58.129735 137.21730 NA
## 5   1991-01-21    PLOO          NA      NA       NA   23.205128  59.61538 NA
## 6   1991-01-28    PLOO          NA      NA       NA   31.818910  69.78365 NA
## 7   1991-02-04    PLOO          NA      NA       NA  154.230769 428.58974 NA
## 8   1991-02-11    PLOO          NA      NA       NA   16.838141  14.63141 NA
## 9   1991-02-18    PLOO          NA      NA 5.597500   45.317879 112.33029 NA
## 10  1991-02-25    PLOO          NA      NA       NA    9.083333  16.10737 NA
## 11  1991-03-04    PLOO          NA      NA       NA   16.512821  15.05128 NA
## 12  1991-03-11    PLOO          NA      NA 4.808333   43.496041 247.95270 NA
## 13  1991-03-18    PLOO          NA      NA       NA   32.542347 179.98990 NA
## 14  1991-03-25    PLOO          NA      NA       NA 1370.111538 517.44812 NA
## 15  1991-04-01    PLOO          NA      NA       NA   15.025641  33.15385 NA
## 16  1991-04-08    PLOO          NA      NA       NA   38.837607 136.90598 NA
## 17  1991-04-15    PLOO          NA      NA 4.730833   43.944524 190.35018 NA
##          PH SALINITY SUSO     TEMP      XMS
## 1  8.080000 33.61700   NA 19.43000 44.85000
## 2  8.180000 33.57400   NA 19.31000 75.60000
```

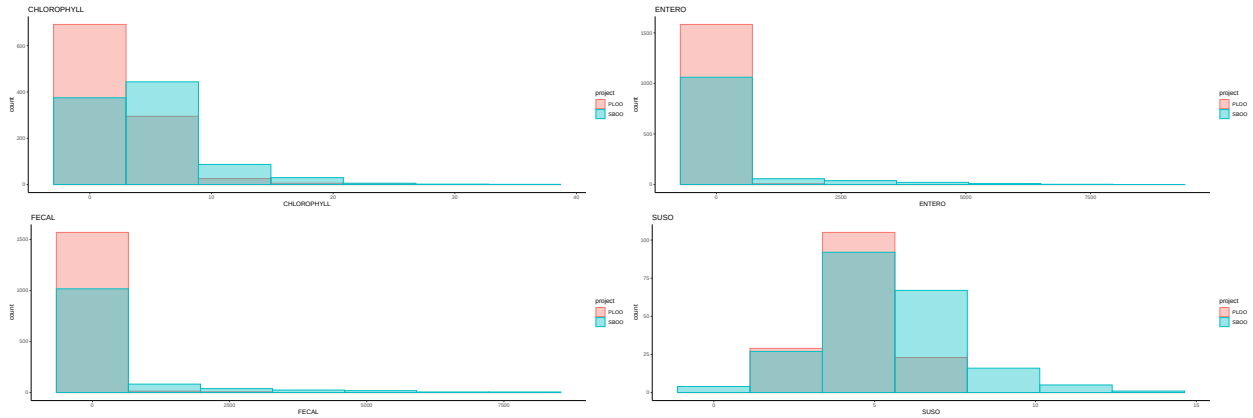
```
## 3        NA       NA   NA 14.45000 81.96154
## 4  8.195000 33.50113   NA 14.07478 82.04876
## 5        NA       NA   NA 14.54487 70.19231
## 6        NA       NA   NA 14.28846 77.61167
## 7        NA       NA   NA 14.23462 81.83333
## 8        NA       NA   NA 14.46154 70.83333
## 9  8.173333 33.51717   NA 14.00639 79.30243
## 10       NA       NA   NA 14.05769 79.71518
## 11       NA       NA   NA 14.24231 82.44872
## 12 8.201667 33.48729   NA 13.93447 70.49667
## 13       NA       NA   NA 12.97995 68.95260
## 14       NA       NA   NA 13.11026 69.92308
## 15       NA       NA   NA 13.46667 75.12719
## 16       NA       NA   NA 13.19487 81.09818
## 17 8.138333 33.55379   NA 13.33149 71.94475
```

Displaying (Visually in Histograms) the Data per Project (Overarching Location)

```r
# owt_df02_gb09_wkly03
# plotting histograms per project (no depth)

# chlorophyll
hist_chloro <- ggplot(owt_df02_gb09_wkly03, aes(x= CHLOROPHYLL)) +
  geom_histogram(aes(color= project, fill= project),
                 position= "identity", bins=7, alpha=.4) +
  labs(title= "CHLOROPHYLL") +
  theme_classic()

# density
hist_density <- ggplot(owt_df02_gb09_wkly03, aes(x= DENSITY)) +
  geom_histogram(aes(color= project, fill= project),
                 position= "identity", bins=7, alpha=.4) +
  labs(title= "DENSITY")+
  theme_classic()

# DO
hist_do <- ggplot(owt_df02_gb09_wkly03, aes(x= DO)) +
  geom_histogram(aes(color= project, fill= project),
                 position= "identity", bins=7, alpha=.4) +
  labs(title= "DO")+
  theme_classic()

# ENTERO
hist_entero <- ggplot(owt_df02_gb09_wkly03, aes(x= ENTERO)) +
  geom_histogram(aes(color= project, fill= project),
                 position= "identity", bins=7, alpha=.4) +
  labs(title= "ENTERO")+
  theme_classic()

# FECAL
hist_fecal <- ggplot(owt_df02_gb09_wkly03, aes(x= FECAL)) +
  geom_histogram(aes(color= project, fill= project),
                 position= "identity", bins=7, alpha=.4) +
```

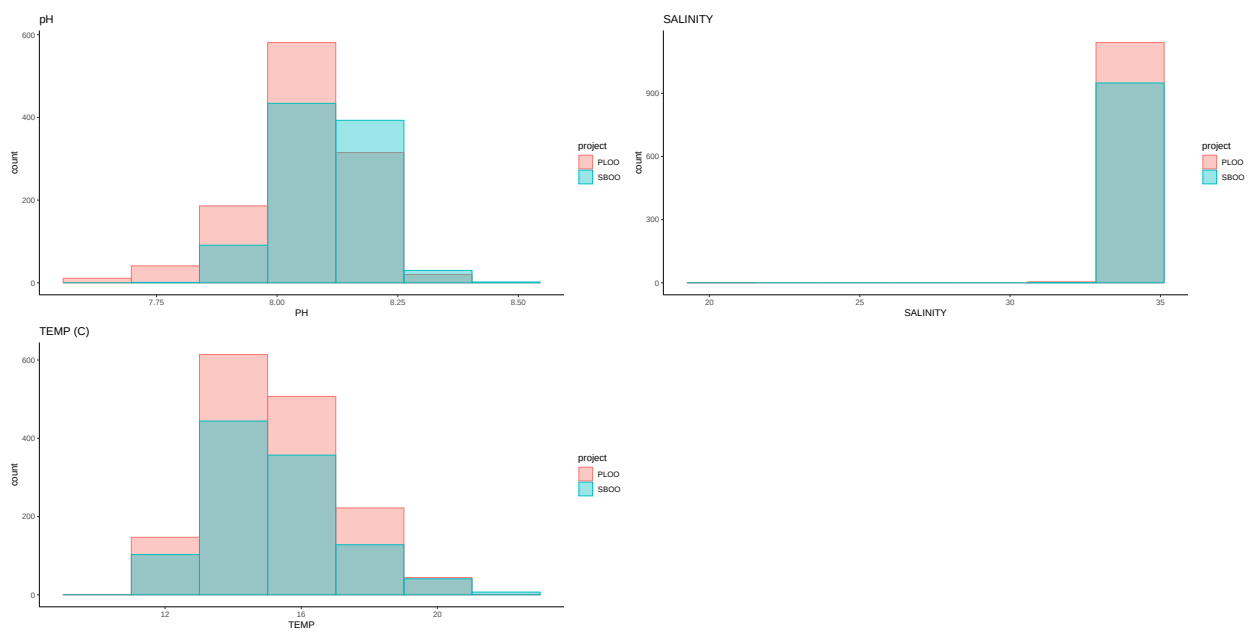
```
  labs(title= "FECAL")+
  theme_classic()

# OG
hist_og <- ggplot(owt_df02_gb09_wkly03, aes(x= OG)) +
  geom_histogram(aes(color= project, fill= project),
                 position= "identity", bins=7, alpha=.4) +
  labs(title= "OG")+
  theme_classic()

# PH
hist_ph <- ggplot(owt_df02_gb09_wkly03, aes(x= PH)) +
  geom_histogram(aes(color= project, fill= project),
                 position= "identity", bins=7, alpha=.4) +
  labs(title= "pH")+
  theme_classic()

# SALINITY
hist_salinity <- ggplot(owt_df02_gb09_wkly03, aes(x= SALINITY)) +
  geom_histogram(aes(color= project, fill= project),
                 position= "identity", bins=7, alpha=.4) +
  labs(title= "SALINITY")+
  theme_classic()

# SUSO
hist_suso <- ggplot(owt_df02_gb09_wkly03, aes(x= SUSO)) +
  geom_histogram(aes(color= project, fill= project),
                 position= "identity", bins=7, alpha=.4) +
  labs(title= "SUSO")+
  theme_classic()

# TEMP
hist_temp <- ggplot(owt_df02_gb09_wkly03, aes(x= TEMP)) +
  geom_histogram(aes(color= project, fill= project),
                 position= "identity", bins=7, alpha=.4) +
  labs(title= "TEMP (C)")+
  theme_classic()

# XMS
hist_xms <- ggplot(owt_df02_gb09_wkly03, aes(x= XMS)) +
  geom_histogram(aes(color= project, fill= project),
                 position= "identity", bins=7, alpha=.4) +
  labs(title= "XMS")+
theme_classic()

# plotting groups:

# bacteriological basis (chlorophyll, entero, fecal, suso (dissolved solids))
grid.arrange(hist_chloro, hist_entero, hist_fecal,hist_suso,
             ncol=2, nrow=2) +
  theme(legend.key.size = unit(0.5, "cm"),
        legend.title = element_text(size=10),
        legend.text = element_text(size=8),
```

```
        text = element_text(size=10))
```




```
## NULL
```

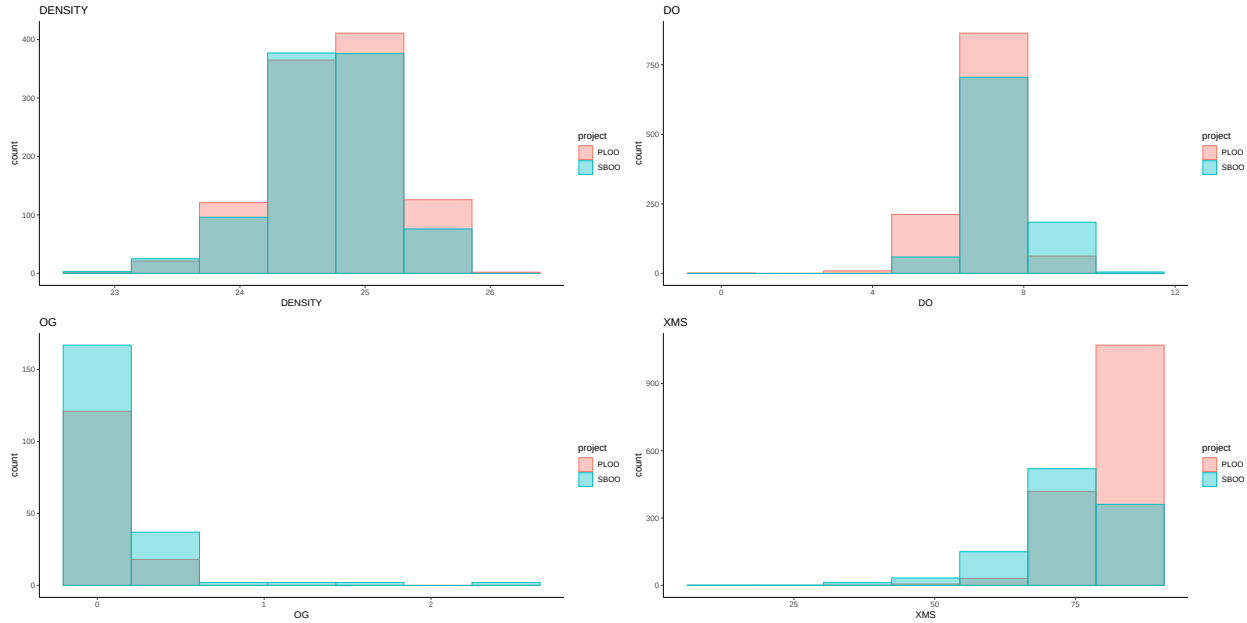
```
# plotting chemical types (pH, salinity, temp)
grid.arrange(hist_ph, hist_salinity, hist_temp,
             ncol=2, nrow=2) +
  theme(legend.key.size = unit(0.5, "cm"),
        legend.title = element_text(size=10),
        legend.text = element_text(size=8),
        text = element_text(size=10))
```




```
## NULL
```

```
# plotting optical-chemical type (density, DO, OG, xms)
grid.arrange(hist_density, hist_do, hist_og, hist_xms,
             ncol=2, nrow=2) +
  theme(legend.key.size = unit(0.5, "cm"),
        legend.title = element_text(size=10),
        legend.text = element_text(size=8),
```

```
        text = element_text(size=10))
```




```
## NULL
```

Setting up for Descriptive Statistics and Looking at Non-Time Series Correlations

```
# descriptive stats (no depth) for numeric columns for whole time frame
owt_df02_gb09_wkly03_nums <- subset(owt_df02_gb09_wkly03, select= -c(date_sample))
summary(owt_df02_gb09_wkly03_nums)
```

```
##  project      CHLOROPHYLL         DENSITY            DO
##  PLOO:1606   Min.   : 0.3333   Min.   :22.71   Min.   : 0.000
##  SBOO:1196   1st Qu.: 1.5610   1st Qu.:24.46   1st Qu.: 6.789
##              Median : 2.7145   Median :24.76   Median : 7.350
##              Mean   : 3.8885   Mean   :24.73   Mean   : 7.243
##              3rd Qu.: 4.8582   3rd Qu.:25.05   3rd Qu.: 7.805
##              Max.   :36.0533   Max.   :25.98   Max.   :10.810
##              NA's   :835       NA's   :802     NA's   :701
##      ENTERO             FECAL                OG               PH
##  Min.   :   2.000   Min.   :   2.000   Min.   :0.2000   Min.   :7.592
##  1st Qu.:   3.279   1st Qu.:   3.709   1st Qu.:0.2000   1st Qu.:8.020
##  Median :   7.579   Median :   9.445   Median :0.2000   Median :8.095
##  Mean   : 169.274   Mean   : 233.754   Mean   :0.2441   Mean   :8.080
##  3rd Qu.:  27.682   3rd Qu.:  63.223   3rd Qu.:0.2000   3rd Qu.:8.145
##  Max.   :8668.000   Max.   :7881.917   Max.   :2.6500   Max.   :8.439
##  NA's   :16         NA's   :16         NA's   :2451     NA's   :697
##     SALINITY          SUSO             TEMP            XMS
##  Min.   :20.38   Min.   : 0.200   Min.   :10.96   Min.   :18.11
##  1st Qu.:33.41   1st Qu.: 3.697   1st Qu.:13.91   1st Qu.:74.39
##  Median :33.51   Median : 4.637   Median :15.01   Median :79.29
##  Mean   :33.50   Mean   : 4.909   Mean   :15.22   Mean   :77.43
##  3rd Qu.:33.61   3rd Qu.: 6.043   3rd Qu.:16.32   3rd Qu.:82.67
##  Max.   :33.98   Max.   :13.709   Max.   :22.97   Max.   :90.68
```

```
##  NA's   :705     NA's   :2433     NA's   :186     NA's   :196
```

If we remove the NA's of the owt_df02_gb09_wkly03 full time frame

```
chlornum <- data.frame("CHLOROPHYLL" = owt_df02_gb09_wkly03_nums$CHLOROPHYLL)
chlornum <- chlornum %>% drop_na()
summary(chlornum)
```

```
##   CHLOROPHYLL
##  Min.   : 0.3333
##  1st Qu.: 1.5610
##  Median : 2.7146
##  Mean   : 3.8885
##  3rd Qu.: 4.8582
##  Max.   :36.0533
```

```
densnum <- data.frame("DENSITY" = owt_df02_gb09_wkly03_nums$DENSITY)
densnum <- densnum %>% drop_na()
summary(densnum)
```

```
##     DENSITY
##  Min.   :22.71
##  1st Qu.:24.46
##  Median :24.76
##  Mean   :24.73
##  3rd Qu.:25.05
##  Max.   :25.98
```

```
donum <- data.frame("DO" = owt_df02_gb09_wkly03_nums$DO)
donum <- donum %>% drop_na()
summary(donum)
```

```
##        DO
##  Min.   : 0.000
##  1st Qu.: 6.789
##  Median : 7.350
##  Mean   : 7.243
##  3rd Qu.: 7.805
##  Max.   :10.810
```

```
enteronum <- data.frame("ENTERO" = owt_df02_gb09_wkly03_nums$ENTERO)
enteronum <- enteronum %>% drop_na()
summary(enteronum)
```

```
##      ENTERO
##  Min.   :   2.000
##  1st Qu.:   3.279
##  Median :   7.579
##  Mean   : 169.274
##  3rd Qu.:  27.682
##  Max.   :8668.000
```

```
fecalnum <- data.frame("FECAL" = owt_df02_gb09_wkly03_nums$FECAL)
fecalnum <- fecalnum %>% drop_na()
summary(fecalnum)
```

```
##      FECAL
##  Min.   :   2.000
##  1st Qu.:   3.709
##  Median :   9.445
##  Mean   : 233.754
##  3rd Qu.:  63.223
##  Max.   :7881.917
```

```
ognum <- data.frame("OG" = owt_df02_gb09_wkly03_nums$OG)
ognum <- ognum %>% drop_na()
summary(ognum)
```

```
##        OG
##  Min.   :0.2000
##  1st Qu.:0.2000
##  Median :0.2000
##  Mean   :0.2441
##  3rd Qu.:0.2000
##  Max.   :2.6500
```

```
phnum <- data.frame("PH" = owt_df02_gb09_wkly03_nums$PH)
phnum <- phnum %>% drop_na()
summary(phnum)
```

```
##        PH
##  Min.   :7.592
##  1st Qu.:8.020
##  Median :8.095
##  Mean   :8.080
##  3rd Qu.:8.145
##  Max.   :8.439
```

```
salinnum <- data.frame("SALINITY" = owt_df02_gb09_wkly03_nums$SALINITY)
salinnum <- salinnum %>% drop_na()
summary(salinnum)
```

```
##     SALINITY
##  Min.   :20.38
##  1st Qu.:33.41
##  Median :33.51
##  Mean   :33.50
##  3rd Qu.:33.61
##  Max.   :33.98
```

```
susunum <- data.frame("SUSO" = owt_df02_gb09_wkly03_nums$SUSO)
susunum <- susunum %>% drop_na()
summary(susunum)
```

```
##       SUSO
##  Min.   : 0.200
##  1st Qu.: 3.697
##  Median : 4.637
##  Mean   : 4.909
##  3rd Qu.: 6.043
##  Max.   :13.709
```

```r
tempnum <- data.frame("TEMP" = owt_df02_gb09_wkly03_nums$TEMP)
tempnum <- tempnum %>% drop_na()
summary(tempnum)
```

```
##       TEMP
##  Min.   :10.96
##  1st Qu.:13.91
##  Median :15.01
##  Mean   :15.22
##  3rd Qu.:16.32
##  Max.   :22.97
```

```r
xmsnum <- data.frame("XMS" = owt_df02_gb09_wkly03_nums$XMS)
xmsnum <- xmsnum %>% drop_na()
summary(xmsnum)
```

```
##       XMS
##  Min.   :18.11
##  1st Qu.:74.39
##  Median :79.29
##  Mean   :77.43
##  3rd Qu.:82.67
##  Max.   :90.68
```

Looking at each column if we remove NA's (for 1/1/2000 onward)

```r
# descriptive stats (no depth) for numeric columns for arbitrary after 1/1/2000
owt_df02_gb09_wkly03_nums_2000s <- owt_df02_gb09_wkly03 %>% filter(date_sample >=
↪  "2000-01-01")
owt_df02_gb09_wkly03_nums_2000s <- subset(owt_df02_gb09_wkly03_nums_2000s, select=
↪  -c(date_sample))
summary(owt_df02_gb09_wkly03_nums_2000s)
```

```
##  project      CHLOROPHYLL         DENSITY            DO
##  PLOO:1141   Min.   : 0.3333   Min.   :22.71   Min.   : 2.876
##  SBOO:1146   1st Qu.: 1.5956   1st Qu.:24.45   1st Qu.: 6.852
##              Median : 2.7296   Median :24.75   Median : 7.388
##              Mean   : 3.9388   Mean   :24.72   Mean   : 7.305
##              3rd Qu.: 4.9511   3rd Qu.:25.04   3rd Qu.: 7.819
##              Max.   :36.0533   Max.   :25.98   Max.   :10.810
##              NA's   :386       NA's   :368     NA's   :373
##      ENTERO             FECAL                OG               PH
##  Min.   :   2.000   Min.   :   2.000   Min.   :0.2000   Min.   :7.628
##  1st Qu.:   3.141   1st Qu.:   3.480   1st Qu.:0.2000   1st Qu.:8.031
##  Median :   6.909   Median :   8.333   Median :0.2000   Median :8.100
##  Mean   : 197.919   Mean   : 255.213   Mean   :0.2652   Mean   :8.088
##  3rd Qu.:  26.498   3rd Qu.:  47.318   3rd Qu.:0.2000   3rd Qu.:8.147
##  Max.   :8668.000   Max.   :7881.917   Max.   :2.6500   Max.   :8.439
##  NA's   :12         NA's   :13         NA's   :2057     NA's   :369
##     SALINITY          SUSO             TEMP            XMS
##  Min.   :32.21   Min.   : 0.200   Min.   :10.96   Min.   :18.11
##  1st Qu.:33.41   1st Qu.: 3.804   1st Qu.:13.92   1st Qu.:73.89
##  Median :33.51   Median : 4.954   Median :15.05   Median :79.06
##  Mean   :33.50   Mean   : 5.173   Mean   :15.25   Mean   :77.02
```

```
##  3rd Qu.:33.60   3rd Qu.: 6.423   3rd Qu.:16.33   3rd Qu.:82.45
##  Max.   :33.92   Max.   :13.709   Max.   :22.97   Max.   :90.68
##  NA's   :377     NA's   :2041     NA's   :167     NA's   :177
```

Dropping NA's

```
chlornum2000s <- data.frame("CHLOROPHYLL" = owt_df02_gb09_wkly03_nums_2000s$CHLOROPHYLL)
chlornum2000s <- chlornum2000s %>% drop_na()
summary(chlornum2000s)
```

```
##   CHLOROPHYLL
##  Min.   : 0.3333
##  1st Qu.: 1.5956
##  Median : 2.7296
##  Mean   : 3.9388
##  3rd Qu.: 4.9511
##  Max.   :36.0533
```

```
densnum2000s <- data.frame("DENSITY" = owt_df02_gb09_wkly03_nums_2000s$DENSITY)
densnum2000s <- densnum2000s %>% drop_na()
summary(densnum2000s)
```

```
##     DENSITY
##  Min.   :22.71
##  1st Qu.:24.45
##  Median :24.75
##  Mean   :24.72
##  3rd Qu.:25.04
##  Max.   :25.98
```

```
donum2000s <- data.frame("DO" = owt_df02_gb09_wkly03_nums_2000s$DO)
donum2000s <- donum2000s %>% drop_na()
summary(donum2000s)
```

```
##        DO
##  Min.   : 2.876
##  1st Qu.: 6.852
##  Median : 7.389
##  Mean   : 7.305
##  3rd Qu.: 7.819
##  Max.   :10.810
```

```
enteronum2000s <- data.frame("ENTERO" = owt_df02_gb09_wkly03_nums_2000s$ENTERO)
enteronum2000s <- enteronum2000s %>% drop_na()
summary(enteronum2000s)
```

```
##      ENTERO
##  Min.   :   2.000
##  1st Qu.:   3.141
##  Median :   6.909
##  Mean   : 197.919
##  3rd Qu.:  26.498
##  Max.   :8668.000
```

```
fecalnum2000s <- data.frame("FECAL" = owt_df02_gb09_wkly03_nums_2000s$FECAL)
fecalnum2000s <- fecalnum2000s %>% drop_na()
```

```r
summary(fecalnum2000s)
```

```
##      FECAL
##  Min.   :   2.000
##  1st Qu.:   3.480
##  Median :   8.333
##  Mean   : 255.213
##  3rd Qu.:  47.318
##  Max.   :7881.917
```

```r
ognum2000s <- data.frame("OG" = owt_df02_gb09_wkly03_nums_2000s$OG)
ognum2000s <- ognum2000s %>% drop_na()
summary(ognum2000s)
```

```
##        OG
##  Min.   :0.2000
##  1st Qu.:0.2000
##  Median :0.2000
##  Mean   :0.2652
##  3rd Qu.:0.2000
##  Max.   :2.6500
```

```r
phnum2000s <- data.frame("PH" = owt_df02_gb09_wkly03_nums_2000s$PH)
phnum2000s <- phnum2000s %>% drop_na()
summary(phnum2000s)
```

```
##        PH
##  Min.   :7.628
##  1st Qu.:8.031
##  Median :8.100
##  Mean   :8.088
##  3rd Qu.:8.147
##  Max.   :8.439
```

```r
salinnum2000s <- data.frame("SALINITY" = owt_df02_gb09_wkly03_nums_2000s$SALINITY)
salinnum2000s <- salinnum2000s %>% drop_na()
summary(salinnum2000s)
```

```
##     SALINITY
##  Min.   :32.21
##  1st Qu.:33.41
##  Median :33.51
##  Mean   :33.50
##  3rd Qu.:33.60
##  Max.   :33.92
```

```r
susunum2000s <- data.frame("SUSO" = owt_df02_gb09_wkly03_nums_2000s$SUSO)
susunum2000s <- susunum2000s %>% drop_na()
summary(susunum2000s)
```

```
##       SUSO
##  Min.   : 0.200
##  1st Qu.: 3.804
##  Median : 4.954
##  Mean   : 5.173
```

```
##  3rd Qu.: 6.423
##  Max.   :13.709
```

```
tempnum2000s <- data.frame("TEMP" = owt_df02_gb09_wkly03_nums_2000s$TEMP)
tempnum2000s <- tempnum2000s %>% drop_na()
summary(tempnum2000s)
```

```
##       TEMP
##  Min.   :10.96
##  1st Qu.:13.92
##  Median :15.05
##  Mean   :15.25
##  3rd Qu.:16.33
##  Max.   :22.97
```

```
xmsnum2000s <- data.frame("XMS" = owt_df02_gb09_wkly03_nums_2000s$XMS)
xmsnum2000s <- xmsnum2000s %>% drop_na()
summary(xmsnum2000s)
```

```
##       XMS
##  Min.   :18.11
##  1st Qu.:73.89
##  Median :79.06
##  Mean   :77.02
##  3rd Qu.:82.45
##  Max.   :90.68
```

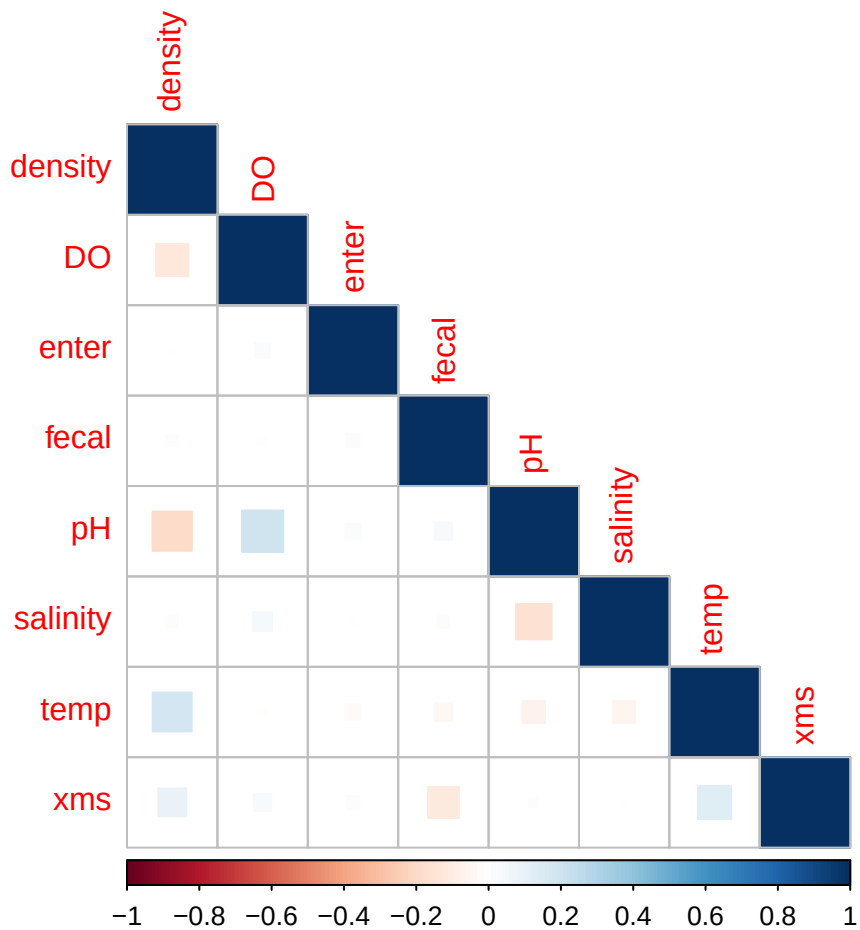
looking at non time series correlations out of curiousity

```
print(paste("chlorophyll", nrow(chlornum), ", density", nrow(densnum), ", DO",
↪  nrow(donum),
           ", entero", nrow(enteronum), ", fecal", nrow(fecalnum), ", OG", nrow(ognum),
           ", pH", nrow(phnum), ", salinity", nrow(salinnum), ", Suso", nrow(susunum),
           ", Temp", nrow(tempnum), ", XMS", nrow(xmsnum)))
```

```
## [1] "chlorophyll 1967 , density 2000 , DO 2101 , entero 2786 , fecal 2786 , OG 351 , pH 2105 , salin
```

```
 # least populated in OG at 351 and SUSO at 369.
    # focusing on others, the limit will be Chlorophyll at 1967

densnum_sub <- densnum[1:1967,]
donum_sub <- donum[1:1967,]
enteronum_sub <- enteronum[1:1967,]
fecalnum_sub <- fecalnum[1:1967,]
phnum_sub <- phnum[1:1967,]
salinnum_sub <- salinnum[1:1967,]
tempnum_sub <- tempnum[1:1967,]
xmsnum_sub <- xmsnum[1:1967,]

splitnum_sub <- data.frame("density" = densnum_sub, "DO" =donum_sub,
                           "enter" =enteronum_sub, "fecal" = fecalnum_sub,
                           "pH" = phnum_sub, "salinity" = salinnum_sub,
                           "temp" = tempnum_sub, "xms" = xmsnum_sub)

corrplot(
```

```
  cor(splitnum_sub),
  method = "square",
  type= "lower")
```




```
round(cor(splitnum_sub), 2)
```

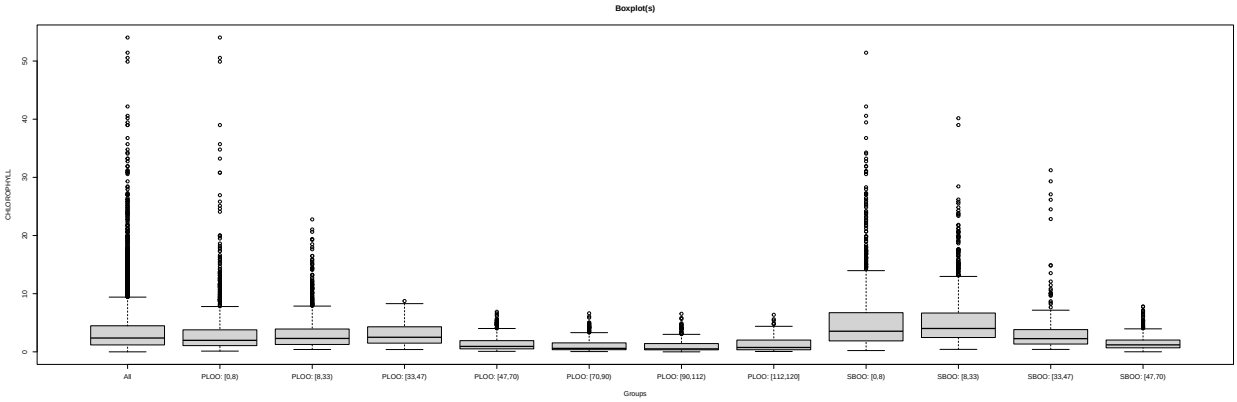
```
##           density    DO enter fecal    pH salinity  temp   xms
## density      1.00 -0.13  0.00  0.02 -0.19    -0.02  0.18  0.10
## DO          -0.13  1.00  0.03 -0.01  0.21     0.04 -0.01  0.04
## enter        0.00  0.03  1.00  0.02  0.03    -0.01 -0.03 -0.02
## fecal        0.02 -0.01  0.02  1.00  0.04    -0.02 -0.04 -0.12
## pH          -0.19  0.21  0.03  0.04  1.00    -0.15 -0.06  0.01
## salinity    -0.02  0.04 -0.01 -0.02 -0.15     1.00 -0.06  0.00
## temp         0.18 -0.01 -0.03 -0.04 -0.06    -0.06  1.00  0.13
## xms          0.10  0.04 -0.02 -0.12  0.01     0.00  0.13  1.00
```

Run custom function on data aggregated by `date_sample`, `project`, `depth_m_bin` and `parameter`

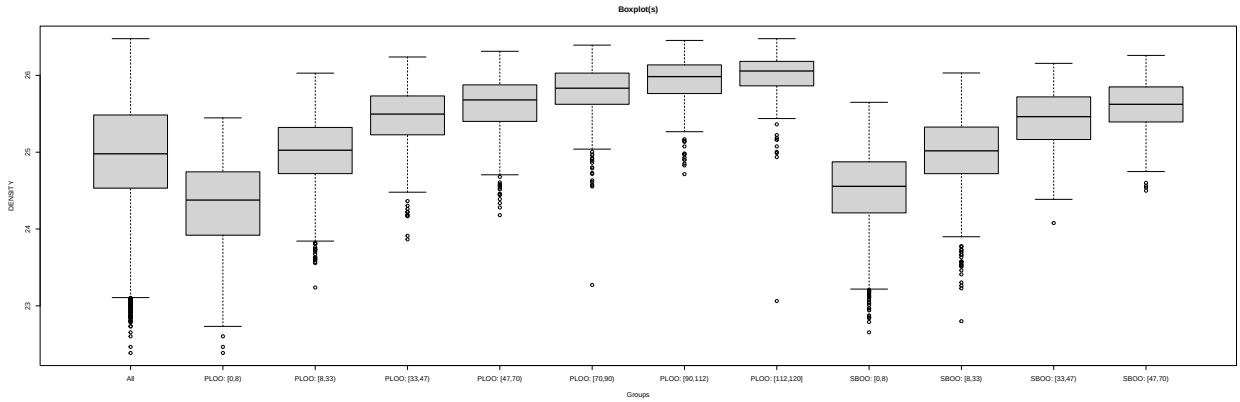
```
owt_df02_gb07_mrgd = ts_eda(ts_df = owt_df02_gb07,
                            form_lead = c("date_sample", "project", "depth_m_bin"),
                            form_cast = "parameter",
```

```
                                param_lst = param_lst02,
                                l1_col = c("project"),
                                l1_param = c("PLOO", "SBOO"),
                                l2_col = c("depth_m_bin"),
                                l2_param = depth_lvls01,
                                rtn_met = FALSE,
                                box = FALSE
                                )
```

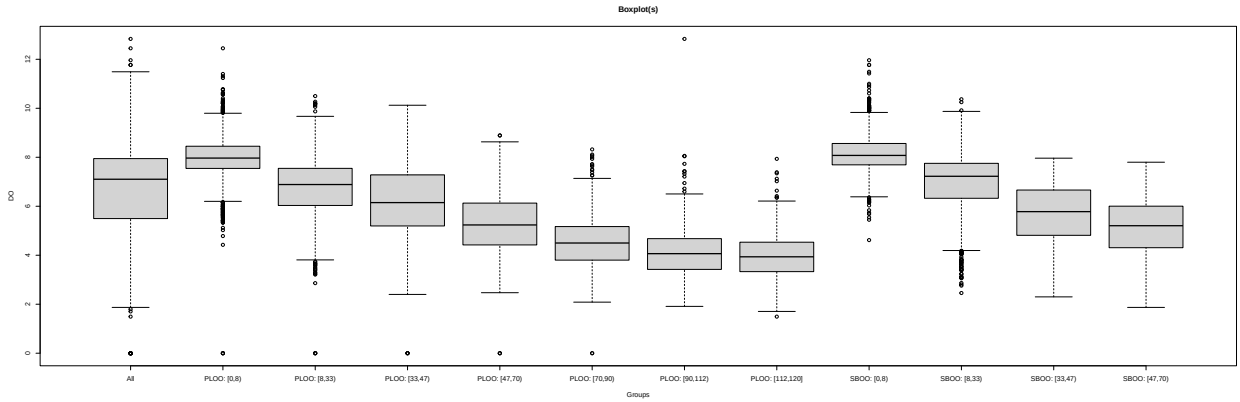
```
## Error in `$<-.data.frame`(`*tmp*`, "Groups", value = structure(1L, levels = "PLOO: Unknown", class =
##   replacement has 1 row, data has 0
## Error in `$<-.data.frame`(`*tmp*`, "Groups", value = structure(1L, levels = "SBOO: [70,90)", class =
##   replacement has 1 row, data has 0
## Error in `$<-.data.frame`(`*tmp*`, "Groups", value = structure(1L, levels = "SBOO: [90,112)", class =
##   replacement has 1 row, data has 0
## Error in `$<-.data.frame`(`*tmp*`, "Groups", value = structure(1L, levels = "SBOO: [112,120]", class
##   replacement has 1 row, data has 0
## Error in `$<-.data.frame`(`*tmp*`, "Groups", value = structure(1L, levels = "SBOO: Unknown", class =
##   replacement has 1 row, data has 0
```



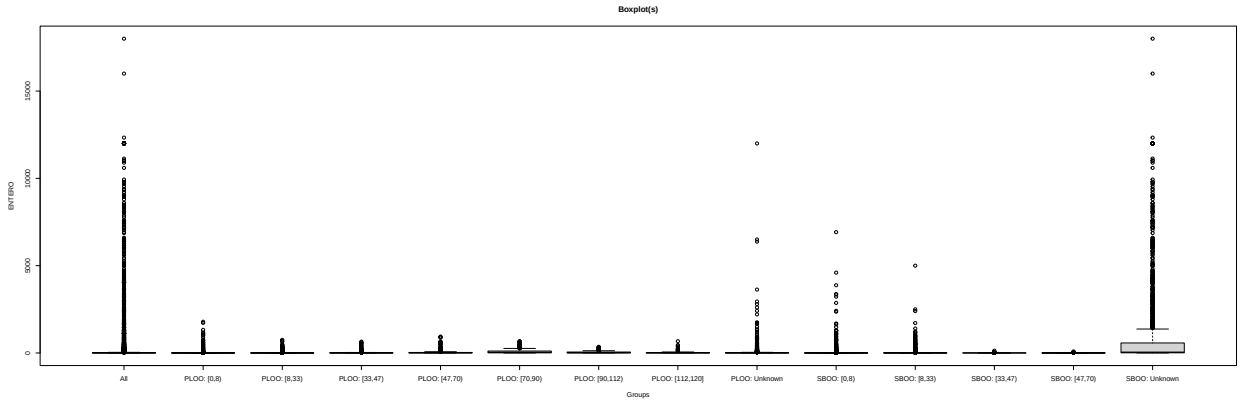

```
## Error in `$<-.data.frame`(`*tmp*`, "Groups", value = structure(1L, levels = "PLOO: Unknown", class =
##   replacement has 1 row, data has 0
## Error in `$<-.data.frame`(`*tmp*`, "Groups", value = structure(1L, levels = "SBOO: [70,90)", class =
##   replacement has 1 row, data has 0
## Error in `$<-.data.frame`(`*tmp*`, "Groups", value = structure(1L, levels = "SBOO: [90,112)", class =
##   replacement has 1 row, data has 0
## Error in `$<-.data.frame`(`*tmp*`, "Groups", value = structure(1L, levels = "SBOO: [112,120]", class
##   replacement has 1 row, data has 0
## Error in `$<-.data.frame`(`*tmp*`, "Groups", value = structure(1L, levels = "SBOO: Unknown", class =
##   replacement has 1 row, data has 0
```



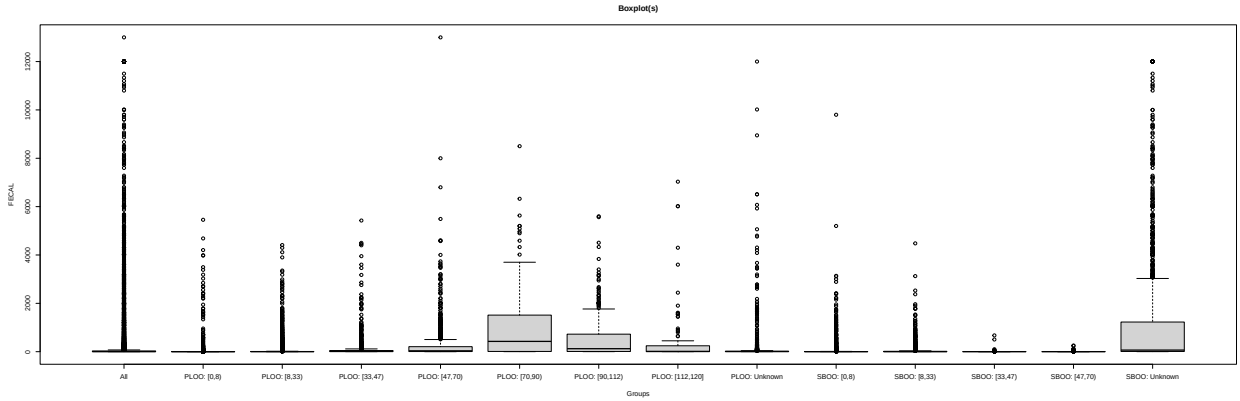

```
## Error in `$<-.data.frame`(`*tmp*`, "Groups", value = structure(1L, levels = "PLOO: Unknown", class =
##   replacement has 1 row, data has 0
## Error in `$<-.data.frame`(`*tmp*`, "Groups", value = structure(1L, levels = "SBOO: [70,90)", class =
##   replacement has 1 row, data has 0
## Error in `$<-.data.frame`(`*tmp*`, "Groups", value = structure(1L, levels = "SBOO: [90,112)", class =
##   replacement has 1 row, data has 0
## Error in `$<-.data.frame`(`*tmp*`, "Groups", value = structure(1L, levels = "SBOO: [112,120]", class
##   replacement has 1 row, data has 0
## Error in `$<-.data.frame`(`*tmp*`, "Groups", value = structure(1L, levels = "SBOO: Unknown", class =
##   replacement has 1 row, data has 0
```



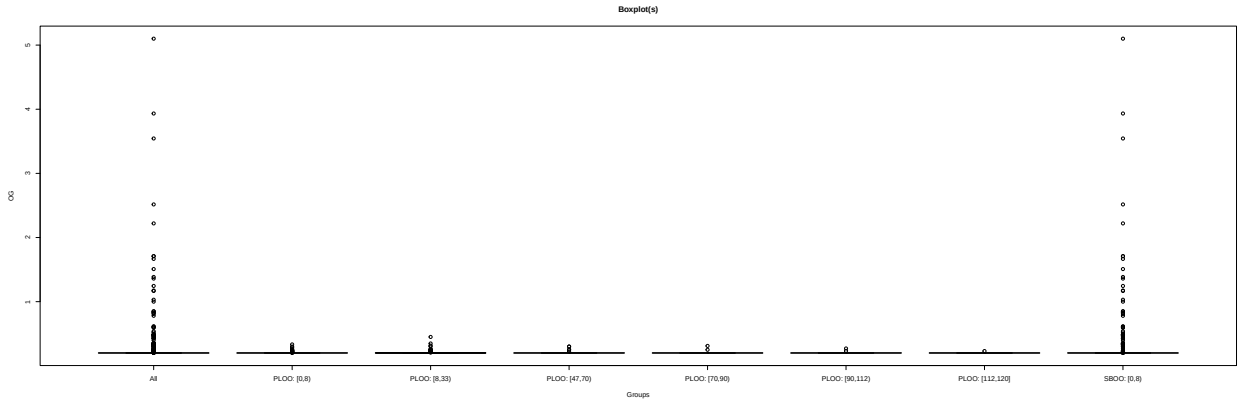

```
## Error in `$<-.data.frame`(`*tmp*`, "Groups", value = structure(1L, levels = "SBOO: [70,90)", class =
##   replacement has 1 row, data has 0
## Error in `$<-.data.frame`(`*tmp*`, "Groups", value = structure(1L, levels = "SBOO: [90,112)", class =
##   replacement has 1 row, data has 0
## Error in `$<-.data.frame`(`*tmp*`, "Groups", value = structure(1L, levels = "SBOO: [112,120]", class
##   replacement has 1 row, data has 0
```



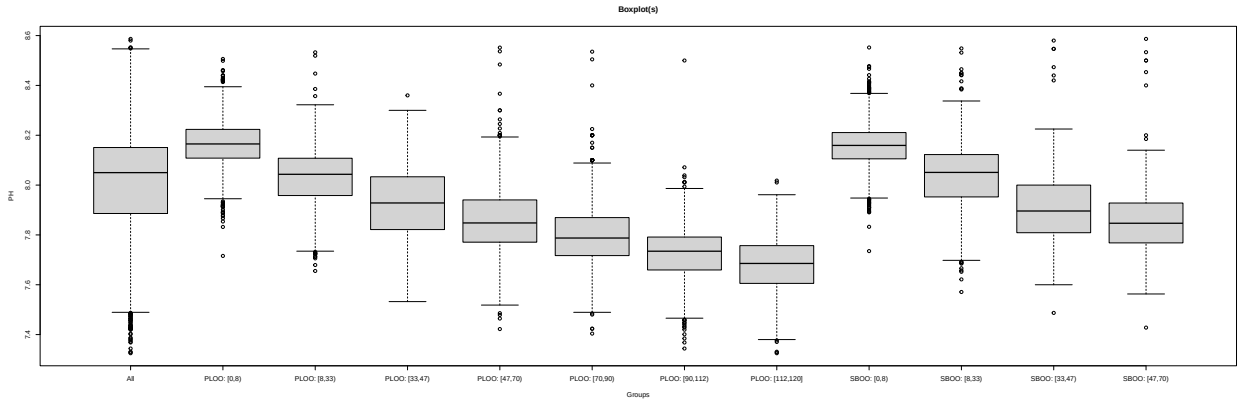

```
## Error in `$<-.data.frame`(`*tmp*`, "Groups", value = structure(1L, levels = "SBOO: [70,90)", class =
##   replacement has 1 row, data has 0
## Error in `$<-.data.frame`(`*tmp*`, "Groups", value = structure(1L, levels = "SBOO: [90,112)", class =
##   replacement has 1 row, data has 0
## Error in `$<-.data.frame`(`*tmp*`, "Groups", value = structure(1L, levels = "SBOO: [112,120]", class
##   replacement has 1 row, data has 0
```



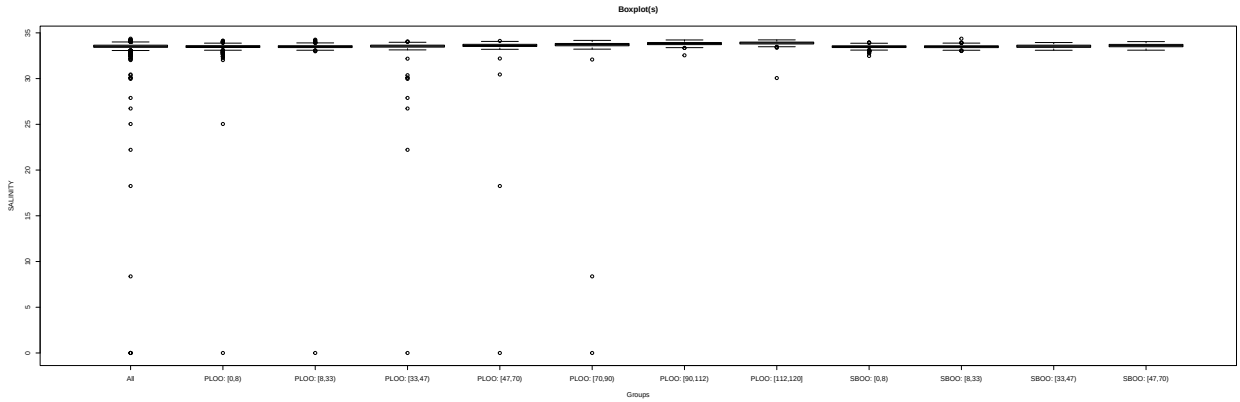

```
## Error in `$<-.data.frame`(`*tmp*`, "Groups", value = structure(1L, levels = "PLOO: [33,47)", class =
##   replacement has 1 row, data has 0
## Error in `$<-.data.frame`(`*tmp*`, "Groups", value = structure(1L, levels = "PLOO: Unknown", class =
##   replacement has 1 row, data has 0
## Error in `$<-.data.frame`(`*tmp*`, "Groups", value = structure(1L, levels = "SBOO: [8,33)", class =
##   replacement has 1 row, data has 0
## Error in `$<-.data.frame`(`*tmp*`, "Groups", value = structure(1L, levels = "SBOO: [33,47)", class =
##   replacement has 1 row, data has 0
## Error in `$<-.data.frame`(`*tmp*`, "Groups", value = structure(1L, levels = "SBOO: [47,70)", class =
##   replacement has 1 row, data has 0
## Error in `$<-.data.frame`(`*tmp*`, "Groups", value = structure(1L, levels = "SBOO: [70,90)", class =
##   replacement has 1 row, data has 0
## Error in `$<-.data.frame`(`*tmp*`, "Groups", value = structure(1L, levels = "SBOO: [90,112)", class =
##   replacement has 1 row, data has 0
## Error in `$<-.data.frame`(`*tmp*`, "Groups", value = structure(1L, levels = "SBOO: [112,120]", class
##   replacement has 1 row, data has 0
## Error in `$<-.data.frame`(`*tmp*`, "Groups", value = structure(1L, levels = "SBOO: Unknown", class =
##   replacement has 1 row, data has 0
```



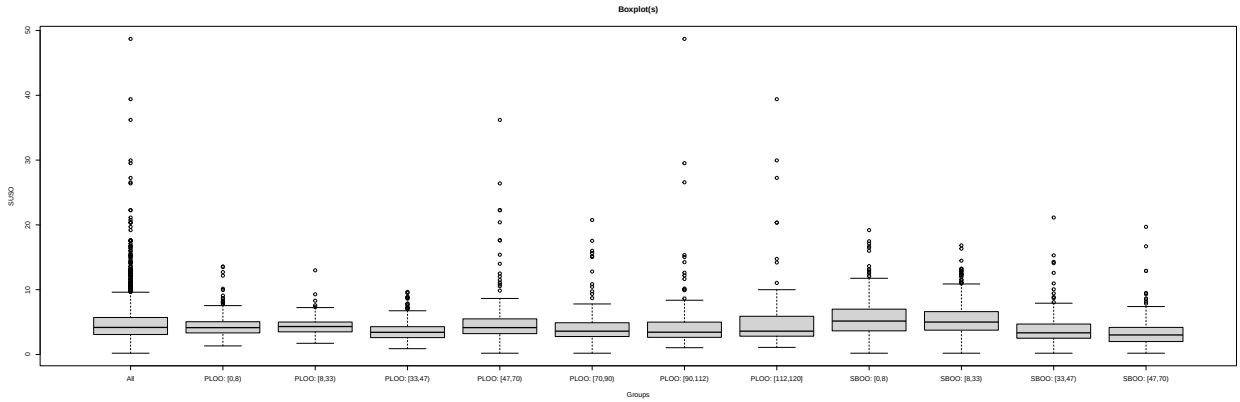

```
## Error in `$<-.data.frame`(`*tmp*`, "Groups", value = structure(1L, levels = "PLOO: Unknown", class =
##   replacement has 1 row, data has 0
## Error in `$<-.data.frame`(`*tmp*`, "Groups", value = structure(1L, levels = "SBOO: [70,90)", class =
##   replacement has 1 row, data has 0
## Error in `$<-.data.frame`(`*tmp*`, "Groups", value = structure(1L, levels = "SBOO: [90,112)", class =
##   replacement has 1 row, data has 0
## Error in `$<-.data.frame`(`*tmp*`, "Groups", value = structure(1L, levels = "SBOO: [112,120]", class
##   replacement has 1 row, data has 0
## Error in `$<-.data.frame`(`*tmp*`, "Groups", value = structure(1L, levels = "SBOO: Unknown", class =
##   replacement has 1 row, data has 0
```




```
## Error in `$<-.data.frame`(`*tmp*`, "Groups", value = structure(1L, levels = "PLOO: Unknown", class =
##   replacement has 1 row, data has 0
## Error in `$<-.data.frame`(`*tmp*`, "Groups", value = structure(1L, levels = "SBOO: [70,90)", class =
##   replacement has 1 row, data has 0
## Error in `$<-.data.frame`(`*tmp*`, "Groups", value = structure(1L, levels = "SBOO: [90,112)", class =
##   replacement has 1 row, data has 0
## Error in `$<-.data.frame`(`*tmp*`, "Groups", value = structure(1L, levels = "SBOO: [112,120]", class
##   replacement has 1 row, data has 0
## Error in `$<-.data.frame`(`*tmp*`, "Groups", value = structure(1L, levels = "SBOO: Unknown", class =
##   replacement has 1 row, data has 0
```




```
## Error in `$<-.data.frame`(`*tmp*`, "Groups", value = structure(1L, levels = "PLOO: Unknown", class =
##   replacement has 1 row, data has 0
## Error in `$<-.data.frame`(`*tmp*`, "Groups", value = structure(1L, levels = "SBOO: [70,90)", class =
##   replacement has 1 row, data has 0
## Error in `$<-.data.frame`(`*tmp*`, "Groups", value = structure(1L, levels = "SBOO: [90,112)", class =
##   replacement has 1 row, data has 0
## Error in `$<-.data.frame`(`*tmp*`, "Groups", value = structure(1L, levels = "SBOO: [112,120]", class
##   replacement has 1 row, data has 0
## Error in `$<-.data.frame`(`*tmp*`, "Groups", value = structure(1L, levels = "SBOO: Unknown", class =
##   replacement has 1 row, data has 0
```




```
## Error in `$<-.data.frame`(`*tmp*`, "Groups", value = structure(1L, levels = "PLOO: Unknown", class =
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## Error in `$<-.data.frame`(`*tmp*`, "Groups", value = structure(1L, levels = "SBOO: [70,90)", class =
##   replacement has 1 row, data has 0
## Error in `$<-.data.frame`(`*tmp*`, "Groups", value = structure(1L, levels = "SBOO: [90,112)", class =
##   replacement has 1 row, data has 0
## Error in `$<-.data.frame`(`*tmp*`, "Groups", value = structure(1L, levels = "SBOO: [112,120]", class
##   replacement has 1 row, data has 0
## Error in `$<-.data.frame`(`*tmp*`, "Groups", value = structure(1L, levels = "SBOO: Unknown", class =
##   replacement has 1 row, data has 0
```
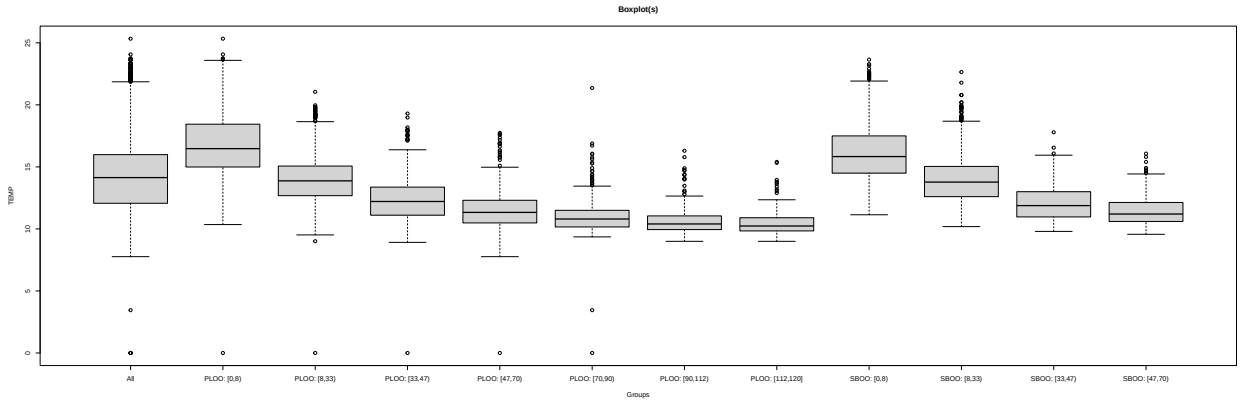
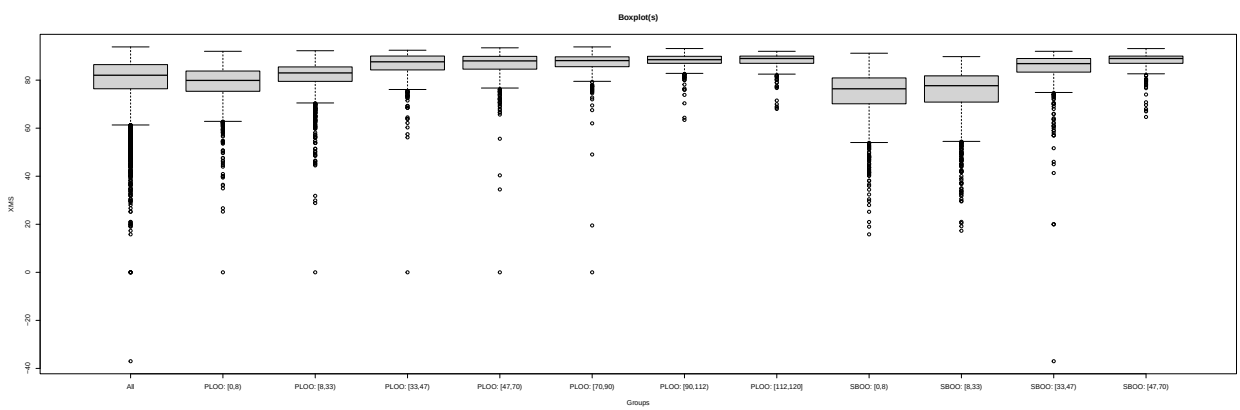




```
## Error in `$<-.data.frame`(`*tmp*`, "Groups", value = structure(1L, levels = "PLOO: Unknown", class =
##   replacement has 1 row, data has 0
## Error in `$<-.data.frame`(`*tmp*`, "Groups", value = structure(1L, levels = "SBOO: [70,90)", class =
##   replacement has 1 row, data has 0
## Error in `$<-.data.frame`(`*tmp*`, "Groups", value = structure(1L, levels = "SBOO: [90,112)", class =
##   replacement has 1 row, data has 0
## Error in `$<-.data.frame`(`*tmp*`, "Groups", value = structure(1L, levels = "SBOO: [112,120]", class
##   replacement has 1 row, data has 0
## Error in `$<-.data.frame`(`*tmp*`, "Groups", value = structure(1L, levels = "SBOO: Unknown", class =
##   replacement has 1 row, data has 0
```



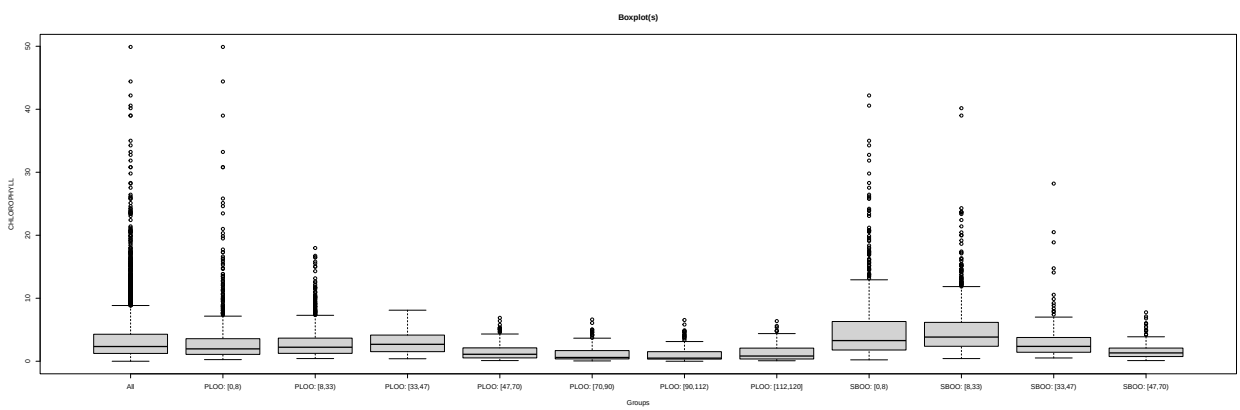

```
##    date_sample project depth_m_bin CHLOROPHYLL DENSITY       DO    ENTERO
## 1   1990-11-15    PLOO      [8,33)        0.87  23.855 6.550000        NA
## 2   1990-11-15    SBOO       [0,8)        1.27  23.853 7.410000        NA
## 3   1991-01-02    PLOO       [0,8)          NA      NA       NA  34.07407
## 4   1991-01-02    PLOO      [8,33)          NA      NA       NA  27.50000
## 5   1991-01-03    PLOO       [0,8)          NA      NA       NA  17.40741
## 6   1991-01-03    PLOO      [8,33)          NA      NA       NA  21.66667
## 7   1991-01-07    PLOO       [0,8)          NA      NA       NA  77.40741
## 8   1991-01-07    PLOO      [8,33)          NA      NA       NA 170.83333
## 9   1991-01-08    PLOO       [0,8)          NA      NA       NA  36.25000
## 10  1991-01-08    PLOO     [33,47)          NA      NA       NA  10.00000
## 11  1991-01-08    PLOO     [47,70)          NA      NA       NA  16.66667
## 12  1991-01-08    PLOO      [8,33)          NA      NA       NA  57.50000
## 13  1991-01-09    PLOO       [0,8)          NA      NA 5.675000  11.81818
## 14  1991-01-09    PLOO     [33,47)          NA      NA 5.391667  32.50000
## 15  1991-01-09    PLOO     [47,70)          NA      NA 5.300000  10.00000
```

```
## 16  1991-01-09    PLOO     [70,90)          NA      NA 5.025000  10.00000
## 17  1991-01-09    PLOO      [8,33)          NA      NA 5.496154  30.00000
##        FECAL OG       PH SALINITY SUSO     TEMP      XMS
## 1         NA NA 8.080000 33.61700   NA 19.43000 44.85000
## 2         NA NA 8.180000 33.57400   NA 19.31000 75.60000
## 3  134.81481 NA       NA       NA   NA 14.56667 77.03704
## 4  105.00000 NA       NA       NA   NA 14.37500 86.75000
## 5   45.55556 NA       NA       NA   NA 14.48519 83.55556
## 6   64.16667 NA       NA       NA   NA 14.18333 84.66667
## 7   44.07407 NA       NA       NA   NA 14.61852 77.62963
## 8  163.33333 NA       NA       NA   NA 14.36667 82.00000
## 9   31.66667 NA       NA       NA   NA 13.36667 81.00000
## 10  12.50000 NA       NA       NA   NA       NA       NA
## 11  10.00000 NA       NA       NA   NA       NA       NA
## 12  66.00000 NA       NA       NA   NA 13.52500 79.00000
## 13  11.36364 NA 8.200000 33.51292   NA 14.59333 85.96667
## 14  10.00000 NA 8.200000 33.52583   NA 14.08333 86.25000
## 15  75.00000 NA 8.192857 33.52500   NA 13.70000 85.50000
## 16  10.00000 NA 8.150000 33.52500   NA 13.07500 85.00000
## 17  42.50000 NA 8.200000 33.51846   NA 14.44333 86.93333
##              vars     n   mean      sd median trimmed  mad    min      max
## date_sample     1 17003    NaN      NA     NA     NaN   NA    Inf     -Inf
## project*        2 17003   1.37    0.48   1.00    1.34 0.00   1.00     2.00
## depth_m_bin*    3 17003   4.49    2.61   5.00    4.48 2.97   1.00     8.00
## CHLOROPHYLL     4  8386   3.60    4.09   2.38    2.82 2.13   0.00    54.04
## DENSITY         5  8627  24.96    0.69  24.98   24.99 0.70  22.39    26.48
## DO              6  9842   6.70    1.69   7.10    6.80 1.58   0.00    12.83
## ENTERO          7 15533 150.11  925.42   2.80   10.66 1.19   0.00 18000.00
## FECAL           8 14874 269.82 1129.98   3.85   28.41 2.74   0.00 13000.00
## OG              9  1115   0.24    0.26   0.20    0.20 0.00   0.20     5.10
## PH             10  9695   8.01    0.18   8.05    8.02 0.18   7.33     8.59
## SALINITY       11  9844  33.52    0.86  33.54   33.54 0.17   0.00    34.36
## SUSO           12  3023   4.77    2.99   4.18    4.40 1.89   0.20    48.70
## TEMP           13 12010  14.27    2.80  14.14   14.11 2.90   0.00    25.34
## XMS            14 11969  80.22    9.07  82.04   81.41 7.25 -37.00    93.83
##                 range   skew kurtosis   se
## date_sample      -Inf     NA       NA   NA
## project*         1.00   0.54    -1.71 0.00
## depth_m_bin*     7.00  -0.11    -1.42 0.02
## CHLOROPHYLL     54.04   3.70    22.87 0.04
## DENSITY          4.09  -0.36    -0.15 0.01
## DO              12.83  -0.55    -0.16 0.02
## ENTERO       18000.00   9.88   111.40 7.43
## FECAL        13000.00   7.12    59.92 9.27
## OG               4.90  11.87   171.74 0.01
## PH               1.26  -0.50    -0.10 0.00
## SALINITY        34.36 -34.13  1283.78 0.01
## SUSO            48.50   3.91    33.72 0.05
## TEMP            25.34   0.42     0.06 0.03
## XMS            130.83  -2.14     9.79 0.08
##          date_sample project depth_m_bin parameter         Avg
## Not NA n      121286  121286      121286    121286 119635.0000
## NA n               0       0           0         0   1651.0000
## Not NA %           1       1           1         1      0.9864
```

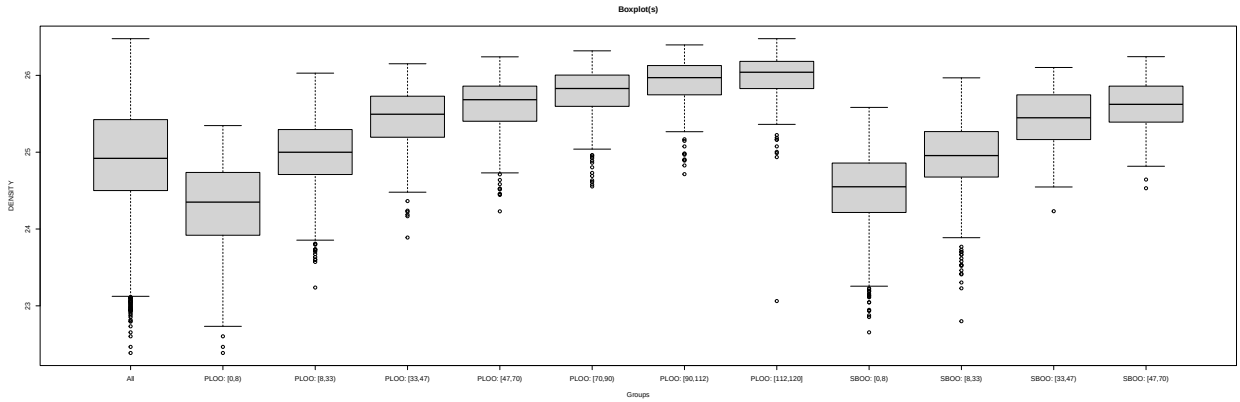
```
## NA %                0        0            0          0       0.0136
```

```
owt_df02_gb07_wkly = ts_eda(ts_df = owt_df02_gb07,
                            form_lead = c("date_sample", "project", "depth_m_bin"),
                            form_cast = "parameter",
                            param_lst = param_lst02,
                            l1_col = c("project"),
                            l1_param = c("PLOO", "SBOO"),
                            l2_col = c("depth_m_bin"),
                            l2_param = depth_lvls01,
                            rtn_met = FALSE,
                            box = FALSE,
                            week_agg = TRUE
                            )
```

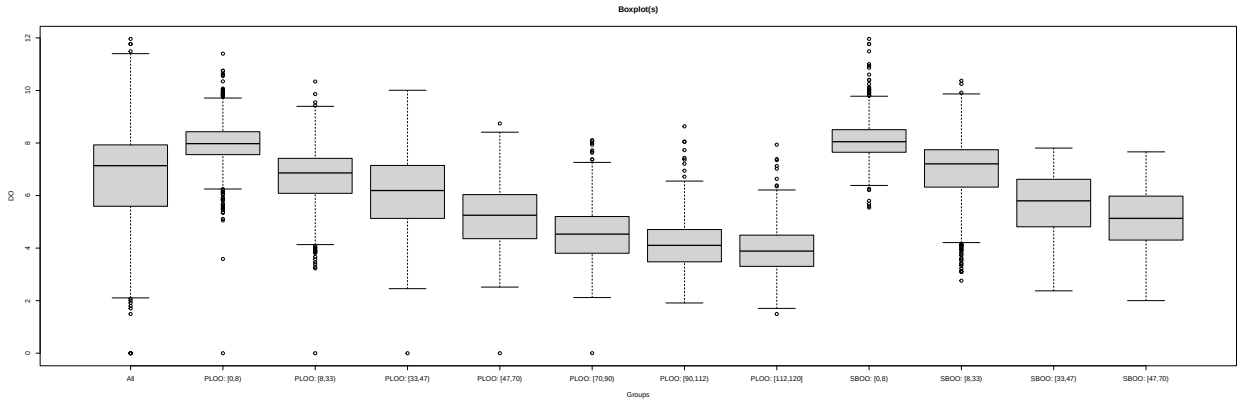
```
## Error in `$<-.data.frame`(`*tmp*`, "Groups", value = structure(1L, levels = "PLOO: Unknown", class =
##   replacement has 1 row, data has 0
## Error in `$<-.data.frame`(`*tmp*`, "Groups", value = structure(1L, levels = "SBOO: [70,90)", class =
##   replacement has 1 row, data has 0
## Error in `$<-.data.frame`(`*tmp*`, "Groups", value = structure(1L, levels = "SBOO: [90,112)", class =
##   replacement has 1 row, data has 0
## Error in `$<-.data.frame`(`*tmp*`, "Groups", value = structure(1L, levels = "SBOO: [112,120]", class
##   replacement has 1 row, data has 0
## Error in `$<-.data.frame`(`*tmp*`, "Groups", value = structure(1L, levels = "SBOO: Unknown", class =
##   replacement has 1 row, data has 0
```



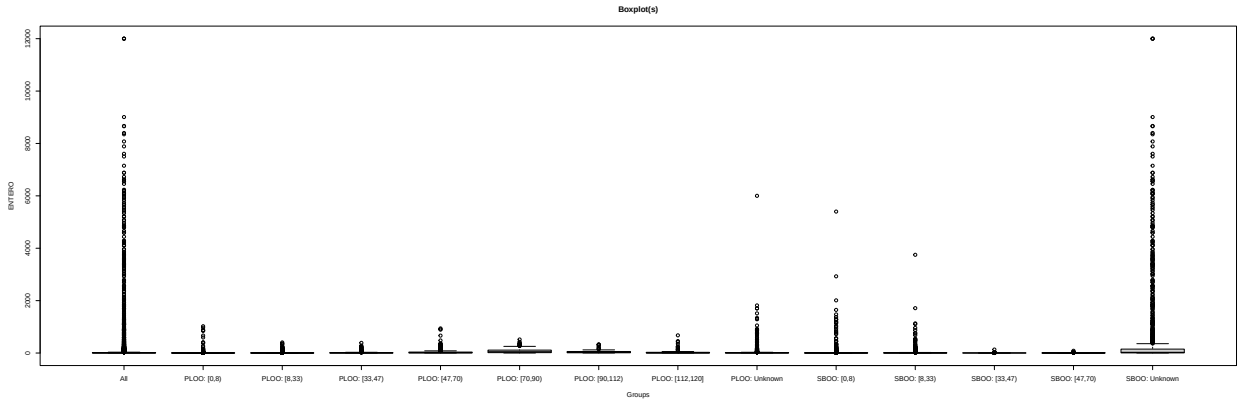

```
## Error in `$<-.data.frame`(`*tmp*`, "Groups", value = structure(1L, levels = "PLOO: Unknown", class =
##   replacement has 1 row, data has 0
## Error in `$<-.data.frame`(`*tmp*`, "Groups", value = structure(1L, levels = "SBOO: [70,90)", class =
##   replacement has 1 row, data has 0
## Error in `$<-.data.frame`(`*tmp*`, "Groups", value = structure(1L, levels = "SBOO: [90,112)", class =
##   replacement has 1 row, data has 0
## Error in `$<-.data.frame`(`*tmp*`, "Groups", value = structure(1L, levels = "SBOO: [112,120]", class
##   replacement has 1 row, data has 0
## Error in `$<-.data.frame`(`*tmp*`, "Groups", value = structure(1L, levels = "SBOO: Unknown", class =
##   replacement has 1 row, data has 0
```



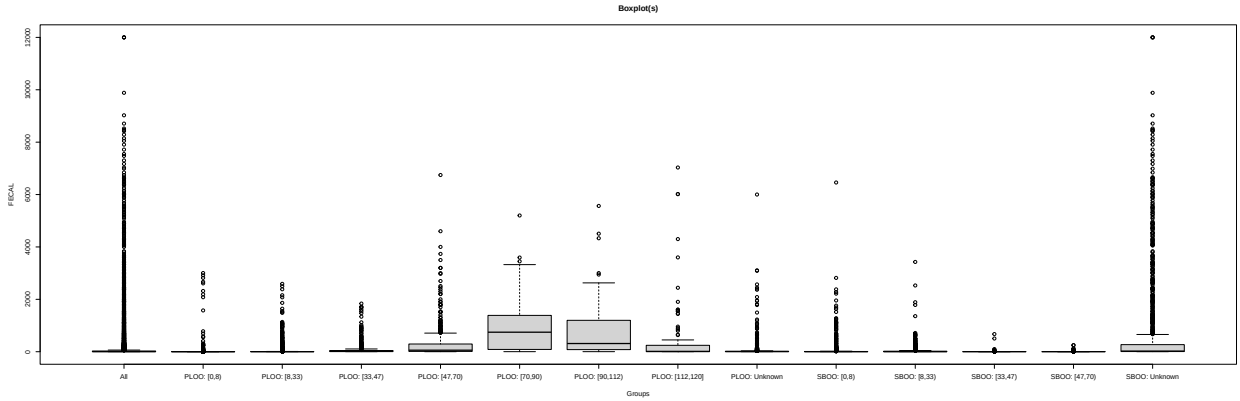

```
## Error in `$<-.data.frame`(`*tmp*`, "Groups", value = structure(1L, levels = "PLOO: Unknown", class =
##   replacement has 1 row, data has 0
## Error in `$<-.data.frame`(`*tmp*`, "Groups", value = structure(1L, levels = "SBOO: [70,90)", class =
##   replacement has 1 row, data has 0
## Error in `$<-.data.frame`(`*tmp*`, "Groups", value = structure(1L, levels = "SBOO: [90,112)", class =
##   replacement has 1 row, data has 0
## Error in `$<-.data.frame`(`*tmp*`, "Groups", value = structure(1L, levels = "SBOO: [112,120]", class
##   replacement has 1 row, data has 0
## Error in `$<-.data.frame`(`*tmp*`, "Groups", value = structure(1L, levels = "SBOO: Unknown", class =
##   replacement has 1 row, data has 0
```



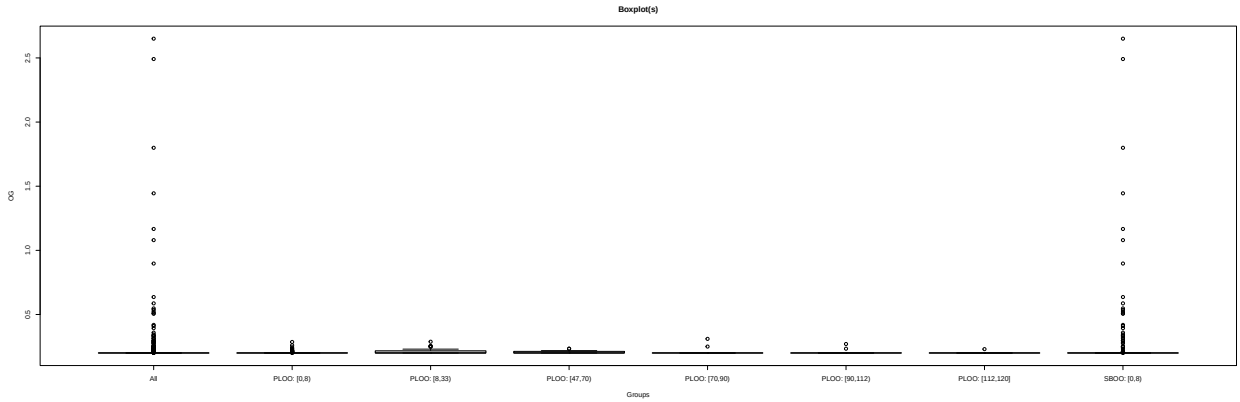

```
## Error in `$<-.data.frame`(`*tmp*`, "Groups", value = structure(1L, levels = "SBOO: [70,90)", class =
##   replacement has 1 row, data has 0
## Error in `$<-.data.frame`(`*tmp*`, "Groups", value = structure(1L, levels = "SBOO: [90,112)", class =
##   replacement has 1 row, data has 0
## Error in `$<-.data.frame`(`*tmp*`, "Groups", value = structure(1L, levels = "SBOO: [112,120]", class
##   replacement has 1 row, data has 0
```



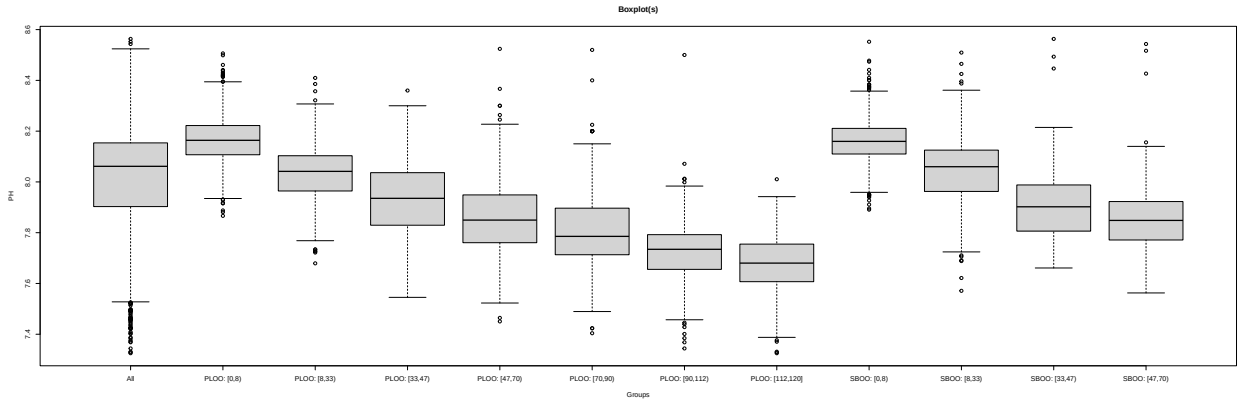

```
## Error in `$<-.data.frame`(`*tmp*`, "Groups", value = structure(1L, levels = "SBOO: [70,90)", class =
##   replacement has 1 row, data has 0
## Error in `$<-.data.frame`(`*tmp*`, "Groups", value = structure(1L, levels = "SBOO: [90,112)", class =
##   replacement has 1 row, data has 0
## Error in `$<-.data.frame`(`*tmp*`, "Groups", value = structure(1L, levels = "SBOO: [112,120]", class
##   replacement has 1 row, data has 0
```



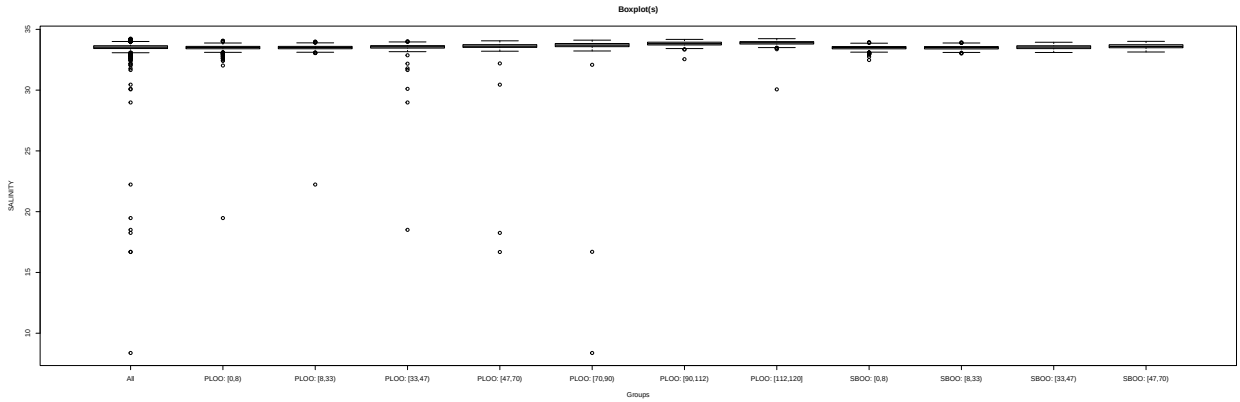

```
## Error in `$<-.data.frame`(`*tmp*`, "Groups", value = structure(1L, levels = "PLOO: [33,47)", class =
##   replacement has 1 row, data has 0
## Error in `$<-.data.frame`(`*tmp*`, "Groups", value = structure(1L, levels = "PLOO: Unknown", class =
##   replacement has 1 row, data has 0
## Error in `$<-.data.frame`(`*tmp*`, "Groups", value = structure(1L, levels = "SBOO: [8,33)", class =
##   replacement has 1 row, data has 0
## Error in `$<-.data.frame`(`*tmp*`, "Groups", value = structure(1L, levels = "SBOO: [33,47)", class =
##   replacement has 1 row, data has 0
## Error in `$<-.data.frame`(`*tmp*`, "Groups", value = structure(1L, levels = "SBOO: [47,70)", class =
##   replacement has 1 row, data has 0
## Error in `$<-.data.frame`(`*tmp*`, "Groups", value = structure(1L, levels = "SBOO: [70,90)", class =
##   replacement has 1 row, data has 0
## Error in `$<-.data.frame`(`*tmp*`, "Groups", value = structure(1L, levels = "SBOO: [90,112)", class =
##   replacement has 1 row, data has 0
## Error in `$<-.data.frame`(`*tmp*`, "Groups", value = structure(1L, levels = "SBOO: [112,120]", class
##   replacement has 1 row, data has 0
## Error in `$<-.data.frame`(`*tmp*`, "Groups", value = structure(1L, levels = "SBOO: Unknown", class =
##   replacement has 1 row, data has 0
```



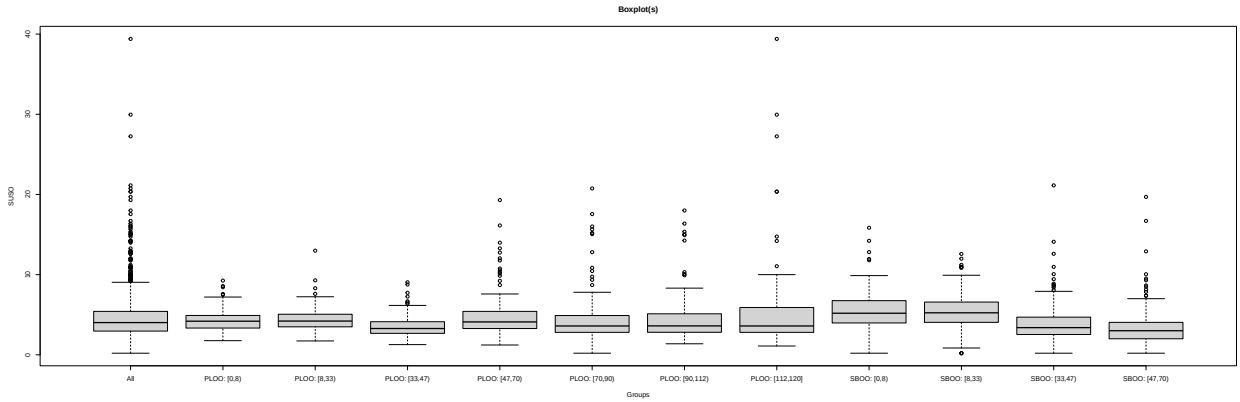

```
## Error in `$<-.data.frame`(`*tmp*`, "Groups", value = structure(1L, levels = "PLOO: Unknown", class =
##   replacement has 1 row, data has 0
## Error in `$<-.data.frame`(`*tmp*`, "Groups", value = structure(1L, levels = "SBOO: [70,90)", class =
##   replacement has 1 row, data has 0
## Error in `$<-.data.frame`(`*tmp*`, "Groups", value = structure(1L, levels = "SBOO: [90,112)", class =
##   replacement has 1 row, data has 0
## Error in `$<-.data.frame`(`*tmp*`, "Groups", value = structure(1L, levels = "SBOO: [112,120]", class
##   replacement has 1 row, data has 0
## Error in `$<-.data.frame`(`*tmp*`, "Groups", value = structure(1L, levels = "SBOO: Unknown", class =
##   replacement has 1 row, data has 0
```



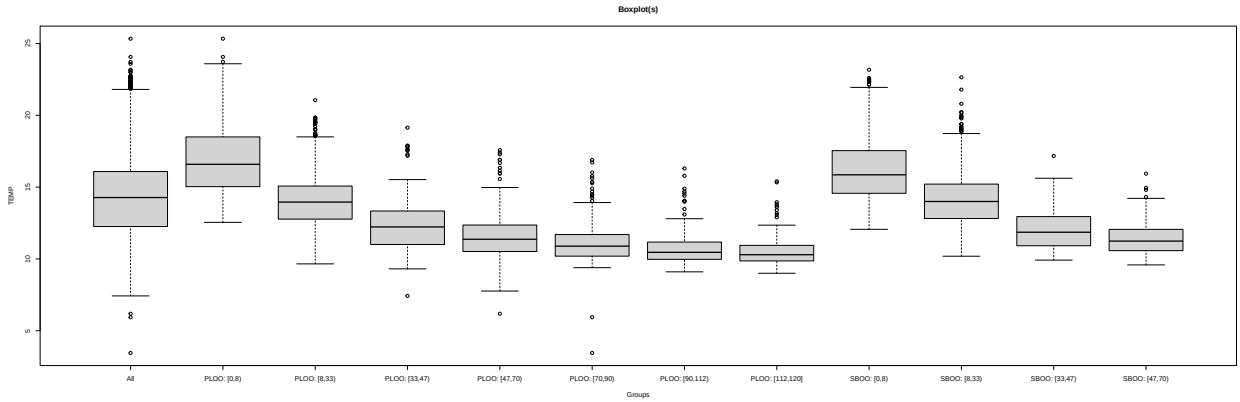

```
## Error in `$<-.data.frame`(`*tmp*`, "Groups", value = structure(1L, levels = "PLOO: Unknown", class =
##   replacement has 1 row, data has 0
## Error in `$<-.data.frame`(`*tmp*`, "Groups", value = structure(1L, levels = "SBOO: [70,90)", class =
##   replacement has 1 row, data has 0
## Error in `$<-.data.frame`(`*tmp*`, "Groups", value = structure(1L, levels = "SBOO: [90,112)", class =
##   replacement has 1 row, data has 0
## Error in `$<-.data.frame`(`*tmp*`, "Groups", value = structure(1L, levels = "SBOO: [112,120]", class
##   replacement has 1 row, data has 0
## Error in `$<-.data.frame`(`*tmp*`, "Groups", value = structure(1L, levels = "SBOO: Unknown", class =
##   replacement has 1 row, data has 0
```



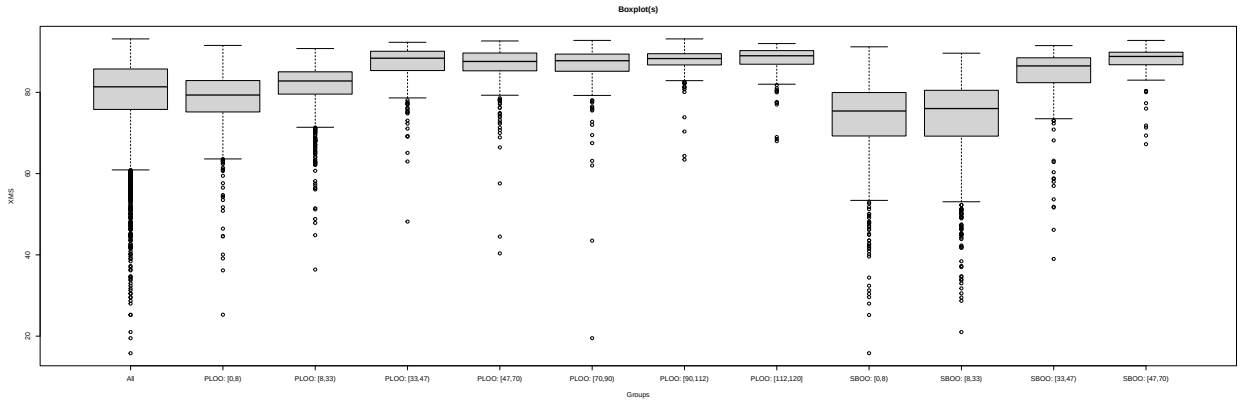

```
## Error in `$<-.data.frame`(`*tmp*`, "Groups", value = structure(1L, levels = "PLOO: Unknown", class =
##   replacement has 1 row, data has 0
## Error in `$<-.data.frame`(`*tmp*`, "Groups", value = structure(1L, levels = "SBOO: [70,90)", class =
##   replacement has 1 row, data has 0
## Error in `$<-.data.frame`(`*tmp*`, "Groups", value = structure(1L, levels = "SBOO: [90,112)", class =
##   replacement has 1 row, data has 0
## Error in `$<-.data.frame`(`*tmp*`, "Groups", value = structure(1L, levels = "SBOO: [112,120]", class
##   replacement has 1 row, data has 0
## Error in `$<-.data.frame`(`*tmp*`, "Groups", value = structure(1L, levels = "SBOO: Unknown", class =
##   replacement has 1 row, data has 0
```




```
## Error in `$<-.data.frame`(`*tmp*`, "Groups", value = structure(1L, levels = "PLOO: Unknown", class =
##   replacement has 1 row, data has 0
## Error in `$<-.data.frame`(`*tmp*`, "Groups", value = structure(1L, levels = "SBOO: [70,90)", class =
##   replacement has 1 row, data has 0
## Error in `$<-.data.frame`(`*tmp*`, "Groups", value = structure(1L, levels = "SBOO: [90,112)", class =
##   replacement has 1 row, data has 0
## Error in `$<-.data.frame`(`*tmp*`, "Groups", value = structure(1L, levels = "SBOO: [112,120]", class
##   replacement has 1 row, data has 0
## Error in `$<-.data.frame`(`*tmp*`, "Groups", value = structure(1L, levels = "SBOO: Unknown", class =
##   replacement has 1 row, data has 0
```




```
## Error in `$<-.data.frame`(`*tmp*`, "Groups", value = structure(1L, levels = "PLOO: Unknown", class =
##   replacement has 1 row, data has 0
## Error in `$<-.data.frame`(`*tmp*`, "Groups", value = structure(1L, levels = "SBOO: [70,90)", class =
##   replacement has 1 row, data has 0
## Error in `$<-.data.frame`(`*tmp*`, "Groups", value = structure(1L, levels = "SBOO: [90,112)", class =
##   replacement has 1 row, data has 0
## Error in `$<-.data.frame`(`*tmp*`, "Groups", value = structure(1L, levels = "SBOO: [112,120]", class
##   replacement has 1 row, data has 0
## Error in `$<-.data.frame`(`*tmp*`, "Groups", value = structure(1L, levels = "SBOO: Unknown", class =
##   replacement has 1 row, data has 0
```




```
##    date_sample project depth_m_bin CHLOROPHYLL DENSITY       DO    ENTERO
## 1   1990-11-19    PLOO      [8,33)        0.87  23.855 6.550000        NA
## 2   1990-11-19    SBOO       [0,8)        1.27  23.853 7.410000        NA
## 3   1991-01-07    PLOO       [0,8)          NA      NA       NA  25.74074
## 4   1991-01-07    PLOO      [8,33)          NA      NA       NA  24.58333
## 5   1991-01-14    PLOO       [0,8)          NA      NA 5.550000  36.09512
## 6   1991-01-14    PLOO     [33,47)          NA      NA 5.347222  66.25000
## 7   1991-01-14    PLOO     [47,70)          NA      NA 5.300000  13.33333
## 8   1991-01-14    PLOO     [70,90)          NA      NA 5.025000  10.00000
## 9   1991-01-14    PLOO      [8,33)          NA      NA 5.448718  85.73333
## 10  1991-01-14    PLOO     Unknown          NA      NA       NA  18.88889
## 11  1991-01-21    PLOO       [0,8)          NA      NA       NA  11.11111
## 12  1991-01-21    PLOO      [8,33)          NA      NA       NA  50.41667
## 13  1991-01-28    PLOO       [0,8)          NA      NA       NA  39.62963
## 14  1991-01-28    PLOO      [8,33)          NA      NA       NA  26.66667
## 15  1991-01-28    PLOO     Unknown          NA      NA       NA  10.00000
```

```
## 16  1991-02-04    PLOO       [0,8)          NA      NA       NA 137.96296
## 17  1991-02-04    PLOO      [8,33)          NA      NA       NA 190.83333
##        FECAL OG       PH SALINITY SUSO     TEMP      XMS
## 1         NA NA 8.080000 33.61700   NA 19.43000 44.85000
## 2         NA NA 8.180000 33.57400   NA 19.31000 75.60000
## 3   90.18519 NA       NA       NA   NA 14.52593 80.29630
## 4   84.58333 NA       NA       NA   NA 14.27917 85.70833
## 5   33.47643 NA 8.200000 33.49806   NA 14.19729 82.40221
## 6  352.50000 NA 8.200000 33.50861   NA 14.15278 82.25000
## 7   31.66667 NA 8.192857 33.52500   NA 13.70000 85.50000
## 8   10.00000 NA 8.150000 33.52500   NA 13.07500 85.00000
## 9  200.06667 NA 8.200000 33.49907   NA 14.01900 82.28000
## 10 120.00000 NA       NA       NA   NA       NA       NA
## 11  17.22222 NA       NA       NA   NA 14.65926 70.83333
## 12 155.00000 NA       NA       NA   NA 14.28750 68.75000
## 13  77.96296 NA       NA       NA   NA 14.46296 76.07407
## 14  87.50000 NA       NA       NA   NA 13.89583 81.14015
## 15  12.22222 NA       NA       NA   NA       NA       NA
## 16 296.48148 NA       NA       NA   NA 14.37407 82.00000
## 17 725.83333 NA       NA       NA   NA 13.92083 81.45833
##              vars     n   mean     sd median trimmed  mad   min      max
## date_sample     1 10371    NaN     NA     NA     NaN   NA   Inf     -Inf
## project*        2 10371   1.36   0.48   1.00    1.33 0.00  1.00     2.00
## depth_m_bin*    3 10371   4.69   2.66   6.00    4.74 2.97  1.00     8.00
## CHLOROPHYLL     4  5198   3.50   3.91   2.34    2.76 1.97  0.00    49.89
## DENSITY         5  5282  24.93   0.69  24.92   24.95 0.68 22.39    26.48
## DO              6  5851   6.72   1.66   7.14    6.84 1.49  0.00    11.96
## ENTERO          7  9986  92.65 572.67   3.16    9.41 1.72  1.93 12000.00
## FECAL           8  9842 175.67 733.02   4.00   21.43 2.97  1.00 12000.00
## OG              9   458   0.24   0.20   0.20    0.20 0.00  0.20     2.65
## PH             10  5856   8.02   0.18   8.06    8.03 0.17  7.33     8.56
## SALINITY       11  5851  33.52   0.62  33.54   33.54 0.17  8.38    34.23
## SUSO           12  1709   4.54   2.80   4.02    4.19 1.74  0.20    39.40
## TEMP           13  6958  14.37   2.78  14.27   14.23 2.84  3.45    25.34
## XMS            14  6937  79.59   8.90  81.36   80.71 7.23 15.80    93.15
##                 range   skew kurtosis   se
## date_sample      -Inf     NA       NA   NA
## project*         1.00   0.56    -1.68 0.00
## depth_m_bin*     7.00  -0.21    -1.42 0.03
## CHLOROPHYLL     49.89   3.74    22.93 0.05
## DENSITY          4.09  -0.29    -0.15 0.01
## DO              11.96  -0.59    -0.20 0.02
## ENTERO       11998.07  10.78   141.08 5.73
## FECAL        11999.00   7.39    68.78 7.39
## OG               2.45   9.07    92.51 0.01
## PH               1.24  -0.62     0.11 0.00
## SALINITY        25.86 -26.02   816.01 0.01
## SUSO            39.20   3.44    24.87 0.07
## TEMP            21.89   0.42    -0.15 0.03
## XMS             77.35  -1.69     4.81 0.11
##          date_sample project depth_m_bin parameter         Avg
## Not NA n      121286  121286      121286    121286 119635.0000
## NA n               0       0           0         0   1651.0000
## Not NA %           1       1           1         1      0.9864
```

```
## NA %                0       0            0          0      0.0136
```

```r
# Define function that imputes the missing values to parameter dataframe using linear
↪  interpolation
impute_missing_values <- function(df_data) {

    params <- c("CHLOROPHYLL", "DENSITY", "DO", "ENTERO", "FECAL", "OG", "PH",
↪  "SALINITY", "SUSO", "TEMP", "XMS")

  for (param in params) {
    print(head(df_data, 17))
    print(param)
    print(date_sample)

    x <- zoo(df_data$param, df_data$date_sample)
    df_data$param <- na.interpolation(x, option = "linear")
    return(df_data)

  }
}

# remove NAs
# Linear Interpolation

# owt_df02_gb04_mrgd
x <- zoo(owt_df02_gb04_mrgd$CHLOROPHYLL, owt_df02_gb04_mrgd$date_sample)
owt_df02_gb04_mrgd$CHLOROPHYLL <- na.interpolation(x, option = "linear")

x <- zoo(owt_df02_gb04_mrgd$DENSITY, owt_df02_gb04_mrgd$date_sample)
owt_df02_gb04_mrgd$DENSITY <- na.interpolation(x, option = "linear")

x <- zoo(owt_df02_gb04_mrgd$DO, owt_df02_gb04_mrgd$date_sample)
owt_df02_gb04_mrgd$DO <- na.interpolation(x, option = "linear")

x <- zoo(owt_df02_gb04_mrgd$ENTERO, owt_df02_gb04_mrgd$date_sample)
owt_df02_gb04_mrgd$ENTERO <- na.interpolation(x, option = "linear")

x <- zoo(owt_df02_gb04_mrgd$FECAL, owt_df02_gb04_mrgd$date_sample)
owt_df02_gb04_mrgd$FECAL <- na.interpolation(x, option = "linear")

x <- zoo(owt_df02_gb04_mrgd$OG, owt_df02_gb04_mrgd$date_sample)
owt_df02_gb04_mrgd$OG <- na.interpolation(x, option = "linear")

x <- zoo(owt_df02_gb04_mrgd$PH, owt_df02_gb04_mrgd$date_sample)
owt_df02_gb04_mrgd$PH <- na.interpolation(x, option = "linear")

x <- zoo(owt_df02_gb04_mrgd$SALINITY, owt_df02_gb04_mrgd$date_sample)
owt_df02_gb04_mrgd$SALINITY <- na.interpolation(x, option = "linear")

x <- zoo(owt_df02_gb04_mrgd$SUSO, owt_df02_gb04_mrgd$date_sample)
owt_df02_gb04_mrgd$SUSO <- na.interpolation(x, option = "linear")

x <- zoo(owt_df02_gb04_mrgd$TEMP, owt_df02_gb04_mrgd$date_sample)
owt_df02_gb04_mrgd$TEMP <- na.interpolation(x, option = "linear")
```

```r
x <- zoo(owt_df02_gb04_mrgd$XMS, owt_df02_gb04_mrgd$date_sample)
owt_df02_gb04_mrgd$XMS <- na.interpolation(x, option = "linear")


# owt_df02_gb04_wkly
x <- zoo(owt_df02_gb04_wkly$CHLOROPHYLL, owt_df02_gb04_wkly$date_sample)
owt_df02_gb04_wkly$CHLOROPHYLL <- na.interpolation(x, option = "linear")

x <- zoo(owt_df02_gb04_wkly$DENSITY, owt_df02_gb04_wkly$date_sample)
owt_df02_gb04_wkly$DENSITY <- na.interpolation(x, option = "linear")

x <- zoo(owt_df02_gb04_wkly$DO, owt_df02_gb04_wkly$date_sample)
owt_df02_gb04_wkly$DO <- na.interpolation(x, option = "linear")

x <- zoo(owt_df02_gb04_wkly$ENTERO, owt_df02_gb04_wkly$date_sample)
owt_df02_gb04_wkly$ENTERO <- na.interpolation(x, option = "linear")

x <- zoo(owt_df02_gb04_wkly$FECAL, owt_df02_gb04_wkly$date_sample)
owt_df02_gb04_wkly$FECAL <- na.interpolation(x, option = "linear")

x <- zoo(owt_df02_gb04_wkly$OG, owt_df02_gb04_wkly$date_sample)
owt_df02_gb04_wkly$OG <- na.interpolation(x, option = "linear")

x <- zoo(owt_df02_gb04_wkly$PH, owt_df02_gb04_wkly$date_sample)
owt_df02_gb04_wkly$PH <- na.interpolation(x, option = "linear")

x <- zoo(owt_df02_gb04_wkly$SALINITY, owt_df02_gb04_wkly$date_sample)
owt_df02_gb04_wkly$SALINITY <- na.interpolation(x, option = "linear")

x <- zoo(owt_df02_gb04_wkly$SUSO, owt_df02_gb04_wkly$date_sample)
owt_df02_gb04_wkly$SUSO <- na.interpolation(x, option = "linear")

x <- zoo(owt_df02_gb04_wkly$TEMP, owt_df02_gb04_wkly$date_sample)
owt_df02_gb04_wkly$TEMP <- na.interpolation(x, option = "linear")

x <- zoo(owt_df02_gb04_wkly$XMS, owt_df02_gb04_wkly$date_sample)
owt_df02_gb04_wkly$XMS <- na.interpolation(x, option = "linear")


# owt_df02_gb09_mrgd
x <- zoo(owt_df02_gb09_mrgd$CHLOROPHYLL, owt_df02_gb09_mrgd$date_sample)
owt_df02_gb09_mrgd$CHLOROPHYLL <- na.interpolation(x, option = "linear")

x <- zoo(owt_df02_gb09_mrgd$DENSITY, owt_df02_gb09_mrgd$date_sample)
owt_df02_gb09_mrgd$DENSITY <- na.interpolation(x, option = "linear")

x <- zoo(owt_df02_gb09_mrgd$DO, owt_df02_gb09_mrgd$date_sample)
owt_df02_gb09_mrgd$DO <- na.interpolation(x, option = "linear")

x <- zoo(owt_df02_gb09_mrgd$ENTERO, owt_df02_gb09_mrgd$date_sample)
owt_df02_gb09_mrgd$ENTERO <- na.interpolation(x, option = "linear")
```

```r
x <- zoo(owt_df02_gb09_mrgd$FECAL, owt_df02_gb09_mrgd$date_sample)
owt_df02_gb09_mrgd$FECAL <- na.interpolation(x, option = "linear")

x <- zoo(owt_df02_gb09_mrgd$OG, owt_df02_gb09_mrgd$date_sample)
owt_df02_gb09_mrgd$OG <- na.interpolation(x, option = "linear")

x <- zoo(owt_df02_gb09_mrgd$PH, owt_df02_gb09_mrgd$date_sample)
owt_df02_gb09_mrgd$PH <- na.interpolation(x, option = "linear")

x <- zoo(owt_df02_gb09_mrgd$SALINITY, owt_df02_gb09_mrgd$date_sample)
owt_df02_gb09_mrgd$SALINITY <- na.interpolation(x, option = "linear")

x <- zoo(owt_df02_gb09_mrgd$SUSO, owt_df02_gb09_mrgd$date_sample)
owt_df02_gb09_mrgd$SUSO <- na.interpolation(x, option = "linear")

x <- zoo(owt_df02_gb09_mrgd$TEMP, owt_df02_gb09_mrgd$date_sample)
owt_df02_gb09_mrgd$TEMP <- na.interpolation(x, option = "linear")

x <- zoo(owt_df02_gb09_mrgd$XMS, owt_df02_gb09_mrgd$date_sample)
owt_df02_gb09_mrgd$XMS <- na.interpolation(x, option = "linear")


# owt_df02_gb09_wkly <- impute_missing_values(owt_df02_gb09_wkly)
x <- zoo(owt_df02_gb09_wkly$CHLOROPHYLL, owt_df02_gb09_wkly$date_sample)
owt_df02_gb09_wkly$CHLOROPHYLL <- na.interpolation(x, option = "linear")

x <- zoo(owt_df02_gb09_wkly$DENSITY, owt_df02_gb09_wkly$date_sample)
owt_df02_gb09_wkly$DENSITY <- na.interpolation(x, option = "linear")

x <- zoo(owt_df02_gb09_wkly$DO, owt_df02_gb09_wkly$date_sample)
owt_df02_gb09_wkly$DO <- na.interpolation(x, option = "linear")

x <- zoo(owt_df02_gb09_wkly$ENTERO, owt_df02_gb09_wkly$date_sample)
owt_df02_gb09_wkly$ENTERO <- na.interpolation(x, option = "linear")

x <- zoo(owt_df02_gb09_wkly$FECAL, owt_df02_gb09_wkly$date_sample)
owt_df02_gb09_wkly$FECAL <- na.interpolation(x, option = "linear")

x <- zoo(owt_df02_gb09_wkly$OG, owt_df02_gb09_wkly$date_sample)
owt_df02_gb09_wkly$OG <- na.interpolation(x, option = "linear")

x <- zoo(owt_df02_gb09_wkly$PH, owt_df02_gb09_wkly$date_sample)
owt_df02_gb09_wkly$PH <- na.interpolation(x, option = "linear")

x <- zoo(owt_df02_gb09_wkly$SALINITY, owt_df02_gb09_wkly$date_sample)
owt_df02_gb09_wkly$SALINITY <- na.interpolation(x, option = "linear")

x <- zoo(owt_df02_gb09_wkly$SUSO, owt_df02_gb09_wkly$date_sample)
owt_df02_gb09_wkly$SUSO <- na.interpolation(x, option = "linear")

x <- zoo(owt_df02_gb09_wkly$TEMP, owt_df02_gb09_wkly$date_sample)
owt_df02_gb09_wkly$TEMP <- na.interpolation(x, option = "linear")
```

```r
x <- zoo(owt_df02_gb09_wkly$XMS, owt_df02_gb09_wkly$date_sample)
owt_df02_gb09_wkly$XMS <- na.interpolation(x, option = "linear")


# owt_df02_gb07_mrgd
x <- zoo(owt_df02_gb07_mrgd$CHLOROPHYLL, owt_df02_gb07_mrgd$date_sample)
owt_df02_gb07_mrgd$CHLOROPHYLL <- na.interpolation(x, option = "linear")

x <- zoo(owt_df02_gb07_mrgd$DENSITY, owt_df02_gb07_mrgd$date_sample)
owt_df02_gb07_mrgd$DENSITY <- na.interpolation(x, option = "linear")

x <- zoo(owt_df02_gb07_mrgd$DO, owt_df02_gb07_mrgd$date_sample)
owt_df02_gb07_mrgd$DO <- na.interpolation(x, option = "linear")

x <- zoo(owt_df02_gb07_mrgd$ENTERO, owt_df02_gb07_mrgd$date_sample)
owt_df02_gb07_mrgd$ENTERO <- na.interpolation(x, option = "linear")

x <- zoo(owt_df02_gb07_mrgd$FECAL, owt_df02_gb07_mrgd$date_sample)
owt_df02_gb07_mrgd$FECAL <- na.interpolation(x, option = "linear")

x <- zoo(owt_df02_gb07_mrgd$OG, owt_df02_gb07_mrgd$date_sample)
owt_df02_gb07_mrgd$OG <- na.interpolation(x, option = "linear")

x <- zoo(owt_df02_gb07_mrgd$PH, owt_df02_gb07_mrgd$date_sample)
owt_df02_gb07_mrgd$PH <- na.interpolation(x, option = "linear")

x <- zoo(owt_df02_gb07_mrgd$SALINITY, owt_df02_gb07_mrgd$date_sample)
owt_df02_gb07_mrgd$SALINITY <- na.interpolation(x, option = "linear")

x <- zoo(owt_df02_gb07_mrgd$SUSO, owt_df02_gb07_mrgd$date_sample)
owt_df02_gb07_mrgd$SUSO <- na.interpolation(x, option = "linear")

x <- zoo(owt_df02_gb07_mrgd$TEMP, owt_df02_gb07_mrgd$date_sample)
owt_df02_gb07_mrgd$TEMP <- na.interpolation(x, option = "linear")

x <- zoo(owt_df02_gb07_mrgd$XMS, owt_df02_gb07_mrgd$date_sample)
owt_df02_gb07_mrgd$XMS <- na.interpolation(x, option = "linear")


# owt_df02_gb07_mrgd
x <- zoo(owt_df02_gb07_wkly$CHLOROPHYLL, owt_df02_gb07_wkly$date_sample)
owt_df02_gb07_wkly$CHLOROPHYLL <- na.interpolation(x, option = "linear")

x <- zoo(owt_df02_gb07_wkly$DENSITY, owt_df02_gb07_wkly$date_sample)
owt_df02_gb07_wkly$DENSITY <- na.interpolation(x, option = "linear")

x <- zoo(owt_df02_gb07_wkly$DO, owt_df02_gb07_wkly$date_sample)
owt_df02_gb07_wkly$DO <- na.interpolation(x, option = "linear")

x <- zoo(owt_df02_gb07_wkly$ENTERO, owt_df02_gb07_wkly$date_sample)
owt_df02_gb07_wkly$ENTERO <- na.interpolation(x, option = "linear")

x <- zoo(owt_df02_gb07_wkly$FECAL, owt_df02_gb07_wkly$date_sample)
```

```r
owt_df02_gb07_wkly$FECAL <- na.interpolation(x, option = "linear")

x <- zoo(owt_df02_gb07_wkly$OG, owt_df02_gb07_wkly$date_sample)
owt_df02_gb07_wkly$OG <- na.interpolation(x, option = "linear")

x <- zoo(owt_df02_gb07_wkly$PH, owt_df02_gb07_wkly$date_sample)
owt_df02_gb07_wkly$PH <- na.interpolation(x, option = "linear")

x <- zoo(owt_df02_gb07_wkly$SALINITY, owt_df02_gb07_wkly$date_sample)
owt_df02_gb07_wkly$SALINITY <- na.interpolation(x, option = "linear")

x <- zoo(owt_df02_gb07_wkly$SUSO, owt_df02_gb07_wkly$date_sample)
owt_df02_gb07_wkly$SUSO <- na.interpolation(x, option = "linear")

x <- zoo(owt_df02_gb07_wkly$TEMP, owt_df02_gb07_wkly$date_sample)
owt_df02_gb07_wkly$TEMP <- na.interpolation(x, option = "linear")

x <- zoo(owt_df02_gb07_wkly$XMS, owt_df02_gb07_wkly$date_sample)
owt_df02_gb07_wkly$XMS <- na.interpolation(x, option = "linear")
```

```r
# https://cran.r-project.org/web/packages/padr/vignettes/padr.html
#library(dplyr)

owt_df02_gb04_mrgd %>%
  pad()
```

```
##      date_sample CHLOROPHYLL  DENSITY         DO       ENTERO        FECAL
## 1     1990-11-15   1.0700000 23.85400  6.9800000    32.051282   125.641026
## 2     1990-11-16   1.0690476 23.85410  6.6792500    32.051282   125.641026
## 3     1990-11-17   1.0680952 23.85420  6.3785000    18.717949    51.282051
## 4     1990-11-18   1.0671429 23.85431  6.0777500   106.153846    80.769231
## 5     1990-11-19   1.0661905 23.85441  5.7770000    40.000000    40.555556
## 6     1990-11-20   1.0652381 23.85451  5.4762500    20.338983    40.508475
## 7     1990-11-21   1.0642857 23.85461  5.5000000    40.227273    78.181818
## 8     1990-11-22   1.0633333 23.85471  5.3600000    83.928571   446.071429
## 9     1990-11-23   1.0623810 23.85482  5.3561364    33.846154    95.641026
## 10    1990-11-24   1.0614286 23.85492  5.3522727    12.564103    23.589744
## 11    1990-11-25   1.0604762 23.85502  5.3484091    20.512821    31.025641
## 12    1990-11-26   1.0595238 23.85512  5.3445455    43.125000   108.541667
## 13    1990-11-27   1.0585714 23.85522  5.3406818   183.076923   427.692308
## 14    1990-11-28   1.0576190 23.85533  5.3368182   125.384615   429.487179
## 15    1990-11-29   1.0566667 23.85543  5.3329545    16.291667    16.750000
## 16    1990-11-30   1.0557143 23.85553  5.3290909    17.384615    12.512821
## 17    1990-12-01   1.0547619 23.85563  5.3252273    51.897436    55.435897
## 18    1990-12-02   1.0538095 23.85573  5.3213636    45.666667    49.925926
## 19    1990-12-03   1.0528571 23.85584  5.3175000     6.700000    33.900000
## 20    1990-12-04   1.0519048 23.85594  5.8800000    36.204082   120.571429
## 21    1990-12-05   1.0509524 23.85604  5.5950000    86.121212   301.818182
## 22    1990-12-06   1.0500000 23.85614  5.4528571    15.500000    27.291667
## 23    1990-12-07   1.0490476 23.85624  5.3107143     2.666667     4.923077
## 24    1990-12-08   1.0480952 23.85635  5.1685714    26.666667    18.410256
## 25    1990-12-09   1.0471429 23.85645  5.0264286     6.358974    11.692308
## 26    1990-12-10   1.0461905 23.85655  4.8842857   122.923077   575.230769
```

```
## 27    1990-12-11   1.0452381 23.85665  4.7421429     7.746032    11.841270
## 28    1990-12-12   1.0442857 23.85676  4.6000000    49.240000   374.160000
## 29    1990-12-13   1.0433333 23.85686  4.8700000     3.692308     5.743590
## 30    1990-12-14   1.0423810 23.85696  4.9550000    33.878788   272.787879
## 31    1990-12-15   1.0414286 23.85706  4.9370313    72.717949   406.666667
## 32    1990-12-16   1.0404762 23.85716  4.9190625    18.242424    98.303030
## 33    1990-12-17   1.0395238 23.85727  4.9010938     6.666667    35.000000
## 34    1990-12-18   1.0385714 23.85737  4.8831250     6.974359    10.512821
## 35    1990-12-19   1.0376190 23.85747  4.8651563   173.333333   125.777778
## 36    1990-12-20   1.0366667 23.85757  4.8471875   138.000000  1650.000000
## 37    1990-12-21   1.0357143 23.85767  4.8292187  6500.000000   725.000000
## 38    1990-12-22   1.0347619 23.85778  4.8112500    32.250000    75.950000
## 39    1990-12-23   1.0338095 23.85788  4.7932813     7.333333     5.076923
## 40    1990-12-24   1.0328571 23.85798  4.7753125    22.717949    61.230769
## 41    1990-12-25   1.0319048 23.85808  4.7573438    48.923077   240.923077
## 42    1990-12-26   1.0309524 23.85818  4.7393750     2.000000     2.000000
## 43    1990-12-27   1.0300000 23.85829  4.7214063    65.589744   167.794872
## 44    1990-12-28   1.0290476 23.85839  4.7034375    17.897436    10.820513
## 45    1990-12-29   1.0280952 23.85849  4.6854688    15.074074    21.407407
## 46    1990-12-30   1.0271429 23.85859  4.6675000   168.440000   856.560000
## 47    1990-12-31   1.0261905 23.85869  4.7400000     2.444444    16.518519
## 48    1991-01-01   1.0252381 23.85880  4.7850000    15.866667    46.444444
## 49    1991-01-02   1.0242857 23.85890  4.7770833    41.076923   127.076923
## 50    1991-01-03   1.0233333 23.85900  4.7691667     5.555556     3.555556
## 51    1991-01-04   1.0223810 23.85910  4.7612500    26.307692   101.692308
## 52    1991-01-05   1.0214286 23.85920  4.7533333     4.974359     6.051282
## 53    1991-01-06   1.0204762 23.85931  4.7454167    15.692308    15.230769
## 54    1991-01-07   1.0195238 23.85941  4.7375000    13.025641    42.358974
## 55    1991-01-08   1.0185714 23.85951  4.7295833     3.111111     4.222222
## 56    1991-01-09   1.0176190 23.85961  4.7216667     7.846154    35.435897
## 57    1991-01-10   1.0166667 23.85971  4.7137500     7.435897     7.333333
## 58    1991-01-11   1.0157143 23.85982  4.7058333    15.125000    28.208333
## 59    1991-01-12   1.0147619 23.85992  4.6979167    12.051282     0.000000
## 60    1991-01-13   1.0138095 23.86002  4.6900000    36.476190   152.571429
## 61    1991-01-14   1.0128571 23.86012  4.1200000    27.600000   162.520000
## 62    1991-01-15   1.0119048 23.86022  4.6400000    21.076923    39.589744
## 63    1991-01-16   1.0109524 23.86033  4.6750000   275.272727  1842.242424
## 64    1991-01-17   1.0100000 23.86043  4.7220000   101.179487   124.307692
## 65    1991-01-18   1.0090476 23.86053  4.7690000    52.250000   119.083333
## 66    1991-01-19   1.0080952 23.86063  4.8160000    46.051282   205.384615
## 67    1991-01-20   1.0071429 23.86073  4.8630000    45.250000   362.708333
## 68    1991-01-21   1.0061905 23.86084  4.9100000     6.205128     8.820513
## 69    1991-01-22   1.0052381 23.86094  4.9570000     2.444444     2.000000
## 70    1991-01-23   1.0042857 23.86104  5.0040000    13.179487    69.538462
## 71    1991-01-24   1.0033333 23.86114  5.0510000    16.512821    19.692308
## 72    1991-01-25   1.0023810 23.86124  5.0980000    34.380952   178.126984
## 73    1991-01-26   1.0014286 23.86135  5.1450000   103.800000   849.960000
## 74    1991-01-27   1.0004762 23.86145  6.0500000    27.948718   162.102564
## 75    1991-01-28   0.9995238 23.86155  6.5700000    21.575758   292.000000
## 76    1991-01-29   0.9985714 23.86165  6.5060648     4.666667    18.923077
## 77    1991-01-30   0.9976190 23.86176  6.4421296     3.333333     7.555556
## 78    1991-01-31   0.9966667 23.86186  6.3781944    11.641026    16.256410
## 79    1991-02-01   0.9957143 23.86196  6.3142593    61.076923   189.897436
## 80    1991-02-02   0.9947619 23.86206  6.2503241     8.222222    18.000000
```

```
## 81    1991-02-03   0.9938095 23.86216  6.1863889    12.256410    73.384615
## 82    1991-02-04   0.9928571 23.86227  6.1224537    18.564103    48.923077
## 83    1991-02-05   0.9919048 23.86237  6.0585185     2.666667     2.000000
## 84    1991-02-06   0.9909524 23.86247  5.9945833    13.230769    10.717949
## 85    1991-02-07   0.9900000 23.86257  5.9306481    73.743590  1348.564103
## 86    1991-02-08   0.9890476 23.86267  5.8667130   113.904762   798.190476
## 87    1991-02-09   0.9880952 23.86278  5.8027778    61.200000   424.080000
## 88    1991-02-10   0.9871429 23.86288  6.3300000    55.487179   530.051282
## 89    1991-02-11   0.9861905 23.86298  6.6700000   125.757576  1728.000000
## 90    1991-02-12   0.9852381 23.86308  6.6078824    16.102564    65.897436
## 91    1991-02-13   0.9842857 23.86318  6.5457647    24.888889    50.444444
## 92    1991-02-14   0.9833333 23.86329  6.4836471    35.076923   172.205128
## 93    1991-02-15   0.9823810 23.86339  6.4215294   157.897436  1172.666667
## 94    1991-02-16   0.9814286 23.86349  6.3594118   122.820513   925.333333
## 95    1991-02-17   0.9804762 23.86359  6.2972941    19.333333     5.777778
## 96    1991-02-18   0.9795238 23.86369  6.2351765     5.333333    14.222222
## 97    1991-02-19   0.9785714 23.86380  6.1730588    17.128205   298.615385
## 98    1991-02-20   0.9776190 23.86390  6.1109412    16.461538   367.384615
## 99    1991-02-21   0.9766667 23.86400  6.0488235    24.615385    26.794872
## 100   1991-02-22   0.9757143 23.86410  5.9867059    16.444444     7.111111
## 101   1991-02-23   0.9747619 23.86420  5.9245882    38.820513   566.051282
## 102   1991-02-24   0.9738095 23.86431  5.8624706    12.820513    34.615385
## 103   1991-02-25   0.9728571 23.86441  5.8003529    32.444444   480.476190
## 104   1991-02-26   0.9719048 23.86451  5.7382353    11.160000   227.000000
## 105   1991-02-27   0.9709524 23.86461  5.8200000     5.025641   221.538462
## 106   1991-02-28   0.9700000 23.86471  5.8800000    97.515152  1627.818182
## 107   1991-03-01   0.9690476 23.86482  5.8840271     9.666667   172.875000
## 108   1991-03-02   0.9680952 23.86492  5.8880543    69.076923   725.846154
## 109   1991-03-03   0.9671429 23.86502  5.8920814   167.589744  1607.897436
## 110   1991-03-04   0.9661905 23.86512  5.8961086     5.166667    38.916667
## 111   1991-03-05   0.9652381 23.86522  5.9001357     6.666667    41.487179
## 112   1991-03-06   0.9642857 23.86533  5.9041629     6.444444     2.222222
## 113   1991-03-07   0.9633333 23.86543  5.9081900     9.743590     2.358974
## 114   1991-03-08   0.9623810 23.86553  5.9122172     4.410256    19.230769
## 115   1991-03-09   0.9614286 23.86563  5.9162443     8.444444     8.888889
## 116   1991-03-10   0.9604762 23.86573  5.9202715     6.871795    23.179487
## 117   1991-03-11   0.9595238 23.86584  5.9242986     3.897436     8.307692
## 118   1991-03-12   0.9585714 23.86594  5.9283258    19.592593   188.703704
## 119   1991-03-13   0.9576190 23.86604  5.9323529     3.830508     4.677966
## 120   1991-03-14   0.9566667 23.86614  6.3000000     7.076923     3.384615
## 121   1991-03-15   0.9557143 23.86624  6.7650000     2.484848    30.242424
## 122   1991-03-16   0.9547619 23.86635  6.6540196    16.666667    30.000000
## 123   1991-03-17   0.9538095 23.86645  6.5430392    41.128205   518.205128
## 124   1991-03-18   0.9528571 23.86655  6.4320588    12.358974    97.897436
## 125   1991-03-19   0.9519048 23.86665  6.3210784     3.025641    25.743590
## 126   1991-03-20   0.9509524 23.86676  6.2100980     4.000000     7.777778
## 127   1991-03-21   0.9500000 23.86686  6.0991176     2.512821    15.743590
## 128   1991-03-22   0.9490476 23.86696  5.9881373    14.615385    97.282051
## 129   1991-03-23   0.9480952 23.86706  5.8771569     9.619048    31.714286
## 130   1991-03-24   0.9471429 23.86716  5.7661765    15.322344   603.200000
## 131   1991-03-25   0.9461905 23.86727  5.8900000    21.025641  1116.461538
## 132   1991-03-26   0.9452381 23.86737  6.2100000     2.000000     4.424242
## 133   1991-03-27   0.9442857 23.86747  6.1741176    10.256410    23.641026
## 134   1991-03-28   0.9433333 23.86757  6.1382353     7.333333    95.555556
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## 135   1991-03-29   0.9423810 23.86767  6.1023529     4.153846    14.923077
## 136   1991-03-30   0.9414286 23.86778  6.0664706     6.974359   139.076923
## 137   1991-03-31   0.9404762 23.86788  6.0305882    15.777778     8.888889
## 138   1991-04-01   0.9395238 23.86798  5.9947059    17.794872   300.358974
## 139   1991-04-02   0.9385714 23.86808  5.9588235    12.717949    11.538462
## 140   1991-04-03   0.9376190 23.86818  5.9229412   141.555556   380.888889
## 141   1991-04-04   0.9366667 23.86829  5.8870588    17.743590   124.000000
## 142   1991-04-05   0.9357143 23.86839  5.8511765    13.743590    79.333333
## 143   1991-04-06   0.9347619 23.86849  5.8152941    21.074074    15.629630
## 144   1991-04-07   0.9338095 23.86859  5.7794118    51.560000   196.920000
## 145   1991-04-08   0.9328571 23.86869  6.0066667     2.000000     3.638889
## 146   1991-04-09   0.9319048 23.86880  6.1711111    44.333333   179.625000
## 147   1991-04-10   0.9309524 23.86890  6.3355556     2.933333     9.066667
## 148   1991-04-11   0.9300000 23.86900  6.5000000    18.222222   142.888889
## 149   1991-04-12   0.9299043 23.86905  6.4151471    20.880000   127.520000
## 150   1991-04-13   0.9298086 23.86911  6.3302941    16.428571    14.285714
## 151   1991-04-14   0.9297129 23.86916  6.2454412    15.025641    71.948718
## 152   1991-04-15   0.9296172 23.86921  6.1605882    25.948718   217.743590
## 153   1991-04-16   0.9295215 23.86926  6.0757353     6.416667    27.541667
## 154   1991-04-17   0.9294258 23.86932  5.9908824     6.615385    26.256410
## 155   1991-04-18   0.9293301 23.86937  5.9060294    24.923077   188.410256
## 156   1991-04-19   0.9292344 23.86942  5.8211765    27.529412   111.235294
## 157   1991-04-20   0.9291388 23.86947  5.7363235   123.904762  1099.238095
## 158   1991-04-21   0.9290431 23.86953  5.6514706    10.640000   280.080000
## 159   1991-04-22   0.9289474 23.86958  5.3600000     5.589744    40.102564
## 160   1991-04-23   0.9288517 23.86963  5.3300000    72.000000   791.142857
## 161   1991-04-24   0.9287560 23.86968  5.3730719     2.058824     6.823529
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## 163   1991-04-26   0.9285646 23.86979  5.4592157    74.235294     8.352941
## 164   1991-04-27   0.9284689 23.86984  5.5022876    36.232558     6.093023
## 165   1991-04-28   0.9283732 23.86989  5.5453595    87.764706   258.000000
## 166   1991-04-29   0.9282775 23.86995  5.5884314    19.705882    15.823529
## 167   1991-04-30   0.9281818 23.87000  5.6315033   113.466667   623.133333
## 168   1991-05-01   0.9280861 23.87005  5.6745752    26.476190    16.222222
## 169   1991-05-02   0.9279904 23.87011  5.7176471    88.290909   317.864407
## 170   1991-05-03   0.9278947 23.87016  5.6766667    18.833333   172.055556
## 171   1991-05-04   0.9277990 23.87021  5.2036111   497.333333  1991.487179
## 172   1991-05-05   0.9277033 23.87026  4.7305556    33.230769    29.692308
## 173   1991-05-06   0.9276077 23.87032  4.2575000     9.435897    28.256410
## 174   1991-05-07   0.9275120 23.87037  3.7844444    16.153846    39.282051
## 175   1991-05-08   0.9274163 23.87042  3.3113889     3.111111    10.888889
## 176   1991-05-09   0.9273206 23.87047  2.8383333     7.948718    16.631579
## 177   1991-05-10   0.9272249 23.87053  2.3652778     6.717949    13.487179
## 178   1991-05-11   0.9271292 23.87058  1.8922222    68.000000   272.717949
## 179   1991-05-12   0.9270335 23.87063  1.4191667   231.538462  1394.871795
## 180   1991-05-13   0.9269378 23.87068  0.9461111    12.000000    13.272727
## 181   1991-05-14   0.9268421 23.87074  0.4730556    70.000000   427.916667
## 182   1991-05-15   0.9267464 23.87079  0.0000000    78.177215   793.478261
## 183   1991-05-16   0.9266507 23.87084  0.0000000   315.928571  2185.142857
## 184   1991-05-17   0.9265550 23.87089  0.0000000  1151.456790  3205.111111
## 185   1991-05-18   0.9264593 23.87095  0.2476716   504.222222   915.111111
## 186   1991-05-19   0.9263636 23.87100  0.4953431   179.555556   462.000000
## 187   1991-05-20   0.9262679 23.87105  0.7430147   674.604651  4376.000000
## 188   1991-05-21   0.9261722 23.87111  0.9906863   884.444444  2718.666667
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## 189   1991-05-22   0.9260766 23.87116  1.2383578   351.125000  1597.208333
## 190   1991-05-23   0.9259809 23.87121  1.4860294   848.222222  3453.555556
## 191   1991-05-24   0.9258852 23.87126  1.7337010   415.625000  1085.291667
## 192   1991-05-25   0.9257895 23.87132  1.9813725   473.555556   732.888889
## 193   1991-05-26   0.9256938 23.87137  2.2290441   754.222222  2772.888889
## 194   1991-05-27   0.9255981 23.87142  2.4767157   241.111111  1648.000000
## 195   1991-05-28   0.9255024 23.87147  2.7243873   122.375000  1143.833333
## 196   1991-05-29   0.9254067 23.87153  2.9720588   413.333333  1564.625000
## 197   1991-05-30   0.9253110 23.87158  3.2197304    75.777778   382.222222
## 198   1991-05-31   0.9252153 23.87163  3.4674020   200.500000  1596.375000
## 199   1991-06-01   0.9251196 23.87168  3.7150735   352.666667  3126.000000
## 200   1991-06-02   0.9250239 23.87174  3.9627451   327.777778  1284.000000
## 201   1991-06-03   0.9249282 23.87179  4.2104167   700.416667  2808.833333
## 202   1991-06-04   0.9248325 23.87184  4.4580882   209.555556  1689.333333
## 203   1991-06-05   0.9247368 23.87189  4.7057598   483.000000  1747.458333
## 204   1991-06-06   0.9246411 23.87195  4.9534314   797.333333  4762.000000
## 205   1991-06-07   0.9245455 23.87200  5.2011029   435.500000  1515.583333
## 206   1991-06-08   0.9244498 23.87205  5.4487745   160.888889  1094.666667
## 207   1991-06-09   0.9243541 23.87211  5.6964461  1650.000000  6506.888889
## 208   1991-06-10   0.9242584 23.87216  5.9441176    35.755102    88.857143
## 209   1991-06-11   0.9241627 23.87221  6.0045588   887.000000  2295.583333
## 210   1991-06-12   0.9240670 23.87226  6.0650000   301.956044  1697.708333
## 211   1991-06-13   0.9239713 23.87232  5.8900000   238.222222  1099.833333
## 212   1991-06-14   0.9238756 23.87237  5.8630607   460.458333  1874.208333
## 213   1991-06-15   0.9237799 23.87242  5.8361213   256.666667   842.222222
## 214   1991-06-16   0.9236842 23.87247  5.8091820   391.555556  1769.777778
## 215   1991-06-17   0.9235885 23.87253  5.7822426   636.666667  1993.000000
## 216   1991-06-18   0.9234928 23.87258  5.7553033    34.888889    57.111111
## 217   1991-06-19   0.9233971 23.87263  5.7283640   213.083333  1354.916667
## 218   1991-06-20   0.9233014 23.87268  5.7014246   370.222222  3435.111111
## 219   1991-06-21   0.9232057 23.87274  5.6744853   674.291667  1548.083333
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## 221   1991-06-23   0.9230144 23.87284  5.6206066    39.333333   227.333333
## 222   1991-06-24   0.9229187 23.87289  5.5936673   264.041667  1163.791667
## 223   1991-06-25   0.9228230 23.87295  5.5667279   262.666667  1796.000000
## 224   1991-06-26   0.9227273 23.87300  5.5397886   582.958333  2253.333333
## 225   1991-06-27   0.9226316 23.87305  5.5128493   145.333333   352.000000
## 226   1991-06-28   0.9225359 23.87311  5.4859099   652.625000  2266.750000
## 227   1991-06-29   0.9224402 23.87316  5.4589706  2605.777778  6511.777778
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## 229   1991-07-01   0.9222488 23.87326  5.4050919  1166.500000  3512.916667
## 230   1991-07-02   0.9221531 23.87332  5.3781526    80.000000    98.888889
## 231   1991-07-03   0.9220574 23.87337  5.3512132    84.708333   598.166667
## 232   1991-07-04   0.9219617 23.87342  5.3242739   750.500000  2913.500000
## 233   1991-07-05   0.9218660 23.87347  5.2973346   256.888889  1587.333333
## 234   1991-07-06   0.9217703 23.87353  5.2703952   534.888889  2781.111111
## 235   1991-07-07   0.9216746 23.87358  5.2434559   436.000000  2678.000000
## 236   1991-07-08   0.9215789 23.87363  5.2165165   288.958333  2054.833333
## 237   1991-07-09   0.9214833 23.87368  5.1895772  1191.777778  5062.888889
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## 242   1991-07-14   0.9210048 23.87395  5.0548805     8.222222    16.888889
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## 243   1991-07-15   0.9209091 23.87400  5.0279412    51.536232   391.362319
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## 245   1991-07-17   0.9207177 23.87411  5.2715359    39.458333   107.583333
## 246   1991-07-18   0.9206220 23.87416  5.3933333    51.916667   141.805556
## 247   1991-07-19   0.9205263 23.87421  5.3425408    18.888889     2.851852
## 248   1991-07-20   0.9204306 23.87426  5.2917484    25.897436    86.564103
## 249   1991-07-21   0.9203349 23.87432  5.2409559    50.461538   129.076923
## 250   1991-07-22   0.9202392 23.87437  5.1901634   141.846154   640.000000
## 251   1991-07-23   0.9201435 23.87442  5.1393709     2.444444     3.111111
## 252   1991-07-24   0.9200478 23.87447  5.0885784     6.871795    11.487179
## 253   1991-07-25   0.9199522 23.87453  5.0377859     3.435897     2.871795
## 254   1991-07-26   0.9198565 23.87458  4.9869935     2.102564     3.641026
## 255   1991-07-27   0.9197608 23.87463  4.9362010     2.000000     6.358974
## 256   1991-07-28   0.9196651 23.87468  4.8854085    21.794872   303.102564
## 257   1991-07-29   0.9195694 23.87474  4.8346160    14.539683    95.142857
## 258   1991-07-30   0.9194737 23.87479  4.7838235    51.345455   486.036364
## 259   1991-07-31   0.9193780 23.87484  4.8685784     4.666667    13.555556
## 260   1991-08-01   0.9192823 23.87489  4.9533333    70.296296   306.740741
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## 262   1991-08-03   0.9190909 23.87500  5.0003548    11.777778     4.222222
## 263   1991-08-04   0.9189952 23.87505  5.0238655     2.051282     2.153846
## 264   1991-08-05   0.9188995 23.87511  5.0473763    44.820513   335.641026
## 265   1991-08-06   0.9188038 23.87516  5.0708870    74.717949   404.512821
## 266   1991-08-07   0.9187081 23.87521  5.0943978     4.888889    10.666667
## 267   1991-08-08   0.9186124 23.87526  5.1179085   167.948718  1503.692308
## 268   1991-08-09   0.9185167 23.87532  5.1414192     9.333333    16.461538
## 269   1991-08-10   0.9184211 23.87537  5.1649300     8.307692     7.538462
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## 271   1991-08-12   0.9182297 23.87547  5.2119514    36.358974   162.512821
## 272   1991-08-13   0.9181340 23.87553  5.2354622   123.948718  1446.615385
## 273   1991-08-14   0.9180383 23.87558  5.2589729    58.000000    27.333333
## 274   1991-08-15   0.9179426 23.87563  5.2824837   173.076923   972.153846
## 275   1991-08-16   0.9178469 23.87568  5.3059944    22.307692   261.692308
## 276   1991-08-17   0.9177512 23.87574  5.3295051    44.102564   203.384615
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## 278   1991-08-19   0.9175598 23.87584  5.3765266    10.307692    64.923077
## 279   1991-08-20   0.9174641 23.87589  5.4000373    17.487179    11.025641
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## 281   1991-08-22   0.9172727 23.87600  5.4470588    57.520000   427.280000
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## 284   1991-08-25   0.9169856 23.87616  5.7832773    44.051282   185.948718
## 285   1991-08-26   0.9168900 23.87621  5.8365546    31.333333   108.500000
## 286   1991-08-27   0.9167943 23.87626  5.8898319    91.589744   796.256410
## 287   1991-08-28   0.9166986 23.87632  5.9431092    53.875000   202.166667
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## 289   1991-08-30   0.9165072 23.87642  6.0496639    55.460317   208.126984
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## 296   1991-09-06   0.9158373 23.87679  6.6659664    84.615385   809.743590
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## 297   1991-09-07   0.9157416 23.87684  6.5874580    25.025641   165.538462
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## 312   1991-09-22   0.9143062 23.87763  6.0355263     8.615385    26.051282
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## 315   1991-09-25   0.9140191 23.87779  5.9084211     6.205128    25.846154
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## 317   1991-09-27   0.9138278 23.87789  5.8236842    13.333333   178.256410
## 318   1991-09-28   0.9137321 23.87795  5.7813158     7.487179    13.179487
## 319   1991-09-29   0.9136364 23.87800  5.7389474     5.777778    36.444444
## 320   1991-09-30   0.9135407 23.87805  5.6965789    44.769231   564.871795
## 321   1991-10-01   0.9134450 23.87811  5.6542105    69.230769   469.384615
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## 324   1991-10-04   0.9131579 23.87826  5.5271053    39.128205   396.153846
## 325   1991-10-05   0.9130622 23.87832  5.4847368    40.769231   271.846154
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## 327   1991-10-07   0.9128708 23.87842  5.4000000    18.560000   351.240000
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## 331   1991-10-11   0.9124880 23.87863  5.7523856     3.384615     6.717949
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## 333   1991-10-13   0.9122967 23.87874  5.6961983     7.555556    19.333333
## 334   1991-10-14   0.9122010 23.87879  5.6681046     7.641026     3.692308
## 335   1991-10-15   0.9121053 23.87884  5.6400109    54.153846   348.358974
## 336   1991-10-16   0.9120096 23.87889  5.6119172    16.476190    46.539683
## 337   1991-10-17   0.9119139 23.87895  5.5838235    29.640000   371.640000
## 338   1991-10-18   0.9118182 23.87900  5.9700000    56.769231   466.205128
## 339   1991-10-19   0.9117225 23.87905  5.7450000   102.363636   625.212121
## 340   1991-10-20   0.9116268 23.87911  5.7212896     2.717949    17.692308
## 341   1991-10-21   0.9115311 23.87916  5.6975792     6.222222    16.222222
## 342   1991-10-22   0.9114354 23.87921  5.6738688    13.384615   110.666667
## 343   1991-10-23   0.9113397 23.87926  5.6501584     4.512821    35.230769
## 344   1991-10-24   0.9112440 23.87932  5.6264480     2.541667    27.958333
## 345   1991-10-25   0.9111483 23.87937  5.6027376     3.692308     8.358974
## 346   1991-10-26   0.9110526 23.87942  5.5790271     3.589744    21.384615
## 347   1991-10-27   0.9109569 23.87947  5.5553167     4.444444    13.111111
## 348   1991-10-28   0.9108612 23.87953  5.5316063    31.025641   316.461538
## 349   1991-10-29   0.9107656 23.87958  5.5078959    28.256410   253.076923
## 350   1991-10-30   0.9106699 23.87963  5.4841855    97.435897    47.333333
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## 351   1991-10-31   0.9105742 23.87968  5.4604751     8.571429     6.793651
## 352   1991-11-01   0.9104785 23.87974  5.4367647   100.000000   153.520000
## 353   1991-11-02   0.9103828 23.87979  5.6833333    29.555556   570.388889
## 354   1991-11-03   0.9102871 23.87984  5.8850000     2.051282     2.256410
## 355   1991-11-04   0.9101914 23.87989  6.0866667     8.871795    41.897436
## 356   1991-11-05   0.9100957 23.87995  6.2883333     7.282051     3.333333
## 357   1991-11-06   0.9100000 23.88000  6.4900000     5.666667     3.794872
## 358   1991-11-07   0.9098333 23.88002  6.4202451     4.051282     4.256410
## 359   1991-11-08   0.9096667 23.88004  6.3504902     3.333333   120.222222
## 360   1991-11-09   0.9095000 23.88007  6.2807353     6.358974    55.692308
## 361   1991-11-10   0.9093333 23.88009  6.2109804     7.794872    17.589744
## 362   1991-11-11   0.9091667 23.88011  6.1412255    26.000000   132.615385
## 363   1991-11-12   0.9090000 23.88013  6.0714706    33.487179   110.000000
## 364   1991-11-13   0.9088333 23.88016  6.0017157     2.222222    16.666667
## 365   1991-11-14   0.9086667 23.88018  5.9319608    73.897436   336.923077
## 366   1991-11-15   0.9085000 23.88020  5.8622059     9.538462   100.307692
## 367   1991-11-16   0.9083333 23.88022  5.7924510    10.333333     2.000000
## 368   1991-11-17   0.9081667 23.88024  5.7226961    29.222222    73.407407
## 369   1991-11-18   0.9080000 23.88027  5.6529412    16.960000   101.160000
## 370   1991-11-19   0.9078333 23.88029  5.7600000     5.384615    35.384615
## 371   1991-11-20   0.9076667 23.88031  5.5250000    41.212121   396.484848
## 372   1991-11-21   0.9075000 23.88033  5.5273529     2.000000     2.421053
## 373   1991-11-22   0.9073333 23.88036  5.5297059     3.333333     6.444444
## 374   1991-11-23   0.9071667 23.88038  5.5320588    25.794872   182.666667
## 375   1991-11-24   0.9070000 23.88040  5.5344118    18.307692    18.102564
## 376   1991-11-25   0.9068333 23.88042  5.5367647    78.153846   409.025641
## 377   1991-11-26   0.9066667 23.88044  5.5391176    85.250000    86.041667
## 378   1991-11-27   0.9065000 23.88047  5.5414706     8.871795    15.692308
## 379   1991-11-28   0.9063333 23.88049  5.5438235     2.000000     2.205128
## 380   1991-11-29   0.9061667 23.88051  5.5461765     2.000000     2.037037
## 381   1991-11-30   0.9060000 23.88053  5.5485294     6.840000    19.440000
## 382   1991-12-01   0.9058333 23.88056  5.5933333    34.333333   157.777778
## 383   1991-12-02   0.9056667 23.88058  5.6251120    62.307692    24.205128
## 384   1991-12-03   0.9055000 23.88060  5.6568908   290.000000   163.333333
## 385   1991-12-04   0.9053333 23.88062  5.6886695    24.153846     8.769231
## 386   1991-12-05   0.9051667 23.88064  5.7204482   348.564103   893.333333
## 387   1991-12-06   0.9050000 23.88067  5.7522269   590.000000   956.733333
## 388   1991-12-07   0.9048333 23.88069  5.7840056   101.555556   159.111111
## 389   1991-12-08   0.9046667 23.88071  5.8157843    37.846154    20.717949
## 390   1991-12-09   0.9045000 23.88073  5.8475630    59.897436   174.974359
## 391   1991-12-10   0.9043333 23.88076  5.8793417    16.222222    26.444444
## 392   1991-12-11   0.9041667 23.88078  5.9111204     8.358974    16.102564
## 393   1991-12-12   0.9040000 23.88080  5.9428992    12.205128    16.102564
## 394   1991-12-13   0.9038333 23.88082  5.9746779    18.000000    17.076923
## 395   1991-12-14   0.9036667 23.88084  6.0064566    18.451613   111.015873
## 396   1991-12-15   0.9035000 23.88087  6.0382353   154.720000   273.660714
## 397   1991-12-16   0.9033333 23.88089  6.1266667   121.888889   436.305556
## 398   1991-12-17   0.9031667 23.88091  6.0608734    35.179487   240.820513
## 399   1991-12-18   0.9030000 23.88093  5.9950802    60.717949   103.538462
## 400   1991-12-19   0.9028333 23.88096  5.9292870    20.974359    27.076923
## 401   1991-12-20   0.9026667 23.88098  5.8634938    57.384615    99.435897
## 402   1991-12-21   0.9025000 23.88100  5.7977005    27.375000   187.875000
## 403   1991-12-22   0.9023333 23.88102  5.7319073    41.333333    46.205128
## 404   1991-12-23   0.9021667 23.88104  5.6661141    74.000000   278.051282
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## 405   1991-12-24   0.9020000 23.88107  5.6003209   110.615385   328.102564
## 406   1991-12-25   0.9018333 23.88109  5.5345276    28.820513    39.846154
## 407   1991-12-26   0.9016667 23.88111  5.4687344    69.111111   111.873016
## 408   1991-12-27   0.9015000 23.88113  5.4029412    81.080000   160.440000
## 409   1991-12-28   0.9013333 23.88116  5.7200000    18.194444    32.972222
## 410   1991-12-29   0.9011667 23.88118  5.6653922    12.461538     6.410256
## 411   1991-12-30   0.9010000 23.88120  5.6107843    11.384615    47.435897
## 412   1991-12-31   0.9008333 23.88122  5.5561765    25.333333    97.487179
## 413   1992-01-01   0.9006667 23.88124  5.5015686     2.222222     3.777778
## 414   1992-01-02   0.9005000 23.88127  5.4469608     3.025641     4.256410
## 415   1992-01-03   0.9003333 23.88129  5.3923529    63.333333   130.410256
## 416   1992-01-04   0.9001667 23.88131  5.3377451   152.256410   917.025641
## 417   1992-01-05   0.9000000 23.88133  5.2831373    14.769231    40.871795
## 418   1992-01-06   0.8998333 23.88136  5.2285294     5.166667     4.291667
## 419   1992-01-07   0.8996667 23.88138  5.1739216    39.641026    56.564103
## 420   1992-01-08   0.8995000 23.88140  5.1193137    46.296296   108.481481
## 421   1992-01-09   0.8993333 23.88142  5.0647059    67.320000   238.440000
## 422   1992-01-10   0.8991667 23.88144  5.6933333    73.361111   348.416667
## 423   1992-01-11   0.8990000 23.88147  5.6214480     5.076923     6.769231
## 424   1992-01-12   0.8988333 23.88149  5.5495626     2.222222     2.000000
## 425   1992-01-13   0.8986667 23.88151  5.4776772    21.846154    74.615385
## 426   1992-01-14   0.8985000 23.88153  5.4057919     5.794872    14.871795
## 427   1992-01-15   0.8983333 23.88156  5.3339065    50.256410   288.717949
## 428   1992-01-16   0.8981667 23.88158  5.2620211     7.641026    17.794872
## 429   1992-01-17   0.8980000 23.88160  5.1901357     2.923077     5.384615
## 430   1992-01-18   0.8978333 23.88162  5.1182504     2.222222    10.000000
## 431   1992-01-19   0.8976667 23.88164  5.0463650     8.358974    45.384615
## 432   1992-01-20   0.8975000 23.88167  4.9744796     6.205128    12.871795
## 433   1992-01-21   0.8973333 23.88169  4.9025943    24.769231     6.564103
## 434   1992-01-22   0.8971667 23.88171  4.8307089    51.384615   256.307051
## 435   1992-01-23   0.8970000 23.88173  4.7588235    78.000000   506.050000
## 436   1992-01-24   0.8968333 23.88176  4.7669853   103.965517   546.655172
## 437   1992-01-25   0.8966667 23.88178  4.7751471    70.769231   541.435897
## 438   1992-01-26   0.8965000 23.88180  4.7833088   891.333333   300.435897
## 439   1992-01-27   0.8963333 23.88182  4.7914706    22.410256    59.435897
## 440   1992-01-28   0.8961667 23.88184  4.7996324    96.512821   121.487179
## 441   1992-01-29   0.8960000 23.88187  4.8077941     8.717949    59.948718
## 442   1992-01-30   0.8958333 23.88189  4.8159559     7.111111    61.777778
## 443   1992-01-31   0.8956667 23.88191  4.8241176     2.000000     2.000000
## 444   1992-02-01   0.8955000 23.88193  4.8322794    27.897436   148.717949
## 445   1992-02-02   0.8953333 23.88196  4.8404412   604.666667     8.000000
## 446   1992-02-03   0.8951667 23.88198  4.8486029    45.846154   221.487179
## 447   1992-02-04   0.8950000 23.88200  4.8567647     3.555556   101.777778
## 448   1992-02-05   0.8948333 23.88202  4.8649265    50.564103   192.974359
## 449   1992-02-06   0.8946667 23.88204  4.8730882    28.564103   147.282051
## 450   1992-02-07   0.8945000 23.88207  4.8812500   141.948718   476.307692
## 451   1992-02-08   0.8943333 23.88209  4.8894118    12.444444     4.666667
## 452   1992-02-09   0.8941667 23.88211  4.8975735    11.076923    84.205128
## 453   1992-02-10   0.8940000 23.88213  4.9057353   106.153846   769.435897
## 454   1992-02-11   0.8938333 23.88216  4.9138971    12.465116   118.511628
## 455   1992-02-12   0.8936667 23.88218  4.9220588    72.150000   725.850000
## 456   1992-02-13   0.8935000 23.88220  5.0800000    45.137931   502.482759
## 457   1992-02-14   0.8933333 23.88222  5.1016544     2.000000     2.000000
## 458   1992-02-15   0.8931667 23.88224  5.1233088    37.125000   257.583333
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## 459   1992-02-16   0.8930000 23.88227  5.1449632     2.000000     4.000000
## 460   1992-02-17   0.8928333 23.88229  5.1666176     2.102564     2.717949
## 461   1992-02-18   0.8926667 23.88231  5.1882721    83.791667   625.208333
## 462   1992-02-19   0.8925000 23.88233  5.2099265    22.000000    20.000000
## 463   1992-02-20   0.8923333 23.88236  5.2315809    30.000000   398.923077
## 464   1992-02-21   0.8921667 23.88238  5.2532353     2.102564     2.666667
## 465   1992-02-22   0.8920000 23.88240  5.2748897     3.777778    27.333333
## 466   1992-02-23   0.8918333 23.88242  5.2965441    27.076923    64.051282
## 467   1992-02-24   0.8916667 23.88244  5.3181985     3.435897     9.641026
## 468   1992-02-25   0.8915000 23.88247  5.3398529     8.888889    17.111111
## 469   1992-02-26   0.8913333 23.88249  5.3615074     4.450000     3.450000
## 470   1992-02-27   0.8911667 23.88251  5.3831618     2.512821     2.871795
## 471   1992-02-28   0.8910000 23.88253  5.4048162    42.634921    96.920635
## 472   1992-02-29   0.8908333 23.88256  5.4264706     7.098039    96.392157
## 473   1992-03-01   0.8906667 23.88258  5.4333333     8.166667     3.222222
## 474   1992-03-02   0.8905000 23.88260  5.4197415     3.589744     8.871795
## 475   1992-03-03   0.8903333 23.88262  5.4061497    23.333333   180.222222
## 476   1992-03-04   0.8901667 23.88264  5.3925579    19.300000   180.100000
## 477   1992-03-05   0.8900000 23.88267  5.3789661    42.923077   271.230769
## 478   1992-03-06   0.8898333 23.88269  5.3653743     4.153846     5.589744
## 479   1992-03-07   0.8896667 23.88271  5.3517825     2.222222    12.888889
## 480   1992-03-08   0.8895000 23.88273  5.3381907     3.750000     8.250000
## 481   1992-03-09   0.8893333 23.88276  5.3245989     8.461538    30.974359
## 482   1992-03-10   0.8891667 23.88278  5.3110071    14.051282    17.025641
## 483   1992-03-11   0.8890000 23.88280  5.2974153    29.396825   222.857143
## 484   1992-03-12   0.8888333 23.88282  5.2838235     8.392157   123.568627
## 485   1992-03-13   0.8886667 23.88284  5.9233333    28.916667   182.231884
## 486   1992-03-14   0.8885000 23.88287  5.9471919     9.897436    33.435897
## 487   1992-03-15   0.8883333 23.88289  5.9710504     4.666667    12.666667
## 488   1992-03-16   0.8881667 23.88291  5.9949090    26.358974    72.923077
## 489   1992-03-17   0.8880000 23.88293  6.0187675     0.000000    44.820513
## 490   1992-03-18   0.8878333 23.88296  6.0426261    26.666667   616.888889
## 491   1992-03-19   0.8876667 23.88298  6.0664846    49.000000   237.050000
## 492   1992-03-20   0.8875000 23.88300  6.0903431   110.051282   915.333333
## 493   1992-03-21   0.8873333 23.88302  6.1142017    80.708333   732.458333
## 494   1992-03-22   0.8871667 23.88304  6.1380602    34.153846   394.769231
## 495   1992-03-23   0.8870000 23.88307  6.1619188     4.871795    69.743590
## 496   1992-03-24   0.8868333 23.88309  6.1857773     3.282051    13.897436
## 497   1992-03-25   0.8866667 23.88311  6.2096359    16.000000     6.222222
## 498   1992-03-26   0.8865000 23.88313  6.2334944     6.592593    23.333333
## 499   1992-03-27   0.8863333 23.88316  6.2573529   139.160000   931.320000
## 500   1992-03-28   0.8861667 23.88318  6.3666667     2.138889     2.222222
## 501   1992-03-29   0.8860000 23.88320  6.3727839    20.083333     5.541667
## 502   1992-03-30   0.8858333 23.88322  6.3789011     6.000000    12.000000
## 503   1992-03-31   0.8856667 23.88324  6.3850183    13.076923    58.820513
## 504   1992-04-01   0.8855000 23.88327  6.3911355     3.487179    12.307692
## 505   1992-04-02   0.8853333 23.88329  6.3972527    90.000000   108.666667
## 506   1992-04-03   0.8851667 23.88331  6.4033700     2.100000     4.800000
## 507   1992-04-04   0.8850000 23.88333  6.4094872     7.538462    53.948718
## 508   1992-04-05   0.8848333 23.88336  6.4156044     4.410256    12.615385
## 509   1992-04-06   0.8846667 23.88338  6.4217216     6.444444    23.111111
## 510   1992-04-07   0.8845000 23.88340  6.4278388     9.550000    31.450000
## 511   1992-04-08   0.8843333 23.88342  6.4339560     2.000000     2.871795
## 512   1992-04-09   0.8841667 23.88344  6.4400733     5.541667    37.291667
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## 513   1992-04-10   0.8840000 23.88347  6.4461905     8.727273   154.109091
## 514   1992-04-11   0.8838333 23.88349  6.4523077    24.840000   521.920000
## 515   1992-04-12   0.8836667 23.88351  5.4300000     2.285714     2.363636
## 516   1992-04-13   0.8835000 23.88353  0.0000000    11.642857    14.181818
## 517   1992-04-14   0.8833333 23.88356  0.3625000    21.000000    26.000000
## 518   1992-04-15   0.8831667 23.88358  0.7250000     2.051282     2.000000
## 519   1992-04-16   0.8830000 23.88360  1.0875000   146.000000   177.555556
## 520   1992-04-17   0.8828333 23.88362  1.4500000     7.047619    23.428571
## 521   1992-04-18   0.8826667 23.88364  1.8125000    28.000000    56.000000
## 522   1992-04-19   0.8825000 23.88367  2.1750000    24.769231   180.615385
## 523   1992-04-20   0.8823333 23.88369  2.5375000     8.666667    77.538462
## 524   1992-04-21   0.8821667 23.88371  2.9000000     7.833333    74.333333
## 525   1992-04-22   0.8820000 23.88373  3.2625000    16.000000     8.000000
## 526   1992-04-23   0.8818333 23.88376  3.6250000    19.230769    58.820513
## 527   1992-04-24   0.8816667 23.88378  3.9875000    18.564103    67.897436
## 528   1992-04-25   0.8815000 23.88380  4.3500000    16.583333    63.875000
## 529   1992-04-26   0.8813333 23.88382  4.7125000    10.000000    54.000000
## 530   1992-04-27   0.8811667 23.88384  5.0750000     7.384615    53.230769
## 531   1992-04-28   0.8810000 23.88387  5.4375000     5.074074    12.777778
## 532   1992-04-29   0.8808333 23.88389  5.8000000    10.000000   106.392157
## 533   1992-04-30   0.8806667 23.88391  5.2433333     5.722222    35.805556
## 534   1992-05-01   0.8805000 23.88393  5.5550000     7.555556     2.888889
## 535   1992-05-02   0.8803333 23.88396  5.8666667    46.871795   273.743590
## 536   1992-05-03   0.8801667 23.88398  6.1783333    16.256410    62.410256
## 537   1992-05-04   0.8800000 23.88400  6.4900000    28.512821   202.564103
## 538   1992-05-05   0.8798830 23.88402  6.4663284    36.153846   134.410256
## 539   1992-05-06   0.8797661 23.88405  6.4426568     6.000000    12.888889
## 540   1992-05-07   0.8796491 23.88407  6.4189853     6.358974     6.358974
## 541   1992-05-08   0.8795322 23.88409  6.3953137    21.435897    14.820513
## 542   1992-05-09   0.8794152 23.88412  6.3716421     2.000000     2.615385
## 543   1992-05-10   0.8792982 23.88414  6.3479705     2.102564     2.102564
## 544   1992-05-11   0.8791813 23.88416  6.3242990     6.153846    21.076923
## 545   1992-05-12   0.8790643 23.88419  6.3006274   108.000000     7.555556
## 546   1992-05-13   0.8789474 23.88421  6.2769558     3.384615     2.307692
## 547   1992-05-14   0.8788304 23.88423  6.2532842    11.631083    27.153846
## 548   1992-05-15   0.8787135 23.88426  7.4965367    19.877551    52.000000
## 549   1992-05-16   0.8785965 23.88428  6.6097509     9.784615    12.800000
## 550   1992-05-17   0.8784795 23.88430  6.8048389     4.769231     3.076923
## 551   1992-05-18   0.8783626 23.88433  6.9999269     4.051282     3.179487
## 552   1992-05-19   0.8782456 23.88435  7.1239043     3.333333     3.282051
## 553   1992-05-20   0.8781287 23.88437  7.2261491     2.615385     3.384615
## 554   1992-05-21   0.8780117 23.88440  7.3283940     2.068966     3.218391
## 555   1992-05-22   0.8778947 23.88442  7.4306388     3.230769     3.230769
## 556   1992-05-23   0.8777778 23.88444  7.5328836     5.897436     2.461538
## 557   1992-05-24   0.8776608 23.88447  7.6351284     2.512821     3.128205
## 558   1992-05-25   0.8775439 23.88449  7.7373732     3.692308     5.333333
## 559   1992-05-26   0.8774269 23.88451  7.8396180     2.444444     3.555556
## 560   1992-05-27   0.8773099 23.88454  7.9418629     2.512821     2.871795
## 561   1992-05-28   0.8771930 23.88456  8.0441077     2.000000     2.871795
## 562   1992-05-29   0.8770760 23.88458  8.1463525     5.272727     4.545455
## 563   1992-05-30   0.8769591 23.88461  7.7147970     4.032915     8.858934
## 564   1992-05-31   0.8768421 23.88463  7.9296952     2.793103    13.172414
## 565   1992-06-01   0.8767251 23.88465  7.6750258     2.000000     7.282051
## 566   1992-06-02   0.8766082 23.88468  7.4203564     7.777778     9.333333
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## 567   1992-06-03   0.8764912 23.88470  7.4175935     2.000000     3.230769
## 568   1992-06-04   0.8763743 23.88473  7.4148306     2.000000     2.641026
## 569   1992-06-05   0.8762573 23.88475  7.4831195     2.000000     2.051282
## 570   1992-06-06   0.8761404 23.88477  7.5514083     2.051282     9.692308
## 571   1992-06-07   0.8760234 23.88480  7.6196971     3.538462     2.461538
## 572   1992-06-08   0.8759064 23.88482  7.6879860    16.717949     6.410256
## 573   1992-06-09   0.8757895 23.88484  7.7562748     2.000000     2.000000
## 574   1992-06-10   0.8756725 23.88487  7.8245637     7.375000     3.708333
## 575   1992-06-11   0.8755556 23.88489  7.8928525     6.767241     6.702107
## 576   1992-06-12   0.8754386 23.88491  7.8851421     6.159483     9.695881
## 577   1992-06-13   0.8753216 23.88494  7.9787590     5.551724    12.689655
## 578   1992-06-14   0.8752047 23.88496  7.6818610     4.051282     3.538462
## 579   1992-06-15   0.8750877 23.88498  7.3849631     7.076923     3.589744
## 580   1992-06-16   0.8749708 23.88501  7.0880651     5.256410     2.794872
## 581   1992-06-17   0.8748538 23.88503  5.9766136     3.435897     2.000000
## 582   1992-06-18   0.8747368 23.88505  4.8651622    10.606838    10.333333
## 583   1992-06-19   0.8746199 23.88508  6.9143915    17.777778    18.666667
## 584   1992-06-20   0.8745029 23.88510  7.1184833    16.000000    22.000000
## 585   1992-06-21   0.8743860 23.88512  7.3225752     2.051282     4.512821
## 586   1992-06-22   0.8742690 23.88515  7.5266670     2.256410     2.410256
## 587   1992-06-23   0.8741520 23.88517  7.7307589     2.102564     3.333333
## 588   1992-06-24   0.8740351 23.88519  7.9348507     2.102564     2.051282
## 589   1992-06-25   0.8739181 23.88522  8.1389426     2.000000     2.205128
## 590   1992-06-26   0.8738012 23.88524  8.3430344     2.102564     2.307692
## 591   1992-06-27   0.8736842 23.88526  8.5471263     3.333333    16.666667
## 592   1992-06-28   0.8735673 23.88529  8.7512181     3.550000    14.650000
## 593   1992-06-29   0.8734503 23.88531  8.9553100   103.090909     3.045455
## 594   1992-06-30   0.8733333 23.88533  8.2420666    65.045455     5.591693
## 595   1992-07-01   0.8732164 23.88536  8.0308553    27.000000     8.137931
## 596   1992-07-02   0.8730994 23.88538  7.8346420     7.333333     9.641026
## 597   1992-07-03   0.8729825 23.88540  7.6384287     3.846154     2.102564
## 598   1992-07-04   0.8728655 23.88543  7.4422154   170.888889  1066.222222
## 599   1992-07-05   0.8727485 23.88545  7.2460021     2.093023     2.093023
## 600   1992-07-06   0.8726316 23.88547  7.0497888     8.379845     4.841383
## 601   1992-07-07   0.8725146 23.88550  6.8615583    14.666667     7.589744
## 602   1992-07-08   0.8723977 23.88552  6.6733278     9.358974     6.153846
## 603   1992-07-09   0.8722807 23.88554  6.8996152     4.051282     4.717949
## 604   1992-07-10   0.8721637 23.88557  7.1259026     7.230769     4.000000
## 605   1992-07-11   0.8720468 23.88559  7.3521899     3.500000     6.458333
## 606   1992-07-12   0.8719298 23.88561  7.5784773     2.863636     2.363636
## 607   1992-07-13   0.8718129 23.88564  6.9972805     7.880094     3.612853
## 608   1992-07-14   0.8716959 23.88566  8.3055789    12.896552     4.862069
## 609   1992-07-15   0.8715789 23.88568  7.8916610     3.230769     4.000000
## 610   1992-07-16   0.8714620 23.88571  7.4777430     2.820513     3.692308
## 611   1992-07-17   0.8713450 23.88573  7.0638250     2.410256     8.358974
## 612   1992-07-18   0.8712281 23.88575  6.6499070     3.333333     3.384615
## 613   1992-07-19   0.8711111 23.88578  6.2359890     2.666667     3.111111
## 614   1992-07-20   0.8709942 23.88580  6.0396410     2.000000     2.410256
## 615   1992-07-21   0.8708772 23.88582  5.8432930     2.230769     2.589744
## 616   1992-07-22   0.8707602 23.88585  6.0974162     2.461538     2.769231
## 617   1992-07-23   0.8706433 23.88587  6.3515394     2.000000     2.410256
## 618   1992-07-24   0.8705263 23.88589  6.6056626     2.102564     3.025641
## 619   1992-07-25   0.8704094 23.88592  6.8597859     2.000000     3.282051
## 620   1992-07-26   0.8702924 23.88594  7.1139091     6.045455     4.227273
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## 621   1992-07-27   0.8701754 23.88596  6.5139756     4.022727     3.217085
## 622   1992-07-28   0.8700585 23.88599  7.7331207     2.000000     2.206897
## 623   1992-07-29   0.8699415 23.88601  7.6034085     4.461538     2.102564
## 624   1992-07-30   0.8698246 23.88604  7.4736964     2.000000     2.051282
## 625   1992-07-31   0.8697076 23.88606  7.3439843    17.777778   118.444444
## 626   1992-08-01   0.8695906 23.88608  7.2142721    10.000000    86.000000
## 627   1992-08-02   0.8694737 23.88611  7.0845600     5.692308     2.307692
## 628   1992-08-03   0.8693567 23.88613  6.9548478     3.846154     2.153846
## 629   1992-08-04   0.8692398 23.88615  6.8915440     2.000000     2.000000
## 630   1992-08-05   0.8691228 23.88618  6.8282401     6.333333     2.222222
## 631   1992-08-06   0.8690058 23.88620  6.9021026    10.666667     2.444444
## 632   1992-08-07   0.8688889 23.88622  6.9759651    10.256410     5.384615
## 633   1992-08-08   0.8687719 23.88625  7.0498276    18.974359     3.025641
## 634   1992-08-09   0.8686550 23.88627  7.1236901     2.000000     2.051282
## 635   1992-08-10   0.8685380 23.88629  7.1975526     2.222222     5.555556
## 636   1992-08-11   0.8684211 23.88632  7.2714151     4.102564     3.333333
## 637   1992-08-12   0.8683041 23.88634  7.3452775     8.358974     2.256410
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## 639   1992-08-14   0.8680702 23.88639  7.4930025     2.153846     5.435897
## 640   1992-08-15   0.8679532 23.88641  7.5668650     5.794872     3.538462
## 641   1992-08-16   0.8678363 23.88643  7.6407275   123.875000     7.416667
## 642   1992-08-17   0.8677193 23.88646  7.7145900    24.136364     7.136364
## 643   1992-08-18   0.8676023 23.88648  7.5864465    20.688871     5.016458
## 644   1992-08-19   0.8674854 23.88650  8.7135324    17.241379     2.896552
## 645   1992-08-20   0.8673684 23.88653  7.9235537     4.410256     2.461538
## 646   1992-08-21   0.8672515 23.88655  7.1335750    18.444444     7.777778
## 647   1992-08-22   0.8671345 23.88657  7.0367289     2.102564     2.461538
## 648   1992-08-23   0.8670175 23.88660  6.9398829     2.666667     4.102564
## 649   1992-08-24   0.8669006 23.88662  7.1831561     3.230769     5.743590
## 650   1992-08-25   0.8667836 23.88664  7.4264293     3.041667     6.708333
## 651   1992-08-26   0.8666667 23.88667  7.6697024     4.461538     2.000000
## 652   1992-08-27   0.8665497 23.88669  7.9129756     3.344406     3.886364
## 653   1992-08-28   0.8664327 23.88671  6.6736892     2.227273     5.772727
## 654   1992-08-29   0.8663158 23.88674  6.8077935     2.000000     4.000000
## 655   1992-08-30   0.8661988 23.88676  7.7734655    46.413793   438.379310
## 656   1992-08-31   0.8660819 23.88678  7.7350211     2.000000     2.102564
## 657   1992-09-01   0.8659649 23.88681  7.6965768     7.777778    10.444444
## 658   1992-09-02   0.8658480 23.88683  7.6581324     4.000000     6.000000
## 659   1992-09-03   0.8657310 23.88685  7.6196880    12.205128     2.000000
## 660   1992-09-04   0.8656140 23.88688  7.5812436     3.230769     2.000000
## 661   1992-09-05   0.8654971 23.88690  7.5427993     3.333333     3.111111
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## 663   1992-09-07   0.8652632 23.88695  7.4659105     2.000000     2.666667
## 664   1992-09-08   0.8651462 23.88697  7.4274661     2.564103     3.333333
## 665   1992-09-09   0.8650292 23.88699  7.3890217     8.079772     5.111111
## 666   1992-09-10   0.8649123 23.88702  7.1496872    13.595442     6.888889
## 667   1992-09-11   0.8647953 23.88704  7.5241233    19.111111     8.666667
## 668   1992-09-12   0.8646784 23.88706  7.8985595    12.000000     5.230769
## 669   1992-09-13   0.8645614 23.88709  8.2729957   115.333333   233.333333
## 670   1992-09-14   0.8644444 23.88711  8.6474318     2.266667     3.244444
## 671   1992-09-15   0.8643275 23.88713  8.4449146     4.667816     2.742912
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## 673   1992-09-17   0.8640936 23.88718  8.3353146     3.538462     4.717949
## 674   1992-09-18   0.8639766 23.88720  8.3475257     4.444444     7.777778
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## 675   1992-09-19   0.8638596 23.88723  8.3597368     4.461538     2.000000
## 676   1992-09-20   0.8637427 23.88725  8.3719480     5.111111     2.000000
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## 678   1992-09-22   0.8635088 23.88730  8.2770690     2.066667     5.400000
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## 680   1992-09-24   0.8632749 23.88735  8.9337143     9.243243     2.702703
## 681   1992-09-25   0.8631579 23.88737  8.7626736     2.000000     2.000000
## 682   1992-09-26   0.8630409 23.88739  8.5916328     3.384615     2.000000
## 683   1992-09-27   0.8629240 23.88742  8.4205921    18.888889    11.111111
## 684   1992-09-28   0.8628070 23.88744  8.2495514    11.222222     7.444444
## 685   1992-09-29   0.8626901 23.88746  8.0785107     3.555556     3.777778
## 686   1992-09-30   0.8625731 23.88749  7.9074699     9.726496     2.914530
## 687   1992-10-01   0.8624561 23.88751  7.8810145    15.897436     2.051282
## 688   1992-10-02   0.8623392 23.88753  7.8545590    11.118529     5.742622
## 689   1992-10-03   0.8622222 23.88756  8.4362727     6.339623     9.433962
## 690   1992-10-04   0.8621053 23.88758  8.2676071     3.714286     3.714286
## 691   1992-10-05   0.8619883 23.88760  8.5352222     4.457143     3.990476
## 692   1992-10-06   0.8618713 23.88763  8.6629667     5.200000     4.266667
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## 696   1992-10-10   0.8614035 23.88772  7.8057921     2.000000     2.256410
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## 698   1992-10-12   0.8611696 23.88777  8.1118596    13.333333     2.393162
## 699   1992-10-13   0.8610526 23.88779  8.0879876     3.333333     2.564103
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## 703   1992-10-17   0.8605848 23.88788  7.9925000     7.681818    16.545455
## 704   1992-10-18   0.8604678 23.88791  7.7699444     3.888889    59.222222
## 705   1992-10-19   0.8603509 23.88793  7.8848171     3.276353    40.216524
## 706   1992-10-20   0.8602339 23.88795  7.9091935     2.663818    21.210826
## 707   1992-10-21   0.8601170 23.88798  7.5769019     2.051282     2.205128
## 708   1992-10-22   0.8600000 23.88800  7.2446102     3.515670    50.507123
## 709   1992-10-23   0.8602098 23.88803  7.6376099     4.980057    98.809117
## 710   1992-10-24   0.8604196 23.88806  7.6771246     6.444444   147.111111
## 711   1992-10-25   0.8606294 23.88808  7.7166392     3.024390     6.439024
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## 719   1992-11-02   0.8623077 23.88831  7.7671333     4.400000     4.733333
## 720   1992-11-03   0.8625175 23.88834  7.9194615     3.714286     2.214286
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## 726   1992-11-09   0.8637762 23.88850  6.7441278    19.777778     7.333333
## 727   1992-11-10   0.8639860 23.88853  6.9437410    14.452991     7.743590
## 728   1992-11-11   0.8641958 23.88856  7.1433542     9.128205     8.153846
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## 729   1992-11-12   0.8644056 23.88859  7.3429674    39.609557    50.849650
## 730   1992-11-13   0.8646154 23.88862  7.5181136    70.090909    93.545455
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## 742   1992-11-25   0.8671329 23.88895  8.2166533    16.310345     2.724138
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## 745   1992-11-28   0.8677622 23.88903  7.1009775   153.994302   126.626781
## 746   1992-11-29   0.8679720 23.88906  7.3202780   226.222222   188.888889
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## 751   1992-12-04   0.8690210 23.88920  8.4167804     4.461538     2.102564
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## 764   1992-12-17   0.8717483 23.88957  5.9234444    26.307692    15.692308
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## 769   1992-12-22   0.8727972 23.88971  5.3348229    18.531746   109.087302
## 770   1992-12-23   0.8730070 23.88973  5.2447831    34.980159    91.257937
## 771   1992-12-24   0.8732168 23.88976  5.5375800    51.428571    73.428571
## 772   1992-12-25   0.8734266 23.88979  5.1796905    86.727273   522.545455
## 773   1992-12-26   0.8736364 23.88982  5.7654972    49.113636   263.314394
## 774   1992-12-27   0.8738462 23.88985  6.4830588    11.500000     4.083333
## 775   1992-12-28   0.8740559 23.88987  6.2892311    17.083333     8.833333
## 776   1992-12-29   0.8742657 23.88990  6.0954033     6.888889    36.222222
## 777   1992-12-30   0.8744755 23.88993  5.9015755    49.333333    18.666667
## 778   1992-12-31   0.8746853 23.88996  5.7077478     9.916667    23.583333
## 779   1993-01-01   0.8748951 23.88999  5.5139200     7.000000    36.142857
## 780   1993-01-02   0.8751049 23.89001  8.5644545     2.666667     2.909091
## 781   1993-01-03   0.8753147 23.89004  6.7272683     2.000000     2.200000
## 782   1993-01-04   0.8755245 23.89007  4.7412337    10.767677     6.193939
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## 783   1993-01-05   0.8757343 23.89010  4.4753006    19.535354    10.187879
## 784   1993-01-06   0.8759441 23.89013  4.8090555    28.303030    14.181818
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## 786   1993-01-08   0.8763636 23.89018  5.4765654     2.083333     2.083333
## 787   1993-01-09   0.8765734 23.89021  5.8103203     7.212121     4.181818
## 788   1993-01-10   0.8767832 23.89024  6.1440752     4.606061     6.424242
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## 790   1993-01-12   0.8772028 23.89029  6.8115851     2.606061     5.757576
## 791   1993-01-13   0.8774126 23.89032  7.1453400    10.000000    28.714286
## 792   1993-01-14   0.8776224 23.89035  7.4751707     2.200000     4.400000
## 793   1993-01-15   0.8778322 23.89038  7.9042059    10.500000    10.333333
## 794   1993-01-16   0.8780420 23.89041  6.6786328     5.636364     8.969697
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## 796   1993-01-18   0.8784615 23.89046  5.4685327     6.787879     6.969697
## 797   1993-01-19   0.8786713 23.89049  5.4840056     7.424242     8.090909
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## 799   1993-01-21   0.8790909 23.89055  5.5113052     3.454545     4.484848
## 800   1993-01-22   0.8793007 23.89057  5.5249549    13.996503   446.953963
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## 806   1993-01-28   0.8805594 23.89074  7.1822465     3.757576    28.363636
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## 815   1993-02-06   0.8824476 23.89099  6.9507696    10.333333     2.166667
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## 839   1993-03-02   0.8874825 23.89166  6.0889931     2.121212     2.303030
## 840   1993-03-03   0.8876923 23.89169  6.8824286     9.000000    18.142857
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## 845   1993-03-08   0.8887413 23.89183  6.6910312    44.000000    26.000000
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## 869   1993-04-01   0.5069806 23.89239  6.7816235    12.250000     4.666667
## 870   1993-04-02   0.4857017 23.89242  6.1226471   144.307692  1073.807692
## 871   1993-04-03   0.4644228 23.89244  6.0051244    20.000000    36.888889
## 872   1993-04-04   0.4431440 23.89246  5.8876018     5.416667     4.583333
## 873   1993-04-05   0.4218651 23.89248  5.7700792     4.611111     4.333333
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## 901   1993-05-03   0.5543948 23.89309  5.1361887   108.000000    10.000000
## 902   1993-05-04   0.5600914 23.89312  5.1418775     4.083333     6.333333
## 903   1993-05-05   0.5657880 23.89314  5.1475662     2.416667     9.750000
## 904   1993-05-06   0.5714846 23.89316  5.1532549    85.615385  1203.423077
## 905   1993-05-07   0.5771812 23.89318  5.0955000    48.029915   611.267094
## 906   1993-05-08   0.5828778 23.89320  6.3639375    10.444444    19.111111
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## 920   1993-05-22   0.6626304 23.89351  5.9653088     2.888889     2.444444
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## 922   1993-05-24   0.6740236 23.89355  6.3995791     3.555556     7.111111
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## 937   1993-06-08   0.7594728 23.89388  6.3498571    28.285714   250.142857
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## 987   1993-07-28   1.0443034 23.89498  5.8312500     4.166667     2.166667
## 988   1993-07-29   1.0500000 23.89500  6.1900000     6.305556     2.194444
## 989   1993-07-30   1.0125319 23.96153  6.3183558     8.444444     2.222222
## 990   1993-07-31   0.9750637 24.02807  6.4467115    57.692308   542.307692
## 991   1993-08-01   0.9375956 24.09460  6.1825686    30.512821   277.862179
## 992   1993-08-02   0.9001275 24.16114  6.3940827     3.333333    13.416667
## 993   1993-08-03   0.8626593 24.22767  6.6055968     4.166667     9.833333
## 994   1993-08-04   0.8251912 24.29420  6.8171109     2.222222     2.888889
## 995   1993-08-05   0.7877230 24.36074  7.0286250     9.166667    38.416667
## 996   1993-08-06   0.7502549 24.42727  7.5027083    13.583333     6.916667
## 997   1993-08-07   0.7127868 24.49380  7.0212286     3.166667     7.000000
## 998   1993-08-08   0.6753186 24.56034  6.5397489     8.363636     2.606061
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## 999   1993-08-09   0.6378505 24.62687  6.0582692    23.769231   260.769231
## 1000  1993-08-10   0.6003824 24.69341  6.0639118    14.000000    12.000000
## 1001  1993-08-11   0.5629142 24.75994  6.4192544     2.000000     2.166667
## 1002  1993-08-12   0.5254461 24.82647  6.7745971     2.000000     2.000000
## 1003  1993-08-13   0.4879779 24.89301  7.1299397     4.888889    22.222222
## 1004  1993-08-14   0.4505098 24.95954  7.4852824     2.083333     2.333333
## 1005  1993-08-15   0.4130417 25.02607  7.8406250     4.083333     8.916667
## 1006  1993-08-16   0.4193208 25.28558  6.7653750    75.666667   314.916667
## 1007  1993-08-17   0.4155739 25.30111  6.6974176  1039.777778   479.333333
## 1008  1993-08-18   0.4118270 25.31665  6.6294603   122.400000    74.000000
## 1009  1993-08-19   0.4080801 25.33218  6.5615029     2.000000     4.083333
## 1010  1993-08-20   0.4043332 25.34772  6.4935456     2.416667     6.583333
## 1011  1993-08-21   0.4005863 25.36325  6.4255882   166.769231   818.423077
## 1012  1993-08-22   0.4304683 25.34881  6.4979505    84.551282   411.711538
## 1013  1993-08-23   0.4512429 25.38724  6.6105566     2.333333     5.000000
## 1014  1993-08-24   0.4720175 25.42568  6.7231627     3.111111     8.888889
## 1015  1993-08-25   0.4927921 25.46411  6.8357689     2.083333    10.583333
## 1016  1993-08-26   0.5135667 25.50254  6.9483750     9.000000    16.166667
## 1017  1993-08-27   0.5460417 25.54097  7.6870417     2.500000     3.000000
## 1018  1993-08-28   0.5283656 25.57941  6.9984381     2.000000     2.303030
## 1019  1993-08-29   0.5106895 25.61784  6.3098346    10.666667     5.333333
## 1020  1993-08-30   0.4930134 25.65627  5.6212310     2.500000     6.583333
## 1021  1993-08-31   0.4753373 25.69470  4.9326275    90.038462   349.576923
## 1022  1993-09-01   0.4607545 25.76662  4.8654950    46.019231   177.010684
## 1023  1993-09-02   0.7036043 25.51559  6.3339975     2.000000     4.444444
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## 1027  1993-09-06   0.4553969 25.53555  5.7814975     8.060606     3.212121
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## 1032  1993-09-11   0.4307849 25.34282  6.4189032     2.222222     2.000000
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## 1036  1993-09-15   0.4972385 25.27073  6.6920299     2.000000     2.000000
## 1037  1993-09-16   0.4665495 25.48627  5.8714407     2.000000     2.000000
## 1038  1993-09-17   0.4358604 25.70181  5.0508515   109.980769   316.326923
## 1039  1993-09-18   0.4178192 25.72990  5.1255769   217.961538   630.653846
## 1040  1993-09-19   0.4635632 25.59637  5.4582516   119.132284   316.357226
## 1041  1993-09-20   0.5093073 25.46284  5.7909263    20.303030     2.060606
## 1042  1993-09-21   0.5550513 25.32931  6.1236010     5.333333     4.222222
## 1043  1993-09-22   0.6007953 25.19578  6.4562756     2.083333     2.250000
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## 1050  1993-09-29   0.4368308 25.36145  5.7114808   104.692308  1895.692308
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## 1066  1993-10-15   0.5512625 24.44269  7.5803333     2.583333     4.833333
## 1067  1993-10-16   0.4713417 24.83196  6.5817500    14.916667   325.666667
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## 1080  1993-10-29   0.4534250 24.88048  7.1030385    78.692308   821.076923
## 1081  1993-10-30   0.5917583 23.86565  9.2438750     2.000000     4.000000
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## 1086  1993-11-04   0.4048800 24.73414  6.8535300     4.222222     2.222222
## 1087  1993-11-05   0.4300937 24.59941  7.0183792     6.000000     2.000000
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## 1100  1993-11-18   0.4353633 24.36616  7.9677074     2.000000     2.000000
## 1101  1993-11-19   0.4312950 24.38424  7.9377910     2.666667     5.111111
## 1102  1993-11-20   0.4272267 24.40233  7.9078747    16.333333     4.166667
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## 1104  1993-11-22   0.4197160 24.65221  7.7762800    28.423077  1213.769231
## 1105  1993-11-23   0.5135792 24.02755  7.9774167    15.363054   610.339161
## 1106  1993-11-24   0.4629385 24.21577  7.9445820     2.303030     6.909091
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## 1107  1993-11-25   0.4122978 24.40400  7.9117473     3.151515     4.496212
## 1108  1993-11-26   0.4185921 24.27111  7.7067375     4.000000     2.083333
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## 1110  1993-11-28   0.4311807 24.00533  7.2967181     4.000000     3.250000
## 1111  1993-11-29   0.4374750 23.87245  7.0917083     8.166667    13.166667
## 1112  1993-11-30   0.4071588 24.26412  7.7582549    41.192308   448.653846
## 1113  1993-12-01   0.4298042 23.83694  7.1936250    20.666667     6.545455
## 1114  1993-12-02   1.2300000 23.89600  6.1600000    15.361111     4.272727
## 1115  1993-12-03   1.0626943 24.01709  6.4593465    10.055556     2.000000
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## 1117  1993-12-05   0.7280828 24.25927  7.0580396    10.250000     2.000000
## 1118  1993-12-06   0.5607770 24.38035  7.3573861     2.000000     2.000000
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## 1125  1993-12-13   0.4468655 24.43566  7.9288276    46.896552   953.034483
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## 1131  1993-12-19   2.0796218 24.59504  2.4593987    26.833333     2.083333
## 1132  1993-12-20   2.3517478 24.60538  0.0000000    41.246855   190.475629
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## 1138  1993-12-26   2.8663594 24.74896  7.0569849    58.000000    29.555556
## 1139  1993-12-27   3.0586187 24.70818  7.2574084    49.805556    25.870370
## 1140  1993-12-28   3.2508781 24.66739  7.4578319    41.611111    22.185185
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## 1144  1994-01-01   3.0444246 24.75041  6.9168219   250.000000    40.000000
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## 1147  1994-01-04   3.2026732 25.22005  5.5350212    12.000000    10.541667
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## 1175  1994-02-01   3.4580302 25.48214  5.1165943   158.666667   253.555556
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## 1203  1994-03-01   3.4787768 24.90642  7.2109229     4.166667     7.458333
## 1204  1994-03-02   3.5973452 24.83169  7.3570990   242.666667    29.333333
## 1205  1994-03-03   3.7159137 24.75697  7.5032752     2.083333     8.416667
## 1206  1994-03-04   3.8344821 24.68225  7.6494514    10.333333     5.583333
## 1207  1994-03-05   3.9530506 24.60752  7.7956276     2.666667     6.000000
## 1208  1994-03-06   4.0716190 24.53280  7.9418038    10.333333    18.833333
## 1209  1994-03-07   4.1901875 24.45808  8.0879800     2.363636     7.151515
## 1210  1994-03-08   3.9013833 24.69610  7.8564342     2.316498     6.101010
## 1211  1994-03-09   3.4552327 24.86780  7.6283573     2.269360     5.050505
## 1212  1994-03-10   3.4161050 24.88170  7.3887795     2.222222     4.000000
## 1213  1994-03-11   3.3769773 24.89559  7.1492017     4.000000     5.416667
## 1214  1994-03-12   3.3378497 24.90949  6.9096239     7.333333     2.444444
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## 1215  1994-03-13   3.2987220 24.92338  6.6700461     8.833333     3.847222
## 1216  1994-03-14   2.9925565 24.83685  7.1012187    10.333333     5.250000
## 1217  1994-03-15   2.6863911 24.75032  7.5323913     2.000000     2.166667
## 1218  1994-03-16   2.3802256 24.66379  7.9635639     6.666667    16.222222
## 1219  1994-03-17   2.0740601 24.57726  8.3947365     2.000000     4.083333
## 1220  1994-03-18   1.7678946 24.49073  8.8259091     4.222222     2.666667
## 1221  1994-03-19   1.4617292 24.40420  9.2570817     2.166667     2.416667
## 1222  1994-03-20   1.6479463 24.89415  6.9633191     4.416667    10.208333
## 1223  1994-03-21   1.8341634 24.89452  6.9737284     6.666667    18.000000
## 1224  1994-03-22   2.0203806 24.89490  6.9841378    18.583333     2.083333
## 1225  1994-03-23   2.2065977 24.89528  6.9945471    11.291667    13.708333
## 1226  1994-03-24   2.3928148 24.82194  7.0636383     4.000000    25.333333
## 1227  1994-03-25   2.5790319 24.74861  7.1327295     6.500000   243.666667
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## 1229  1994-03-27   2.9514662 24.60194  7.2709118     2.000000    10.916667
## 1230  1994-03-28   3.1376833 24.52860  7.3400029     9.212121    41.636364
## 1231  1994-03-29   3.4182028 24.89319  6.8685830    29.614035   440.175439
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## 1248  1994-04-15   2.0968722 25.38397  5.4379717    34.000000    12.000000
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## 1251  1994-04-18   2.9860417 25.33336  5.5837325    59.166667   164.500000
## 1252  1994-04-19   4.5063042 25.18432  6.3259117     5.000000    12.500000
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## 1265  1994-05-02   4.8205193 25.34742  6.0384957     3.818182     3.151515
## 1266  1994-05-03   4.9707283 25.36262  5.9157902    19.835017   353.750000
## 1267  1994-05-04   5.1209373 25.37783  5.7930847    35.851852   390.114286
## 1268  1994-05-05   5.2711463 25.34460  6.8868948   888.101695   718.169492
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## 1269  1994-05-06   5.4213553 25.22979  7.7111622   198.888889   119.555556
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## 1271  1994-05-08   5.7217732 25.19323  8.3609570    23.818182    39.393939
## 1272  1994-05-09   5.8719822 25.17494  8.6858544     5.333333    45.342857
## 1273  1994-05-10   5.2666253 25.21664  8.3817212    63.625000    54.250000
## 1274  1994-05-11   4.6612683 25.28857  8.1083034    10.055556    88.888889
## 1275  1994-05-12   4.5175240 25.31711  8.0350131   108.060606    78.121212
## 1276  1994-05-13   4.3737796 25.34565  7.9617228     5.333333     3.333333
## 1277  1994-05-14   4.2300353 25.37420  7.8884325   277.454545   282.454545
## 1278  1994-05-15   4.0862910 25.40274  7.8151422   170.949495   754.000000
## 1279  1994-05-16   3.9425466 25.43128  7.7418519    64.444444    11.777778
## 1280  1994-05-17   3.7988023 25.45982  7.6685616    35.555556   145.500000
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## 1282  1994-05-19   3.5113137 25.51691  7.5219810   488.545455    33.090909
## 1283  1994-05-20   3.3675693 25.54545  7.4486907     7.757576    59.560976
## 1284  1994-05-21   3.2238250 25.57399  7.3754004     5.083333   228.312500
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## 1302  1994-06-08   3.3205895 25.62875  6.6193968    14.727273     8.727273
## 1303  1994-06-09   3.0236219 25.56830  6.9056148     2.060606     2.969697
## 1304  1994-06-10   2.7266542 25.50785  7.1918327    11.111111     8.888889
## 1305  1994-06-11   2.4296866 25.44740  7.4780506     3.957447    20.085106
## 1306  1994-06-12   2.1327190 25.38696  7.7642685     5.200000    56.266667
## 1307  1994-06-13   1.8357514 25.41308  7.4927384   141.106383   696.297872
## 1308  1994-06-14   1.5387837 25.24285  8.0519364   336.228571   481.885714
## 1309  1994-06-15   1.2418161 24.58020  7.6117258     4.722222    22.722222
## 1310  1994-06-16   0.9448485 23.91755  7.1715152     6.227778    29.872222
## 1311  1994-06-17   1.1047081 24.28973  6.8992361     7.733333    37.022222
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## 1313  1994-06-19   1.4244274 25.03411  6.3546779    41.333333    58.666667
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## 1317  1994-06-23   5.5751961 25.77726  5.1481054     9.333333   134.952381
## 1318  1994-06-24   7.4907208 24.95150  8.4401108     3.259259    40.518519
## 1319  1994-06-25   6.9353928 25.11889  8.0948322     4.900000     3.400000
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## 1321  1994-06-27   5.8247366 25.45367  7.4042750     4.190476    11.238095
## 1322  1994-06-28   5.2694085 25.48226  7.5510762    11.392857   164.642857
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## 1323  1994-06-29   4.7140804 25.51241  7.7561719     2.074074     3.037037
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## 1325  1994-07-01   3.6034243 25.53119  7.0825949     4.042553    22.127660
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## 1329  1994-07-05   2.2762010 25.59256  7.6376887    72.952381  1647.761905
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## 1335  1994-07-11   4.3087667 25.40473  7.3572167    13.861111    48.861111
## 1336  1994-07-12   5.1925892 25.39674  7.5182613    10.222222     7.777778
## 1337  1994-07-13   6.0764117 25.38875  7.6793059    20.181818    84.181818
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## 1348  1994-07-24   6.0490342 25.20668  7.4731640    18.800000   407.371429
## 1349  1994-07-25   5.3079525 25.54452  6.1552293    52.952381   899.285714
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## 1353  1994-07-29   4.3788393 24.86648  9.0488711     2.000000     2.888889
## 1354  1994-07-30   4.3161622 24.87470  9.0292187     3.111111    34.166667
## 1355  1994-07-31   4.2534850 24.88292  9.0095663     3.500000    29.500000
## 1356  1994-08-01   4.1908078 24.95239  8.3855921    28.666667    69.644444
## 1357  1994-08-02   4.1281307 24.84656  8.7383145    15.481481    19.185185
## 1358  1994-08-03   4.0654535 24.88643  8.5452018     2.000000    12.000000
## 1359  1994-08-04   4.0027763 24.92630  8.3520890     3.444444     3.666667
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## 1373  1994-08-18   3.4136624 25.13634  8.8185031    17.357143   219.392857
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## 1376  1994-08-21   3.3337683 25.19138  7.4405471     5.818182    13.090909
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## 1400  1994-09-14   4.5609721 25.03711  8.1390440     3.333333     3.944444
## 1401  1994-09-15   4.4928834 25.05087  8.0688691     5.454545     6.363636
## 1402  1994-09-16   4.4247948 25.06463  7.9986943     2.055556     2.166667
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## 1407  1994-09-21   4.0843516 25.21416  7.3731861     5.500000    46.722222
## 1408  1994-09-22   4.0162629 25.30878  6.9811130     5.000000    44.000000
## 1409  1994-09-23   3.9481743 25.40340  6.5890400     2.526316     8.526316
## 1410  1994-09-24   3.8800856 25.09278  7.6944133     4.461538     8.461538
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## 1414  1994-09-28   4.3721439 24.85248  8.1260205   245.636364    83.272727
## 1415  1994-09-29   4.6862617 24.88174  8.0251213    20.888889     7.333333
## 1416  1994-09-30   5.0003795 24.91100  7.9242222     3.523810    17.619048
## 1417  1994-10-01   5.3144973 24.96085  7.8870855    14.755556   151.200000
## 1418  1994-10-02   5.6286152 24.98569  8.0191927     2.000000     5.555556
## 1419  1994-10-03   5.5502026 25.06322  7.6737220    10.000000     9.454545
## 1420  1994-10-04   5.4717901 25.14074  7.3282514     4.666667    12.133333
## 1421  1994-10-05   5.3933776 25.21827  6.9827807     2.611111    16.666667
## 1422  1994-10-06   5.3149651 25.29579  6.6373100    28.909091    22.363636
## 1423  1994-10-07   5.2365525 25.37332  6.2918393     2.210526     2.421053
## 1424  1994-10-08   5.1581400 25.22215  7.0163333     4.769231    21.384615
## 1425  1994-10-09   5.1023263 25.50194  5.7011177    87.190476  1746.047619
## 1426  1994-10-10   5.0465125 25.08632  7.5045404     3.259259    17.333333
## 1427  1994-10-11   5.1320441 25.09949  7.5892879    31.777778    35.777778
## 1428  1994-10-12   5.2175757 25.11266  7.6740355     3.837838    23.675676
## 1429  1994-10-13   5.3031073 25.12582  7.7587830    64.545455    15.272727
## 1430  1994-10-14   5.3886389 25.13899  7.8435305    22.468085    63.787234
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## 1431  1994-10-15   5.4741705 25.15216  7.9282781     2.444444    13.333333
## 1432  1994-10-16   5.5597021 25.16532  8.0130256    21.555556     6.666667
## 1433  1994-10-17   5.6452338 25.17849  8.0977731     4.571429    26.571429
## 1434  1994-10-18   5.7307654 25.13632  8.0065853    35.107143   401.892857
## 1435  1994-10-19   5.8162970 25.14939  8.2927003     2.111111     7.777778
## 1436  1994-10-20   5.7920457 25.27642  7.5501117     2.333333     8.333333
## 1437  1994-10-21   5.7677945 25.40344  6.8075231     4.809524     9.095238
## 1438  1994-10-22   5.7435432 25.55306  6.0929051    55.733333   591.688889
## 1439  1994-10-23   5.7192920 25.22272  8.0506929     6.148148    19.259259
## 1440  1994-10-24   5.6950407 25.21392  8.0201634     3.866667     3.511111
## 1441  1994-10-25   5.6707895 25.20512  7.9896338   171.636364    33.090909
## 1442  1994-10-26   5.6465383 25.19633  7.9591043     5.272727    10.727273
## 1443  1994-10-27   5.6222870 25.18753  7.9285747     2.388889     5.611111
## 1444  1994-10-28   5.5980358 25.17873  7.8980452     2.222222     3.111111
## 1445  1994-10-29   5.5737845 25.16231  7.8496557    11.138462   128.184615
## 1446  1994-10-30   5.5495333 25.19443  7.7877918     7.142857    20.000000
## 1447  1994-10-31   5.5252820 25.49758  6.1724208     4.682540    12.250000
## 1448  1994-11-01   5.5010308 25.48309  6.2488133     2.222222     4.500000
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## 1451  1994-11-04   5.4282771 25.43963  6.4779907     6.382979    13.106383
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## 1453  1994-11-06   5.3797746 25.41065  6.6307756    41.000000    79.000000
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## 1465  1994-11-18   4.8969058 25.60256  5.6404936    88.285714  1024.035714
## 1466  1994-11-19   4.8513375 25.02425  7.9340500     6.296296    45.481481
## 1467  1994-11-20   4.7597068 25.02590  7.9745114    40.000000   150.000000
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## 1472  1994-11-25   4.3015530 25.03419  8.1768183   516.833333   692.285354
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## 1474  1994-11-27   4.1182915 25.03750  8.2577410   737.333333  1176.000000
## 1475  1994-11-28   4.0266608 25.03916  8.2982024    11.944444    40.777778
## 1476  1994-11-29   3.9350300 25.04081  8.3386638   142.222222    71.222222
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## 1479  1994-12-02   3.6601378 25.18093  8.0179261   159.030303    67.757576
## 1480  1994-12-03   3.5685071 25.67289  5.7380022    85.570707    49.628788
## 1481  1994-12-04   3.4768763 25.63628  5.8483545    12.111111    31.500000
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## 1483  1994-12-06   3.2936148 25.56306  6.0690593   614.333333  2885.000000
## 1484  1994-12-07   3.2019841 25.52645  6.1794116     5.777778     3.777778
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## 1485  1994-12-08   3.1103533 25.48984  6.2897640    13.161290    37.161290
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## 1491  1994-12-14   6.2628717 25.14213  7.9900843    24.545455    25.454545
## 1492  1994-12-15   6.9959878 25.16441  8.0255001   200.000000    60.000000
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## 1494  1994-12-17   8.4622200 25.20896  8.0963317    22.444444     6.666667
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## 1497  1994-12-20   9.9734911 25.83738  4.8689561     3.265873    19.007937
## 1498  1994-12-21  10.4772481 25.81200  5.1961877     3.388889    32.777778
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## 1502  1994-12-25  12.4922763 25.84801  4.9706430     9.165200   149.863148
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## 1512  1995-01-04   9.0846848 25.43613  6.7504618     6.888889    14.244444
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## 1516  1995-01-08   9.0846848 25.76293  5.2437735     2.645161     5.548387
## 1517  1995-01-09   9.0846848 25.84509  4.8149919    14.892857   207.714286
## 1518  1995-01-10   9.0846848 25.56779  7.0849279     2.518519     2.888889
## 1519  1995-01-11   9.0846848 25.55133  7.0431197     2.444444     5.333333
## 1520  1995-01-12   9.0846848 25.53487  7.0013114    30.340426   173.063830
## 1521  1995-01-13   9.0846848 25.51842  6.9595031   133.000000   312.000000
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## 1527  1995-01-19   8.9938543 25.35828  6.8991260    11.642857    98.785714
## 1528  1995-01-20   8.9030237 25.40862  6.7309025     2.476190     3.238095
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## 1531  1995-01-23   8.6305320 25.43281  6.2475961     3.600000    16.050000
## 1532  1995-01-24   8.5397014 25.69458  5.2633891    28.607143   743.107143
## 1533  1995-01-25   8.4488708 25.04280  8.4871433     2.000000     2.740741
## 1534  1995-01-26   8.2423745 25.04751  8.3440204    69.100000    93.800000
## 1535  1995-01-27   8.0358781 25.05221  8.2008975     2.000000     3.055556
## 1536  1995-01-28   7.8293818 25.05692  8.0577746     7.636364    11.272727
## 1537  1995-01-29   7.6228854 25.06163  7.9146517     4.222222     9.111111
## 1538  1995-01-30   7.4163890 25.06633  7.7715288     2.000000     2.277778
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## 1539  1995-01-31   7.2098927 25.07104  7.6284059     2.000000     8.000000
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## 1541  1995-02-02   6.7969000 24.85794  7.8787881     5.703704    29.925926
## 1542  1995-02-03   6.5904036 24.82943  7.5639400     2.000000     3.714286
## 1543  1995-02-04   6.3839072 25.08348  6.6077729     2.000000     2.666667
## 1544  1995-02-05   6.1774109 25.33753  5.6516058    78.321429   662.928571
## 1545  1995-02-06   5.9709145 24.95399  6.6140394    37.225806   339.096774
## 1546  1995-02-07   5.7644182 24.53445  6.4556348     2.000000     2.000000
## 1547  1995-02-08   5.5579218 24.73807  6.2972303     4.000000     5.777778
## 1548  1995-02-09   5.3514254 24.94169  6.1388257    13.090909    16.363636
## 1549  1995-02-10   5.1449291 25.14531  5.9804212    27.111111   319.111111
## 1550  1995-02-11   4.9384327 25.34892  5.8220166     2.000000     2.000000
## 1551  1995-02-12   4.7319364 25.29693  5.9430868     2.468085     4.680851
## 1552  1995-02-13   4.5254400 25.24494  6.0641570     4.166667     4.277778
## 1553  1995-02-14   5.5290285 25.10558  6.4566689    20.444444     9.111111
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## 1555  1995-02-16   7.5362055 24.82686  7.2416927    56.727273   535.454545
## 1556  1995-02-17   8.5397939 24.68750  7.6342045     3.185185     2.518519
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## 1564  1995-02-25   4.0465019 24.98819  5.2804075     2.055556     4.555556
## 1565  1995-02-26   4.1446916 24.68692  5.3416259     6.181818     3.818182
## 1566  1995-02-27   4.2428813 24.38564  5.4028444     2.000000     2.222222
## 1567  1995-02-28   4.3410710 24.08437  5.4640628     2.388889     4.972222
## 1568  1995-03-01   4.4392606 24.26161  5.7658371     2.777778     7.722222
## 1569  1995-03-02   4.5374503 24.43885  6.0676114     4.909091     6.727273
## 1570  1995-03-03   4.6356400 24.61609  6.3693857    12.177778    50.088889
## 1571  1995-03-04   4.7338297 24.79333  6.6711600     2.000000     6.000000
## 1572  1995-03-05   4.8320194 24.97057  6.9729344    39.875000    19.937500
## 1573  1995-03-06   4.9302090 24.77238  7.2747087    17.155556   318.133333
## 1574  1995-03-07   5.0283987 24.72854  7.1060683    14.000000    62.111111
## 1575  1995-03-08   5.1265884 24.84551  6.9374279     3.777778     2.222222
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## 1580  1995-03-13   5.0515272 24.61446  8.2952468     2.333333     7.944444
## 1581  1995-03-14   4.9036293 24.71473  8.1980694    58.888889     6.888889
## 1582  1995-03-15   4.7557315 24.81500  8.1008920     7.243243    24.756757
## 1583  1995-03-16   4.6078336 24.91526  8.0037147    26.000000   177.636364
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## 1587  1995-03-20   4.0162423 24.68395  7.6150052     7.277778    11.833333
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## 1589  1995-03-22   4.5243117 24.34115  8.1617003    39.396226   771.283019
## 1590  1995-03-23   5.9892718 24.28404  7.5580564     2.333333     3.066667
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## 1592  1995-03-25   5.3174000 24.23263  8.0203267     2.615385     9.897436
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## 1597  1995-03-30   3.9014667 24.65720  8.1429038    10.333333    32.055556
## 1598  1995-03-31   4.2820102 24.65933  8.0903151     6.297872    17.063830
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## 1607  1995-04-09   6.0618500 24.89044  7.3573167    16.095238   193.047619
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## 1610  1995-04-12   0.6200000 23.88000  6.8100000   244.839243    28.323877
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## 1612  1995-04-14   2.5496500 25.25512  7.4651704     3.419355     9.870968
## 1613  1995-04-15   3.5144750 25.44774  7.7927556   250.500000   334.928571
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## 1616  1995-04-18   3.4169529 25.44197  5.9178512    31.454545    16.181818
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## 1619  1995-04-21   4.9135387 25.22726  6.7626355     6.645161    23.870968
## 1620  1995-04-22   4.3572841 25.35443  6.1861349    79.928571   656.500000
## 1621  1995-04-23   4.5724083 25.02482  7.2912225     6.074074     6.888889
## 1622  1995-04-24   8.0498773 25.15172  7.3210066     4.500000   108.666667
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## 1625  1995-04-27   7.9446737 25.19735  7.5097913     4.055556    18.944444
## 1626  1995-04-28   7.9427356 25.29194  7.5926301     4.500000    30.222222
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## 1628  1995-04-30   7.9388593 25.48113  7.7583076    32.000000   430.545455
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## 1632  1995-05-04   7.9311068 25.00813  7.9289693     3.388889     3.055556
## 1633  1995-05-05   7.1764512 24.90811  7.5982118     2.933333     3.933333
## 1634  1995-05-06   6.4217956 24.96817  7.2674543     3.388889     5.666667
## 1635  1995-05-07   5.6671400 25.02824  6.9366968     8.451613    14.451613
## 1636  1995-05-08   4.9124844 25.19683  6.6059393    13.077658    16.707288
## 1637  1995-05-09   3.7434375 24.94779  7.5647333    17.703704    18.962963
## 1638  1995-05-10   4.6333694 25.16390  7.6096273   347.090909  2507.090909
## 1639  1995-05-11   5.5233014 25.38000  7.6545212    28.808511   128.255319
## 1640  1995-05-12   6.4132333 25.59611  7.6994151    38.978723   164.680851
## 1641  1995-05-13   7.3031653 25.54920  7.7443091    49.148936   201.106383
## 1642  1995-05-14   8.1930972 25.50229  7.7892030    60.400000  1970.000000
## 1643  1995-05-15   9.0830291 25.45539  7.8340969     2.000000     6.000000
## 1644  1995-05-16   9.9729611 25.40848  7.8789909    81.611111    94.333333
## 1645  1995-05-17  10.8628930 25.36157  7.9238848   482.727273  1731.090909
## 1646  1995-05-18  11.7528249 25.31467  7.9687788  1922.000000  3100.800000
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## 1647  1995-05-19  12.6427569 25.26776  8.0136727     2.000000     6.222222
## 1648  1995-05-20  13.5326888 25.22085  8.0585666     3.833333     5.166667
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## 1650  1995-05-22   9.5592333 25.09894  7.8971050    23.000000     7.384615
## 1651  1995-05-23   8.6907630 25.22652  7.8696809     4.857143     3.047619
## 1652  1995-05-24   7.8222927 25.60051  7.7488286     2.000000     2.000000
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## 1655  1995-05-27   5.2168819 25.44779  7.3862717  4721.428571  4550.000000
## 1656  1995-05-28   4.3484116 25.39688  7.2654194    29.688889    17.022222
## 1657  1995-05-29   3.4799413 25.34597  7.1445671    39.000000   122.000000
## 1658  1995-05-30   2.6114710 25.29506  7.0237148    75.809524   383.761905
## 1659  1995-05-31   2.5100295 25.53357  6.0804077    30.166667   261.666667
## 1660  1995-06-01   4.2868125 25.20181  7.5002729     6.962963    10.296296
## 1661  1995-06-02   4.6057826 25.18431  7.5590076  2528.481481  1515.564815
## 1662  1995-06-03   4.9247527 25.16681  7.6177423  5050.000000  3020.833333
## 1663  1995-06-04   5.2437227 25.14931  7.6764770   210.000000    74.388889
## 1664  1995-06-05   5.5626928 25.13181  7.7352117    17.555556     5.555556
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## 1671  1995-06-12   4.3981573 25.46131  5.8848994  2400.000000  9600.000000
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## 1687  1995-06-28  10.3425197 25.75383  4.9456374    34.967742   127.741935
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## 1700  1995-07-11   8.7119868 25.15136  7.1072628     2.000000     7.944444
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## 1707  1995-07-18   4.8684364 25.56157  5.4061150    25.785714   446.964286
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## 1735  1995-08-15   5.1422511 25.55815  5.6331520    11.071429   399.678571
## 1736  1995-08-16  26.7030333 24.76613  9.5748733     2.666667     7.037037
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## 1846  1995-12-04   2.3104677 25.40187  7.0343923     4.709677    10.064516
## 1847  1995-12-05   3.1143333 25.20095  7.7791617     8.789474    28.315789
## 1848  1995-12-06   1.7916489 25.50995  6.0520818   101.777778   915.688889
## 1849  1995-12-07   1.2790500 25.64343  5.5810273  1114.909091  1226.545455
## 1850  1995-12-08   1.2824643 25.61923  5.6796633     5.052632    20.578947
## 1851  1995-12-09   1.2858786 25.59503  5.7782993     2.666667     3.555556
## 1852  1995-12-10   1.2892929 25.57084  5.8769353     3.555556    10.500000
## 1853  1995-12-11   1.2927073 25.54664  5.9755714    22.181818    13.818182
## 1854  1995-12-12   1.2961216 25.52244  6.0742074     6.944444    40.444444
## 1855  1995-12-13   1.2995359 25.49825  6.1728434     3.574468     6.042553
## 1856  1995-12-14   1.3029502 25.47405  6.2714795     3.555556     6.222222
## 1857  1995-12-15   1.3063645 25.44985  6.3701155    18.645161    53.870968
## 1858  1995-12-16   1.0657467 25.69097  5.3654713    10.507766    28.713262
## 1859  1995-12-17   3.1278167 25.14899  7.7300675     2.370370     3.555556
## 1860  1995-12-18   2.6215212 25.67150  6.2218348     2.000000     3.888889
## 1861  1995-12-19   1.9239488 25.71547  5.7180205   324.682927   571.121951
## 1862  1995-12-20   3.4126409 25.71515  5.7940066    25.794872   678.923077
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## 1863  1995-12-21   2.9651677 25.74232  5.7688012     2.500000     4.111111
## 1864  1995-12-22   2.5176945 25.76948  5.7435959     3.822222    12.311111
## 1865  1995-12-23   2.0702212 25.79665  5.7183905     8.545455     4.000000
## 1866  1995-12-24   1.6227480 25.82382  5.6931852     6.376176     4.689655
## 1867  1995-12-25   5.5469515 25.47401  7.0189215     4.206897     5.379310
## 1868  1995-12-26   6.1911023 25.38974  7.4713058     2.888889    16.611111
## 1869  1995-12-27   4.5899643 25.36739  6.9578824     2.533333    43.266667
## 1870  1995-12-28   3.8833128 25.43867  6.6471883     2.055556     2.555556
## 1871  1995-12-29   3.1766612 25.50994  6.3364942     3.333333    16.222222
## 1872  1995-12-30   2.4700097 25.58122  6.0258002    13.833333     2.333333
## 1873  1995-12-31   1.7633582 25.65250  5.7151061     2.777778     5.111111
## 1874  1996-01-01   1.0567067 25.72378  5.4044120    49.071429   411.107143
## 1875  1996-01-02   2.4843167 24.89156  8.4580829     4.740741    10.888889
## 1876  1996-01-03   1.5195161 25.48392  6.1329374     5.354839    16.000000
## 1877  1996-01-04   1.3241161 25.63533  5.5732592     6.888889    28.000000
## 1878  1996-01-05   1.1287160 25.78674  5.0135809     3.200000     6.000000
## 1879  1996-01-06   1.7530088 25.76497  5.2456286    10.638298    89.872340
## 1880  1996-01-07   2.3773015 25.74321  5.4776763     6.545455    13.636364
## 1881  1996-01-08   3.0015943 25.72145  5.7097239     3.277778     4.111111
## 1882  1996-01-09   3.6258871 25.69968  5.9417716     5.419355     5.548387
## 1883  1996-01-10   1.4285644 25.88729  4.6927264   230.285714  1847.928571
## 1884  1996-01-11   7.9166500 25.15400  7.7259408     2.000000     2.000000
## 1885  1996-01-12   7.2152624 25.16677  7.6329183     4.666667     2.222222
## 1886  1996-01-13   6.5138749 25.17954  7.5398957     5.166667    22.777778
## 1887  1996-01-14   5.8124873 25.19231  7.4468732    10.545455     9.818182
## 1888  1996-01-15   5.1110998 25.20507  7.3538506     2.000000     4.222222
## 1889  1996-01-16   4.4097122 25.21784  7.2608280    35.066667   264.400000
## 1890  1996-01-17   5.0494606 25.47282  6.5712185     2.551724     2.551724
## 1891  1996-01-18   4.0834773 25.58643  5.0139050     2.055556     2.722222
## 1892  1996-01-19   3.3034105 25.63987  4.6462681     4.888889     6.833333
## 1893  1996-01-20   2.5233438 25.69331  4.2786313     5.777778     9.111111
## 1894  1996-01-21   1.7432771 25.74675  3.9109944    27.454545    18.181818
## 1895  1996-01-22   1.7943890 25.61614  4.7161845     2.055556     2.000000
## 1896  1996-01-23   1.8455010 25.48552  5.5213747     3.333333     2.000000
## 1897  1996-01-24   1.8966129 25.35490  6.3265648    11.096774    74.709677
## 1898  1996-01-25   0.8946227 25.66776  5.3938293   442.714286  2088.357143
## 1899  1996-01-26   4.8811500 25.02583  6.7894017     3.333333     6.148148
## 1900  1996-01-27   5.0955735 24.92591  7.1054633     2.444444     3.555556
## 1901  1996-01-28   5.3099970 24.82600  7.4215249     5.191489     6.553191
## 1902  1996-01-29   5.5244205 24.72608  7.7375866   485.555556  1011.500000
## 1903  1996-01-30   6.2826545 24.76301  7.7645036     2.333333    11.555556
## 1904  1996-01-31   3.9083119 25.19494  6.9350707     3.133333    11.933333
## 1905  1996-02-01   3.1381663 25.30211  6.4432093     3.900000     2.800000
## 1906  1996-02-02   2.3680207 25.40928  5.9513479     2.000000     2.888889
## 1907  1996-02-03   1.5978750 25.51645  5.4594865     7.944444    27.000000
## 1908  1996-02-04   0.8277294 25.62362  4.9676251     3.818182     4.909091
## 1909  1996-02-05   4.2451630 25.45298  5.9828578     4.666667     3.777778
## 1910  1996-02-06   7.6625967 25.28235  6.9980906     4.444444    11.500000
## 1911  1996-02-07  11.0800303 25.11171  8.0133233     3.000000     6.555556
## 1912  1996-02-08   5.5216341 25.05562  8.0644880     3.712121     4.459596
## 1913  1996-02-09   5.7474222 25.03123  8.0971022     4.424242     2.363636
## 1914  1996-02-10   4.6688022 25.05850  7.6430012     3.111111     2.000000
## 1915  1996-02-11   3.5901821 25.08577  7.1889001     2.277778     3.222222
## 1916  1996-02-12   2.5115620 25.11304  6.7347991     2.444444     4.000000
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## 1917  1996-02-13   1.4329419 25.14031  6.2806981    12.064516    51.806452
## 1918  1996-02-14   3.6301875 24.48828  8.2288783    54.321147   423.903226
## 1919  1996-02-15   1.2695289 25.44432  5.5280916    96.577778   796.000000
## 1920  1996-02-16   1.4426317 25.45465  5.4607079     3.000000    16.333333
## 1921  1996-02-17   1.6157345 25.46497  5.3933242     4.444444     6.000000
## 1922  1996-02-18   1.7888373 25.47530  5.3259405     2.388889     3.055556
## 1923  1996-02-19   1.9619401 25.48563  5.2585568     4.222222     3.555556
## 1924  1996-02-20   2.1350429 25.49596  5.1911732     6.888889    17.388889
## 1925  1996-02-21   3.8376352 25.45052  5.9121773     9.555556    31.222222
## 1926  1996-02-22   5.5402275 25.40508  6.6331814    23.555556    11.000000
## 1927  1996-02-23   7.2428198 25.35964  7.3541856     4.000000     5.888889
## 1928  1996-02-24   8.9454121 25.31420  8.0751897     5.851852    15.407407
## 1929  1996-02-25   9.1820818 25.25016  8.4336055     3.992593     8.837037
## 1930  1996-02-26   5.6060488 25.22334  7.6419759     2.133333     2.266667
## 1931  1996-02-27   1.8960387 25.09677  5.9103542     4.709677    10.967742
## 1932  1996-02-28   4.6301042 24.75904  7.7266350    29.361702    73.319149
## 1933  1996-02-29   0.6109489 25.45027  5.0562411   204.311111  1773.244444
## 1934  1996-03-01   0.6622955 25.46259  4.9786535    14.181818     4.181818
## 1935  1996-03-02   0.7136421 25.47490  4.9010659     3.022222     3.022222
## 1936  1996-03-03   0.7649887 25.48721  4.8234783     6.722222     6.000000
## 1937  1996-03-04   0.8163353 25.49952  4.7458908    17.636364    12.727273
## 1938  1996-03-05   0.8676818 25.51183  4.6683032     2.222222     3.111111
## 1939  1996-03-06   0.9190284 25.52415  4.5907156     4.076628     2.727969
## 1940  1996-03-07   5.7122667 24.77158  7.7469752     5.931034     2.344828
## 1941  1996-03-08   4.2474684 24.65737  7.4699066     4.133333     9.266667
## 1942  1996-03-09   8.1299867 24.58123  7.6669324   257.444444   594.722222
## 1943  1996-03-10   4.8356272 24.78624  6.8519464     5.422222     5.733333
## 1944  1996-03-11   1.5412677 24.99124  6.0369603    13.666667    82.333333
## 1945  1996-03-12   1.3386907 25.27893  5.4178084     7.644444   225.111111
## 1946  1996-03-13   1.2845542 24.14867  7.2712246     2.000000     2.592593
## 1947  1996-03-14   1.2580894 24.34761  6.9079030     9.777778     2.888889
## 1948  1996-03-15   1.2316247 24.54655  6.5445813     4.222222    10.055556
## 1949  1996-03-16   1.2051599 24.74549  6.1812597     5.636364     4.363636
## 1950  1996-03-17   1.1786952 24.94443  5.8179381    10.888889    22.444444
## 1951  1996-03-18   1.1522304 25.14337  5.4546164    13.636364    10.363636
## 1952  1996-03-19   1.1257657 25.34231  5.0912948     7.818182     6.181818
## 1953  1996-03-20   2.9093118 25.14393  5.8653882     2.000000     2.000000
## 1954  1996-03-21   4.6928580 24.94555  6.6394816     2.000000     2.311111
## 1955  1996-03-22   6.4764042 24.74717  7.4135750     4.275862     4.827586
## 1956  1996-03-23   5.0710800 24.84936  7.5153638   147.722222   367.666667
## 1957  1996-03-24   3.1541905 24.88554  7.3477019     2.000000     2.000000
## 1958  1996-03-25   2.1643778 25.06797  6.5459922     2.444444     4.277778
## 1959  1996-03-26   2.1719534 25.06736  6.5437784     2.111111     2.055556
## 1960  1996-03-27   2.1795290 25.06676  6.5415645     5.225806    18.129032
## 1961  1996-03-28   1.4904791 25.29897  5.9745467    55.642857   958.071429
## 1962  1996-03-29   3.2715292 24.81784  6.8795725     3.611111     5.333333
## 1963  1996-03-30   2.6299184 24.94968  6.4364640    18.181818     8.909091
## 1964  1996-03-31   1.9883077 25.08153  5.9933555     4.800000     6.711111
## 1965  1996-04-01   1.3466969 25.21337  5.5502469     2.765957    20.893617
## 1966  1996-04-02   0.7050861 25.34521  5.1071384     5.160757    16.891253
## 1967  1996-04-03   1.2982479 25.21452  5.6170481     7.555556    12.888889
## 1968  1996-04-04   1.8914097 25.08383  6.1269578     2.000000     2.555556
## 1969  1996-04-05   2.4845715 24.95314  6.6368675     2.000000     5.277778
## 1970  1996-04-06   3.0777333 24.82245  7.1467771   103.317073    31.219512
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## 1971  1996-04-07   3.6141133 24.83610  7.3292331   266.166667   672.777778
## 1972  1996-04-08   4.0425879 24.91302  7.2398809     2.222222     2.777778
## 1973  1996-04-09   1.6628613 25.07454  6.2107442    21.714286   145.714286
## 1974  1996-04-10   1.5182292 24.68932  6.5024054     3.407407     9.333333
## 1975  1996-04-11   1.2131727 25.24272  5.4875270   135.733333  1403.244444
## 1976  1996-04-12   0.8600000 23.88500  6.7500000    72.088889   707.733333
## 1977  1996-04-13   0.8539257 24.20299  6.4031708     8.444444    12.222222
## 1978  1996-04-14   0.8478515 24.52097  6.0563416    42.363636    22.545455
## 1979  1996-04-15   0.8417772 24.83896  5.7095124     2.000000     2.000000
## 1980  1996-04-16   0.8357029 25.15694  5.3626832     2.106383     2.425532
## 1981  1996-04-17   1.1952444 25.01048  5.7350608     2.212766     2.851064
## 1982  1996-04-18   1.5547859 24.86403  6.1074384     3.555556     6.666667
## 1983  1996-04-19   1.9143274 24.71757  6.4798160     2.777778     4.111111
## 1984  1996-04-20   2.2738689 24.57111  6.8521936    83.574468   342.893617
## 1985  1996-04-21   2.9156545 24.61064  6.9584142     2.000000     2.000000
## 1986  1996-04-22   1.9946929 24.61820  6.7620931     4.200000     7.333333
## 1987  1996-04-23   1.2444871 24.90545  5.9882945     9.225806    42.193548
## 1988  1996-04-24   3.0939208 24.55917  6.5750400     3.473684     5.315789
## 1989  1996-04-25   1.0343200 25.16714  5.2348420    46.311111   512.133333
## 1990  1996-04-26   1.0524251 25.17748  5.2305709    56.444444    12.222222
## 1991  1996-04-27   1.0705302 25.18783  5.2262998   280.181818   483.272727
## 1992  1996-04-28   1.0886353 25.19817  5.2220288  6000.000000 12000.000000
## 1993  1996-04-29   1.1067404 25.20852  5.2177577  3020.833333  6035.305556
## 1994  1996-04-30   1.4710573 25.16868  5.4456832    41.666667    70.611111
## 1995  1996-05-01   1.8353742 25.12885  5.6736086    50.000000   160.800000
## 1996  1996-05-02   2.1996912 25.08901  5.9015341  3016.500000  3069.500000
## 1997  1996-05-03   2.5640081 25.04918  6.1294596     2.444444     7.722222
## 1998  1996-05-04   2.9283250 25.00934  6.3573851    61.882353   351.647059
## 1999  1996-05-05   3.2926419 24.96951  6.5853106   270.000000  3100.000000
## 2000  1996-05-06   3.6569588 24.92967  6.8132360     3.666667     6.888889
## 2001  1996-05-07   4.0212758 24.88984  7.0411615     6.111111    49.666667
## 2002  1996-05-08   3.6786391 24.84925  7.0738331    58.545455    45.818182
## 2003  1996-05-09   3.3360024 24.80867  7.1065048    17.866667    58.066667
## 2004  1996-05-10   3.5297000 24.76806  7.2612862    23.944444    87.666667
## 2005  1996-05-11   2.4902323 24.90791  6.7571820     2.666667     4.500000
## 2006  1996-05-12   1.4507645 25.04775  6.2530777     9.047619    44.904762
## 2007  1996-05-13   1.1270659 25.22805  5.7042439    19.407407   561.000000
## 2008  1996-05-14   1.4415542 24.90697  6.8948179     8.074074    57.555556
## 2009  1996-05-15   1.3162890 24.97387  6.6178287   296.545455    66.727273
## 2010  1996-05-16   1.1910239 25.04076  6.3408395     2.944444     6.388889
## 2011  1996-05-17   1.0657587 25.10765  6.0638503     4.833333    13.777778
## 2012  1996-05-18   0.9404936 25.17454  5.7868612     6.545455     7.090909
## 2013  1996-05-19   0.8152284 25.24143  5.5098720     5.828283     4.878788
## 2014  1996-05-20   1.4800691 25.12079  6.0502717     5.111111     2.666667
## 2015  1996-05-21   2.1449097 25.00014  6.5906714     2.000000     2.000000
## 2016  1996-05-22   2.8097503 24.87950  7.1310712    13.702128    36.851064
## 2017  1996-05-23   3.4745909 24.75885  7.6714709     2.000000     2.000000
## 2018  1996-05-24   4.0393432 24.76099  7.8783402    79.000000   432.500000
## 2019  1996-05-25   2.3875500 24.76115  7.7204505     2.533333     3.400000
## 2020  1996-05-26   1.5748619 25.13593  6.3254143   648.424242  1146.000000
## 2021  1996-05-27   1.4558895 24.91192  6.9230316   296.695652  1219.217391
## 2022  1996-05-28   1.6094250 24.60423  7.6801128     4.615385    12.923077
## 2023  1996-05-29   1.6336955 24.80289  7.1106441   824.500000   735.812500
## 2024  1996-05-30   1.3817802 24.92678  6.7818457   230.500000   122.000000
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## 2025  1996-05-31   1.1298649 25.05068  6.4530473    74.341463   346.731707
## 2026  1996-06-01   0.8779496 25.17458  6.1242490    36.000000     3.000000
## 2027  1996-06-02   0.6260343 25.29848  5.7954506    20.611111     4.444444
## 2028  1996-06-03   1.0428406 25.26973  5.9034182     5.222222     5.888889
## 2029  1996-06-04   1.4596468 25.24098  6.0113858  8400.000000  8520.000000
## 2030  1996-06-05   1.8764531 25.21222  6.1193534    50.133333    48.000000
## 2031  1996-06-06   2.2932594 25.18347  6.2273210    22.000000    14.000000
## 2032  1996-06-07   2.7100656 25.15472  6.3352886   107.090909   557.090909
## 2033  1996-06-08   3.1268719 25.12597  6.4432562   315.200000  2047.200000
## 2034  1996-06-09   3.5436782 25.09721  6.5512238    20.333333    31.833333
## 2035  1996-06-10   3.9604844 25.06846  6.6591915   500.000000  3000.000000
## 2036  1996-06-11   4.3772907 25.03971  6.7671591     5.277778     6.222222
## 2037  1996-06-12   4.7940970 25.01096  6.8751267     2.666667     2.222222
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## 2039  1996-06-14   5.0990273 24.97055  7.2934991   366.307692  1577.743590
## 2040  1996-06-15   0.6048882 25.59211  4.0651052  1034.376068  1766.316239
## 2041  1996-06-16   0.7395193 25.48902  4.2960522  1702.444444  1954.888889
## 2042  1996-06-17   0.8741504 25.38593  4.5269993   658.666667   550.000000
## 2043  1996-06-18   1.0087814 25.28284  4.7579463   439.272727   407.090909
## 2044  1996-06-19   1.1434125 25.17975  4.9888933    28.785714    96.071429
## 2045  1996-06-20   1.9112710 25.50793  5.1544826    13.096774    64.129032
## 2046  1996-06-21   1.6531187 25.78419  4.1924359   129.000000   805.625000
## 2047  1996-06-22   1.4125923 25.74264  3.6646469    47.866667   232.933333
## 2048  1996-06-23   3.1031653 25.57977  4.5734311   808.666667  4017.333333
## 2049  1996-06-24   4.7937384 25.41691  5.4822154     2.000000     2.222222
## 2050  1996-06-25   6.4843114 25.25405  6.3909996     3.872340     9.787234
## 2051  1996-06-26   8.1748844 25.09118  7.2997838    31.722222    99.166667
## 2052  1996-06-27   7.3612667 25.24249  7.2210206     7.111111    78.222222
## 2053  1996-06-28   4.8538571 25.35696  6.5550140    33.800000   165.666667
## 2054  1996-06-29   2.8080516 25.62383  5.0709365    25.419355   134.064516
## 2055  1996-06-30   1.8441488 25.80588  4.2682244    65.250000   601.214286
## 2056  1996-07-01   4.7600583 25.24538  6.0778967     5.703704    29.185185
## 2057  1996-07-02   4.3584197 25.31845  5.7577225  2241.300000  2762.500000
## 2058  1996-07-03   3.9567810 25.39151  5.4375484   619.000000  3050.000000
## 2059  1996-07-04   3.5551423 25.46458  5.1173743    16.944444   344.222222
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## 2062  1996-07-07   2.3502263 25.68377  4.1568519   414.666667  4002.666667
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## 2064  1996-07-09   1.5469489 25.82990  3.5165036     5.111111    15.166667
## 2065  1996-07-10   1.1453102 25.90296  3.1963295    12.000000     4.909091
## 2066  1996-07-11   0.7436716 25.97602  2.8761554     7.138889     6.204545
## 2067  1996-07-12   4.6440507 25.72643  4.5187476     2.277778     7.500000
## 2068  1996-07-13   8.5444299 25.47683  6.1613399     3.000000    15.722222
## 2069  1996-07-14  12.4448091 25.22723  7.8039321     5.000000    22.333333
## 2070  1996-07-15   8.3862841 25.15373  7.6324493    64.085106   648.000000
## 2071  1996-07-16   4.1722976 25.27272  6.7648986   345.111111   832.833333
## 2072  1996-07-17   2.6409488 25.82653  4.4502465   176.974910   439.287634
## 2073  1996-07-18   2.2674839 25.51925  4.7955177     8.838710    45.741935
## 2074  1996-07-19   3.3873375 25.58895  6.7818688    10.578947    39.105263
## 2075  1996-07-20   2.7812019 25.65865  6.1036013     2.000000     2.888889
## 2076  1996-07-21   2.1750663 25.72835  5.4253339     2.555556     8.888889
## 2077  1996-07-22   1.5689307 25.79804  4.7470665    11.090909     6.000000
## 2078  1996-07-23   0.9627951 25.86774  4.0687990     7.545455     4.111111
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## 2079  1996-07-24   2.1656794 25.72548  4.5899338     4.000000     2.222222
## 2080  1996-07-25   3.3685637 25.58323  5.1110686    50.909091   103.272727
## 2081  1996-07-26   4.5714480 25.44097  5.6322035     3.611111    58.944444
## 2082  1996-07-27   5.7743324 25.29871  6.1533383     2.222222     2.000000
## 2083  1996-07-28   6.9772167 25.15645  6.6744731     5.000000    10.933333
## 2084  1996-07-29   8.5528311 24.87624  7.3234669   258.553191   616.170213
## 2085  1996-07-30   7.3449640 24.82280  7.3498230     2.444444    11.000000
## 2086  1996-07-31   6.1370970 24.76935  7.3761791     2.111111     3.222222
## 2087  1996-08-01   2.1166645 25.44336  5.1442284    60.950000     4.600000
## 2088  1996-08-02   3.6122458 24.93738  7.4237325    42.105263    32.473684
## 2089  1996-08-03   1.5580333 25.68291  4.4570267    85.466667  1257.288889
## 2090  1996-08-04   1.2638851 25.67552  4.5347787    80.400000    43.600000
## 2091  1996-08-05   0.9697370 25.66814  4.6125308     4.000000     8.944444
## 2092  1996-08-06   0.6755888 25.66075  4.6902829     3.363636     9.472222
## 2093  1996-08-07   1.2118279 25.59496  4.6642679     2.727273    10.000000
## 2094  1996-08-08   1.7480670 25.52916  4.6382530     2.355556    18.933333
## 2095  1996-08-09   2.2843061 25.46337  4.6122381     4.388889     7.500000
## 2096  1996-08-10   2.8205452 25.39757  4.5862232     9.904762    30.238095
## 2097  1996-08-11   6.2854042 24.86923  7.7266233     2.000000     2.000000
## 2098  1996-08-12   0.9103562 25.58816  4.4065175    12.080000   883.680000
## 2099  1996-08-13   2.8168088 25.18438  4.9878348     2.000000     5.611111
## 2100  1996-08-14   4.7232613 24.78061  5.5691521    73.568966   766.137931
## 2101  1996-08-15   4.3611956 24.42179  7.5181556   263.444444   338.000000
## 2102  1996-08-16   3.3692929 24.67388  7.5542133     2.533333     2.000000
## 2103  1996-08-17   3.4083866 24.67100  7.5450189     2.000000    13.111111
## 2104  1996-08-18   3.4474803 24.66813  7.5358245    12.545455    22.000000
## 2105  1996-08-19   3.4865741 24.66525  7.5266301     4.666667    25.777778
## 2106  1996-08-20   3.5256678 24.66237  7.5174356     9.555556    14.000000
## 2107  1996-08-21   3.5647616 24.65949  7.5082412    18.000000    37.454545
## 2108  1996-08-22   3.6038553 24.65662  7.4990468     2.000000     2.000000
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## 2110  1996-08-24   3.6820428 24.65086  7.4806579    26.727273    27.454545
## 2111  1996-08-25   3.7211366 24.64798  7.4714635     3.333333     5.333333
## 2112  1996-08-26   3.7602303 24.64511  7.4622691     2.611111    38.555556
## 2113  1996-08-27   7.0344182 25.00007  7.7085703     2.307692     6.538462
## 2114  1996-08-28   7.8448556 25.00405  8.0517880    11.021277    23.617021
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## 2117  1996-08-31   5.9251879 24.91151  7.4813230    22.036364    11.018182
## 2118  1996-09-01   5.2535394 24.44853  8.5205909     2.000000     2.722222
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## 2121  1996-09-04   3.8897235 24.66227  7.3097502     9.818182    11.454545
## 2122  1996-09-05   3.4351182 24.73351  6.9061367     2.000000     2.111111
## 2123  1996-09-06   6.2235455 24.71051  7.5154323     8.500000     5.500000
## 2124  1996-09-07   9.0119727 24.68750  8.1247279    75.862069    18.896552
## 2125  1996-09-08   7.7924956 24.70444  8.0891071   343.000000   376.500000
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## 2128  1996-09-11   6.0608583 24.11300  8.2238979     2.962963     2.666667
## 2129  1996-09-12   7.0190470 24.09723  8.0095480   101.454545   127.272727
## 2130  1996-09-13   7.9772356 24.08146  7.7951981     3.500000     6.250000
## 2131  1996-09-14   8.9354242 24.06569  7.5808482     4.444444    43.722222
## 2132  1996-09-15   8.8416417 24.20649  7.3898294    27.818182     9.636364
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## 2133  1996-09-16   8.7478591 24.34729  7.1988106     3.750000     9.750000
## 2134  1996-09-17   8.6540765 24.48809  7.0077918     5.636364     3.636364
## 2135  1996-09-18   8.5602939 24.62889  6.8167730     5.111111    11.111111
## 2136  1996-09-19  15.6675485 24.58576  7.2255682     5.750000     8.250000
## 2137  1996-09-20  22.7748030 24.54263  7.6343633     9.063830     5.191489
## 2138  1996-09-21  14.5271848 24.51010  8.4167048     2.222222     3.333333
## 2139  1996-09-22  18.2777644 24.58426  7.8853333     5.722222    10.611111
## 2140  1996-09-23   8.1641714 24.64903  8.3776643    19.333333    13.666667
## 2141  1996-09-24  17.9138909 24.31299  7.3098745    16.888889     6.722222
## 2142  1996-09-25  30.3534917 24.31519  7.0476246    44.347826    49.347826
## 2143  1996-09-26   4.8975778 24.84229  6.5085084    18.177778   102.444444
## 2144  1996-09-27   3.0618125 24.92251  6.7823737    72.166667  1213.875000
## 2145  1996-09-28   5.4746521 24.82331  7.0030279    11.000000    90.791667
## 2146  1996-09-29   8.2229408 24.52741  7.2765663    34.909091    67.636364
## 2147  1996-09-30  10.9712295 24.23150  7.5501047    59.000000    98.500000
## 2148  1996-10-01  13.7195182 23.93560  7.8236430     5.333333     3.500000
## 2149  1996-10-02   7.0386273 24.05128  6.6505967     5.787234    16.425532
## 2150  1996-10-03   4.5161348 24.13626  6.9275230    17.750000    80.250000
## 2151  1996-10-04   1.9936424 24.22124  7.2044494     4.055556     3.500000
## 2152  1996-10-05   2.6214924 24.18962  7.0247468     3.500000     4.250000
## 2153  1996-10-06   3.2493424 24.15801  6.8450442     2.055556    17.000000
## 2154  1996-10-07   3.2760956 24.23916  7.5666262   162.042553   518.170213
## 2155  1996-10-08   3.8908370 24.33590  7.6737485     3.466667     2.000000
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## 2157  1996-10-10   3.8448970 24.44308  7.2162639     2.666667     6.722222
## 2158  1996-10-11   3.8263758 24.41810  7.1950435   106.750000    61.500000
## 2159  1996-10-12   3.8078545 24.39312  7.1738230    12.510638   106.765957
## 2160  1996-10-13   0.9100000 23.88600  6.8700000     6.250000     8.250000
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## 2162  1996-10-15   3.5131309 24.53185  6.9247063     6.250000    12.250000
## 2163  1996-10-16   3.6045576 24.59599  7.0498688     4.500000    22.444444
## 2164  1996-10-17   3.5820140 24.57165  7.1336651    18.000000    18.210526
## 2165  1996-10-18   3.5594705 24.54731  7.2174615     4.500000    10.000000
## 2166  1996-10-19   3.5369269 24.52296  7.3012578     6.181818     4.181818
## 2167  1996-10-20   3.5143833 24.49862  7.3850542     5.111111    61.333333
## 2168  1996-10-21   3.6115326 24.51541  7.4652727   167.500000    87.750000
## 2169  1996-10-22   3.7086818 24.53220  7.5454912     3.222222    14.888889
## 2170  1996-10-23   4.4480311 24.49034  7.5890938     6.851064    11.659574
## 2171  1996-10-24   3.2166119 24.54483  7.7351238     4.866667    20.933333
## 2172  1996-10-25   3.2886167 24.50195  7.2294779     5.183333    11.966667
## 2173  1996-10-26   2.7443182 24.56357  7.2097832     5.500000     3.000000
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## 2175  1996-10-28   1.6557212 24.68679  7.1703936     2.444444     4.000000
## 2176  1996-10-29   2.4899379 24.71345  7.1102488     7.500000    10.500000
## 2177  1996-10-30   3.3241545 24.74011  7.0501039    14.127660    10.340426
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## 2180  1996-11-02   2.8805333 24.86936  7.0156570    38.210526   135.052632
## 2181  1996-11-03   3.2286970 24.89738  7.0837974    19.000000    36.000000
## 2182  1996-11-04   3.5768606 24.92541  7.1519378     2.000000     2.611111
## 2183  1996-11-05   5.4084727 24.90402  8.1090355     3.153846     3.846154
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## 2185  1996-11-07   2.4293833 24.85360  7.5274212     2.074074     3.111111
## 2186  1996-11-08   4.4328881 24.88671  7.9189419     2.933333     5.866667
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## 2187  1996-11-09   4.0410507 24.96338  7.4716986    17.750000    18.250000
## 2188  1996-11-10   3.6492133 25.04004  7.0244553     6.533333    24.444444
## 2189  1996-11-11   3.1576542 25.11218  6.7231142    98.576271   569.389831
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## 2191  1996-11-13   3.4856879 24.80141  7.5939003     2.000000     2.333333
## 2192  1996-11-14   2.7207682 24.76154  7.4628470    68.000000    14.000000
## 2193  1996-11-15   1.9558485 24.72168  7.3317936    18.510638    27.361702
## 2194  1996-11-16   1.8963232 24.72223  7.4101800     5.500000     4.000000
## 2195  1996-11-17   1.8367980 24.72278  7.4885664    10.545455   112.909091
## 2196  1996-11-18   1.7772727 24.72332  7.5669527     7.661616    62.037879
## 2197  1996-11-19   2.0879303 24.78187  7.3390200     4.777778    11.166667
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## 2200  1996-11-22   4.3650818 24.89331  7.6601040     2.333333     3.888889
## 2201  1996-11-23   5.3231659 24.94141  7.7671320     8.000000     7.454545
## 2202  1996-11-24   6.2812500 24.98951  7.8741600     5.478261     9.304348
## 2203  1996-11-25   5.3818667 25.02815  7.6797206     2.666667    11.538462
## 2204  1996-11-26   5.6525810 25.03124  7.7896521     4.000000    19.866667
## 2205  1996-11-27   2.7703250 25.00773  7.2177700     5.185185    10.888889
## 2206  1996-11-28   3.0647049 24.86593  7.7763555   151.250000    68.750000
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## 2208  1996-11-30   5.2336909 24.87018  7.8292603    18.230769     4.692308
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## 2210  1996-12-02   4.4704439 24.88089  7.5755937   376.000000   376.882353
## 2211  1996-12-03   2.8765939 24.55967  8.1417067     7.272727    19.454545
## 2212  1996-12-04   3.0140960 24.56303  8.0580374     2.000000     2.000000
## 2213  1996-12-05   3.1515980 24.56640  7.9743681    21.272727   563.272727
## 2214  1996-12-06   3.2891000 24.56976  7.8906988    21.684211   434.947368
## 2215  1996-12-07   3.1010485 24.56459  7.9391817     2.000000     7.250000
## 2216  1996-12-08   2.9129970 24.55943  7.9876646    22.000000    79.090909
## 2217  1996-12-09   2.7249455 24.55426  8.0361476     2.222222     3.722222
## 2218  1996-12-10   2.8864530 24.76270  7.6447197     6.000000    13.000000
## 2219  1996-12-11   3.0479606 24.97114  7.2532918     6.765957    32.765957
## 2220  1996-12-12   2.6119532 24.95409  7.2386874     3.500000     9.000000
## 2221  1996-12-13   2.1759458 24.93703  7.2240829     2.740741     6.444444
## 2222  1996-12-14   3.9766153 24.94706  7.4295639    28.842105    20.105263
## 2223  1996-12-15   5.7772848 24.95708  7.6350448     2.888889    10.722222
## 2224  1996-12-16   3.2238583 24.64644  8.3221146     2.666667     9.629630
## 2225  1996-12-17   6.5055121 24.64977  7.5293785     6.461538    32.615385
## 2226  1996-12-18   6.6076533 24.62869  7.6114982   132.297872  1299.446809
## 2227  1996-12-19   4.7568905 24.75011  6.9999193    45.513514   788.702703
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## 2230  1996-12-22   3.7412644 25.16794  5.6077409    26.214286    60.321429
## 2231  1996-12-23   3.2612979 25.24729  5.1667000    64.208333   608.708333
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## 2233  1996-12-25   3.4306932 25.23733  5.5786611     3.000000     4.750000
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## 2235  1996-12-27   4.7854254 25.20937  6.6022630     2.000000    65.000000
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## 2239  1996-12-31   5.2324273 24.49132  8.5264991     6.000000    56.222222
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## 2250  1997-01-11   3.0725545 24.49912  7.2884127     2.425532     2.851064
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## 2269  1997-01-30   3.0410681 24.73631  6.8861713     4.545455     4.545455
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## 2271  1997-02-01   2.3677364 24.16319  8.2375048     2.000000     2.000000
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## 2273  1997-02-03   4.1997848 24.38306  7.6706503     2.896552     2.827586
## 2274  1997-02-04   4.5257159 24.45988  7.7992386    29.777778   174.611111
## 2275  1997-02-05   3.6582929 24.54767  7.6581690     2.666667    10.666667
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## 2279  1997-02-09   2.7657273 24.26787  8.0147564     5.363636     4.090909
## 2280  1997-02-10   2.6809576 24.21145  8.0063139     2.363636     2.909091
## 2281  1997-02-11   2.5961879 24.15502  7.9978715     2.265152     2.537879
## 2282  1997-02-12   3.0330939 23.97054  7.6778485     2.166667     2.166667
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## 2495  1997-09-13   2.3864818 24.59691  6.6642545     3.234043     6.425532
## 2496  1997-09-14   3.2088727 24.76234  6.4411611    22.750000    13.250000
## 2497  1997-09-15   4.0312636 24.92777  6.2180676    17.666667   228.666667
## 2498  1997-09-16   4.6734652 24.82235  6.6238183     4.181818     4.363636
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## 2618  1998-01-14   3.9613165 25.03371  5.8075734    12.421053    22.210526
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## 2709  1998-04-15   2.6083008 24.84408  7.3894702    10.363636    24.909091
## 2710  1998-04-16   2.5479754 24.84887  7.3021364     3.000000     4.750000
## 2711  1998-04-17   2.4876500 24.85366  7.2148026     3.684211     2.947368
## 2712  1998-04-18   3.1767105 24.86380  7.3643311    11.416667     9.166667
## 2713  1998-04-19   3.1181053 24.97323  7.1126200    21.250000     7.000000
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## 2717  1998-04-23   5.2088424 24.97169  7.6708655     2.045455     2.500000
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## 2722  1998-04-28   1.7835758 24.97559  7.7814282     2.333333     8.055556
## 2723  1998-04-29   1.7885141 24.97137  7.7470247     8.250000     5.000000
## 2724  1998-04-30   1.7934525 24.96716  7.7126213   719.454545   256.000000
## 2725  1998-05-01   1.7983909 24.96294  7.6782179    10.777778    17.111111
## 2726  1998-05-02   1.8917616 24.95489  7.6898499    17.600000     6.800000
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## 2729  1998-05-05   1.8121078 25.01683  7.2498393    26.000000    35.272727
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## 2742  1998-05-18  13.1349711 25.60560  7.1388833    12.085106    87.234043
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## 2746  1998-05-22   3.8402545 25.26439  6.8637915     4.045455     4.863636
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## 2922  1998-11-14   6.9817265 25.05659  7.7153198  1113.454545  1258.181818
## 2923  1998-11-15   6.4644470 25.05321  7.6968877 12000.000000 12000.000000
## 2924  1998-11-16   5.9471674 25.04984  7.6784557     2.000000     2.750000
## 2925  1998-11-17   5.4298879 25.04647  7.6600236     8.238095    30.380952
## 2926  1998-11-18   5.5518924 25.06279  7.7374012     2.000000     2.000000
## 2927  1998-11-19   5.6738970 25.07911  7.8147788  1466.545455  2358.909091
## 2928  1998-11-20   5.7959015 25.09543  7.8921564    89.454545   493.636364
## 2929  1998-11-21   5.9179061 25.11175  7.9695339     2.571429     3.476190
## 2930  1998-11-22   5.5343323 25.07303  7.8024926    95.894737   153.684211
## 2931  1998-11-23   5.1507586 25.03431  7.6354513     8.000000     2.000000
## 2932  1998-11-24   4.7671848 24.99559  7.4684100     2.095238     2.190476
## 2933  1998-11-25   4.7716485 25.38699  6.3664667     2.615385     2.769231
## 2934  1998-11-26   3.9942511 25.44135  6.1956604    30.042553    72.255319
## 2935  1998-11-27   3.5690667 25.38566  6.6867683    18.857143    33.028571
## 2936  1998-11-28   4.6577238 25.51064  5.8921102     3.133333     2.133333
## 2937  1998-11-29   8.8442271 25.54683  6.3144125     2.750000     9.000000
## 2938  1998-11-30  13.0307303 25.58302  6.7367148     2.339623     2.301887
## 2939  1998-12-01  12.6028652 25.55960  6.6921044     3.250000     6.500000
## 2940  1998-12-02  12.1750000 25.53618  6.6474939     3.724138     2.689655
## 2941  1998-12-03   8.2550022 25.66534  5.6881478     2.222222     2.666667
## 2942  1998-12-04   4.8647048 25.66268  5.7011683     2.000000     2.200000
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## 2943  1998-12-05   4.9882125 25.47955  6.0080788     2.926829     2.487805
## 2944  1998-12-06   6.1742911 25.58219  5.7198626    34.363636   101.818182
## 2945  1998-12-07   7.3603697 25.68483  5.4316464    12.600000    36.480000
## 2946  1998-12-08  11.2073909 25.63742  6.2124715     9.698113     4.641509
## 2947  1998-12-09   3.1069800 25.79714  4.8850873    26.867925    72.566038
## 2948  1998-12-10   2.4995958 25.83034  4.5670294    77.250000   235.875000
## 2949  1998-12-11   2.7730000 25.75888  5.0132440     2.083333     2.000000
## 2950  1998-12-12   5.7893909 25.44665  6.2678200     2.000000     2.428571
## 2951  1998-12-13   7.3249000 25.48117  6.1260671     4.105263     3.157895
## 2952  1998-12-14   8.8604091 25.51569  5.9843142     2.880000     2.800000
## 2953  1998-12-15  10.3959182 25.33368  6.7798148     2.909091     3.636364
## 2954  1998-12-16  11.9314273 25.15168  7.5753155     2.000000     2.238095
## 2955  1998-12-17  10.1862727 25.20870  7.1215280     2.500000     2.250000
## 2956  1998-12-18   8.4411182 25.26572  6.6677405    50.181818    62.545455
## 2957  1998-12-19   6.6959636 25.32274  6.2139530     2.380952     5.714286
## 2958  1998-12-20   8.6934697 25.34615  6.3785742     3.750000     3.750000
## 2959  1998-12-21  10.6909758 25.36957  6.5431955     2.555556     5.666667
## 2960  1998-12-22  11.4919970 25.29918  7.0623703     5.818182    13.636364
## 2961  1998-12-23  12.2930182 25.22880  7.5815452     2.000000     2.444444
## 2962  1998-12-24   5.6870417 25.11083  6.8292250     2.000000     2.787879
## 2963  1998-12-25   7.9934048 25.24552  6.8459557     2.421053     2.052632
## 2964  1998-12-26   5.8362145 25.03382  6.7620224     5.272727     5.636364
## 2965  1998-12-27   3.6790242 24.82213  6.6780891     4.640000     5.040000
## 2966  1998-12-28   4.4674515 24.98200  6.3258573    13.924528    24.452830
## 2967  1998-12-29   7.0557258 25.32044  5.8590239     2.000000     3.750000
## 2968  1998-12-30   9.6440000 25.65887  5.3921906     2.444444     2.666667
## 2969  1998-12-31  13.0603111 25.54488  6.1063110    31.894737    55.789474
## 2970  1999-01-01  16.4766222 25.43089  6.8204313     2.388889     2.277778
## 2971  1999-01-02   7.5988143 25.53510  5.9417345     2.200000     3.133333
## 2972  1999-01-03  15.9182250 25.30776  6.8813433     2.181818     7.757576
## 2973  1999-01-04  12.9692460 25.11790  7.0579632     2.500000     4.500000
## 2974  1999-01-05  10.0202669 24.92804  7.2345831     6.181818    11.454545
## 2975  1999-01-06   7.0712879 24.73818  7.4112030     2.000000     2.333333
## 2976  1999-01-07   6.3807505 24.84534  7.1197218     2.000000     2.000000
## 2977  1999-01-08   5.6902131 24.95250  6.8282406    10.363636    20.909091
## 2978  1999-01-09   4.9996758 25.05965  6.5367594     2.000000     2.428571
## 2979  1999-01-10   7.4699773 24.63529  7.4934030     5.000000     5.750000
## 2980  1999-01-11   9.9402788 24.21092  8.4500467     2.142857     2.952381
## 2981  1999-01-12   9.5549384 24.31833  7.9600139     9.090909    36.545455
## 2982  1999-01-13   9.1695980 24.42574  7.4699812     2.000000    10.250000
## 2983  1999-01-14   8.7842576 24.53314  6.9799485     3.000000     4.380952
## 2984  1999-01-15   6.0321061 24.70213  6.2550918     2.909091     4.000000
## 2985  1999-01-16   3.2799545 24.87112  5.5302352     2.666667     4.523810
## 2986  1999-01-17   3.0575551 25.04010  5.9739572     9.250000    10.250000
## 2987  1999-01-18   2.8351556 25.20909  6.4176793    26.750000   212.321429
## 2988  1999-01-19   1.7776042 25.23973  6.3031917    93.178571   572.857143
## 2989  1999-01-20   1.9048250 25.25107  6.4280906    21.500000   106.875000
## 2990  1999-01-21   4.8314424 24.45518  7.6473897     2.142857     3.000000
## 2991  1999-01-22   5.9559939 24.81915  8.2286815     2.000000     2.111111
## 2992  1999-01-23   8.5819444 24.94814  7.0606033    11.636364    29.309091
## 2993  1999-01-24   4.5044119 25.06967  7.1625243     2.000000     2.266667
## 2994  1999-01-25   2.8121125 24.76048  6.8111250     2.000000     2.000000
## 2995  1999-01-26   3.9835033 24.65794  7.1481755     4.000000    13.750000
## 2996  1999-01-27   5.1548941 24.55540  7.4852259     2.000000     4.363636
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## 2997  1999-01-28   6.3262848 24.45286  7.8222764     2.380952     6.714286
## 2998  1999-01-29   6.6972000 24.48822  7.4351432     5.250000     7.250000
## 2999  1999-01-30   7.0681152 24.52359  7.0480100     2.226415     2.981132
## 3000  1999-01-31   4.4689939 24.27497  7.7990042     4.560000     5.880000
## 3001  1999-02-01   4.8554357 24.59875  8.1081095     4.731707     3.804878
## 3002  1999-02-02   8.5573911 24.46105  8.6357696     2.000000     2.000000
## 3003  1999-02-03   3.7548333 24.23202  7.5886283     2.606061     3.636364
## 3004  1999-02-04   7.7677424 24.62415  8.5813288     3.384615     3.384615
## 3005  1999-02-05   6.7868152 24.59366  8.2159276     2.363636     3.090909
## 3006  1999-02-06   5.8058879 24.56316  7.8505264     2.809524    12.904762
## 3007  1999-02-07   5.3809591 24.55354  7.5816814     2.000000     2.000000
## 3008  1999-02-08   4.9560303 24.54392  7.3128364     4.188679     7.132075
## 3009  1999-02-09   4.4941152 24.48688  7.4155726    36.500000    64.000000
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## 3011  1999-02-11   4.3280939 24.37364  7.7892187     2.736842    11.789474
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## 3013  1999-02-13   4.9198818 24.26128  8.3310386    10.727273     5.090909
## 3014  1999-02-14   5.2157758 24.20509  8.6019485     2.190476     2.857143
## 3015  1999-02-15   5.9877545 24.36531  8.6392964     3.250000     3.250000
## 3016  1999-02-16   6.7597333 24.52552  8.6766442     6.127660    23.957447
## 3017  1999-02-17   4.4911250 24.25489  7.9888879     2.606061     2.484848
## 3018  1999-02-18   5.7798310 24.56898  8.5351667    39.066667     6.933333
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## 3020  1999-02-20   8.1039106 24.51530  8.1503973     8.750000    19.750000
## 3021  1999-02-21   4.5500667 24.54566  7.8423276     2.285714     5.238095
## 3022  1999-02-22   4.2316667 24.46139  7.6859728    68.000000    20.181818
## 3023  1999-02-23   3.9132667 24.37712  7.5296181    14.750000    19.000000
## 3024  1999-02-24   3.5948667 24.29286  7.3732633     2.190476     3.238095
## 3025  1999-02-25   3.7420222 24.36917  7.2354776     8.181818     5.636364
## 3026  1999-02-26   3.8891778 24.44548  7.0976918     3.000000    10.000000
## 3027  1999-02-27   4.0363333 24.52179  6.9599061     5.095238     9.047619
## 3028  1999-02-28   3.7211258 24.50595  7.1964088    10.000000     4.631579
## 3029  1999-03-01   3.4059182 24.49010  7.4329115     2.190476     2.095238
## 3030  1999-03-02   2.2346867 24.71136  7.5647764    17.155556   164.088889
## 3031  1999-03-03   2.1627208 24.79057  7.4697775     8.298507   106.567164
## 3032  1999-03-04   2.3237125 24.85481  7.2445417     2.000000     2.000000
## 3033  1999-03-05   2.2342909 23.94426  6.8044406     2.047619     2.190476
## 3034  1999-03-06   4.6454758 24.59134  7.8762533     4.538462     3.076923
## 3035  1999-03-07   5.0218089 24.72591  7.8272658   186.170213   290.425532
## 3036  1999-03-08   4.8209214 24.66895  8.4035588    16.733333    59.866667
## 3037  1999-03-09   2.8512333 24.57672  7.1423146     2.000000     2.181818
## 3038  1999-03-10   2.6730293 24.53651  7.1836704    47.000000     8.000000
## 3039  1999-03-11   2.4948253 24.49630  7.2250263     2.000000     2.000000
## 3040  1999-03-12   2.3166212 24.45608  7.2663821     2.000000     2.000000
## 3041  1999-03-13   2.3651985 24.50886  7.1871244     4.250000     7.250000
## 3042  1999-03-14   2.4137758 24.56163  7.1078667     3.849057     6.301887
## 3043  1999-03-15   2.8679530 24.42659  7.3084027    11.000000    19.250000
## 3044  1999-03-16   3.3221303 24.29155  7.5089388     2.000000     2.619048
## 3045  1999-03-17   4.7368600 24.29102  8.1988040     2.944444     7.555556
## 3046  1999-03-18   3.5643955 24.44155  7.9873213   152.909091    93.454545
## 3047  1999-03-19   2.3919310 24.59208  7.7758386   518.774194    75.483871
## 3048  1999-03-20   2.9885208 24.41137  7.0987042     2.146341     3.121951
## 3049  1999-03-21   3.7462576 24.66188  7.3814279     2.333333     2.000000
## 3050  1999-03-22   2.6455970 24.59381  6.4852518    11.147541    12.360656
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## 3051  1999-03-23   0.7700000 23.91900  6.6400000     6.645199     7.466042
## 3052  1999-03-24   3.4989152 24.66768  6.5626379     2.142857     2.571429
## 3053  1999-03-25   3.0751409 24.58607  6.7124065     3.052632     2.421053
## 3054  1999-03-26   2.6513667 24.50445  6.8621752     2.680000     3.280000
## 3055  1999-03-27   3.3684566 24.50849  7.1314489     9.818182    15.636364
## 3056  1999-03-28   4.0855465 24.51254  7.4007226    36.750000    25.500000
## 3057  1999-03-29   4.8026364 24.51658  7.6699964    29.111111    15.111111
## 3058  1999-03-30   4.6700089 24.58846  7.6299062    78.425532   521.234043
## 3059  1999-03-31   3.3642956 24.66464  7.6307887     7.090909    52.666667
## 3060  1999-04-01   2.1221958 24.46667  6.5815658     2.060606     3.151515
## 3061  1999-04-02   2.3765376 24.50169  6.7194296    10.000000    10.000000
## 3062  1999-04-03   2.6308794 24.53670  6.8572935    10.909091    36.727273
## 3063  1999-04-04   2.8852212 24.57171  6.9951573     3.047619     2.285714
## 3064  1999-04-05   2.7654394 24.63176  6.9933647    26.000000    25.500000
## 3065  1999-04-06   2.6456576 24.69180  6.9915721  1137.471698   498.754717
## 3066  1999-04-07   2.5130505 24.65883  7.0198678  8266.666667  5186.666667
## 3067  1999-04-08   2.3804434 24.62585  7.0481634   750.500000   130.750000
## 3068  1999-04-09   2.2478364 24.59288  7.0764591   248.142857   159.809524
## 3069  1999-04-10   2.5048833 24.64645  6.8416573   290.000000    58.000000
## 3070  1999-04-11   2.7619303 24.70001  6.6068555   107.047619    24.571429
## 3071  1999-04-12   2.9810056 24.73754  6.7941951  5070.000000  4900.000000
## 3072  1999-04-13   3.2000810 24.77506  6.9815347  2722.181818  3294.181818
## 3073  1999-04-14   3.4191563 24.81259  7.1688743    19.750000    11.000000
## 3074  1999-04-15   3.6382316 24.85011  7.3562139   139.090909   434.727273
## 3075  1999-04-16   3.8573069 24.88764  7.5435535   370.000000  5600.000000
## 3076  1999-04-17   4.0763823 24.92517  7.7308931     3.750000    21.000000
## 3077  1999-04-18   4.2954576 24.96269  7.9182327   448.068966   610.413793
## 3078  1999-04-19   3.4610089 24.96529  7.7982338    84.550000   690.300000
## 3079  1999-04-20   2.9724500 25.02584  7.3823621    21.066667    53.200000
## 3080  1999-04-21   2.2499909 25.02087  6.7698748     5.523810    17.095238
## 3081  1999-04-22   3.3141172 25.00113  6.9376865     7.000000     2.750000
## 3082  1999-04-23   4.3782434 24.98140  7.1054981    69.090909  1064.545455
## 3083  1999-04-24   5.4423697 24.96166  7.2733097    26.511628   249.209302
## 3084  1999-04-25   4.8661583 24.93160  7.3090424    16.666667   303.333333
## 3085  1999-04-26   4.2899468 24.90154  7.3447752     8.500000     4.750000
## 3086  1999-04-27   3.7137354 24.87147  7.3805079   548.545455  1661.636364
## 3087  1999-04-28   3.1375239 24.84141  7.4162406  1211.000000  6013.000000
## 3088  1999-04-29   2.5613125 24.81135  7.4519733     2.363636     3.333333
## 3089  1999-04-30   2.4999381 24.78550  7.2688197    52.500000    26.000000
## 3090  1999-05-01   2.4385636 24.75965  7.0856661     2.285714     2.476190
## 3091  1999-05-02   2.6152384 24.83425  7.0639174   104.727273   750.181818
## 3092  1999-05-03   2.7919131 24.90884  7.0421687     8.000000    10.000000
## 3093  1999-05-04   2.9685879 24.98344  7.0204200     2.714286     4.761905
## 3094  1999-05-05   9.4389244 25.00475  7.5124624   109.888889   475.944444
## 3095  1999-05-06   5.8184810 25.06534  7.2096798    95.073171   296.000000
## 3096  1999-05-07   6.8338000 25.00222  7.4441807    37.500000    64.125000
## 3097  1999-05-08   4.9701917 24.92189  7.6530316    30.500000     7.750000
## 3098  1999-05-09   3.1065833 24.84155  7.8618825     8.242424     2.424242
## 3099  1999-05-10   1.6677208 25.20554  6.0918944   274.881356   238.237288
## 3100  1999-05-11   2.2692364 24.91271  6.9000455   244.078431   240.470588
## 3101  1999-05-12   1.7851583 25.28541  5.9592365     6.750000    56.500000
## 3102  1999-05-13   1.9980844 25.27846  5.8634913     2.622222     2.133333
## 3103  1999-05-14   3.7650697 24.92806  7.3982164  1074.918033   849.049180
## 3104  1999-05-15   3.5445167 24.94199  7.3526782   254.727273  1016.545455
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## 3105  1999-05-16   3.3239636 24.95592  7.3071400     8.720000    26.400000
## 3106  1999-05-17   3.4270273 24.98417  7.1791968  1768.000000  1250.000000
## 3107  1999-05-18   3.5300909 25.01243  7.0512535 12000.000000 12000.000000
## 3108  1999-05-19   3.6331545 25.04068  6.9233103     3.428571     4.809524
## 3109  1999-05-20   4.4299039 25.16869  6.4333884     2.000000     8.750000
## 3110  1999-05-21   5.2266533 25.29669  5.9434664    34.388889   505.055556
## 3111  1999-05-22   5.1019481 25.32374  5.9125223  1138.363636  2624.363636
## 3112  1999-05-23   4.9772429 25.35079  5.8815781   248.727273   538.969697
## 3113  1999-05-24   3.5747667 25.17833  6.1149550     2.424242     2.303030
## 3114  1999-05-25   7.5056030 25.41339  5.7879912     6.000000     9.222222
## 3115  1999-05-26   7.1761674 25.36542  6.0573344     6.000000     5.250000
## 3116  1999-05-27   6.8467318 25.31744  6.3266776    22.727273    47.818182
## 3117  1999-05-28   6.5172962 25.26947  6.5960208     2.500000     4.250000
## 3118  1999-05-29   6.1878606 25.22149  6.8653639     2.761905     9.761905
## 3119  1999-05-30   5.6528788 25.27391  6.5843688     3.698113     5.018868
## 3120  1999-05-31   7.9246636 25.09554  7.2676195     7.250000     3.750000
## 3121  1999-06-01  10.1964485 24.91716  7.9508703     2.285714     2.047619
## 3122  1999-06-02  10.5489374 24.99008  7.7997749    21.636364    18.545455
## 3123  1999-06-03  10.9014263 25.06299  7.6486796     4.750000     3.500000
## 3124  1999-06-04  11.2539152 25.13591  7.4975842     2.190476     2.571429
## 3125  1999-06-05   8.5842576 25.02115  7.9289803     9.500000    28.500000
## 3126  1999-06-06   5.9146000 24.90640  8.3603764     3.358491     4.792453
## 3127  1999-06-07   5.9060788 25.03061  6.7217997     2.000000     3.076923
## 3128  1999-06-08   5.3525786 25.12154  6.4208505     4.780488    10.926829
## 3129  1999-06-09   5.6045956 25.03193  6.4250362    89.111111   285.722222
## 3130  1999-06-10   2.9519583 25.13137  6.5708279     2.666667     3.272727
## 3131  1999-06-11   2.8182998 25.19743  6.4449375     2.500000     4.500000
## 3132  1999-06-12   2.6846413 25.26350  6.3190470  1288.363636  2480.727273
## 3133  1999-06-13   2.5509828 25.32956  6.1931565    10.666667    41.333333
## 3134  1999-06-14   2.4173242 25.39563  6.0672661     2.761905     4.285714
## 3135  1999-06-15   5.7414924 25.37340  6.5567109     2.000000     2.000000
## 3136  1999-06-16   9.0656606 25.35118  7.0461558     2.226415     8.000000
## 3137  1999-06-17   8.2174758 25.15516  7.6483395     3.750000     5.000000
## 3138  1999-06-18   7.3692909 24.95914  8.2505233     2.047619     2.142857
## 3139  1999-06-19   6.2706646 25.06993  7.1589788    30.909091    46.181818
## 3140  1999-06-20   5.1720384 25.18073  6.0674342     4.750000    12.000000
## 3141  1999-06-21   4.0734121 25.29152  4.9758897     2.571429     2.619048
## 3142  1999-06-22   2.7591133 25.57372  4.7789031     2.088889     2.711111
## 3143  1999-06-23   2.2644083 25.66112  4.5325800    50.125000   672.041667
## 3144  1999-06-24   2.1869042 25.69094  4.2888258     9.552239    92.238806
## 3145  1999-06-25  11.7470182 25.28675  5.6097824     3.523810     4.190476
## 3146  1999-06-26  17.9609422 24.91884  7.6552380     2.055556     2.444444
## 3147  1999-06-27  13.6748842 24.99476  7.1186452    10.105263     6.315789
## 3148  1999-06-28   9.3888262 25.07067  6.5820524     2.266667     2.733333
## 3149  1999-06-29   9.9177722 24.71375  7.0511779     4.121212    33.090909
## 3150  1999-06-30  10.4467182 24.63418  7.5203033     2.000000     2.333333
## 3151  1999-07-01   8.5435162 24.75805  6.8194831     2.000000     2.750000
## 3152  1999-07-02   6.6403141 24.88192  6.1186629     2.909091     8.363636
## 3153  1999-07-03   4.7371121 25.00579  5.4178427    70.809524     7.380952
## 3154  1999-07-04   4.7242909 25.02148  5.3654815     4.000000     6.000000
## 3155  1999-07-05   4.7114697 25.03718  5.3131203    18.716981     4.566038
## 3156  1999-07-06   3.9821970 25.03138  5.5117431     2.000000     2.500000
## 3157  1999-07-07   3.2529242 25.02559  5.7103660     2.181818     4.545455
## 3158  1999-07-08   2.5236515 25.01979  5.9089888     2.095238     4.142857
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## 3159  1999-07-09   6.2039846 25.08661  6.1334578     6.750000     9.250000
## 3160  1999-07-10   9.8843178 25.15343  6.3579269    17.333333    65.055556
## 3161  1999-07-11   6.9848881 24.98139  6.6383428    10.181818     7.272727
## 3162  1999-07-12   4.0854583 24.80935  6.9187588    12.545455     2.121212
## 3163  1999-07-13   5.5427429 25.06275  6.6828681     5.052632    19.789474
## 3164  1999-07-14  11.1702273 25.06460  6.6894206     2.000000     2.000000
## 3165  1999-07-15   3.8425182 24.60757  6.7412561     5.433962    10.301887
## 3166  1999-07-16   6.3456212 24.61830  6.6966356     2.250000     2.000000
## 3167  1999-07-17   8.8487242 24.62902  6.6520152   862.190476     5.000000
## 3168  1999-07-18   6.4938439 24.72553  6.2486130    42.526316     5.157895
## 3169  1999-07-19   4.1389636 24.82203  5.8452109    48.428571     5.095238
## 3170  1999-07-20   4.6145313 24.91699  5.7413545     2.500000     3.000000
## 3171  1999-07-21   5.0900990 25.01195  5.6374982     2.000000     2.181818
## 3172  1999-07-22   5.5656667 25.10690  5.5336418    17.571429     2.761905
## 3173  1999-07-23   8.8610356 25.18849  6.0222605     2.750000     2.750000
## 3174  1999-07-24  12.1564044 25.27007  6.5108791    28.222222    56.444444
## 3175  1999-07-25  12.1197367 25.15372  6.7551079     3.545455     2.500000
## 3176  1999-07-26  12.0830690 25.03736  6.9993367     2.000000     2.933333
## 3177  1999-07-27  14.3809939 24.88410  7.8139461     2.444444     5.666667
## 3178  1999-07-28  11.5623747 24.76936  7.7470507     8.500000     6.750000
## 3179  1999-07-29   8.7437556 24.65462  7.6801554    18.000000    76.727273
## 3180  1999-07-30   5.9251364 24.53988  7.6132600     2.857143     2.333333
## 3181  1999-07-31   4.9972197 24.47863  7.5651779     5.000000     2.000000
## 3182  1999-08-01   4.0693030 24.41738  7.5170958     2.000000     2.000000
## 3183  1999-08-02   4.9732048 24.32697  7.4509712    36.727273    16.545455
## 3184  1999-08-03   5.8771067 24.23656  7.3848465     9.250000     5.500000
## 3185  1999-08-04   6.7810085 24.14615  7.3187219    15.090909     4.363636
## 3186  1999-08-05   7.6849103 24.05574  7.2525973   177.250000     3.500000
## 3187  1999-08-06   8.5888121 23.96533  7.1864727     4.000000     9.190476
## 3188  1999-08-07   1.7749622 24.91661  6.0104562     6.755556    39.200000
## 3189  1999-08-08   1.7952051 25.02593  5.8486901     4.842105     9.368421
## 3190  1999-08-09   1.8154479 25.13526  5.6869240    11.333333    53.875000
## 3191  1999-08-10   2.2702604 25.11809  5.8274950    10.875000   121.000000
## 3192  1999-08-11   4.7365515 24.65564  6.4622567    13.761905     2.428571
## 3193  1999-08-12   9.3571978 24.70142  7.4099982    43.045455   180.272727
## 3194  1999-08-13   9.6707810 24.68170  7.5098417     4.390244     3.853659
## 3195  1999-08-14   9.0899000 24.63511  7.3910233     2.111111     2.000000
## 3196  1999-08-15   2.8612708 24.26395  6.2195162    12.787879     4.303030
## 3197  1999-08-16   2.8916775 24.28567  6.2338420     2.000000     2.750000
## 3198  1999-08-17   2.9220842 24.30740  6.2481678     9.090909     6.000000
## 3199  1999-08-18   2.9524909 24.32912  6.2624936    12.190476     3.190476
## 3200  1999-08-19   2.9242545 24.27066  6.3218753    14.000000    11.000000
## 3201  1999-08-20   2.8960182 24.21220  6.3812570     3.471698     2.716981
## 3202  1999-08-21   3.2805561 24.21182  6.5707177     8.000000    11.250000
## 3203  1999-08-22   3.6650939 24.21144  6.7601785    15.190476     7.095238
## 3204  1999-08-23   3.2691788 24.13615  6.9140298     2.727273     3.818182
## 3205  1999-08-24   2.8732636 24.06085  7.0678811     5.750000    13.750000
## 3206  1999-08-25   2.4773485 23.98556  7.2217324     2.333333     3.904762
## 3207  1999-08-26   3.0813561 23.88328  7.0316476    19.090909     8.727273
## 3208  1999-08-27   3.6853636 23.78099  6.8415627    33.160000     5.840000
## 3209  1999-08-28   3.7621583 24.50410  6.4785487     8.307692     3.384615
## 3210  1999-08-29   7.0484119 24.57002  7.5076786   132.722222   197.722222
## 3211  1999-08-30   7.6253667 24.43704  7.6109222    27.619048     7.619048
## 3212  1999-08-31   2.6708143 24.34993  7.2888545     2.000000     2.000000
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## 3213  1999-09-01   3.9451636 24.29965  7.0370824     4.440000     4.200000
## 3214  1999-09-02   3.3681045 24.25166  7.0232305    11.636364     9.636364
## 3215  1999-09-03   2.7910455 24.20367  7.0093785     5.280000     2.280000
## 3216  1999-09-04   2.4747197 24.22078  6.9022850     4.909091     9.090909
## 3217  1999-09-05   2.1583939 24.23789  6.7951915    16.080000     7.160000
## 3218  1999-09-06   4.4540644 24.41706  7.5552547     3.666667     7.555556
## 3219  1999-09-07   3.1750714 24.47113  7.4468110     4.000000     2.536585
## 3220  1999-09-08   4.2594333 24.27836  7.3997130    10.777778    14.111111
## 3221  1999-09-09   2.6196833 24.20255  6.6471554   167.951220    17.707317
## 3222  1999-09-10   2.9856235 24.14553  6.5346579     2.000000     2.000000
## 3223  1999-09-11   3.3515636 24.08852  6.4221603     6.720000     5.000000
## 3224  1999-09-12   2.6681970 24.13518  6.3902398    13.090909     3.090909
## 3225  1999-09-13   1.9848303 24.18185  6.3583194     6.680000     4.440000
## 3226  1999-09-14   2.3135939 24.11965  6.3815767     4.327869     2.819672
## 3227  1999-09-15   2.4574870 24.50970  6.5771559     4.000000    14.000000
## 3228  1999-09-16   2.6013800 24.89976  6.7727351     5.018868     8.037736
## 3229  1999-09-17   2.4440265 24.93490  6.7066167     8.363636     3.454545
## 3230  1999-09-18   2.2866729 24.97004  6.6404983    23.875000   273.833333
## 3231  1999-09-19   2.3229458 24.86947  6.8460927     2.625000     2.458333
## 3232  1999-09-20   3.3075121 24.51421  8.3514239     2.904762     2.142857
## 3233  1999-09-21   7.2711222 24.58227  7.5247200     4.181818    11.954545
## 3234  1999-09-22   4.8642571 24.67565  7.4008819     4.341463     3.121951
## 3235  1999-09-23   6.5645091 24.73476  7.1449952     2.000000     2.222222
## 3236  1999-09-24   1.7669333 24.37823  7.9564950     3.212121     2.181818
## 3237  1999-09-25   0.7000000 23.93200  6.6600000     4.250000     7.500000
## 3238  1999-09-26   1.3778212 24.19970  7.3600700    38.545455     4.727273
## 3239  1999-09-27   2.0556424 24.46740  8.0601400     2.428571     3.619048
## 3240  1999-09-28   2.1505606 24.42898  8.1198752     8.000000     5.250000
## 3241  1999-09-29   2.2454788 24.39055  8.1796103     3.773585    11.207547
## 3242  1999-09-30   2.2495864 24.46346  7.9767085     3.250000     3.000000
## 3243  1999-10-01   2.2536939 24.53636  7.7738067    23.047619    11.571429
## 3244  1999-10-02   2.3008311 24.55392  7.8512193    52.363636  1327.090909
## 3245  1999-10-03   2.3479682 24.57148  7.9286320    26.000000  1200.000000
## 3246  1999-10-04   2.3951053 24.58904  8.0060446     7.500000     8.500000
## 3247  1999-10-05   2.4422424 24.60660  8.0834573    32.000000     3.904762
## 3248  1999-10-06   2.2383936 24.60983  8.0289548     4.000000     2.000000
## 3249  1999-10-07   2.0345447 24.61305  7.9744524  6515.090909  2584.545455
## 3250  1999-10-08   1.8306958 24.61628  7.9199500   600.083333   440.833333
## 3251  1999-10-09   0.6685095 24.66991  7.1042048    47.400000    18.666667
## 3252  1999-10-10   0.7062697 24.80313  7.0999706    27.111111     5.888889
## 3253  1999-10-11   2.6390818 24.59230  7.9973888    37.142857     6.333333
## 3254  1999-10-12   2.3993205 24.61144  7.9196114     2.000000     2.000000
## 3255  1999-10-13   2.1595591 24.63058  7.8418339   809.157895   565.263158
## 3256  1999-10-14   1.9197977 24.64971  7.7640565    50.666667    80.000000
## 3257  1999-10-15   1.6800364 24.66885  7.6862791     2.619048     3.095238
## 3258  1999-10-16   3.0646422 24.70389  7.0330869    59.888889    38.500000
## 3259  1999-10-17   3.0021841 24.72541  7.2435718  1754.000000     7.250000
## 3260  1999-10-18   2.9397259 24.74692  7.4540566   176.727273   215.090909
## 3261  1999-10-19   2.8772678 24.76843  7.6645415     3.000000     2.000000
## 3262  1999-10-20   2.8148097 24.78995  7.8750263    16.000000     5.500000
## 3263  1999-10-21   2.7523515 24.81146  8.0855112     2.000000     2.000000
## 3264  1999-10-22   2.3997174 24.80717  8.0602556   167.636364   268.363636
## 3265  1999-10-23   2.0470833 24.80288  8.0350000     2.121212     2.060606
## 3266  1999-10-24   6.9988889 24.80102  7.6097778   288.893617   350.723404
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## 3267  1999-10-25   4.0692857 24.74950  7.4385714     4.580645     3.548387
## 3268  1999-10-26   7.1803030 24.80597  7.6936364     8.444444     4.555556
## 3269  1999-10-27   3.1360606 24.71891  8.3166667    11.698113     3.433962
## 3270  1999-10-28   2.3387879 24.67717  8.0803030  5457.454545  1874.000000
## 3271  1999-10-29   1.5415152 24.63542  7.8439394    97.904762    12.952381
## 3272  1999-10-30   1.7550000 24.64309  7.8348485  4336.666667  5340.000000
## 3273  1999-10-31   1.9684848 24.65076  7.8257576    15.857143    11.571429
## 3274  1999-11-01   2.8645455 24.67767  7.8839394     9.904762     5.238095
## 3275  1999-11-02   2.7789091 24.68412  7.9800606   379.090909   262.727273
## 3276  1999-11-03   2.6932727 24.69058  8.0761818   180.000000   260.000000
## 3277  1999-11-04   2.6076364 24.69703  8.1723030  1674.000000  2731.454545
## 3278  1999-11-05   2.5220000 24.70348  8.2684242  9666.666667  9266.666667
## 3279  1999-11-06   2.4363636 24.70994  8.3645455    28.952381    32.476190
## 3280  1999-11-07   2.4887879 24.74158  7.6433333   166.385281   203.965368
## 3281  1999-11-08   2.4542424 24.68220  7.8371212   303.818182   375.454545
## 3282  1999-11-09   2.4196970 24.62282  8.0309091     4.363636    19.363636
## 3283  1999-11-10   3.8462929 24.63973  7.8997879     4.000000    46.000000
## 3284  1999-11-11   5.2728889 24.65664  7.7686667   558.680851   629.872340
## 3285  1999-11-12   2.3233333 24.71579  7.4427273    86.888889   304.444444
## 3286  1999-11-13   3.6169048 24.80760  7.2550000    45.444444   153.611111
## 3287  1999-11-14   3.8578788 24.86733  7.0166667     4.000000     2.777778
## 3288  1999-11-15   1.8085714 24.85850  7.0000000     5.708333    14.680556
## 3289  1999-11-16   1.5770833 25.16996  6.1635417     7.416667    26.583333
## 3290  1999-11-17   2.1231111 25.04873  6.4988889    76.392857   215.285714
## 3291  1999-11-18   4.8781818 24.90003  6.8890909    10.190476    15.190476
## 3292  1999-11-19  10.0054545 24.77424  7.6863636   282.000000   327.888889
## 3293  1999-11-20   6.4912689 24.88550  7.2571402   230.000000   310.000000
## 3294  1999-11-21   2.9770833 24.99675  6.8279167     2.303030     4.181818
## 3295  1999-11-22   1.2783333 25.47779  5.3387500    10.227273    40.066919
## 3296  1999-11-23   3.0288095 25.50569  5.5550000    18.151515    75.952020
## 3297  1999-11-24   4.0651515 25.39991  6.0227273    26.075758   111.837121
## 3298  1999-11-25   3.5166667 25.41200  6.3002222    34.000000   147.722222
## 3299  1999-11-26   6.9524242 25.05485  7.8751515   107.619048     4.904762
## 3300  1999-11-27   5.5262121 25.02582  7.6398485   188.000000  1538.666667
## 3301  1999-11-28   4.1000000 24.99679  7.4045455     2.000000     2.476190
## 3302  1999-11-29   5.8736364 25.22942  6.4393939     7.476190    32.476190
## 3303  1999-11-30   6.8792424 25.17330  6.4250000     2.000000   140.000000
## 3304  1999-12-01   7.8848485 25.11718  6.4106061     2.142857     3.761905
## 3305  1999-12-02   7.5893939 25.00097  7.1278788     2.190476     3.380952
## 3306  1999-12-03   4.3163636 25.41394  6.0927273     2.047619     5.238095
## 3307  1999-12-04   6.2890909 25.32352  6.4245455     2.523810    30.119048
## 3308  1999-12-05   6.1746970 25.38000  6.3912121     3.000000    55.000000
## 3309  1999-12-06   6.0603030 25.43648  6.3578788     2.380952     5.523810
## 3310  1999-12-07   6.1054640 25.53270  5.7737311     2.500000     7.250000
## 3311  1999-12-08   6.1506250 25.62892  5.1895833    52.610169   126.000000
## 3312  1999-12-09   8.5944444 25.47831  5.8386667     2.042553     2.936170
## 3313  1999-12-10   4.5916667 25.54204  5.1883333    13.500000   188.333333
## 3314  1999-12-11   9.5566667 24.93067  8.1248485    33.476190     2.190476
## 3315  1999-12-12  14.3445238 25.10477  7.0111147     8.750000     5.000000
## 3316  1999-12-13  19.1323810 25.27888  5.8973810     2.133333     2.066667
## 3317  1999-12-14  15.9603030 25.29833  5.9872727     2.896552     5.724138
## 3318  1999-12-15  14.3995556 25.34467  5.3273333     2.222222     2.944444
## 3319  1999-12-16   6.4208333 25.25825  5.8891667     2.303030     2.848485
## 3320  1999-12-17   7.7223864 25.11229  6.6494318     4.250000     2.000000
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## 3321  1999-12-18   9.0239394 24.96633  7.4096970     7.360000    17.040000
## 3322  1999-12-19   7.3033333 25.08477  6.9456566    88.000000    54.000000
## 3323  1999-12-20   5.5827273 25.20320  6.4816162     2.750000     2.750000
## 3324  1999-12-21   3.8621212 25.32164  6.0175758     5.952381    32.095238
## 3325  1999-12-22   5.3537157 25.30858  5.9427489    12.181818    14.545455
## 3326  1999-12-23   6.8453102 25.29553  5.8679221     3.750000     2.500000
## 3327  1999-12-24   8.3369048 25.28248  5.7930952     4.040816    39.714286
## 3328  1999-12-25  12.8128889 25.02876  6.8842222    82.055556   310.833333
## 3329  1999-12-26  16.8081818 24.82039  7.7690909    19.666667    48.222222
## 3330  1999-12-27  14.2308333 24.54512  9.0687500     3.151515    15.696970
## 3331  1999-12-28  13.1163131 24.46144  8.7362374     2.000000     3.500000
## 3332  1999-12-29  12.0017929 24.37775  8.4037247   102.363636    66.000000
## 3333  1999-12-30  10.8872727 24.29406  8.0712121     2.000000     2.190476
## 3334  1999-12-31   9.0808081 24.37185  7.7450505     3.250000     2.500000
## 3335  2000-01-01   7.2743434 24.44964  7.4188889     4.545455     9.272727
## 3336  2000-01-02   5.4678788 24.52742  7.0927273     2.000000     2.095238
## 3337  2000-01-03   5.5381818 24.61176  7.0369697    14.500000     2.750000
## 3338  2000-01-04   5.6084848 24.69609  6.9812121     2.490566     4.113208
## 3339  2000-01-05   8.3860606 24.83506  7.2675758     2.250000     3.000000
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## 3344  2000-01-10   8.4650505 24.94688  6.9366667     3.500000     2.250000
## 3345  2000-01-11   8.7466667 25.07624  6.4372727     2.142857     2.000000
## 3346  2000-01-12   6.2803030 25.22015  6.3196970     2.000000     2.000000
## 3347  2000-01-13   2.2869048 25.35288  6.3930952    31.102041    61.632653
## 3348  2000-01-14   4.6591111 25.42604  6.1073333   290.944444   569.500000
## 3349  2000-01-15   5.1827407 25.11533  6.5819596     2.750000     2.500000
## 3350  2000-01-16   5.7063704 24.80462  7.0565859    28.181818    71.636364
## 3351  2000-01-17   6.2300000 24.49391  7.5312121     2.523810     2.571429
## 3352  2000-01-18   4.7733333 24.61608  7.1862500     2.000000     2.181818
## 3353  2000-01-19   4.6943939 24.78710  7.1564583     2.000000     2.000000
## 3354  2000-01-20   4.6154545 24.95812  7.1266667     4.452830    11.358491
## 3355  2000-01-21  12.6665152 25.12632  7.0475758    14.250000     5.500000
## 3356  2000-01-22  20.7175758 25.29452  6.9684848     7.444444    29.000000
## 3357  2000-01-23  10.2307143 25.37988  6.5528571     3.902439     5.756098
## 3358  2000-01-24  17.8160000 25.32364  7.3517778     2.055556     2.000000
## 3359  2000-01-25  11.2891667 24.80504  7.2266667     3.212121     5.515152
## 3360  2000-01-26   8.6665833 25.05311  6.3611111     2.000000     3.750000
## 3361  2000-01-27   6.0440000 25.30118  5.4955556    12.533333     4.056818
## 3362  2000-01-28   6.5945000 25.35711  5.5102778     3.636364     4.363636
## 3363  2000-01-29   7.1450000 25.41304  5.5250000     2.041667     5.431818
## 3364  2000-01-30   6.8508333 25.40015  5.3639583    27.428571     6.500000
## 3365  2000-01-31  11.5254545 24.99782  6.8957576     2.000000     2.363636
## 3366  2000-02-01  12.9153030 24.98150  7.3065152     3.272727     2.909091
## 3367  2000-02-02  14.3051515 24.96518  7.7172727     2.243902     2.292683
## 3368  2000-02-03  10.6793939 25.25909  6.9690909     9.090909     2.000000
## 3369  2000-02-04   8.9613131 25.16090  7.1081818     2.750000     3.250000
## 3370  2000-02-05   7.2432323 25.06271  7.2472727    38.000000    20.000000
## 3371  2000-02-06   5.5251515 24.96452  7.3863636     2.060606     2.000000
## 3372  2000-02-07   6.7917172 24.92243  7.3487879     3.000000     3.500000
## 3373  2000-02-08   8.0582828 24.88035  7.3112121    14.545455    34.727273
## 3374  2000-02-09   9.3248485 24.83827  7.2736364     2.000000     2.000000
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## 3376  2000-02-11   7.4100000 24.91094  7.4572727    23.172414    44.068966
## 3377  2000-02-12  13.6260000 24.90393  7.3933333    37.111111   136.888889
## 3378  2000-02-13   9.9919048 24.91993  7.5823810     2.000000     2.000000
## 3379  2000-02-14   7.0637500 24.80071  7.5541667     2.250000     3.416667
## 3380  2000-02-15   5.4592677 24.87757  6.9756061     5.750000     9.250000
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## 3382  2000-02-17   2.2503030 25.03130  5.8184848     2.000000     2.060606
## 3383  2000-02-18   4.5828788 25.10806  5.6400000     2.000000     3.500000
## 3384  2000-02-19   6.9154545 25.18482  5.4615152     2.060606     2.181818
## 3385  2000-02-20   7.6451515 25.08133  6.2841414    11.454545     8.363636
## 3386  2000-02-21   8.3748485 24.97785  7.1067677     2.000000     3.250000
## 3387  2000-02-22   9.1045455 24.87436  7.9293939     2.121212     2.121212
## 3388  2000-02-23   8.2595960 24.59787  7.8011111    18.500000    18.500000
## 3389  2000-02-24   7.4146465 24.32137  7.6728283    12.500000     4.000000
## 3390  2000-02-25   6.5696970 24.04488  7.5445455    25.818182   264.484848
## 3391  2000-02-26   6.6437374 24.06840  7.4553535     2.000000     2.000000
## 3392  2000-02-27   6.7177778 24.09193  7.3661616     7.875000    21.625000
## 3393  2000-02-28   6.7918182 24.11545  7.2769697     9.333333     5.818182
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## 3395  2000-03-01   6.3290909 24.42097  7.6842424     4.466667     5.400000
## 3396  2000-03-02   6.4359524 24.58660  7.4897619     3.000000     5.066667
## 3397  2000-03-03   6.2866667 24.48909  7.2555556    17.666667    70.222222
## 3398  2000-03-04  11.5987500 24.23846  7.1975000     2.000000     2.000000
## 3399  2000-03-05  10.2038352 24.24049  7.1125947    21.000000     6.500000
## 3400  2000-03-06   8.8089205 24.24252  7.0276894    50.000000    58.704545
## 3401  2000-03-07   7.4140057 24.24455  6.9427841   127.636364   110.909091
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## 3405  2000-03-11   6.3212121 24.34844  6.8751515   109.750000    61.000000
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## 3408  2000-03-14   6.6233333 24.45030  6.8924242    60.090909    60.772727
## 3409  2000-03-15   5.1688889 24.69077  6.6248754    61.000000   390.000000
## 3410  2000-03-16   3.7144444 24.93124  6.3573266     4.500000     8.444444
## 3411  2000-03-17   2.2600000 25.17171  6.0897778    20.166667     7.546296
## 3412  2000-03-18   2.3485417 25.21140  6.0637500    35.833333     6.648148
## 3413  2000-03-19   2.9975000 25.16117  6.3197917     3.508772     5.750000
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## 3415  2000-03-21   8.3300000 24.54270  7.7210101     2.000000    14.030303
## 3416  2000-03-22   8.7933333 24.57579  7.7877778    64.363636    18.909091
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## 3418  2000-03-24   7.0784848 24.87521  7.5539394     2.000000     2.222222
## 3419  2000-03-25   8.1906667 24.81536  7.6184444    11.000000   141.461538
## 3420  2000-03-26   7.7295238 24.80688  7.6378571     3.515152     4.666667
## 3421  2000-03-27   4.0083333 24.68142  7.1533333    13.375000     9.125000
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## 3423  2000-03-29   3.3116162 25.00861  6.7564646     2.000000    18.666667
## 3424  2000-03-30   3.1438384 25.21348  6.5683838     2.500000     3.000000
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## 3426  2000-04-01   7.7660606 25.30282  7.0339394     2.000000     2.000000
## 3427  2000-04-02  13.3413636 25.24399  7.6857197    17.500000     6.500000
## 3428  2000-04-03  18.9166667 25.18517  8.3375000     6.250000     2.000000
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## 3432  2000-04-07  12.6995455 25.20445  7.7657576     2.250000     2.000000
## 3433  2000-04-08  13.3869697 25.17082  7.5609091     2.000000     2.000000
## 3434  2000-04-09  14.4102020 25.14190  7.7725253     4.909091     2.909091
## 3435  2000-04-10  15.4334343 25.11298  7.9841414     2.750000     5.750000
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## 3441  2000-04-16   5.3993434 24.69803  7.3040909   740.000000    40.000000
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## 3443  2000-04-18   3.9244697 24.67595  7.3196970   130.000000    44.000000
## 3444  2000-04-19   4.6610606 24.73109  7.5136364  4490.000000 12000.000000
## 3445  2000-04-20   5.3976515 24.78623  7.7075758  2881.777778  6200.000000
## 3446  2000-04-21   6.1342424 24.84136  7.9015152   657.677419   877.500000
## 3447  2000-04-22   5.4122222 24.80487  7.8933333   416.541667   528.680851
## 3448  2000-04-23   4.2500000 24.90890  7.6966667     5.866667     9.200000
## 3449  2000-04-24   4.0614583 24.84529  7.5614583  4029.333333  4283.333333
## 3450  2000-04-25   3.8729167 24.78167  7.4262500   482.000000   465.230769
## 3451  2000-04-26   3.7205303 24.81161  7.3473990     6.222222     6.222222
## 3452  2000-04-27   3.5681439 24.84155  7.2685480    17.272727    44.363636
## 3453  2000-04-28   3.4157576 24.87148  7.1896970     3.636364     2.000000
## 3454  2000-04-29   4.9400000 24.88733  7.4093939     5.000000    13.500000
## 3455  2000-04-30   6.4642424 24.90318  7.6290909   125.409091   318.363636
## 3456  2000-05-01   7.0493939 24.87677  7.8017172  3001.000000   142.500000
## 3457  2000-05-02   7.6345455 24.85035  7.9743434    27.111111     4.000000
## 3458  2000-05-03   8.2196970 24.82394  8.1469697     6.000000    13.515152
## 3459  2000-05-04   7.6428283 24.85386  7.9886869    26.727273    31.818182
## 3460  2000-05-05   7.0659596 24.88378  7.8304040     5.500000     6.750000
## 3461  2000-05-06   6.4890909 24.91370  7.6721212     9.393939     2.181818
## 3462  2000-05-07   9.7677778 24.99189  7.3124444   310.340426   721.829787
## 3463  2000-05-08   5.6871429 25.14740  6.8921429     4.631579    17.263158
## 3464  2000-05-09   8.5715152 25.10258  7.6712121     3.000000    24.800000
## 3465  2000-05-10   8.4513636 25.12333  7.5396970     2.924242    80.000000
## 3466  2000-05-11   8.3312121 25.14409  7.4081818     2.848485     2.121212
## 3467  2000-05-12   6.1340476 25.38724  6.5428571    62.983607    28.315789
## 3468  2000-05-13   2.5545455 25.50759  5.9627273     6.681818    19.543860
## 3469  2000-05-14   1.8303636 25.64529  5.5718182    23.200000    10.771930
## 3470  2000-05-15   5.8237500 24.95971  8.1229167     2.000000     2.000000
## 3471  2000-05-16   5.5775505 24.98448  7.8026515     3.500000     6.750000
## 3472  2000-05-17   5.3313510 25.00926  7.4823864     2.727273     2.545455
## 3473  2000-05-18   5.0851515 25.03403  7.1621212     2.181818     2.000000
## 3474  2000-05-19   4.8243939 25.00653  7.3725758    46.727273    32.181818
## 3475  2000-05-20   4.5636364 24.97903  7.5830303     3.818182     8.666667
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## 3477  2000-05-22   4.0513636 25.05636  7.2140909    29.000000    37.222222
## 3478  2000-05-23   3.7952273 25.09503  7.0296212     7.500000    51.500000
## 3479  2000-05-24   3.5390909 25.13370  6.8451515     2.000000     2.303030
## 3480  2000-05-25   4.2827273 25.50085  6.2496970     6.068966   441.517241
## 3481  2000-05-26   3.4808889 25.50313  5.8897778     3.833333    54.166667
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## 3483  2000-05-28   2.8133333 25.39392  5.7704167     8.303030     8.000000
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## 3487  2000-06-01  21.4296970 25.34833  8.6284848    13.515152     2.787879
## 3488  2000-06-02  19.0974747 25.35786  8.1720202    76.000000   182.121212
## 3489  2000-06-03  16.7652525 25.36738  7.7155556    35.818182   361.454545
## 3490  2000-06-04  14.4330303 25.37691  7.2590909     5.512195     3.804878
## 3491  2000-06-05  13.4338636 25.33074  7.3958333   360.000000  2003.000000
## 3492  2000-06-06  12.4346970 25.28458  7.5325758    84.000000   440.000000
## 3493  2000-06-07  11.4355303 25.23841  7.6693182   215.730769    10.000000
## 3494  2000-06-08  10.4363636 25.19224  7.8060606   347.461538   455.115385
## 3495  2000-06-09  10.2836364 25.19039  7.5372727  3610.600000  6010.000000
## 3496  2000-06-10  10.1309091 25.18855  7.2684848  1240.000000  5600.000000
## 3497  2000-06-11   9.9781818 25.18670  6.9996970     2.444444     3.222222
## 3498  2000-06-12   9.2273939 25.17712  7.0027273     2.000000     5.250000
## 3499  2000-06-13   8.4766061 25.16755  7.0057576     7.272727     7.636364
## 3500  2000-06-14   7.7258182 25.15797  7.0087879     2.606061     3.151515
## 3501  2000-06-15   6.9750303 25.12032  7.0118182     2.000000     4.250000
## 3502  2000-06-16   6.2242424 25.08267  7.0148485     6.111111     2.111111
## 3503  2000-06-17   4.7338095 25.11845  6.8776190    12.634146    12.634146
## 3504  2000-06-18   5.7051111 25.01138  7.0486667     5.555556    18.277778
## 3505  2000-06-19   4.8843165 25.02612  7.0677980     4.250000    24.000000
## 3506  2000-06-20   4.0635219 25.04086  7.0869293  1275.090909  1849.636364
## 3507  2000-06-21   3.2427273 25.05561  7.1060606    32.545455     2.424242
## 3508  2000-06-22   3.6128788 24.97701  7.1553788  4034.000000  4803.333333
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## 3513  2000-06-27   3.0358333 24.96663  6.7341667     7.875000    29.878788
## 3514  2000-06-28   4.0282197 24.97654  6.8279924     2.000000     2.000000
## 3515  2000-06-29   5.0206061 24.98645  6.9218182    25.772727   337.590909
## 3516  2000-06-30   5.3587229 25.08294  6.8355022     4.250000     2.000000
## 3517  2000-07-01   5.6968398 25.17942  6.7491861    40.000000  6550.000000
## 3518  2000-07-02   6.0349567 25.27590  6.6628701    25.684211    42.000000
## 3519  2000-07-03   6.3730736 25.37238  6.5765541    11.368421     7.263158
## 3520  2000-07-04   6.7111905 25.46886  6.4902381     2.000000     5.947368
## 3521  2000-07-05   4.6490698 25.64495  5.7302326     8.454545     4.631579
## 3522  2000-07-06   4.9978182 25.67269  5.3421818    13.018182     3.315789
## 3523  2000-07-07  16.0436364 25.01761  9.6627273     2.000000     2.000000
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## 3531  2000-07-15   6.3490909 25.15885  6.8551515     5.575758    51.515152
## 3532  2000-07-16   5.7734091 25.05155  7.0485606     4.537879     9.000000
## 3533  2000-07-17   5.1977273 24.94424  7.2419697     3.500000     7.000000
## 3534  2000-07-18   4.6220455 24.83694  7.4353788    76.363636   578.909091
## 3535  2000-07-19   4.0463636 24.72964  7.6287879     2.000000     2.060606
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## 3545  2000-07-29   7.9472727 25.04103  7.3348485     8.076923    11.000000
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## 3548  2000-08-01   7.8015152 24.75588  7.5042424     3.121951     2.341463
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## 3551  2000-08-04   7.5978571 24.72212  7.3928571     2.292683     2.341463
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## 3561  2000-08-14   3.4490909 24.58161  8.3227273    17.157895     9.157895
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## 3570  2000-08-23   2.6781818 24.89793  7.0385714     3.622642     3.818182
## 3571  2000-08-24   2.2159091 25.11414  6.1622727    28.318182     3.358463
## 3572  2000-08-25   1.8709091 25.27191  5.8278182     7.309091     2.898744
## 3573  2000-08-26   4.9912121 24.47806  9.2178788     2.097561     2.439024
## 3574  2000-08-27   7.9312121 24.42355  8.7872727     2.000000     2.111111
## 3575  2000-08-28   6.6664444 24.70876  8.3006667     2.765957     6.468085
## 3576  2000-08-29   4.4183333 24.89545  7.4354762     2.133333     2.133333
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## 3578  2000-08-31   8.0239394 24.69079  8.0181818     2.500000     4.727273
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## 3580  2000-09-02  10.3409091 24.94561  7.1981818     2.807692     4.038462
## 3581  2000-09-03  10.8150000 24.54583  8.9441667     2.750000     2.875000
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## 3585  2000-09-07   7.5509091 24.57588  8.2518182     2.292683     2.536585
## 3586  2000-09-08   8.7557576 24.68748  8.0425758     2.545455     2.545455
## 3587  2000-09-09   9.9606061 24.79909  7.8333333     2.060606     2.000000
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## 3589  2000-09-11   8.6197980 24.83176  7.7438384    35.272727    20.181818
## 3590  2000-09-12   7.9493939 24.84809  7.6990909     2.060606     2.121212
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## 3592  2000-09-14   3.5812121 24.87724  7.5227273     2.000000     2.303030
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## 3596  2000-09-18   3.6570694 24.77077  7.5136806    32.000000    60.000000
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## 3598  2000-09-20   3.3307765 24.80431  7.0363068     7.818182     3.454545
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## 3600  2000-09-22   8.5448485 24.96391  6.2606061     2.192308     2.423077
## 3601  2000-09-23   1.8354545 24.82621  5.4496970     4.195122     5.219512
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## 3613  2000-10-05   5.8796405 24.82435  7.6834314   542.000000   590.444444
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## 3615  2000-10-07   4.0305882 24.59721  8.1402941    13.545455    48.090909
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## 3619  2000-10-11   2.7140909 24.63802  6.7522727   120.909091  1017.333333
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## 3621  2000-10-13   3.1154545 24.74161  5.8418182     3.696970     2.424242
## 3622  2000-10-14   3.3024242 24.73315  6.6206061    12.421053    20.210526
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## 3624  2000-10-16   5.2157576 24.86085  7.8112121     2.307692     2.153846
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## 3633  2000-10-25   3.4963636 24.83333  6.3460606     7.090909    18.666667
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## 3649  2000-11-10   1.6538384 25.01614  6.6859596     5.500000     5.250000
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## 3652  2000-11-13   3.0759596 25.06830  6.7671717    19.000000   171.000000
## 3653  2000-11-14   3.0558586 25.05927  6.8891919     2.250000     3.000000
## 3654  2000-11-15   3.0357576 25.05024  7.0112121     2.000000     2.303030
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## 3662  2000-11-23   0.9004167 24.93188  8.4583333   135.312500    71.187500
## 3663  2000-11-24   0.9631061 24.96262  8.2984848     2.000000    10.000000
## 3664  2000-11-25   1.0257955 24.99337  8.1386364  3246.363636  2637.090909
## 3665  2000-11-26   1.0884848 25.02412  7.9787879    23.365854    39.707317
## 3666  2000-11-27   1.2086364 25.06079  7.6931061  5006.666667  6660.000000
## 3667  2000-11-28   1.3287879 25.09745  7.4074242   448.400000  1328.800000
## 3668  2000-11-29   1.4489394 25.13412  7.1217424    20.000000    70.000000
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## 3671  2000-12-02   1.8490909 25.63780  4.6677273     9.818182     2.893996
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## 3673  2000-12-04   1.4233333 25.02506  7.9533333     2.097561     2.634146
## 3674  2000-12-05   1.2688889 25.13458  7.4451515    14.000000   303.000000
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## 3679  2000-12-10  11.2862222 25.30211  6.7373333     2.666667     5.500000
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## 3683  2000-12-14   3.7913258 25.42572  6.2922096    17.636364     4.000000
## 3684  2000-12-15   4.1863636 25.39818  6.0739394     6.058824     2.000000
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## 3693  2000-12-24   3.0562879 25.46738  6.3296970    45.789474    97.157895
## 3694  2000-12-25   2.9736364 25.55742  5.7527273     2.000000     2.000000
## 3695  2000-12-26   4.6950505 25.50415  6.6778788     2.500000    17.750000
## 3696  2000-12-27   6.4164646 25.45088  7.6030303  1275.636364  2184.181818
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## 3705  2001-01-05  19.9891919 25.41405  6.8052525     2.250000     4.500000
## 3706  2001-01-06  11.1074747 25.38801  6.6950505    18.545455    36.545455
## 3707  2001-01-07   2.2257576 25.36197  6.5848485     2.000000     2.000000
## 3708  2001-01-08   2.0123232 25.18376  7.0330303 12000.000000 12000.000000
## 3709  2001-01-09   1.7988889 25.00555  7.4812121  1335.333333  1354.000000
## 3710  2001-01-10   1.5854545 24.82733  7.9293939     9.000000    49.176471
## 3711  2001-01-11   0.8125000 25.02829  7.6679167     6.375000    20.125000
## 3712  2001-01-12   7.5714286 25.11207  6.5621429    11.636364    11.333333
## 3713  2001-01-13   8.0748889 24.98431  6.9797778     2.000000     3.244444
## 3714  2001-01-14   7.4045455 24.97570  6.7648485     2.000000     2.222222
## 3715  2001-01-15   1.1263636 24.81121  7.2639394     2.000000     2.000000
## 3716  2001-01-16   2.3854762 25.26214  5.5092857     7.132075     7.636364
## 3717  2001-01-17   2.1436472 25.47450  4.8231818     5.137466     5.860140
## 3718  2001-01-18   1.9018182 25.61095  4.4794545     3.142857     4.083916
## 3719  2001-01-19   1.0657576 25.38609  5.3621212     2.000000     2.307692
## 3720  2001-01-20   5.2363636 25.19948  7.2563636     2.000000     2.181818
## 3721  2001-01-21   4.3525455 25.13492  7.2604242     2.000000     2.000000
## 3722  2001-01-22   3.4687273 25.07036  7.2644848     2.545455     3.090909
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## 3724  2001-01-24   1.7010909 24.94123  7.2726061     2.000000     2.000000
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## 3726  2001-01-26   1.2969697 24.95203  7.0100000     2.048780     2.195122
## 3727  2001-01-27   5.9676190 24.96019  7.3428571     2.048780     2.341463
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## 3729  2001-01-29  12.0109091 24.93067  7.2418182     2.000000     2.000000
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## 3732  2001-02-01   1.4290909 24.55676  7.7496970     2.146341     2.243902
## 3733  2001-02-02   1.4289394 24.79141  7.6018182    11.818182     7.272727
## 3734  2001-02-03   1.4287879 25.02606  7.4539394     2.097561     2.292683
## 3735  2001-02-04   5.6190909 25.05727  8.8393939     3.038462     2.423077
## 3736  2001-02-05   4.2230303 24.98242  8.2245455     2.000000     2.000000
## 3737  2001-02-06   6.1135671 25.02883  8.0899697     3.750000     7.000000
## 3738  2001-02-07   8.0041039 25.07523  7.9553939     3.818182     3.272727
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## 3751  2001-02-20   2.0631515 24.76672  7.9708485     2.545455     3.636364
## 3752  2001-02-21   2.0433333 24.80397  7.8424242     2.097561     5.853659
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## 3756  2001-02-25   2.5294872 24.78646  7.1517949     2.379310     2.631579
## 3757  2001-02-26   2.4529787 25.03560  6.4397872     6.765957     2.421053
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## 3766  2001-03-07   1.1115152 23.84145  7.8254545     2.121212     2.000000
## 3767  2001-03-08   1.0936364 23.99611  7.7509091    30.000000     6.272727
## 3768  2001-03-09   1.0757576 24.15076  7.6763636    13.863636    10.545455
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## 3772  2001-03-13   3.6591111 24.47940  8.1695556     2.111111     2.111111
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## 3787  2001-03-28   1.1954167 24.11517  7.8454167     2.416667     2.000000
## 3788  2001-03-29   4.8913333 24.20351  8.1740000     2.000000     2.000000
## 3789  2001-03-30   3.6182626 24.14214  8.0100404     2.500000     8.500000
## 3790  2001-03-31   2.3451919 24.08077  7.8460808     2.363636     2.909091
## 3791  2001-04-01   1.0721212 24.01939  7.6821212    29.073171    48.975610
## 3792  2001-04-02   1.0697727 24.06749  7.6355303    17.000000    25.487805
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## 3794  2001-04-04   1.0650758 24.16369  7.5423485    84.000000    20.363636
## 3795  2001-04-05   1.0627273 24.21179  7.4957576     2.060606     2.000000
## 3796  2001-04-06   1.0648485 24.28057  7.4304040    14.222222    52.000000
## 3797  2001-04-07   1.0669697 24.34934  7.3650505     3.000000    13.250000
## 3798  2001-04-08   1.0690909 24.41812  7.2996970     2.000000     2.000000
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## 3804  2001-04-14   2.4073333 24.44700  7.6120000     2.000000     4.055556
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## 3814  2001-04-24   1.4350000 24.57505  7.9505303     7.090909     2.000000
## 3815  2001-04-25   1.3266667 24.58250  7.7765152    12.181818    10.363636
## 3816  2001-04-26   1.2183333 24.58995  7.6025000     6.000000     4.750000
## 3817  2001-04-27   1.1100000 24.59739  7.4284848     3.227273     2.727273
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## 3831  2001-05-11   1.0862338 24.96916  7.1837229     6.750000    12.000000
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## 3867  2001-06-16   2.2045455 25.28715  7.2893939     2.000000     2.000000
## 3868  2001-06-17   2.7770000 25.15327  7.9993333     3.135135     5.081081
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## 3922  2001-08-10   1.4693939 24.44758  7.6815152     2.303030     2.000000
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## 4444  2003-01-14   1.5426667 24.61416  6.9837778     2.000000     2.000000
## 4445  2003-01-15   0.3436364 25.40293  5.6454545    44.509091     2.263158
## 4446  2003-01-16   1.7266667 24.98540  6.2392857    22.524590     2.526316
## 4447  2003-01-17   0.8959091 25.28223  5.5461364    61.272727     2.263158
## 4448  2003-01-18   2.2493333 24.57382  6.9768889     2.044444     2.000000
## 4449  2003-01-19   2.1426190 24.83586  6.9333333     4.947368     2.000000
## 4450  2003-01-20   2.7246667 24.67511  7.0808889   494.680851   531.829787
## 4451  2003-01-21   2.7787879 24.82545  6.2551515     2.111111     2.000000
## 4452  2003-01-22   1.9387500 24.95829  6.0287500   329.333333   261.481481
## 4453  2003-01-23   1.8883519 24.82536  6.4751667  1800.000000  6400.000000
## 4454  2003-01-24   1.8379537 24.69242  6.9215833     9.555556     2.444444
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## 4456  2003-01-26   1.6220000 24.56328  7.1191111    58.727273     7.454545
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## 4458  2003-01-28   2.9248889 24.73346  6.6350000    65.454545    16.363636
## 4459  2003-01-29   4.3933333 24.89984  6.3997778     4.035714     3.321429
## 4460  2003-01-30   4.8224444 24.89660  6.7248889     9.911111     8.711111
## 4461  2003-01-31   4.2264444 24.57930  6.9085556    18.000000     7.636364
## 4462  2003-02-01   3.6304444 24.26200  7.0922222     2.000000     2.133333
## 4463  2003-02-02   2.6297778 24.94673  5.6117778     2.037736     2.113208
## 4464  2003-02-03   3.6621111 24.66159  6.3738889    25.818182    10.909091
## 4465  2003-02-04   4.6944444 24.37644  7.1360000     6.844444     3.288889
## 4466  2003-02-05   2.6122222 24.07111  6.9680000     2.150943     3.132075
## 4467  2003-02-06   2.7248889 24.10972  6.9960000     5.272727    10.363636
## 4468  2003-02-07   2.8375556 24.14833  7.0240000     3.750000     4.250000
## 4469  2003-02-08   2.9502222 24.18694  7.0520000   366.181818   220.181818
## 4470  2003-02-09   3.0628889 24.22556  7.0800000     2.000000     2.000000
## 4471  2003-02-10   2.9792889 24.16322  7.0560889     2.000000     2.500000
## 4472  2003-02-11   2.8956889 24.10088  7.0321778     2.000000     2.181818
## 4473  2003-02-12   2.8120889 24.03854  7.0082667     2.000000     2.000000
## 4474  2003-02-13   2.7284889 23.97620  6.9843556     2.000000     2.250000
## 4475  2003-02-14   2.6448889 23.91387  6.9604444    13.035714     2.535714
## 4476  2003-02-15   2.7956296 23.87078  7.0988889     3.250000   109.000000
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## 4478  2003-02-17   3.0971111 23.78460  7.3757778     2.000000     2.000000
## 4479  2003-02-18   3.0794815 23.75198  7.7113333     2.181818     3.636364
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## 4482  2003-02-21   1.6866667 23.54029  8.5787500     2.333333     2.000000
## 4483  2003-02-22   2.0738095 23.98269  7.8776190    27.959184    13.673469
## 4484  2003-02-23   2.1942424 23.90261  7.3863636     2.000000     2.000000
## 4485  2003-02-24   2.3331111 23.85518  7.3702222     2.222222     2.000000
## 4486  2003-02-25   1.4569048 24.32264  6.9742857     4.400000     5.500000
## 4487  2003-02-26   0.8550000 24.63325  6.5993182     9.418182     5.272727
## 4488  2003-02-27   0.4721818 24.92951  5.9383636    31.927273     3.636364
## 4489  2003-02-28   2.3771111 23.53267  6.9217778     2.000000     2.000000
## 4490  2003-03-01   2.3771111 23.67355  7.0184444     4.000000     2.000000
## 4491  2003-03-02   2.3771111 23.81443  7.1151111   297.090909     9.818182
## 4492  2003-03-03   2.3771111 23.95531  7.2117778     3.000000     4.250000
## 4493  2003-03-04   2.3771111 24.09619  7.3084444     4.181818     6.181818
## 4494  2003-03-05   2.3771111 24.23707  7.4051111     2.000000     2.000000
## 4495  2003-03-06   2.7262222 24.22057  7.2906667     2.000000     6.750000
## 4496  2003-03-07   3.0753333 24.20407  7.1762222     2.000000     2.088889
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## 4498  2003-03-09   2.8060000 24.11702  6.8535556     2.113208     3.886792
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## 4507  2003-03-18   2.5803556 24.24406  7.7514222    17.500000     5.000000
## 4508  2003-03-19   2.5645333 24.24454  7.7545778    73.636364    22.727273
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## 4518  2003-03-29   2.8895556 24.31962  7.9755556     2.000000     2.088889
## 4519  2003-03-30   1.8702222 24.44796  7.2266667     2.679245     2.981132
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## 4521  2003-04-01   2.1097619 24.64507  7.4711905     2.000000     2.000000
## 4522  2003-04-02   2.5593939 24.63906  7.4842424     2.000000     2.000000
## 4523  2003-04-03   1.9650000 24.65042  7.2504167     2.583333     2.500000
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## 4528  2003-04-08   2.1808889 24.40129  7.8684444     2.044444     2.088889
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## 4534  2003-04-14   2.2706222 24.51659  7.3464000  1434.363636  1577.272727
## 4535  2003-04-15   2.3812444 24.53735  7.3099111  2213.333333  6090.000000
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## 4537  2003-04-17   2.6024889 24.57888  7.2369333    70.000000   300.000000
## 4538  2003-04-18   2.7131111 24.59964  7.2004444     5.142857     4.178571
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## 4541  2003-04-21   2.0633333 24.76862  7.1266667     2.577778     4.755556
## 4542  2003-04-22   1.9185333 24.75508  7.1174222    50.736842   155.684211
## 4543  2003-04-23   1.7737333 24.74154  7.1081778    30.000000   300.000000
## 4544  2003-04-24   1.6289333 24.72800  7.0989333    19.375000    24.000000
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## 4547  2003-04-27   1.4532222 24.69931  7.2248889     7.357143    22.000000
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## 4549  2003-04-29   1.4450000 24.74250  7.4760000     4.250000     6.500000
## 4550  2003-04-30   1.3228889 24.78729  7.5826667    11.107143    25.321429
## 4551  2003-05-01   1.3123778 24.76825  7.5714889 12000.000000 12000.000000
## 4552  2003-05-02   1.3018667 24.74920  7.5603111   409.777778   122.666667
## 4553  2003-05-03   1.2913556 24.73016  7.5491333  3022.000000  8400.000000
## 4554  2003-05-04   1.2808444 24.71112  7.5379556   536.727273   418.909091
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## 4557  2003-05-07   1.2493111 24.65399  7.5044222   600.000000    33.806818
## 4558  2003-05-08   1.2388000 24.63495  7.4932444   110.545455    56.363636
## 4559  2003-05-09   1.2282889 24.61591  7.4820667  1041.166667     6.250000
## 4560  2003-05-10   1.2177778 24.59687  7.4708889   364.255319   127.688889
## 4561  2003-05-11   1.3077333 24.59884  7.4902667  6020.000000   650.753535
## 4562  2003-05-12   1.3976889 24.60082  7.5096444  1141.454545  1173.818182
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## 4563  2003-05-13   1.4876444 24.60280  7.5290222    48.250000    21.500000
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## 4567  2003-05-17   1.6082222 24.63900  7.3500000    56.656250    57.031250
## 4568  2003-05-18   1.4888889 24.63399  7.4045778  1650.000000  1200.000000
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## 4573  2003-05-23   1.0380741 24.69418  7.3057778  1666.000000  2939.500000
## 4574  2003-05-24   1.0645926 24.77442  6.9886667  6280.000000  3355.000000
## 4575  2003-05-25   1.0911111 24.85467  6.6715556   311.890909   265.740741
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## 4577  2003-05-27   1.7114286 24.92833  6.9550000     6.952381  1148.090909
## 4578  2003-05-28   0.5645455 25.19868  6.1727273   229.125000  2120.000000
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## 4580  2003-05-30   2.9313333 24.69311  7.9160000   494.561404   393.642857
## 4581  2003-05-31   1.2487500 24.76075  7.3916667   890.814815   925.000000
## 4582  2003-06-01   1.2997619 24.77062  7.5857143   349.317073   332.682927
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## 4586  2003-06-05   1.8569495 24.77114  7.4091919    38.000000     2.000000
## 4587  2003-06-06   1.9013333 24.78344  7.3333333   197.535714    28.500000
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## 4591  2003-06-10   1.4913016 24.87208  6.9424762  1181.636364  1120.909091
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## 4597  2003-06-16   1.1731111 24.82238  6.6807778  5684.842105  2617.263158
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## 4604  2003-06-23   2.0998667 24.84624  6.3712444    32.000000    22.246465
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## 4620  2003-07-09   3.2545556 25.04343  5.9446667     6.000000    12.000000
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## 4629  2003-07-18   8.4166667 24.94791  7.1782222     5.111111     2.888889
## 4630  2003-07-19   5.5731250 24.99512  7.0372997     6.750000     2.750000
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## 4643  2003-08-01   2.7543182 25.50902  4.9738636    24.222222     2.736842
## 4644  2003-08-02   2.1859524 25.39529  5.3061905     5.571429     2.435088
## 4645  2003-08-03   5.9104444 25.28853  5.2826667     2.888889     2.133333
## 4646  2003-08-04   4.3270000 25.18329  5.3587778     8.857143     3.142857
## 4647  2003-08-05   2.7435556 25.07804  5.4348889    13.859649     8.631579
## 4648  2003-08-06   3.1928889 24.87618  5.9635556     2.488889     2.222222
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## 4656  2003-08-14   5.1744000 24.64037  6.0724444     9.272727     6.181818
## 4657  2003-08-15   5.8890222 24.67981  6.4891111     9.500000     6.750000
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## 4660  2003-08-18   8.0328889 24.79813  7.7391111     2.000000     2.044444
## 4661  2003-08-19   7.2580000 24.73202  7.7267407     6.000000     9.500000
## 4662  2003-08-20   6.4831111 24.66591  7.7143704    12.545455     3.454545
## 4663  2003-08-21   5.7082222 24.59980  7.7020000     2.044444     2.000000
## 4664  2003-08-22   5.2460741 24.41533  8.1580741     2.000000     4.500000
## 4665  2003-08-23   4.7839259 24.23087  8.6141481     2.909091     2.000000
## 4666  2003-08-24   4.3217778 24.04640  9.0702222     2.044444     2.000000
## 4667  2003-08-25   3.5722222 23.82174  8.8311111     4.250000     4.250000
## 4668  2003-08-26   2.8226667 23.59709  8.5920000     2.035714     2.392857
## 4669  2003-08-27   2.2446667 23.83617  8.0007778     4.500000     6.750000
## 4670  2003-08-28   1.6666667 24.07524  7.4095556    99.785714    54.928571
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## 4672  2003-08-30   1.8226667 24.11407  7.3166667     2.000000     2.000000
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## 4675  2003-09-02   3.3209091 24.52876  7.7472727     2.000000     2.461538
## 4676  2003-09-03   2.4108333 24.17679  7.7962500     2.000000     2.000000
## 4677  2003-09-04   2.0352381 24.48538  7.1180952     2.190476     4.090909
## 4678  2003-09-05   1.0765909 24.92532  5.9304545    12.181818     6.181818
## 4679  2003-09-06   0.8505455 25.11569  5.5876364    40.603175     2.500000
## 4680  2003-09-07   1.8980000 24.57900  7.2797778     2.044444     2.177778
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## 4683  2003-09-10   1.4497778 24.31335  7.6252593    10.750000     8.000000
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## 4685  2003-09-12   1.5537778 24.38262  7.3975556     2.000000     2.444444
## 4686  2003-09-13   1.4836667 24.46354  7.4977778   280.000000     3.500000
## 4687  2003-09-14   1.4135556 24.54447  7.5980000     2.000000     2.177778
## 4688  2003-09-15   1.5810000 24.32067  7.7400556     6.000000     3.636364
## 4689  2003-09-16   1.7484444 24.09687  7.8821111  1504.750000    25.750000
## 4690  2003-09-17   1.9158889 23.87307  8.0241667     2.000000    14.232143
## 4691  2003-09-18   2.0833333 23.64927  8.1662222    12.714286     2.714286
## 4692  2003-09-19   1.8765185 23.93290  7.8905185     2.000000     2.482143
## 4693  2003-09-20   1.6697037 24.21654  7.6148148     2.000000     2.250000
## 4694  2003-09-21   1.4628889 24.50018  7.3391111     2.000000     2.000000
## 4695  2003-09-22   1.6421481 24.46122  7.4259259     2.727273     3.636364
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## 4699  2003-09-26   1.9113333 24.10331  7.8784444     3.584906     2.716981
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## 4704  2003-10-01   1.5906667 23.82400  7.7302222    32.750000    18.000000
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## 4714  2003-10-11   1.5760000 24.05676  7.7200000     2.044444     2.000000
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## 4716  2003-10-13   1.3071795 24.52854  7.2358974     4.170213     3.500000
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## 4722  2003-10-19   1.3075000 24.52767  6.9491667     2.250000     2.000000
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## 4729  2003-10-26   1.6071111 24.60364  7.6797778    23.833333    15.708333
## 4730  2003-10-27   1.4342667 24.59196  7.7157333     2.500000     2.000000
## 4731  2003-10-28   1.2614222 24.58028  7.7516889     2.250000     2.250000
## 4732  2003-10-29   1.0885778 24.56860  7.7876444     3.272727     3.636364
## 4733  2003-10-30   0.9157333 24.55692  7.8236000     2.250000     2.000000
## 4734  2003-10-31   0.7428889 24.54524  7.8595556     2.266667     2.000000
## 4735  2003-11-01   0.7929630 24.56761  7.8396296     9.636364     3.090909
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## 4738  2003-11-04   1.2524444 24.73227  7.9464444     4.857143     2.428571
## 4739  2003-11-05   1.5431111 24.69293  7.8880000     4.250000     2.000000
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## 4744  2003-11-10   1.2184444 24.56290  7.4527778  1720.750000  1676.250000
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## 4751  2003-11-17   1.0888889 24.82836  7.4284444     2.177778     2.044444
## 4752  2003-11-18   1.1540741 24.86736  7.4336296    42.909091    28.363636
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## 4762  2003-11-28   0.8797619 24.80657  7.5028571     9.735849     8.909091
## 4763  2003-11-29   0.5275000 24.99375  6.9413636    15.667925     9.198653
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## 4765  2003-12-01   1.3384444 24.62071  7.9768889     4.177778     9.777778
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## 4772  2003-12-08   4.1926667 24.81191  8.9102222     5.377778    23.022222
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## 4779  2003-12-15   5.7186667 25.13547  8.6326667    21.911111    36.311111
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## 4783  2003-12-19   1.1204444 25.39927  6.0068889     3.422222     3.422222
## 4784  2003-12-20   2.9770000 25.35022  6.9331111    12.727273    18.545455
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## 4786  2003-12-22   3.5547778 25.23832  7.7053333     3.090909     2.181818
## 4787  2003-12-23   2.2760000 25.17547  7.5513333     2.000000     2.000000
## 4788  2003-12-24   0.8666667 25.55133  5.5802381     3.520000     2.000000
## 4789  2003-12-25   0.3829091 25.80329  4.7616364    23.360000     2.000000
## 4790  2003-12-26   0.3681818 25.67586  5.1015909    43.200000     2.000000
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## 4794  2003-12-30  10.8154545 25.22885  7.9990909     2.187500     2.187500
## 4795  2003-12-31   9.1694444 25.30500  6.7152778     2.000000     2.000000
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## 4797  2004-01-02   3.2975556 24.82371  8.2357778     3.200000     2.444444
## 4798  2004-01-03   3.9260000 24.99691  7.2713333     2.909091     2.909091
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## 4813  2004-01-18   4.0157778 24.32764  7.8996296    30.545455    16.000000
## 4814  2004-01-19   3.6648889 24.16216  8.1705926     4.000000    10.911111
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## 4840  2004-02-14   1.4322222 24.35573  7.5875556     5.955556    55.422222
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## 4858  2004-03-03   1.4633333 24.18487  7.9960000     2.266667     2.266667
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## 4861  2004-03-06   0.3429545 24.75695  7.2188636     5.727273     3.781010
## 4862  2004-03-07   0.4442857 24.50517  7.5535714     2.619048     3.216970
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## 4871  2004-03-16   1.1736889 24.56188  7.4435556  7600.000000  6600.000000
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## 4876  2004-03-21   1.1076667 24.50255  7.5754444   162.500000  2633.333333
## 4877  2004-03-22   1.0346667 24.51117  7.5466667     2.666667     2.000000
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## 4879  2004-03-24   2.1600000 24.54793  7.7546667   852.000000    82.400000
## 4880  2004-03-25   1.8788889 24.59461  7.7560000    30.000000   148.450000
## 4881  2004-03-26   1.5977778 24.64128  7.7573333   289.250000   214.500000
## 4882  2004-03-27   1.3166667 24.68796  7.7586667  1399.625000  4007.250000
## 4883  2004-03-28   1.1851852 24.76046  7.7938519  2510.000000  7800.000000
## 4884  2004-03-29   1.0537037 24.83296  7.8290370    71.000000   106.000000
## 4885  2004-03-30   0.9222222 24.90547  7.8642222   207.250000   235.821429
## 4886  2004-03-31   0.8971852 24.88378  7.8905185   136.000000    80.000000
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## 4887  2004-04-01   0.8721481 24.86209  7.9168148   120.000000    60.355556
## 4888  2004-04-02   0.8471111 24.84040  7.9431111    41.866667    40.711111
## 4889  2004-04-03   0.9749778 24.83673  7.9306222   297.272727   570.545455
## 4890  2004-04-04   1.1028444 24.83307  7.9181333    69.333333   273.333333
## 4891  2004-04-05   1.2307111 24.82940  7.9056444    66.000000   480.000000
## 4892  2004-04-06   1.3585778 24.82573  7.8931556    70.200000  2400.000000
## 4893  2004-04-07   1.4864444 24.82207  7.8806667    74.400000   233.511111
## 4894  2004-04-08   1.3425000 24.85546  7.7542222  3011.500000  3145.000000
## 4895  2004-04-09   1.1985556 24.88884  7.6277778   160.000000   762.000000
## 4896  2004-04-10   1.0546111 24.92223  7.5013333   231.090909   289.636364
## 4897  2004-04-11   0.9106667 24.95562  7.3748889   116.545455  1344.818182
## 4898  2004-04-12   1.0482222 24.96043  7.5350556     2.000000  2400.000000
## 4899  2004-04-13   1.1857778 24.96524  7.6952222     9.822222  3600.000000
## 4900  2004-04-14   1.3233333 24.97006  7.8553889    17.644444  3200.000000
## 4901  2004-04-15   1.4608889 24.97487  8.0155556    25.466667    42.000000
## 4902  2004-04-16   1.3825714 24.94661  7.9822540  1147.090909  1221.090909
## 4903  2004-04-17   1.3042540 24.91836  7.9489524   139.000000   300.000000
## 4904  2004-04-18   1.2259365 24.89010  7.9156508  3400.000000  4133.333333
## 4905  2004-04-19   1.1476190 24.86185  7.8823492  9733.333333  7966.666667
## 4906  2004-04-20   1.0693016 24.83360  7.8490476  9000.000000 12000.000000
## 4907  2004-04-21   0.9909841 24.80534  7.8157460   780.909091  1110.833333
## 4908  2004-04-22   0.9126667 24.77709  7.7824444    44.755556    47.377778
## 4909  2004-04-23   1.0345926 24.81667  7.8495556  1680.000000  2433.333333
## 4910  2004-04-24   1.1565185 24.85624  7.9166667  2676.000000  5613.333333
## 4911  2004-04-25   1.2784444 24.89582  7.9837778     9.555556    29.955556
## 4912  2004-04-26   0.9793939 24.95533  7.6339394   427.937500   560.125000
## 4913  2004-04-27   0.8286111 25.00511  7.3963889  6213.968750  4320.062500
## 4914  2004-04-28   1.1366389 24.89702  7.6146944 12000.000000  8080.000000
## 4915  2004-04-29   1.4446667 24.78893  7.8330000   656.400000   482.400000
## 4916  2004-04-30   1.1858519 24.90513  7.5409630  7400.000000  6320.000000
## 4917  2004-05-01   0.9270370 25.02132  7.2489259    92.000000    72.400000
## 4918  2004-05-02   0.6682222 25.13751  6.9568889   204.285714   202.714286
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## 4920  2004-05-04   1.1960000 25.17936  7.1533333  9333.333333    48.207407
## 4921  2004-05-05   1.4598889 25.20028  7.2515556  4233.333333    32.414815
## 4922  2004-05-06   1.7237778 25.22120  7.3497778     9.600000    16.622222
## 4923  2004-05-07   1.6742222 25.18915  7.4667111  1512.545455  2194.727273
## 4924  2004-05-08   1.6246667 25.15710  7.5836444  6037.000000  6014.000000
## 4925  2004-05-09   1.5751111 25.12505  7.7005778 12000.000000 12000.000000
## 4926  2004-05-10   1.5255556 25.09300  7.8175111 12000.000000 12000.000000
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## 4928  2004-05-12   0.5356364 25.55731  6.0167273   191.696970  1456.363636
## 4929  2004-05-13   0.7061905 25.35119  6.5861905    18.720000     2.500000
## 4930  2004-05-14   0.4613636 25.51186  5.9350000    19.288889  1515.000000
## 4931  2004-05-15   1.1575758 25.37746  6.5682222   100.000000  2800.000000
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## 4939  2004-05-23   1.1942222 24.90133  8.1351111    14.434783    47.869565
## 4940  2004-05-24   1.2314074 24.91849  8.0096296    21.750000     9.500000
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## 4941  2004-05-25   1.2685926 24.93564  7.8841481    93.090909   580.363636
## 4942  2004-05-26   1.3057778 24.95279  7.7586667   173.000000   330.666667
## 4943  2004-05-27   1.3429630 24.96994  7.6331852    36.000000   220.000000
## 4944  2004-05-28   1.3801481 24.98709  7.5077037     8.000000    28.000000
## 4945  2004-05-29   1.4173333 25.00424  7.3822222    67.422222   163.333333
## 4946  2004-05-30   1.7018095 24.98925  7.5543175  1682.181818  2363.090909
## 4947  2004-05-31   1.9862857 24.97425  7.7264127     2.500000     7.750000
## 4948  2004-06-01   2.2707619 24.95925  7.8985079  2560.333333  4244.400000
## 4949  2004-06-02   2.5552381 24.94426  8.0706032  4134.000000  4034.000000
## 4950  2004-06-03   2.8397143 24.92926  8.2426984    72.000000   180.000000
## 4951  2004-06-04   3.1241905 24.91426  8.4147937    40.727273   132.000000
## 4952  2004-06-05   3.4086667 24.89927  8.5868889     6.679245    23.773585
## 4953  2004-06-06   2.8785556 24.96844  7.9981111    12.000000    11.000000
## 4954  2004-06-07   2.3484444 25.03762  7.4093333     2.044444     2.755556
## 4955  2004-06-08   2.0831111 25.07128  7.3405926    52.181818    96.727273
## 4956  2004-06-09   1.8177778 25.10494  7.2718519    14.500000     9.750000
## 4957  2004-06-10   1.5524444 25.13860  7.2031111     2.000000     2.933333
## 4958  2004-06-11   1.3316296 25.03637  7.3716574   212.181818   355.272727
## 4959  2004-06-12   1.1108148 24.93414  7.5402037     2.500000     2.500000
## 4960  2004-06-13   0.8900000 24.83192  7.7087500     2.166667     2.666667
## 4961  2004-06-14   2.5785714 25.20652  7.0242857    10.312500    14.687500
## 4962  2004-06-15   2.0457440 25.05268  7.3640179     4.750000     4.750000
## 4963  2004-06-16   1.5129167 24.89883  7.7037500     2.500000     2.000000
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## 4965  2004-06-18   2.0752460 24.73138  8.1675238    64.000000   408.500000
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## 4975  2004-06-28   2.2047222 25.05997  7.4630556     2.000000     6.600000
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## 4977  2004-06-30   2.3075000 25.18651  7.0010185     4.500000    20.250000
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## 4979  2004-07-02   2.9141667 25.19672  7.0360000 12000.000000  6055.000000
## 4980  2004-07-03   3.4694444 25.14367  7.3020000  7200.000000 12000.000000
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## 4982  2004-07-05   4.5800000 25.03756  7.8340000     2.415094    19.773585
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## 4984  2004-07-07   4.6560000 24.89170  7.6860000    15.355556    80.000000
## 4985  2004-07-08   4.6940000 24.81878  7.6120000     2.711111     3.555556
## 4986  2004-07-09   4.6119259 24.77323  7.8688889    13.454545   160.545455
## 4987  2004-07-10   4.5298519 24.72768  8.1257778    11.000000    36.444444
## 4988  2004-07-11   4.4477778 24.68213  8.3826667     2.533333     4.400000
## 4989  2004-07-12   5.1387407 24.72296  7.9874815     7.818182    12.909091
## 4990  2004-07-13   5.8297037 24.76378  7.5922963     2.000000     6.500000
## 4991  2004-07-14   6.5206667 24.80460  7.1971111     2.177778     2.888889
## 4992  2004-07-15   6.4537222 24.83263  6.8927222    17.090909    11.454545
## 4993  2004-07-16   6.3867778 24.86067  6.5883333     4.250000    12.500000
## 4994  2004-07-17   6.3198333 24.88870  6.2839444    18.250000    50.000000
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## 4995  2004-07-18   6.2528889 24.91673  5.9795556    20.958333    15.500000
## 4996  2004-07-19   4.4386667 24.94071  6.0621111     2.000000     4.750000
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## 4998  2004-07-21   2.4256667 24.57584  6.8482222    14.363636    25.090909
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## 5000  2004-07-23   1.9730370 24.39686  7.2147407    10.000000    12.545455
## 5001  2004-07-24   1.7191852 24.60672  6.8777037     2.000000     5.500000
## 5002  2004-07-25   1.4653333 24.81658  6.5406667     2.000000     2.044444
## 5003  2004-07-26   1.4102222 24.83270  6.5915111     5.750000     4.000000
## 5004  2004-07-27   1.3551111 24.84883  6.6423556   247.636364     4.000000
## 5005  2004-07-28   1.3000000 24.86495  6.6932000     2.000000     5.545455
## 5006  2004-07-29   1.2448889 24.88108  6.7440444    11.636364     7.090909
## 5007  2004-07-30   1.1897778 24.89720  6.7948889     3.018868     3.396226
## 5008  2004-07-31   3.4746667 24.44516  8.6862222    13.107143    18.964286
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## 5010  2004-08-02   3.3077778 24.74989  7.7435556     2.000000     2.044444
## 5011  2004-08-03   2.0806162 25.05618  6.7790505    23.818182    61.454545
## 5012  2004-08-04   0.8534545 25.36247  5.8145455    10.984127    12.500000
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## 5014  2004-08-06   0.8400000 25.25530  6.2972727     6.136364    31.658730
## 5015  2004-08-07   3.7390909 24.87885  7.2663636    24.190476    41.238095
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## 5020  2004-08-12   3.0031667 24.47504  7.7963333   586.000000    93.454545
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## 5025  2004-08-17   2.8059259 24.11193  7.5491111    59.000000     7.500000
## 5026  2004-08-18   2.3749630 24.06000  7.4308889     4.000000    15.660714
## 5027  2004-08-19   1.9440000 24.00807  7.3126667    67.571429    23.821429
## 5028  2004-08-20   2.6830000 24.17096  7.0323333     2.750000     8.500000
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## 5032  2004-08-24   2.0144444 24.25323  6.7475556     3.000000     3.750000
## 5033  2004-08-25   1.5606667 24.27596  6.8613333     2.266667     7.644444
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## 5046  2004-09-07   0.7458182 25.06289  6.3932727    42.303030    14.545455
## 5047  2004-09-08   1.3264286 24.69286  7.4916667     4.080000    27.750000
## 5048  2004-09-09   1.0120455 24.90716  6.9497727    16.727273    15.250000
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## 5060  2004-09-21   1.8415556 24.48171  7.7084444  6182.000000   640.000000
## 5061  2004-09-22   1.8089630 24.48227  7.7437037 12000.000000 12000.000000
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## 5098  2004-10-29   1.4432593 24.77204  7.6584074   640.000000  1200.000000
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## 5100  2004-10-31   1.4620556 24.76793  7.6784444    39.250000    25.000000
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## 5110  2004-11-10   1.5988889 24.82573  7.7824444    99.511111   115.911111
## 5111  2004-11-11   1.3442424 24.90400  7.6315152   371.696970   378.363636
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## 5114  2004-11-14   1.3923333 24.88213  7.7508333 12000.000000 12000.000000
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## 5116  2004-11-16   0.4558182 25.21316  6.2550909    30.476190    13.000000
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## 5118  2004-11-18   0.6254545 25.09100  6.7184091    10.297872    62.000000
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## 6776  2009-06-03          NA        NA          NA            NA            NA
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## 6992  2010-01-05          NA        NA          NA            NA            NA
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## 8298  2013-08-03          NA       NA         NA           NA           NA
## 8299  2013-08-04          NA       NA         NA           NA           NA
## 8300  2013-08-05          NA       NA         NA           NA           NA
## 8301  2013-08-06          NA       NA         NA           NA           NA
## 8302  2013-08-07          NA       NA         NA           NA           NA
## 8303  2013-08-08          NA       NA         NA           NA           NA
## 8304  2013-08-09          NA       NA         NA           NA           NA
## 8305  2013-08-10          NA       NA         NA           NA           NA
## 8306  2013-08-11          NA       NA         NA           NA           NA
## 8307  2013-08-12          NA       NA         NA           NA           NA
## 8308  2013-08-13          NA       NA         NA           NA           NA
## 8309  2013-08-14          NA       NA         NA           NA           NA
## 8310  2013-08-15          NA       NA         NA           NA           NA
## 8311  2013-08-16          NA       NA         NA           NA           NA
## 8312  2013-08-17          NA       NA         NA           NA           NA
## 8313  2013-08-18          NA       NA         NA           NA           NA
## 8314  2013-08-19          NA       NA         NA           NA           NA
## 8315  2013-08-20          NA       NA         NA           NA           NA
## 8316  2013-08-21          NA       NA         NA           NA           NA
## 8317  2013-08-22          NA       NA         NA           NA           NA
## 8318  2013-08-23          NA       NA         NA           NA           NA
## 8319  2013-08-24          NA       NA         NA           NA           NA
## 8320  2013-08-25          NA       NA         NA           NA           NA
## 8321  2013-08-26          NA       NA         NA           NA           NA
## 8322  2013-08-27          NA       NA         NA           NA           NA
## 8323  2013-08-28          NA       NA         NA           NA           NA
## 8324  2013-08-29          NA       NA         NA           NA           NA
## 8325  2013-08-30          NA       NA         NA           NA           NA
## 8326  2013-08-31          NA       NA         NA           NA           NA
## 8327  2013-09-01          NA       NA         NA           NA           NA
## 8328  2013-09-02          NA       NA         NA           NA           NA
## 8329  2013-09-03          NA       NA         NA           NA           NA
## 8330  2013-09-04          NA       NA         NA           NA           NA
## 8331  2013-09-05          NA       NA         NA           NA           NA
## 8332  2013-09-06          NA       NA         NA           NA           NA
## 8333  2013-09-07          NA       NA         NA           NA           NA
##             OG       PH  SALINITY       SUSO      TEMP      XMS
## 1    0.2000000 8.130000 33.595500  3.9964286 19.370000 60.22500
## 2    0.2000000 8.143000 33.580275  3.9964286 14.507692 80.02564
## 3    0.2000000 8.156000 33.565050  3.9964286 14.392308 83.89744
## 4    0.2000000 8.169000 33.549825  3.9964286 14.541026 78.97436
## 5    0.2000000 8.182000 33.534600  3.9964286 13.430000 80.20000
## 6    0.2000000 8.195000 33.519375  3.9964286 14.268889 86.21111
## 7    0.2000000 8.193333 33.493000  3.9964286 13.750000 80.45833
## 8    0.2000000 8.191667 33.491000  3.9964286 14.384000 84.40000
```

```
## 9    0.2000000 8.190000 33.495318  3.9964286 14.512821 72.02564
## 10   0.2000000 8.188333 33.499636  3.9964286 14.576923 68.35897
## 11   0.2000000 8.186667 33.503955  3.9964286 14.507692 76.51282
## 12   0.2000000 8.185000 33.508273  3.9964286 14.069231 78.71053
## 13   0.2000000 8.183333 33.512591  3.9964286 14.294872 82.43590
## 14   0.2000000 8.181667 33.516909  3.9964286 14.174359 81.23077
## 15   0.2000000 8.180000 33.521227  3.9964286 14.461538 72.12821
## 16   0.2000000 8.178333 33.525545  3.9964286 14.461538 69.53846
## 17   0.2000000 8.176667 33.529864  3.9964286 13.825641 79.23077
## 18   0.2000000 8.175000 33.534182  3.9964286 13.790000 80.70000
## 19   0.2000000 8.173333 33.538500  3.9964286 13.698824 77.36471
## 20   0.2000000 8.176481 33.504000  3.9964286 14.387500 77.25000
## 21   0.2000000 8.179630 33.509000  3.9964286 14.330000 81.96667
## 22   0.2000000 8.182778 33.509411  3.9964286 13.738462 78.89189
## 23   0.2000000 8.185926 33.509821  3.9964286 14.376923 80.53846
## 24   0.2000000 8.189074 33.510232  3.9964286 14.053846 82.25641
## 25   0.2000000 8.192222 33.510643  3.9964286 14.430769 82.64103
## 26   0.2000000 8.195370 33.511054  3.9964286 14.415385 63.07692
## 27   0.2000000 8.198519 33.511464  3.9964286 14.720000 64.80000
## 28   0.2000000 8.201667 33.511875  3.9964286 13.148889 80.35556
## 29   0.2000000 8.198148 33.491000  3.9964286 13.694737 66.68421
## 30   0.2000000 8.194630 33.459000  3.9964286 13.693333 77.56667
## 31   0.2000000 8.191111 33.466867  3.9964286 13.297436 75.61538
## 32   0.2000000 8.187593 33.474734  3.9964286 12.942424 72.90909
## 33   0.2000000 8.184074 33.482602  3.9964286 12.700000 58.33333
## 34   0.2000000 8.180556 33.490469  3.9964286 12.784615 73.00000
## 35   0.2000000 8.177037 33.498336  3.9964286 12.947436 71.46154
## 36   0.2000000 8.173519 33.506203  3.9964286 13.110256 69.92308
## 37   0.2000000 8.170000 33.514070  3.9964286 13.273077 68.38462
## 38   0.2000000 8.166481 33.521937  3.9964286 13.435897 66.84615
## 39   0.2000000 8.162963 33.529805  3.9964286 13.433333 75.92105
## 40   0.2000000 8.159444 33.537672  3.9964286 13.500000 74.33333
## 41   0.2000000 8.155926 33.545539  3.9964286 13.125641 82.65789
## 42   0.2000000 8.152407 33.553406  3.9964286 13.194872 81.09818
## 43   0.2000000 8.148889 33.561273  3.9964286 13.264103 79.53846
## 44   0.2000000 8.145370 33.569141  3.9964286 14.248718 73.56410
## 45   0.2000000 8.141852 33.577008  3.9964286 13.130000 72.90000
## 46   0.2000000 8.138333 33.584875  3.9964286 12.688889 79.80000
## 47   0.2000000 8.133333 33.528000  3.9964286 13.463158 64.52632
## 48   0.2000000 8.128333 33.548500  3.9964286 13.126667 68.93333
## 49   0.2000000 8.123333 33.557292  3.9964286 13.192308 74.42105
## 50   0.2000000 8.118333 33.566083  3.9964286 12.979487 74.71053
## 51   0.2000000 8.113333 33.574875  3.9964286 12.766667 75.00000
## 52   0.2000000 8.108333 33.583667  3.9964286 12.956410 76.56410
## 53   0.2000000 8.103333 33.592458  3.9964286 11.987179 78.68421
## 54   0.2000000 8.098333 33.601250  3.9964286 13.515385 78.25641
## 55   0.2000000 8.093333 33.610042  3.9964286 13.957692 76.98718
## 56   0.2000000 8.088333 33.618833  3.9964286 14.400000 75.71795
## 57   0.2000000 8.083333 33.627625  3.9964286 11.715385 77.64103
## 58   0.2000000 8.078333 33.636417  3.9964286 13.279487 66.82051
## 59   0.2000000 8.073333 33.645208  3.9964286 13.169231 71.84211
## 60   0.2000000 8.068333 33.654000  3.9964286 12.750000 73.10000
## 61   0.2000000 8.063333 33.227857  3.9964286 11.525000 78.65000
## 62   0.2000000 8.083194 33.653000  3.9964286 13.347368 78.15789
```

```
## 63   0.2000000 8.103056 33.648500  3.9964286 12.600000 79.41379
## 64   0.2000000 8.122917 33.640075  3.9964286 12.305128 74.56410
## 65   0.2000000 8.142778 33.631650  3.9964286 12.520513 76.51282
## 66   0.2000000 8.162639 33.623225  3.9964286 13.802564 68.28205
## 67   0.2000000 8.182500 33.614800  3.9964286 13.169231 70.34211
## 68   0.2000000 8.202361 33.606375  3.9964286 15.138462 66.94872
## 69   0.2000000 8.222222 33.597950  3.9964286 15.103846 66.15385
## 70   0.2000000 8.242083 33.589525  3.9964286 15.069231 65.35897
## 71   0.2000000 8.261944 33.581100  3.9964286 13.658974 70.64103
## 72   0.2000000 8.281806 33.572675  3.9964286 14.500000 77.50000
## 73   0.2000000 8.301667 33.564250  3.9964286 12.565556 71.36667
## 74   0.2000000 8.294679 33.579000  3.9964286 14.705263 66.57895
## 75   0.2000000 8.287692 33.591000  3.9964286 13.720000 70.89655
## 76   0.2000000 8.280705 33.581391  3.9964286 15.787179 74.25641
## 77   0.2000000 8.273718 33.571782  3.9964286 15.988462 74.60256
## 78   0.2000000 8.266731 33.562174  3.9964286 16.189744 74.94872
## 79   0.2000000 8.259744 33.552565  3.9964286 14.502564 73.61538
## 80   0.2000000 8.252756 33.542956  3.9964286 14.271795 74.79487
## 81   0.2000000 8.245769 33.533347  3.9964286 14.041026 75.97436
## 82   0.2000000 8.238782 33.523738  3.9964286 13.674359 68.76316
## 83   0.2000000 8.231795 33.514130  3.9964286 13.674359 68.76316
## 84   0.2000000 8.224808 33.504521  3.9964286 13.674359 68.76316
## 85   0.2000000 8.217821 33.494912  3.9964286 13.674359 68.76316
## 86   0.2000000 8.210833 33.485303  3.9964286 13.500000 75.70000
## 87   0.2000000 8.203846 33.475694  3.9964286 13.209756 81.04878
## 88   0.2000000 8.211340 33.470000  3.9964286 14.884211 76.94737
## 89   0.2000000 8.218835 33.482000  3.9964286 14.320000 78.53333
## 90   0.2000000 8.226329 33.485425  3.9964286 15.346154 75.60526
## 91   0.2000000 8.233824 33.488851  3.9964286 16.057692 78.61032
## 92   0.2000000 8.241318 33.492276  3.9964286 16.769231 81.61538
## 93   0.2000000 8.248812 33.495702  3.9964286 13.538462 81.78947
## 94   0.2000000 8.256307 33.499127  3.9964286 15.502564 80.15385
## 95   0.2000000 8.263801 33.502553  3.9964286 15.502564 80.15385
## 96   0.2000000 8.271295 33.505978  3.9964286 15.502564 80.15385
## 97   0.2000000 8.278790 33.509404  3.9964286 15.502564 80.15385
## 98   0.2000000 8.286284 33.512829  3.9964286 16.251282 80.23077
## 99   0.2000000 8.293778 33.516255  3.9964286 15.256410 70.25641
## 100  0.2000000 8.301273 33.519680  3.9964286 14.419231 73.06410
## 101  0.2000000 8.308767 33.523106  3.9964286 13.582051 75.87179
## 102  0.2000000 8.316261 33.526531  3.9964286 14.461538 75.30769
## 103  0.2000000 8.323756 33.529957  3.9964286 15.080000 48.30000
## 104  0.2000000 8.331250 33.533382  3.9964286 13.774359 80.73077
## 105  0.2000000 8.329167 33.509000  3.9964286 16.552632 84.52632
## 106  0.2000000 8.327083 33.483500  3.9964286 14.916667 86.73333
## 107  0.2000000 8.325000 33.476319  3.9964286 16.700000 83.71795
## 108  0.2000000 8.322917 33.469138  3.9964286 16.700000 83.71795
## 109  0.2000000 8.320833 33.461957  3.9964286 16.605128 82.38462
## 110  0.2000000 8.318750 33.454776  3.9964286 16.605128 82.38462
## 111  0.2000000 8.316667 33.447595  3.9964286 15.182051 77.87179
## 112  0.2000000 8.314583 33.440414  3.9964286 15.039744 78.26923
## 113  0.2000000 8.312500 33.433233  3.9964286 14.897436 78.66667
## 114  0.2000000 8.310417 33.426052  3.9964286 14.543590 82.64103
## 115  0.2000000 8.308333 33.418871  3.9964286 15.171795 83.19231
## 116  0.2000000 8.306250 33.411690  3.9964286 15.800000 83.74359
```

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## 117  0.2000000 8.304167 33.404509  3.9964286 15.292308 81.35897
## 118  0.2000000 8.302083 33.397328  3.9964286 14.590000 80.50000
## 119  0.2000000 8.300000 33.390147  3.9964286 14.328205 86.85897
## 120  0.2000000 8.296591 33.370000  3.9964286 15.694737 83.05263
## 121  0.2000000 8.293182 33.379000  3.9964286 15.423333 86.53333
## 122  0.2000000 8.289773 33.374765  3.9964286 15.643718 84.10000
## 123  0.2000000 8.286364 33.370529  3.9964286 15.864103 81.66667
## 124  0.2000000 8.282955 33.366294  3.9964286 17.715385 76.87179
## 125  0.2000000 8.279545 33.362059  3.9964286 15.933333 80.02564
## 126  0.2000000 8.276136 33.357824  3.9964286 15.807692 80.25641
## 127  0.2000000 8.272727 33.353588  3.9964286 15.682051 80.48718
## 128  0.2000000 8.269318 33.349353  3.9964286 15.258974 79.42105
## 129  0.2000000 8.265909 33.345118  3.9964286 15.830000 83.40000
## 130  0.2000000 8.262500 33.340882  3.9964286 14.119231 85.96154
## 131  0.2000000 8.258929 33.288000  3.9964286 15.378947 81.05263
## 132  0.2000000 8.255357 33.294500  3.9964286 15.246667 85.10000
## 133  0.2000000 8.251786 33.258341  3.9964286 16.787179 79.00000
## 134  0.2000000 8.248214 33.222181  3.9964286 16.533333 78.02564
## 135  0.2000000 8.244643 33.186022  3.9964286 16.279487 77.05128
## 136  0.2000000 8.241071 33.149863  3.9964286 17.215385 82.51282
## 137  0.2000000 8.237500 33.113703  3.9964286 17.288462 83.10256
## 138  0.2000000 8.233929 33.077544  3.9964286 17.361538 83.69231
## 139  0.2000000 8.230357 33.041385  3.9964286 15.884615 69.89744
## 140  0.2000000 8.226786 33.005225  3.9964286 15.743590 74.38462
## 141  0.2000000 8.223214 32.969066  3.9964286 15.602564 78.87179
## 142  0.2000000 8.219643 32.932907  3.9964286 15.474359 82.33333
## 143  0.2000000 8.216071 32.896748  3.9964286 14.760000 81.70000
## 144  0.2000000 8.212500 32.860588  3.9964286 15.050000 85.75641
## 145  0.2000000 8.181875 33.367333  3.9964286 16.895918 83.44898
## 146  0.2000000 8.151250 33.448222  3.9964286 15.684615 75.97436
## 147  0.2000000 8.120625 33.529111  3.9964286 16.976667 75.63333
## 148  0.2000000 8.090000 33.610000  3.9964286 16.295000 47.35400
## 149  0.2000000 8.110375 33.591176  3.9964286 15.212000 76.50000
## 150  0.2000000 8.130750 33.572353  3.9964286 16.100000 45.92857
## 151  0.2000000 8.151125 33.553529  3.9964286 15.241026 71.66667
## 152  0.2000000 8.171500 33.534706  3.9964286 15.435897 82.69231
## 153  0.2000000 8.191875 33.515882  3.9964286 15.643590 82.20513
## 154  0.2000000 8.212250 33.497059  3.9964286 14.051282 80.79487
## 155  0.2000000 8.232625 33.478235  3.9964286 14.038462 85.10256
## 156  0.2000000 8.253000 33.459412  3.9964286 14.541176 78.94118
## 157  0.2000000 8.273375 33.440588  3.9964286 14.730000 84.60000
## 158  0.2000000 8.293750 33.421765  3.9964286 15.256410 85.61538
## 159  0.2000000 8.270455 33.418000  3.9964286 15.310526 76.52632
## 160  0.2000000 8.247159 33.397000  3.9964286 15.300000 84.60000
## 161  0.2000000 8.223864 33.396386  3.9964286 15.158824 79.91176
## 162  0.2000000 8.200568 33.395771  3.9964286 15.188235 82.14706
## 163  0.2000000 8.177273 33.395157  3.9964286 14.658824 80.02941
## 164  0.2000000 8.153977 33.394542  3.9964286 14.620588 82.08824
## 165  0.2000000 8.130682 33.393928  3.9964286 14.641176 67.64706
## 166  0.2000000 8.107386 33.393314  3.9964286 14.641176 67.64706
## 167  0.2000000 8.084091 33.392699  3.9964286 14.866667 80.90000
## 168  0.2000000 8.060795 33.392085  3.9964286 14.560000 65.80000
## 169  0.2000000 8.037500 33.391471  3.9964286 14.748276 83.49425
## 170  0.2000000 8.058761 33.321333  3.9964286 14.687755 81.38776
```

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## 171  0.2000000 8.080021 33.328500  3.9964286 14.597436 78.82051
## 172  0.2000000 8.101282 33.335667  3.9964286 13.866667 77.02703
## 173  0.2000000 8.122543 33.342833  3.9964286 14.587179 78.25641
## 174  0.2000000 8.143803 33.350000  3.9964286 14.533333 79.05128
## 175  0.2000000 8.165064 33.357167  3.9964286 14.533333 79.05128
## 176  0.2000000 8.186325 33.364333  3.9964286 14.533333 79.05128
## 177  0.2000000 8.207585 33.371500  3.9964286 14.261538 66.73684
## 178  0.2000000 8.228846 33.378667  3.9964286 14.261538 66.73684
## 179  0.2000000 8.250107 33.385833  3.9964286 14.682051 64.51282
## 180  0.2000000 8.271368 33.393000  3.9964286 14.820000 68.60000
## 181  0.2000000 8.292628 33.400167  3.9964286 14.720513 69.76923
## 182  0.2000000 8.313889 33.407333  3.9964286 14.603390 78.59322
## 183  0.2000000 8.335150 30.939990  3.9964286 14.942105 78.21053
## 184  0.2000000 8.356410 28.472647  3.9964286 13.296078 63.54455
## 185  0.2000000 8.351051 28.673554  3.9964286 13.839266 64.95953
## 186  0.2000000 8.345691 28.874461  3.9964286 14.382453 66.37450
## 187  0.2000000 8.340331 29.075368  3.9964286 14.925641 67.78947
## 188  0.2000000 8.334972 29.276275  3.9964286 15.230769 64.90756
## 189  0.2000000 8.329612 29.477181  3.9964286 15.535897 62.02564
## 190  0.2000000 8.324252 29.678088  3.9964286 15.680769 66.14103
## 191  0.2000000 8.318892 29.878995  3.9964286 15.825641 70.25641
## 192  0.2000000 8.313533 30.079902  3.9964286 15.835256 71.82051
## 193  0.2000000 8.308173 30.280809  3.9964286 15.844872 73.38462
## 194  0.2000000 8.302813 30.481716  3.9964286 15.854487 74.94872
## 195  0.2000000 8.297454 30.682623  3.9964286 15.864103 76.51282
## 196  0.2000000 8.292094 30.883529  3.9964286 12.779167 78.84615
## 197  0.2000000 8.286734 31.084436  3.9964286 14.061378 79.46154
## 198  0.2000000 8.281375 31.285343  3.9964286 15.343590 80.07692
## 199  0.2000000 8.276015 31.486250  3.9964286 15.299145 78.17949
## 200  0.2000000 8.270655 31.687157  3.9964286 15.254701 76.28205
## 201  0.2000000 8.265296 31.888064  3.9964286 15.210256 74.38462
## 202  0.2000000 8.259936 32.088971  3.9964286 15.317949 68.79487
## 203  0.2000000 8.254576 32.289877  3.9964286 15.425641 63.20513
## 204  0.2000000 8.249217 32.490784  3.9964286 15.402564 70.79487
## 205  0.2000000 8.243857 32.691691  3.9964286 15.379487 78.38462
## 206  0.2000000 8.238497 32.892598  3.9964286 15.378106 80.40253
## 207  0.2000000 8.233137 33.093505  3.9964286 15.376724 82.42044
## 208  0.2000000 8.227778 33.294412  3.9964286 15.375342 84.43836
## 209  0.2000000 8.227341 33.272706  3.9964286 15.405128 68.44737
## 210  0.2000000 8.226905 33.251000  3.9964286 15.808571 77.68571
## 211  0.2000000 8.226468 33.279000  3.9964286 15.917949 77.07692
## 212  0.2000000 8.226032 33.266922  3.9964286 15.794872 79.07692
## 213  0.2000000 8.225595 33.254844  3.9964286 15.825641 76.88889
## 214  0.2000000 8.225159 33.242766  3.9964286 15.856410 74.70085
## 215  0.2000000 8.224722 33.230687  3.9964286 15.887179 72.51282
## 216  0.2000000 8.224286 33.218609  3.9964286 15.828205 72.76923
## 217  0.2000000 8.223849 33.206531  3.9964286 15.769231 73.02564
## 218  0.2000000 8.223413 33.194453  3.9964286 15.923077 72.85897
## 219  0.2000000 8.222976 33.182375  3.9964286 16.076923 72.69231
## 220  0.2000000 8.222540 33.170297  3.9964286 15.820513 73.84615
## 221  0.2000000 8.222103 33.158219  3.9964286 15.564103 75.00000
## 222  0.2000000 8.221667 33.146141  3.9964286 15.307692 76.15385
## 223  0.2000000 8.221230 33.134062  3.9964286 15.315385 76.71795
## 224  0.2000000 8.220794 33.121984  3.9964286 15.323077 77.28205
```

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## 225  0.2000000 8.220357 33.109906  3.9964286 15.641026 75.93590
## 226  0.2000000 8.219921 33.097828  3.9964286 15.958974 74.58974
## 227  0.2000000 8.219484 33.085750  3.9964286 15.959829 71.93702
## 228  0.2000000 8.219048 33.073672  3.9964286 15.960684 69.28430
## 229  0.2000000 8.218611 33.061594  3.9964286 15.961538 66.63158
## 230  0.2000000 8.218175 33.049516  3.9964286 16.152564 72.57220
## 231  0.2000000 8.217738 33.037437  3.9964286 16.343590 78.51282
## 232  0.2000000 8.217302 33.025359  3.9964286 16.266667 68.33333
## 233  0.2000000 8.216865 33.013281  3.9964286 16.398077 69.57692
## 234  0.2000000 8.216429 33.001203  3.9964286 16.529487 70.82051
## 235  0.2000000 8.215992 32.989125  3.9964286 16.660897 72.06410
## 236  0.2000000 8.215556 32.977047  3.9964286 16.792308 73.30769
## 237  0.2000000 8.215119 32.964969  3.9964286 16.596154 73.05128
## 238  0.2000000 8.214683 32.952891  3.9964286 16.400000 72.79487
## 239  0.2000000 8.214246 32.940812  3.9964286 16.126923 74.92308
## 240  0.2000000 8.213810 32.928734  3.9964286 15.853846 77.05128
## 241  0.2000000 8.213373 32.916656  3.9964286 15.710140 78.15919
## 242  0.2000000 8.212937 32.904578  3.9964286 15.566434 79.26709
## 243  0.2000000 8.212500 32.892500  3.9964286 15.422727 80.37500
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## 245  0.2000000 8.211944 33.209278  3.9964286 16.494872 78.56410
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## 251  0.2000000 8.210278 33.414105  3.9964286 15.451282 74.96053
## 252  0.2000000 8.210000 33.423392  3.9964286 15.943590 75.05263
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## 254  0.2000000 8.209444 33.441967  3.9964286 17.200000 71.79487
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## 268  0.2000000 8.220109 33.546852  3.9964286 15.982051 74.79487
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## 270  0.2000000 8.222464 33.578649  3.9964286 16.394872 78.33333
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## 272  0.2000000 8.224819 33.610445  3.9964286 13.407692 80.51282
## 273  0.2000000 8.225996 33.626344  3.9964286 13.341026 81.29487
## 274  0.2000000 8.227174 33.642242  3.9964286 13.274359 82.07692
## 275  0.2000000 8.228351 33.658140  3.9964286 14.841026 77.48718
## 276  0.2000000 8.229529 33.674038  3.9964286 15.579487 68.97436
## 277  0.2000000 8.230707 33.689937  3.9964286 15.537179 68.50000
## 278  0.2000000 8.231884 33.705835  3.9964286 15.494872 68.02564
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## 282  0.2000000 8.243750 33.648000  3.9964286 13.857895 72.57895
## 283  0.2000000 8.252083 33.623500  3.9964286 12.880000 77.00000
## 284  0.2000000 8.260417 33.619029  3.9964286 13.056410 75.69231
## 285  0.2000000 8.268750 33.614559  3.9964286 13.866667 73.71795
## 286  0.2000000 8.277083 33.610088  3.9964286 12.320513 77.82051
## 287  0.2000000 8.285417 33.605618  3.9964286 12.605128 77.94872
## 288  0.2000000 8.293750 33.601147  3.9964286 13.315385 71.02564
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## 333  0.2000000 8.184167 33.344488  3.9964286 17.451282 77.76923
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## 474  0.2000000 8.099801 33.440187  3.9964286 18.384615 79.74359
## 475  0.2000000 8.095445 33.439374  3.9964286 18.258974 80.02564
## 476  0.2000000 8.091090 33.438561  3.9964286 18.133333 80.30769
## 477  0.2000000 8.086735 33.437749  3.9964286 18.307692 82.30769
## 478  0.2000000 8.082380 33.436936  3.9964286 20.300000 78.12821
## 479  0.2000000 8.078025 33.436123  3.9964286 19.943590 79.87179
## 480  0.2000000 8.073670 33.435310  3.9964286 19.587179 81.61538
## 481  0.2000000 8.069315 33.434497  3.9964286 18.461538 82.07692
## 482  0.2000000 8.064960 33.433684  3.9964286 15.487179 77.33333
## 483  0.2000000 8.060605 33.432872  3.9964286 15.200000 79.80000
## 484  0.2000000 8.056250 33.432059  3.9964286 13.051282 78.52564
## 485  0.2000000 8.062500 33.394667  3.9964286 14.755102 76.18367
## 486  0.2000000 8.068750 33.388052  3.9964286 16.253846 82.38462
## 487  0.2000000 8.075000 33.381437  3.9964286 15.506410 81.92308
## 488  0.2000000 8.081250 33.374822  3.9964286 14.758974 81.46154
## 489  0.2000000 8.087500 33.368207  3.9964286 16.971795 79.43590
## 490  0.2000000 8.093750 33.361592  3.9964286 16.741026 79.57692
## 491  0.2000000 8.100000 33.354978  3.9964286 16.510256 79.71795
## 492  0.2000000 8.106250 33.348363  3.9964286 16.156410 80.28205
## 493  0.2000000 8.112500 33.341748  3.9964286 16.666667 79.76923
## 494  0.2000000 8.118750 33.335133  3.9964286 17.266667 79.07692
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## 495  0.2000000 8.125000 33.328518  3.9964286 19.253846 84.84615
## 496  0.2000000 8.131250 33.321903  3.9964286 17.617949 85.00000
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## 506  0.2000000 8.147487 33.338396  3.9964286 17.920513 83.10256
## 507  0.2000000 8.147128 33.339962  3.9964286 17.566667 85.05128
## 508  0.2000000 8.146769 33.341527  3.9964286 17.241026 85.12821
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## 544  0.2000000 8.181030 33.357913  3.9964286 15.989655 77.77011
## 545  0.2000000 8.192606 33.324329  3.9964286 16.077586 76.27011
## 546  0.2000000 8.204182 33.290745  3.9964286 16.165517 74.77011
## 547  0.2000000 8.215758 33.257161  3.9964286 15.144444 83.65497
## 548  0.2000000 8.227917 33.265121  5.2230769 15.656897 84.39655
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## 549  0.2000000 8.130784 33.275700  5.9730769 15.474138 77.41379
## 550  0.2011111 8.116998 33.269849  5.5520513 15.300000 68.37931
## 551  0.2022222 8.103212 33.263999  5.1310256 13.978495 87.68011
## 552  0.2033333 8.079416 33.294960  4.7100000 13.581218 87.01523
## 553  0.2030000 8.091906 33.296749  4.5928462 14.773563 72.25287
## 554  0.2026667 8.104397 33.298538  4.4756923 14.754023 74.44828
## 555  0.2023333 8.116887 33.300327  4.3585385 14.865517 76.54023
## 556  0.2020000 8.129377 33.302115  4.2413846 14.387356 82.27586
## 557  0.2016667 8.141867 33.303904  4.1242308 14.580460 81.74713
## 558  0.2013333 8.154357 33.305693  4.0070769 14.614583 79.06250
## 559  0.2010000 8.166848 33.307482  3.8899231 14.686458 75.72917
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## 562  0.2000000 8.204318 33.312848  3.5384615 14.643182 85.56818
## 563  0.2062500 8.169148 33.363349  4.3178571 14.202469 85.54321
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## 583  0.2184615 8.131537 33.379492  4.7228797 12.971642 88.24378
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## 603  0.2010000 8.024198 33.486232  4.6356410 14.702564 80.10256
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## 624  0.2370222 8.010924 33.607953  3.9927778 14.882051 79.92308
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## 638  0.2416667 8.061084 33.575407  5.3461905 13.791026 76.76923
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## 709  0.2000000 8.111396 33.402930  4.8900000 13.287363 88.26374
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## 711  0.2029167 8.085780 33.406717  4.6758333 14.563158 84.10526
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## 714  0.2072917 8.047356 33.412397  4.3545833 13.943016 83.94298
## 715  0.2087500 8.034548 33.414290  4.2475000 13.730769 83.33333
## 716  0.2102083 8.021740 33.416184  4.1404167 13.694930 84.43939
## 717  0.2116667 8.008932 33.418077  4.0333333 13.659091 85.54545
## 718  0.2444444 7.980707 33.445841  4.5166667 13.339024 85.60976
## 719  0.2000000 7.988500 33.459533  4.6266667 13.363333 81.86667
## 720  0.2000000 8.011038 33.435127  3.6888889 13.453846 81.96154
## 721  0.2272414 7.943956 33.524881  4.5366667 13.083060 86.93443
## 722  0.2239195 7.948711 33.529156  4.8758333 13.807692 69.38462
## 723  0.2205977 7.953465 33.533430  5.2150000 14.014706 74.82353
## 724  0.2172759 7.958220 33.537704  5.5541667 12.940563 84.78592
## 725  0.2139540 7.966275 33.516346  5.8933333 14.415385 75.64103
## 726  0.2106322 7.974330 33.494988  6.2325000 14.392692 73.43718
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## 767  0.2000000 7.900550 33.610893  4.9606838 14.530070 76.91026
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## 788  0.2000000 7.904969 33.765112  5.3837340 14.676471 83.26471
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## 873  0.2000000 7.947356 33.605165  3.9479021 12.019802 86.31683
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## 967  0.2000000 8.007303 33.658218  2.7335069 18.570833 86.91667
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## 971  0.2000000 7.986901 33.618708  3.6800347 15.700000 83.33333
## 972  0.2000000 7.981800 33.608830  3.9166667 14.140000 81.80000
## 973  0.2000000 7.959714 33.590271  3.9230769 14.357143 84.78571
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## 975  0.2000000 8.003021 33.560064  3.4834615 15.768056 81.97222
## 976  0.2000000 8.002458 33.559503  3.2438462 16.148611 81.36111
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## 981  0.2000000 7.995002 33.577331  3.0593333 15.820833 80.20833
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## 986  0.2000000 8.140042 33.505571  4.2730769 15.616667 83.58333
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## 989  0.2000000 8.009779 33.591518  2.9573317 16.139808 68.47154
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## 1037 0.2000000 7.801667 33.751429  5.0477885 15.154167 78.12500
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## 1089 0.2000000 7.898817 33.498411  2.0495793 19.795833 82.37500
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## 1197 0.2000000 7.539538 33.640046  4.8656250 12.753846 88.30769
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## 1202 0.2000000 7.653782 33.492803  3.4583916 16.967687 85.22052
## 1203 0.2000000 7.684831 33.473808  3.3912587 18.750000 84.20833
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## 1209 0.2000000 7.871125 33.359842  2.9884615 16.070833 82.50000
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## 1222 0.2000000 7.974093 33.532107  3.7964912 14.585333 88.54667
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## 1465 0.2000000 7.868422 33.692578  3.2750000 11.777778 76.82071
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## 1467 0.2000000 8.029044 33.539982  5.4307692 14.154848 71.16061
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## 1469 0.2000000 8.012132 33.523880  5.7846154 14.106212 62.23182
## 1470 0.2000000 8.003676 33.515829  5.9615385 14.081894 57.76742
## 1471 0.2000000 7.995220 33.507779  6.1384615 14.057576 53.30303
## 1472 0.2000000 7.986764 33.499728  6.3153846 12.987500 67.87500
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## 1697 0.2000000 8.035296 33.652028  5.1983974 15.451515 79.48485
## 1698 0.2000000 8.051656 33.631745  5.0784856 15.404040 81.42424
## 1699 0.2000000 8.068016 33.611463  4.9585737 15.356566 83.36364
## 1700 0.2000000 8.084376 33.591181  4.8386619 15.309091 85.30303
## 1701 0.2000000 8.100736 33.570898  4.7187500 13.764151 83.79245
## 1702 0.2000000 8.086000 33.600536  4.0300000 13.496970 84.21212
## 1703 0.2000000 8.050969 33.600581  3.3434783 13.103125 88.75000
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## 1706 0.2000000 8.056129 33.667077  3.3535714 12.970968 88.19355
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## 1719 0.2000000 7.813065 33.684641  3.8945685 14.503421 82.66325
## 1720 0.2000000 7.781710 33.697748  3.7392857 13.612903 87.38710
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## 1942 0.2000000 8.058911 33.547271 10.1131579 16.002222 73.93333
## 1943 0.2000000 7.991730 33.571742  8.4565789 18.100000 82.03030
## 1944 0.2000000 7.924548 33.596213  6.8000000 14.106452 89.29032
## 1945 0.2000000 7.742744 33.611360  8.4758621 12.809302 91.32558
## 1946 0.2000000 8.059958 33.573975  6.3307692 17.995833 86.12500
## 1947 0.2000000 8.025313 33.577797  6.4612393 16.641856 84.62311
## 1948 0.2000000 7.990668 33.581619  6.5917094 15.287879 83.12121
## 1949 0.2000000 7.956023 33.585441  6.7221795 14.612968 84.60071
## 1950 0.2000000 7.921378 33.589264  6.8526496 13.938057 86.08021
## 1951 0.2000000 7.886733 33.593086  6.9831197 13.263146 87.55971
## 1952 0.2000000 7.852088 33.596908  7.1135897 12.588235 89.03922
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## 1954 0.2000000 7.987918 33.509050  7.3745299 16.172727 81.60606
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## 1956 0.2000000 7.934156 33.385787  8.0315789 14.342222 82.51111
## 1957 0.2367000 7.917381 33.371012  2.8941176 14.080952 87.30952
## 1958 0.2348154 7.946333 33.413456  3.0270308 14.971429 83.90476
## 1959 0.2329308 7.957651 33.408476  3.1599440 15.606061 83.57576
## 1960 0.2310462 7.968968 33.403497  3.2928571 13.290323 88.93548
## 1961 0.2291615 7.912256 33.485895  2.4103448 12.400000 90.23256
## 1962 0.2272769 7.962208 33.375087  2.7038462 14.454167 84.37500
## 1963 0.2253923 7.938166 33.418960  2.8802036 15.042235 83.94508
## 1964 0.2235077 7.914124 33.462832  3.0565611 15.630303 83.51515
## 1965 0.2216231 7.890082 33.506705  3.2329186 15.430303 85.00000
## 1966 0.2197385 7.866040 33.550577  3.4092760 12.450495 89.47525
## 1967 0.2178538 7.904571 33.493638  3.5856335 14.072217 86.14671
## 1968 0.2159692 7.943103 33.436698  3.7619910 15.693939 82.81818
## 1969 0.2140846 7.981635 33.379759  3.9383484 15.475758 83.24242
## 1970 0.2122000 8.020167 33.322819  4.1147059 14.261905 86.04762
## 1971 0.2001667 8.024756 33.310847  4.5131579 14.188889 84.37778
## 1972 0.2191667 8.004152 33.336312  2.4600000 13.903030 83.48485
## 1973 0.2175694 7.942097 33.415845  2.6321429 13.351613 84.16129
## 1974 0.2159722 8.048833 33.392458  4.8923077 15.170833 78.62500
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## 1976 0.2127778 8.120000 33.588000  3.0073402 19.230000 71.80000
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## 1982 0.2031944 7.964234 33.429030  3.7755193 15.106061 78.16667
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## 2013 0.2000000 7.889980 33.517140  3.3888889 12.936275 87.97059
## 2014 0.2000000 7.935750 33.484376  3.3466667 14.039349 87.15196
## 2015 0.2000000 7.981520 33.451611  3.3044444 15.142424 86.33333
## 2016 0.2000000 8.027291 33.418846  3.2622222 15.239394 86.78788
## 2017 0.2000000 8.073061 33.386082  3.2200000 14.854545 83.09091
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## 2024 0.2000000 8.014684 33.395558  2.2381250 14.894697 81.92424
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## 2057 0.3758333 8.024558 33.662380  4.3928994 13.478788 78.64899
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## 2164 0.2524476 8.045561 33.174683  4.3279121 14.962784 81.31439
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## 2192 0.4000000 8.086364 33.193648  6.3676471 14.142424 75.74242
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## 2437 0.2000000 8.012121 33.625664  7.5069853 14.327273 75.87879
## 2438 0.2000000 8.033040 33.619417  7.7904412 14.200000 73.24242
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## 2439 0.2000000 8.053960 33.613171  8.0738971 14.072727 70.60606
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## 2442 0.2000000 8.004429 33.645264  8.9242647 12.844949 77.14343
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## 2444 0.2000000 7.955095 33.584543  9.4911765 13.247619 84.76190
## 2445 0.2000000 7.929111 33.613537  9.7746324 12.670370 87.96296
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## 2448 0.2000000 8.258182 33.526739 10.6250000 16.609091 81.36364
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## 2492 0.2000000 8.133470 33.399024  4.6282805 16.840909 75.15152
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## 2703 0.2000000 8.078244 33.489978  6.1421053 15.048889 73.84444
## 2704 0.2000000 8.092061 33.492236  6.0346451 15.506061 62.81818
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## 2706 0.2000000 8.133232 33.526448  5.8197249 15.213131 74.03030
## 2707 0.2000000 8.153818 33.543555  5.7122648 15.066667 79.63636
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## 2709 0.2000000 8.124278 33.541070  5.4973445 15.015476 81.55628
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## 3674 0.2000000 8.017172 33.480636  2.7751329 13.382020 79.03343
## 3675 0.2000000 7.983434 33.505606  2.6740703 12.917980 79.53535
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## 3677 0.2000000 7.960682 33.553276  2.4719450 12.392327 80.73221
## 3678 0.2000000 7.971667 33.575976  2.3708824 12.330714 81.42714
## 3679 0.5916667 8.038667 33.524667  3.9057895 12.677778 73.47133
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## 3683 0.7613636 8.000644 33.613861  4.7695742 12.419596 76.11620
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## 8243        NA        NA        NA        NA        NA        NA
## 8244        NA        NA        NA        NA        NA        NA
## 8245        NA        NA        NA        NA        NA        NA
## 8246        NA        NA        NA        NA        NA        NA
## 8247        NA        NA        NA        NA        NA        NA
## 8248        NA        NA        NA        NA        NA        NA
## 8249        NA        NA        NA        NA        NA        NA
## 8250        NA        NA        NA        NA        NA        NA
## 8251        NA        NA        NA        NA        NA        NA
## 8252        NA        NA        NA        NA        NA        NA
## 8253        NA        NA        NA        NA        NA        NA
## 8254        NA        NA        NA        NA        NA        NA
## 8255        NA        NA        NA        NA        NA        NA
## 8256        NA        NA        NA        NA        NA        NA
## 8257        NA        NA        NA        NA        NA        NA
## 8258        NA        NA        NA        NA        NA        NA
## 8259        NA        NA        NA        NA        NA        NA
## 8260        NA        NA        NA        NA        NA        NA
## 8261        NA        NA        NA        NA        NA        NA
## 8262        NA        NA        NA        NA        NA        NA
## 8263        NA        NA        NA        NA        NA        NA
## 8264        NA        NA        NA        NA        NA        NA
## 8265        NA        NA        NA        NA        NA        NA
## 8266        NA        NA        NA        NA        NA        NA
## 8267        NA        NA        NA        NA        NA        NA
## 8268        NA        NA        NA        NA        NA        NA
## 8269        NA        NA        NA        NA        NA        NA
## 8270        NA        NA        NA        NA        NA        NA
```

```
## 8271        NA        NA        NA        NA        NA        NA
## 8272        NA        NA        NA        NA        NA        NA
## 8273        NA        NA        NA        NA        NA        NA
## 8274        NA        NA        NA        NA        NA        NA
## 8275        NA        NA        NA        NA        NA        NA
## 8276        NA        NA        NA        NA        NA        NA
## 8277        NA        NA        NA        NA        NA        NA
## 8278        NA        NA        NA        NA        NA        NA
## 8279        NA        NA        NA        NA        NA        NA
## 8280        NA        NA        NA        NA        NA        NA
## 8281        NA        NA        NA        NA        NA        NA
## 8282        NA        NA        NA        NA        NA        NA
## 8283        NA        NA        NA        NA        NA        NA
## 8284        NA        NA        NA        NA        NA        NA
## 8285        NA        NA        NA        NA        NA        NA
## 8286        NA        NA        NA        NA        NA        NA
## 8287        NA        NA        NA        NA        NA        NA
## 8288        NA        NA        NA        NA        NA        NA
## 8289        NA        NA        NA        NA        NA        NA
## 8290        NA        NA        NA        NA        NA        NA
## 8291        NA        NA        NA        NA        NA        NA
## 8292        NA        NA        NA        NA        NA        NA
## 8293        NA        NA        NA        NA        NA        NA
## 8294        NA        NA        NA        NA        NA        NA
## 8295        NA        NA        NA        NA        NA        NA
## 8296        NA        NA        NA        NA        NA        NA
## 8297        NA        NA        NA        NA        NA        NA
## 8298        NA        NA        NA        NA        NA        NA
## 8299        NA        NA        NA        NA        NA        NA
## 8300        NA        NA        NA        NA        NA        NA
## 8301        NA        NA        NA        NA        NA        NA
## 8302        NA        NA        NA        NA        NA        NA
## 8303        NA        NA        NA        NA        NA        NA
## 8304        NA        NA        NA        NA        NA        NA
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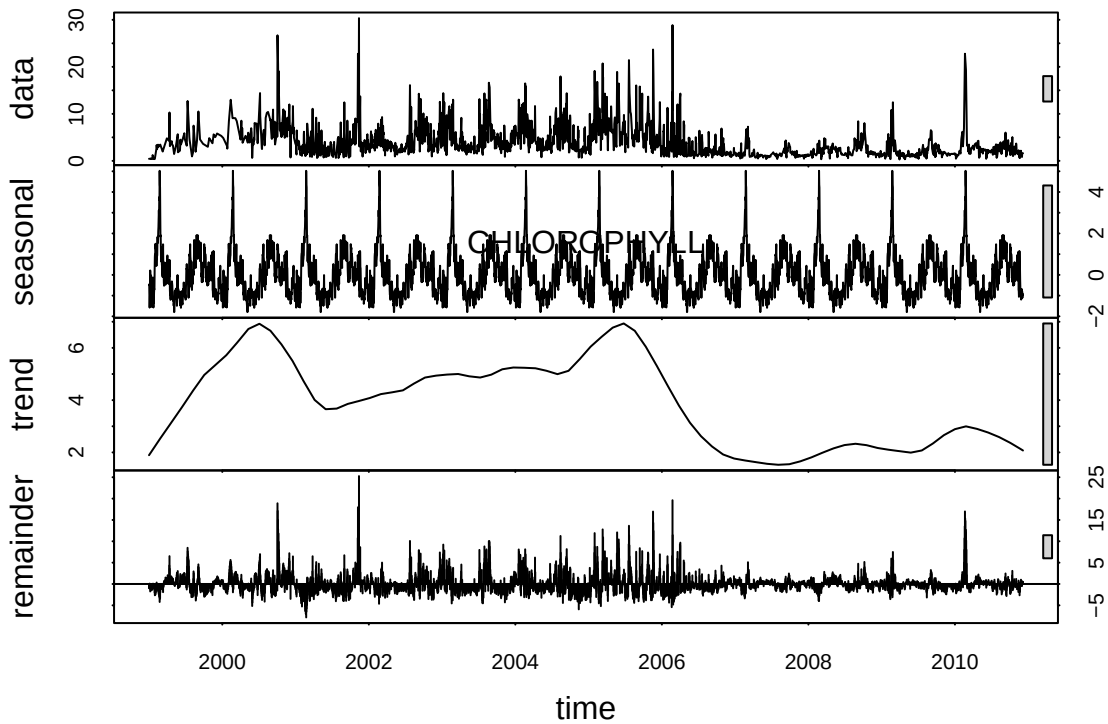
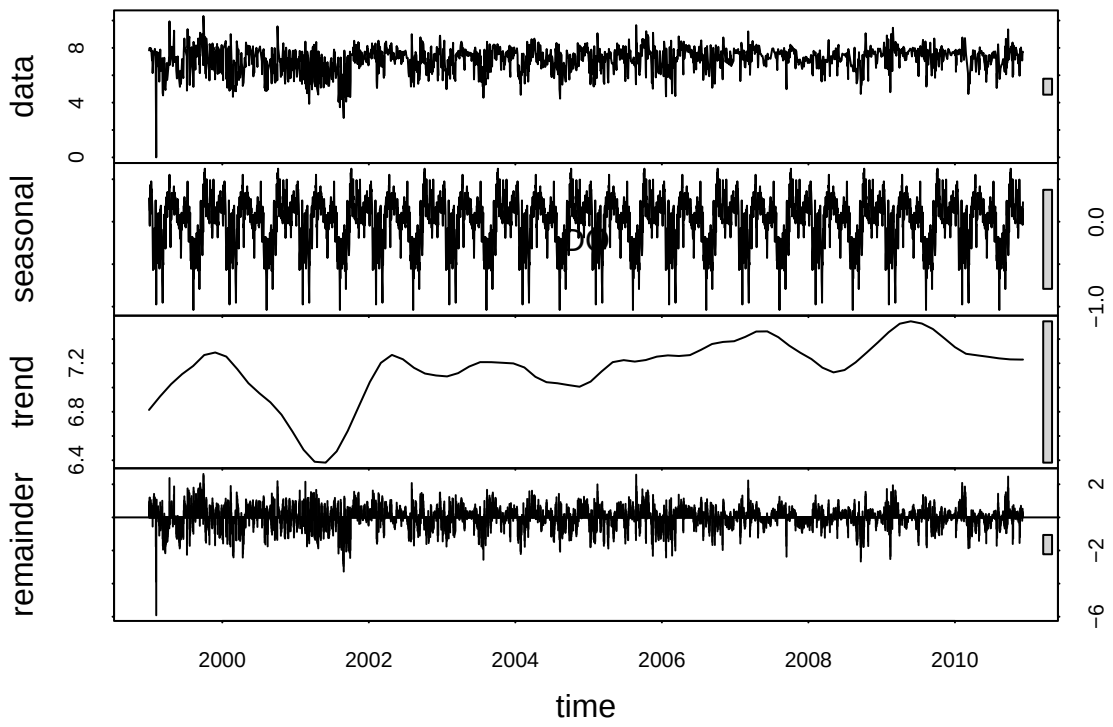
## 8306        NA        NA        NA        NA        NA        NA
## 8307        NA        NA        NA        NA        NA        NA
## 8308        NA        NA        NA        NA        NA        NA
## 8309        NA        NA        NA        NA        NA        NA
## 8310        NA        NA        NA        NA        NA        NA
## 8311        NA        NA        NA        NA        NA        NA
## 8312        NA        NA        NA        NA        NA        NA
## 8313        NA        NA        NA        NA        NA        NA
## 8314        NA        NA        NA        NA        NA        NA
## 8315        NA        NA        NA        NA        NA        NA
## 8316        NA        NA        NA        NA        NA        NA
## 8317        NA        NA        NA        NA        NA        NA
## 8318        NA        NA        NA        NA        NA        NA
## 8319        NA        NA        NA        NA        NA        NA
## 8320        NA        NA        NA        NA        NA        NA
## 8321        NA        NA        NA        NA        NA        NA
## 8322        NA        NA        NA        NA        NA        NA
## 8323        NA        NA        NA        NA        NA        NA
## 8324        NA        NA        NA        NA        NA        NA
```

```
## 8325        NA        NA        NA        NA        NA        NA
## 8326        NA        NA        NA        NA        NA        NA
## 8327        NA        NA        NA        NA        NA        NA
## 8328        NA        NA        NA        NA        NA        NA
## 8329        NA        NA        NA        NA        NA        NA
## 8330        NA        NA        NA        NA        NA        NA
## 8331        NA        NA        NA        NA        NA        NA
## 8332        NA        NA        NA        NA        NA        NA
## 8333        NA        NA        NA        NA        NA        NA
##  [ reached 'max' / getOption("max.print") -- omitted 3035 rows ]
```

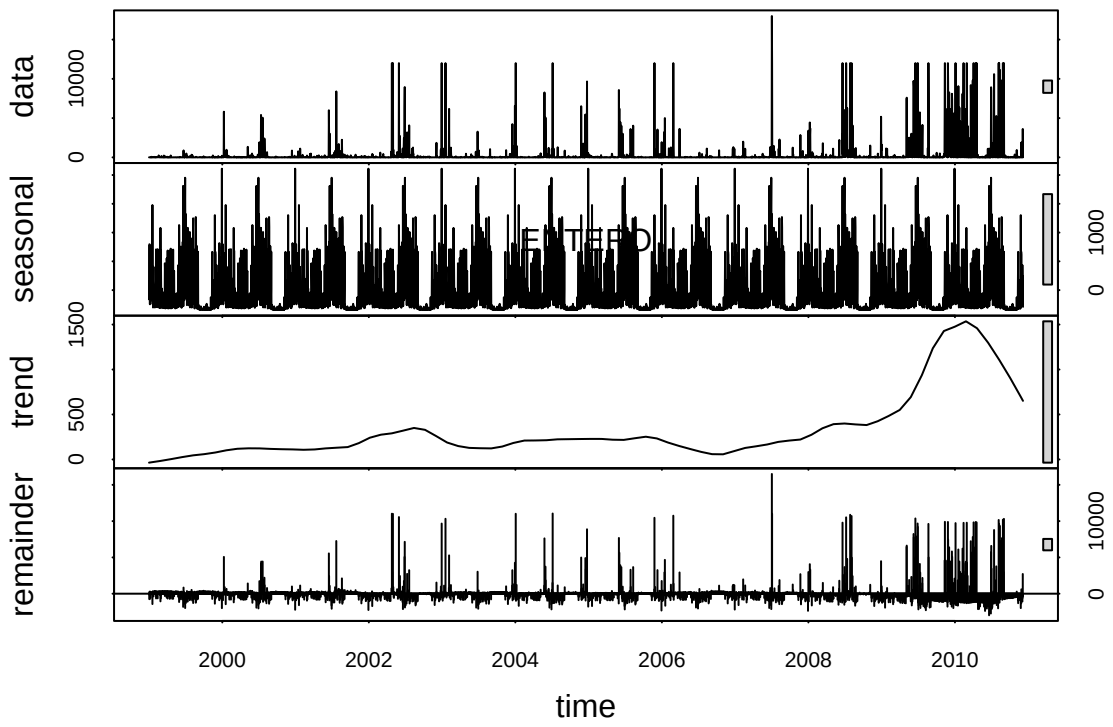
```
####### 5 YEAR - 1996 - 2001 ########################################
ts_chlorophyll <- ts(owt_df02_gb04_mrgd$CHLOROPHYLL, start = c(1996, 1), freq = 365)
ts_1996_2001_chl <- window(ts_chlorophyll, start=c(1999, 1))
stl_chl <- stl(ts_1996_2001_chl, s.window="periodic")
#labels.chart = seq(as.Date("1990-11-15"), as.Date("2021-12-29"), by = "weeks")
plot(stl_chl)
mtext("CHLOROPHYLL", side=3, line = -5)
```



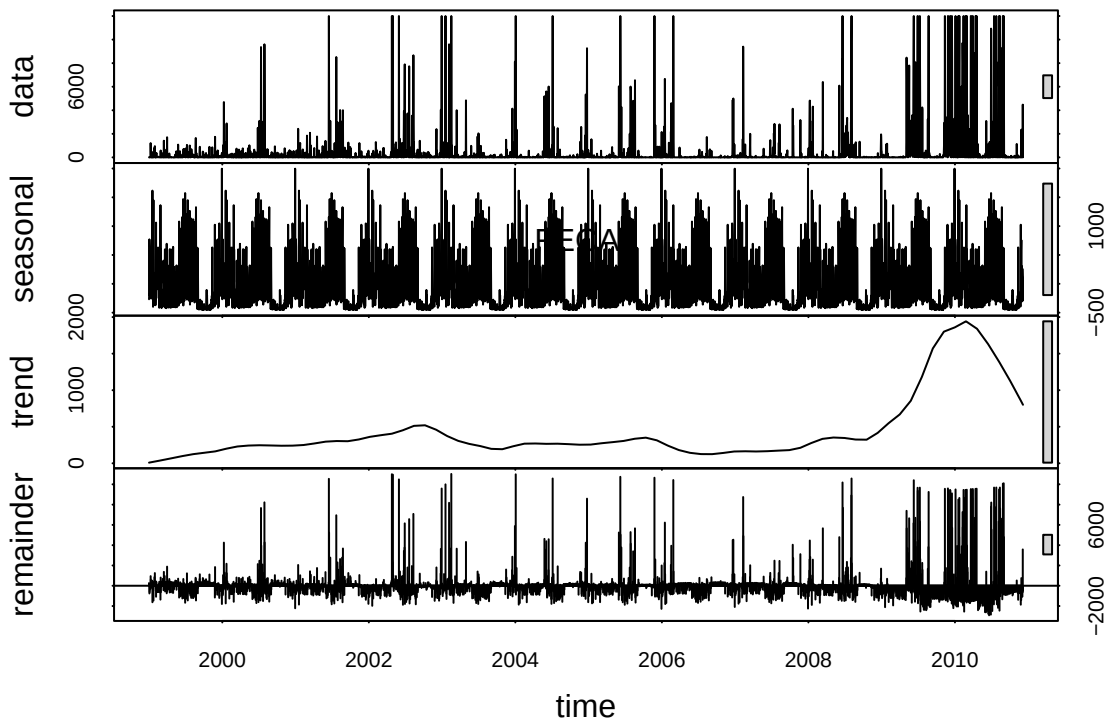

```
ts_do <- ts(owt_df02_gb04_mrgd$DO, start = c(1996, 1), freq = 365)
ts_1996_2001_do <- window(ts_do, start=c(1999, 1))
stl_do <- stl(ts_1996_2001_do, s.window="periodic")
#labels.chart = seq(as.Date("1990-11-15"), as.Date("2021-12-29"), by = "weeks")
plot(stl_do)
mtext("DO", side=3, line = -5)
```



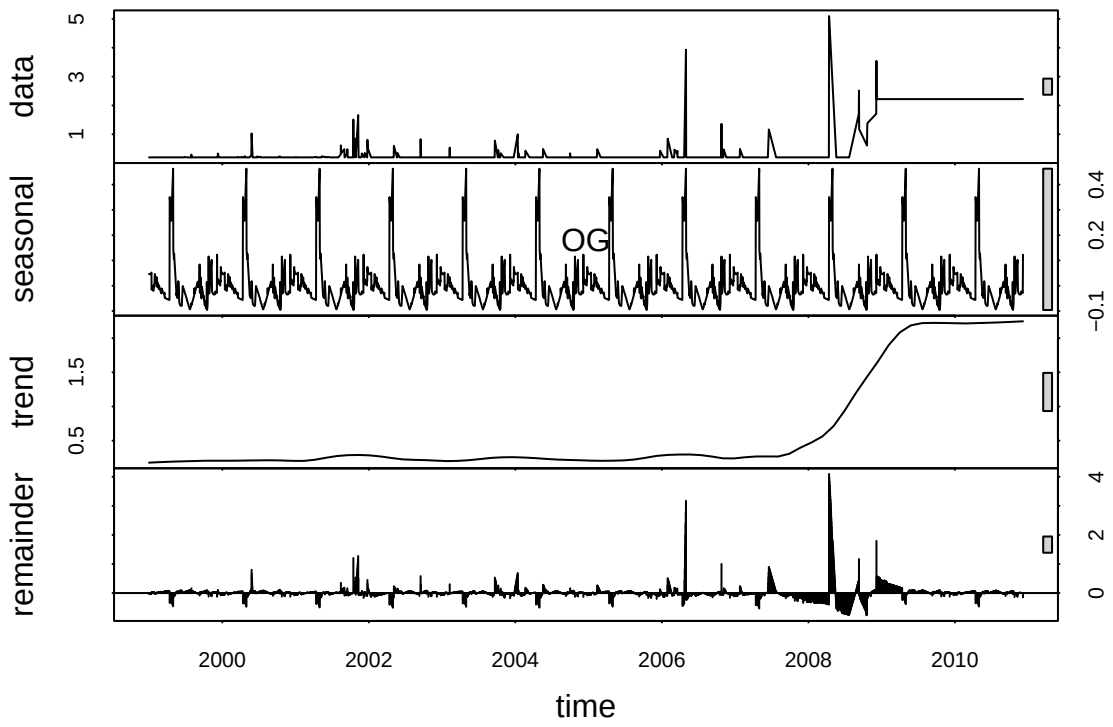

```
ts_ent <- ts(owt_df02_gb04_mrgd$ENTERO, start = c(1996, 1), freq = 365)
ts_1996_2001_ent <- window(ts_ent, start=c(1999, 1))
stl_ent <- stl(ts_1996_2001_ent, s.window="periodic")
#labels.chart = seq(as.Date("1990-11-15"), as.Date("2021-12-29"), by = "weeks")
plot(stl_ent)
mtext("ENTERO", side=3, line = -5)
```



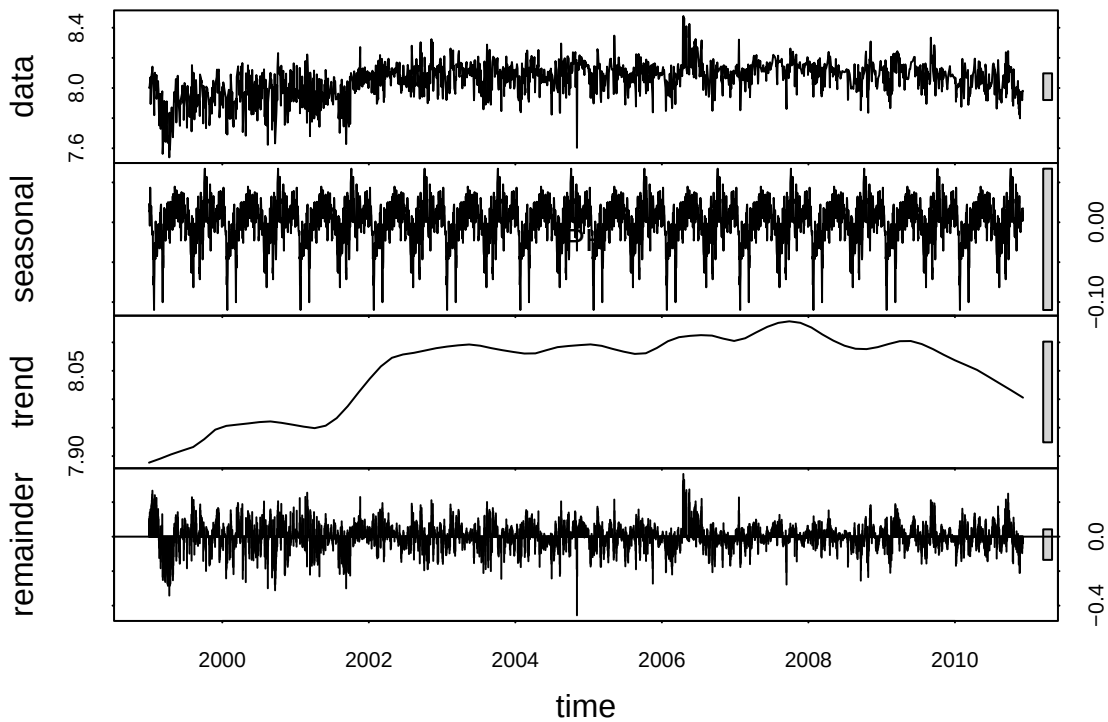

```
ts_fecal <- ts(owt_df02_gb04_mrgd$FECAL, start = c(1996, 1), freq = 365)
ts_1996_2001_fecal <- window(ts_fecal, start=c(1999, 1))
stl_fecal <- stl(ts_1996_2001_fecal, s.window="periodic")
#labels.chart = seq(as.Date("1990-11-15"), as.Date("2021-12-29"), by = "weeks")
plot(stl_fecal)
mtext("FECAL", side=3, line = -5)
```



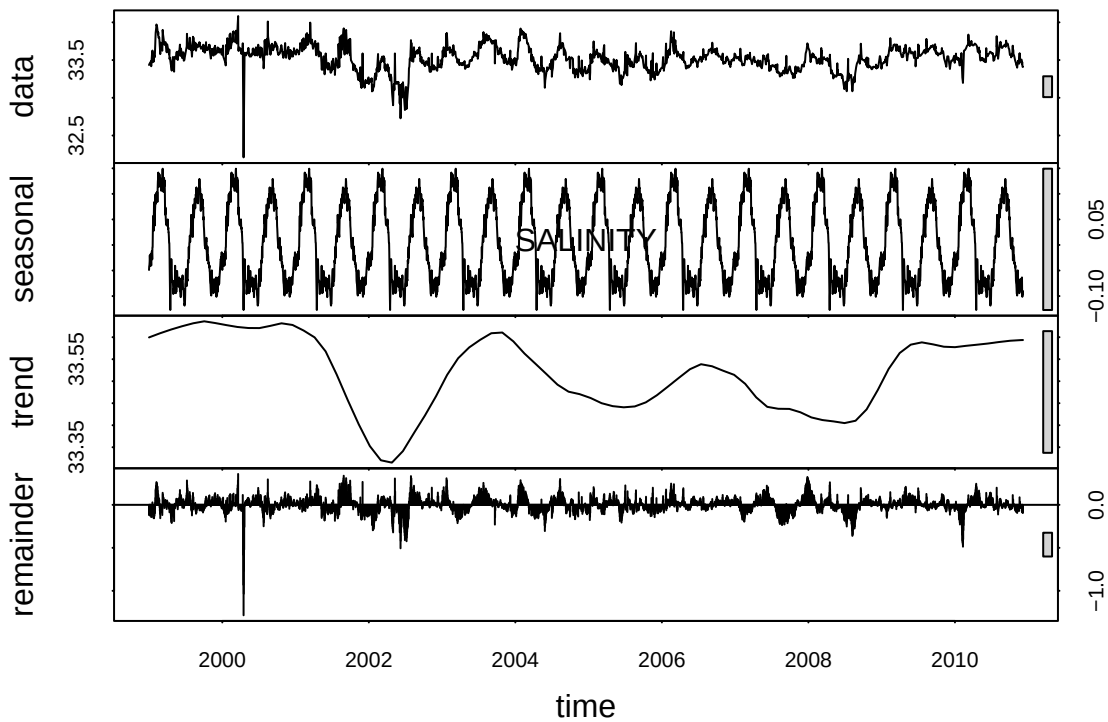

```
ts_og <- ts(owt_df02_gb04_mrgd$OG, start = c(1996, 1), freq = 365)
ts_1996_2001_og <- window(ts_og, start=c(1999, 1))
stl_og <- stl(ts_1996_2001_og, s.window="periodic")
#labels.chart = seq(as.Date("1990-11-15"), as.Date("2021-12-29"), by = "weeks")
plot(stl_og)
mtext("OG", side=3, line = -5)
```



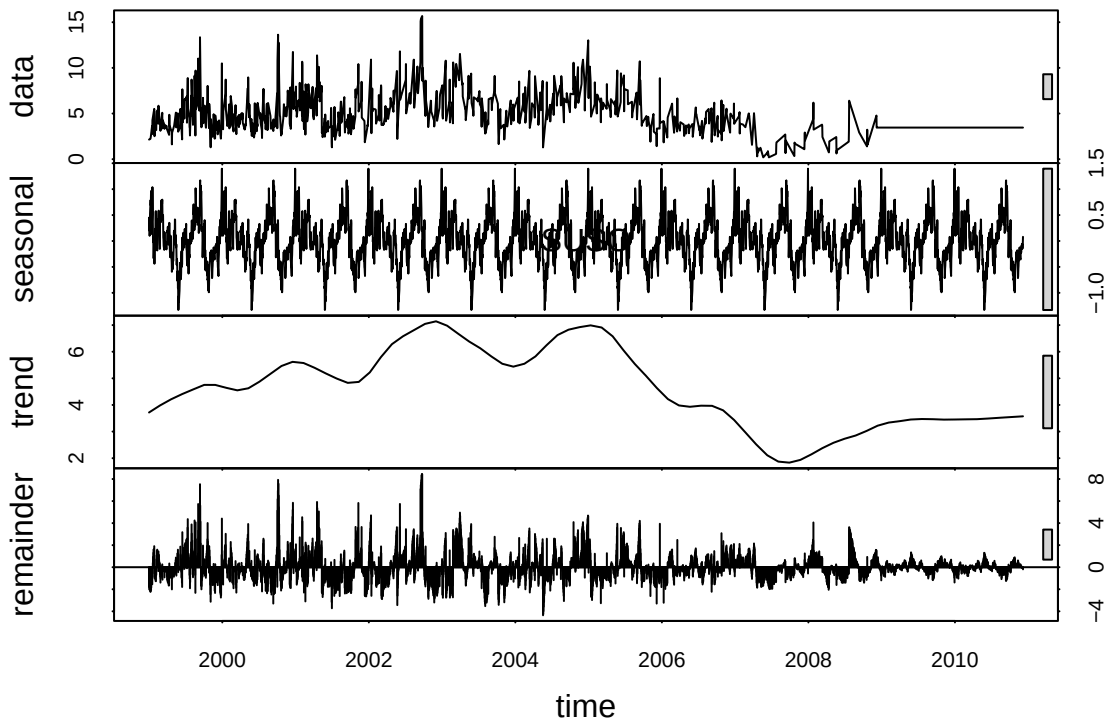

```
ts_ph <- ts(owt_df02_gb04_mrgd$PH, start = c(1996, 1), freq = 365)
ts_1996_2001_ph <- window(ts_ph, start=c(1999, 1))
stl_ph <- stl(ts_1996_2001_ph, s.window="periodic")
#labels.chart = seq(as.Date("1990-11-15"), as.Date("2021-12-29"), by = "weeks")
plot(stl_ph)
mtext("PH", side=3, line = -5)
```



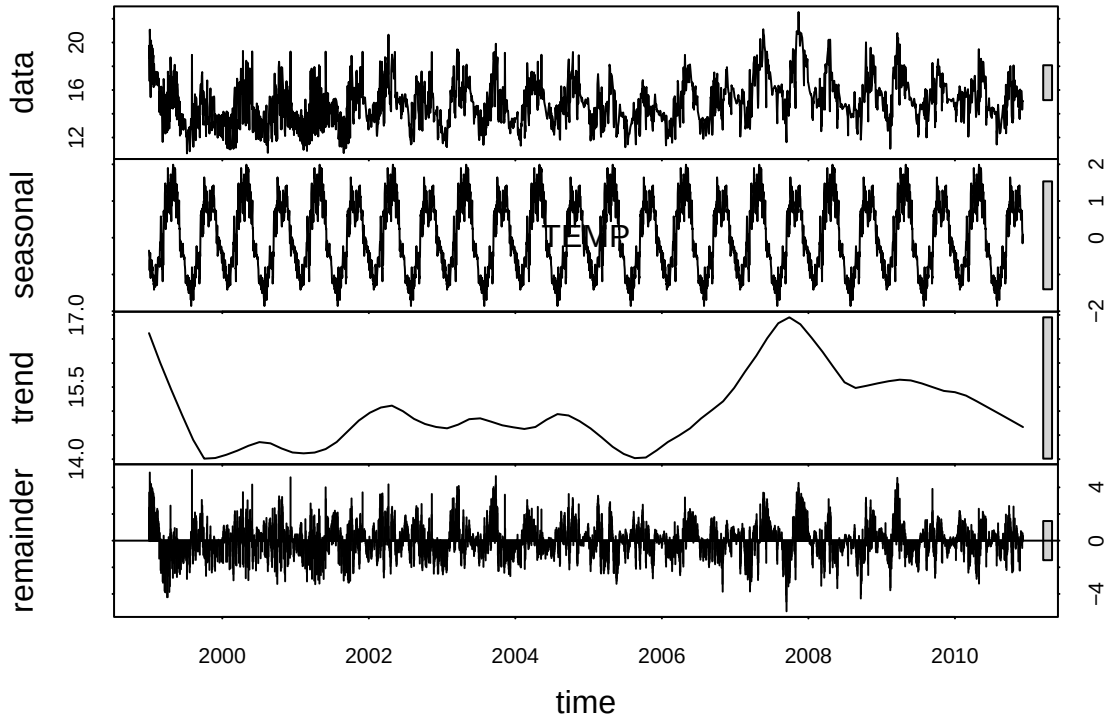

```
ts_salinity <- ts(owt_df02_gb04_mrgd$SALINITY, start = c(1996, 1), freq = 365)
ts_1996_2001_salinity <- window(ts_salinity, start=c(1999, 1))
stl_salinity <- stl(ts_1996_2001_salinity, s.window="periodic")
#labels.chart = seq(as.Date("1990-11-15"), as.Date("2021-12-29"), by = "weeks")
plot(stl_salinity)
mtext("SALINITY", side=3, line = -5)
```



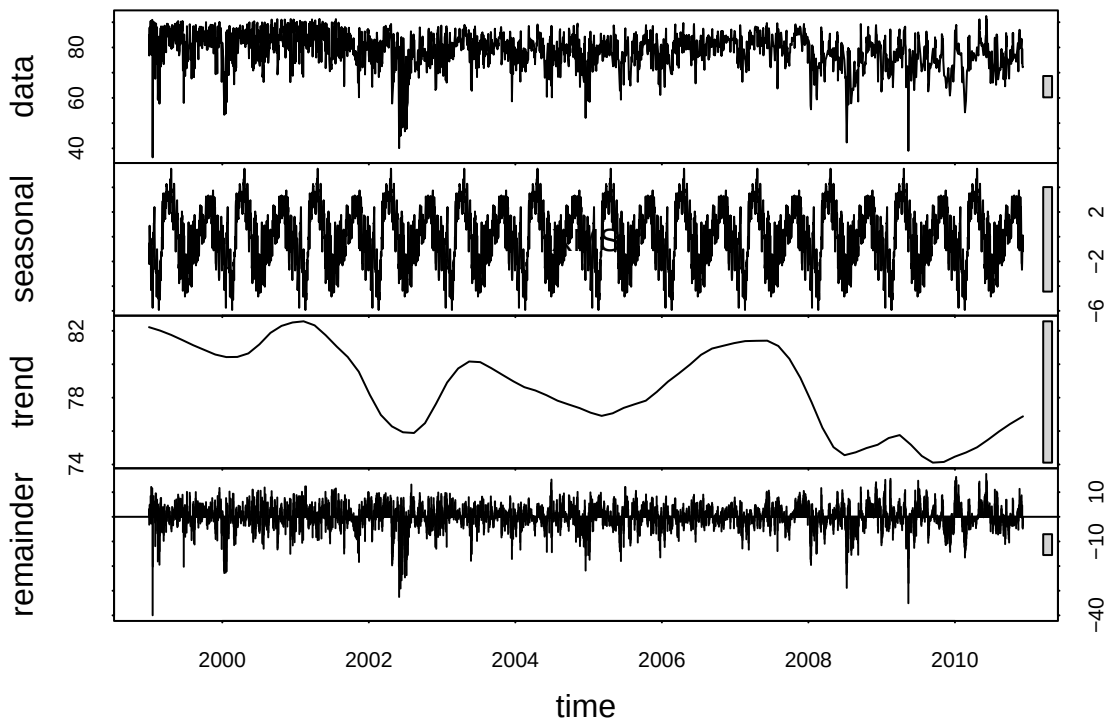

```
ts_suso <- ts(owt_df02_gb04_mrgd$SUSO, start = c(1996, 1), freq = 365)
ts_1996_2001_suso <- window(ts_suso, start=c(1999, 1))
stl_suso <- stl(ts_1996_2001_suso, s.window="periodic")
#labels.chart = seq(as.Date("1990-11-15"), as.Date("2021-12-29"), by = "weeks")
plot(stl_suso)
mtext("SUSO", side=3, line = -5)
```




```
ts_temp <- ts(owt_df02_gb04_mrgd$TEMP, start = c(1996, 1), freq = 365)
ts_1996_2001_temp <- window(ts_temp, start=c(1999, 1))
stl_temp <- stl(ts_1996_2001_temp, s.window="periodic")
#labels.chart = seq(as.Date("1990-11-15"), as.Date("2021-12-29"), by = "weeks")
plot(stl_temp)
mtext("TEMP", side=3, line = -5)
```




```
ts_xms <- ts(owt_df02_gb04_mrgd$XMS, start = c(1996, 1), freq = 365)
ts_1996_2001_xms <- window(ts_xms, start=c(1999, 1))
stl_xms <- stl(ts_1996_2001_xms, s.window="periodic")
#labels.chart = seq(as.Date("1990-11-15"), as.Date("2021-12-29"), by = "weeks")
plot(stl_xms)
mtext("XMS", side=3, line = -5)
```



{r CC-EDA-STL-1YEARPERIOD}

1 YEAR - 2001

ts_chlorophyll <- ts(owt_df02_gb04_mrgd$CHLOROPHYLL, start = c(2001, 1), freq = 365) ts_1996_2001_chl <- window(ts_chlorophyll, start=c(2001, 1), end=c(2001, 2)) plot(ts_1996_2001_chl) stl_chl <- stl(ts_1996_2001_chl, s.window="periodic") #labels.chart = seq(as.Date("1990-11-15"), as.Date("2021-12-29"), by = "weeks") plot(stl_chl) mtext("CHLOROPHYLL", side=3, line = -5)

```
#library(forecast)

# All parameters exhibited seasonal cycles within a year range, so
# it would make sense to have several years worth of datapoints for the training period.
↪  This set below can be used for all parameters.
train <- head(owt_df02_gb04_mrgd, round(NROW(owt_df02_gb04_mrgd) * 0.6))
h <- length(owt_df02_gb04_mrgd) - NROW(train)
test <- tail(owt_df02_gb04_mrgd, h)
```

Define custom function to produce scatterplots comparing multiple predictors to one target

```
param_lst03 <- c("CHLOROPHYLL",
                 "DENSITY",
                 "DO",
                 "FECAL",
                 "OG",
```

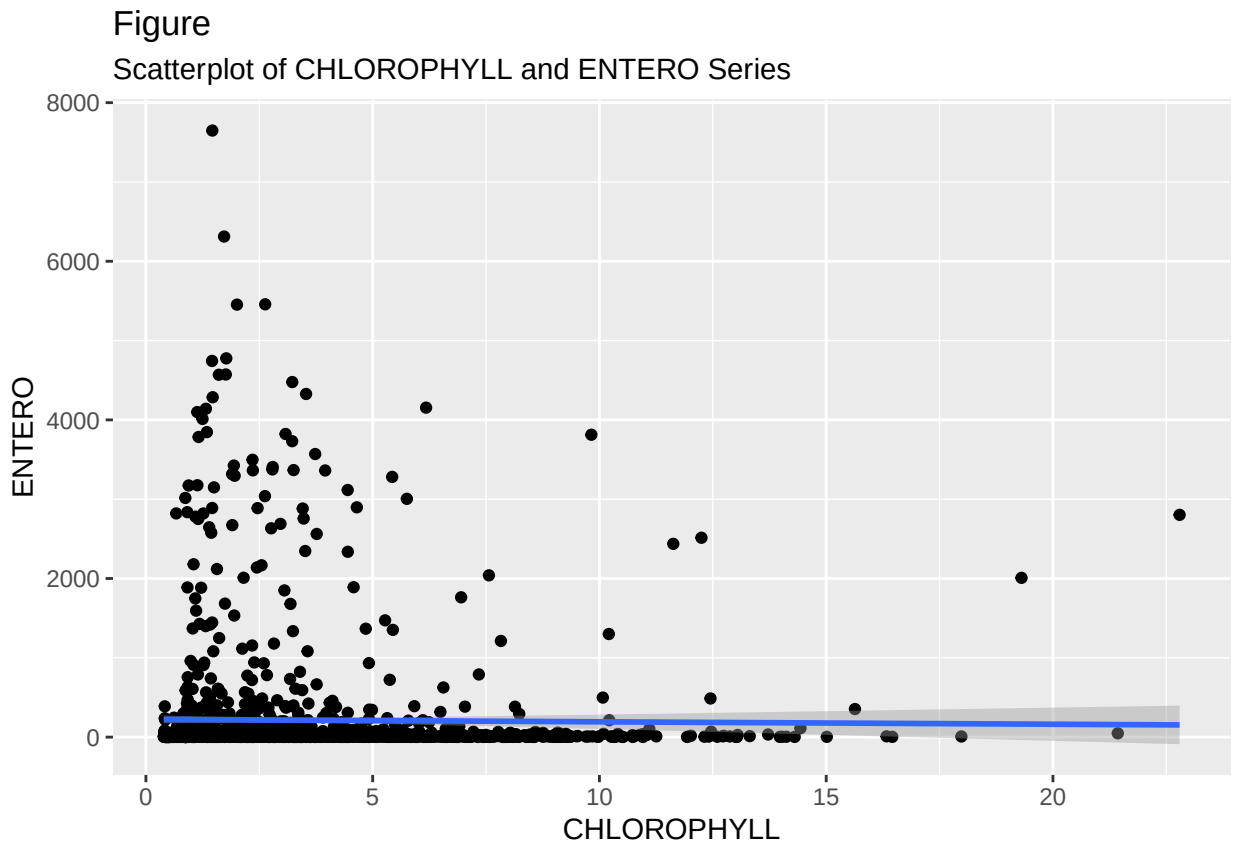
```
                  "PH",
                  "SALINITY",
                  "SUSO",
                  "TEMP",
                  "XMS")

scatr <- function(df = NA,
                   y = NA,
                   x_lst = c()) {
  for (p in x_lst) {
    plot <- ggplot(df, aes(df[, p], df[, y])) +
    geom_point() +
    stat_smooth(method = "lm",
                formula = y ~ x,
                geom = "smooth") +
    labs(x = p,
         y = y,
         title = "Figure",
         subtitle = paste0("Scatterplot of ", p, " and ", y, " Series"))
    print(plot)
  }
}
```

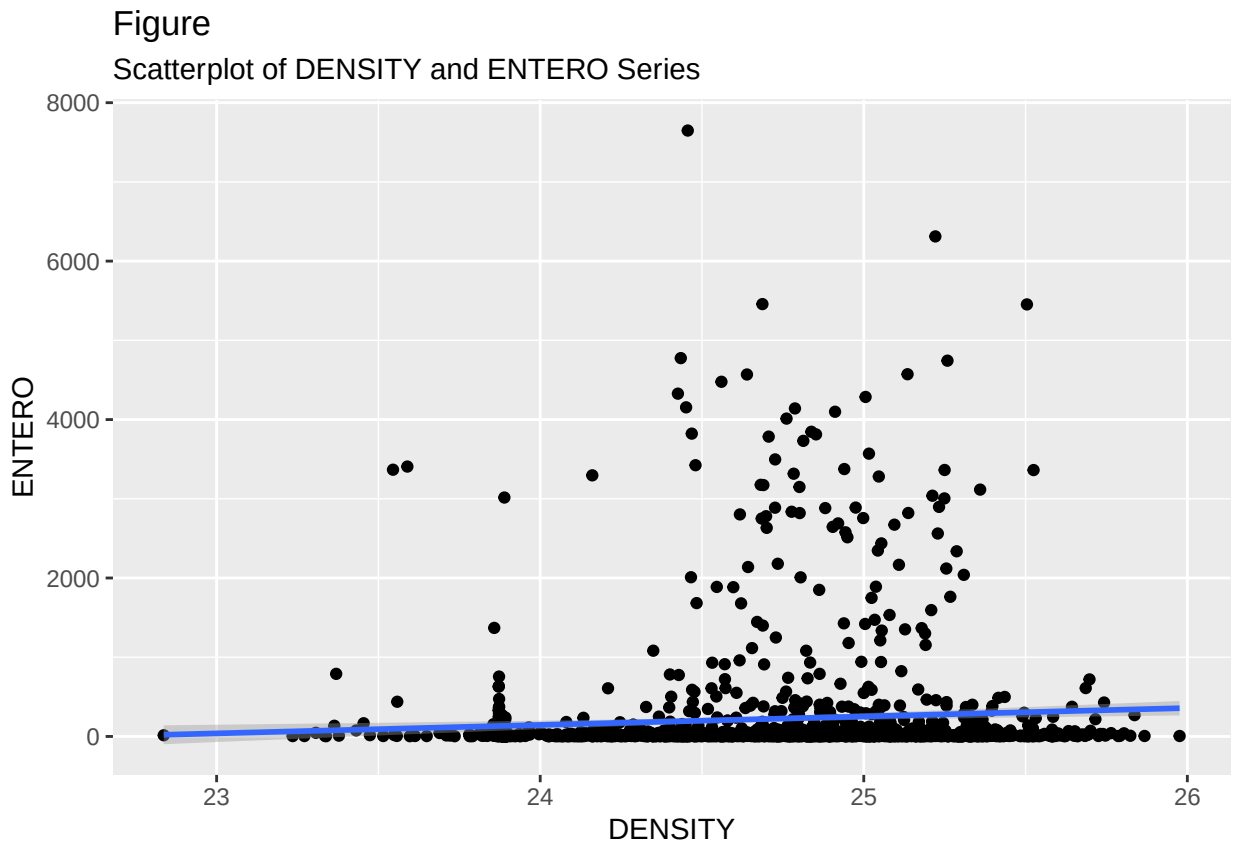
Run custom function on data aggregated by `date_sample` and `parameter`

```
# All data
scatr(df = owt_df02_gb04_wkly,
      y = "ENTERO",
      x_lst = param_lst03)
```

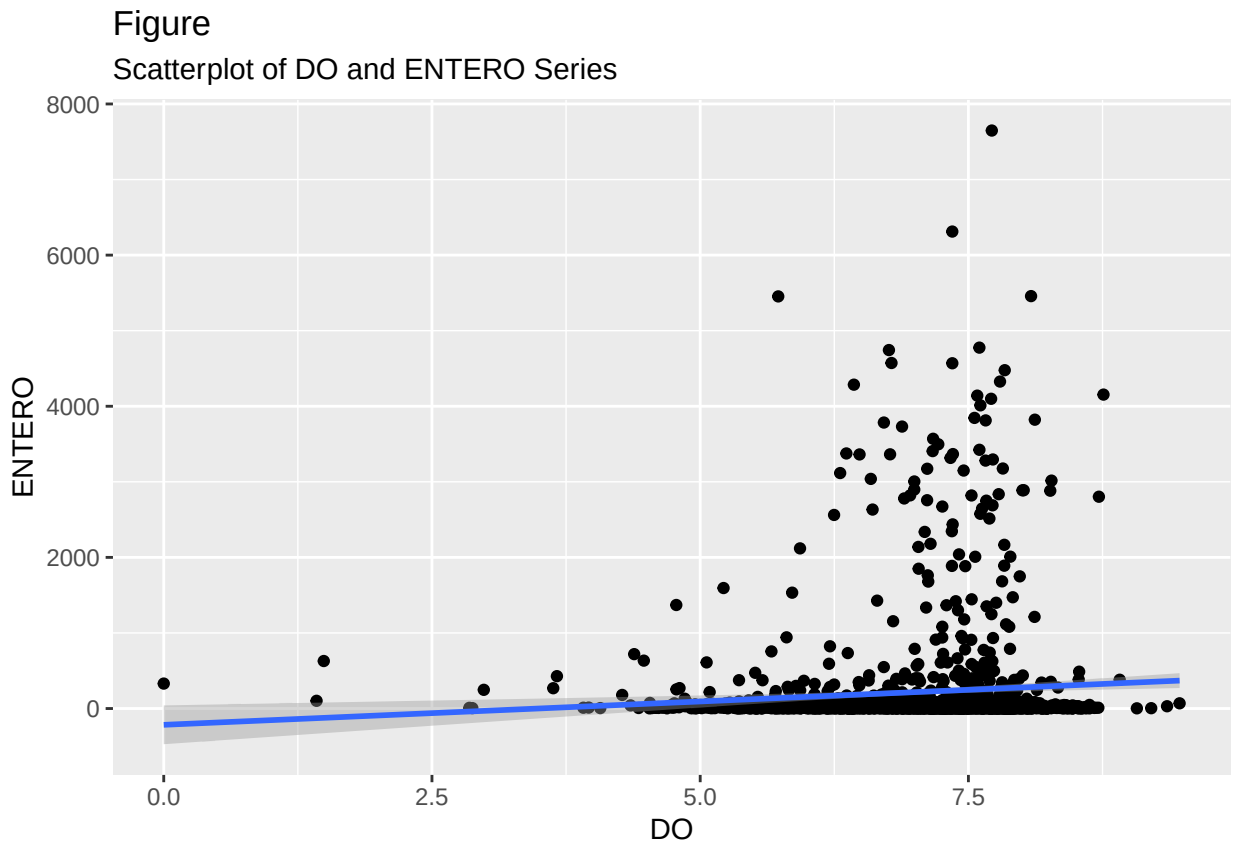
```
## Don't know how to automatically pick scale for object of type <zoo>. Defaulting
## to continuous.
## Don't know how to automatically pick scale for object of type <zoo>. Defaulting
## to continuous.
```



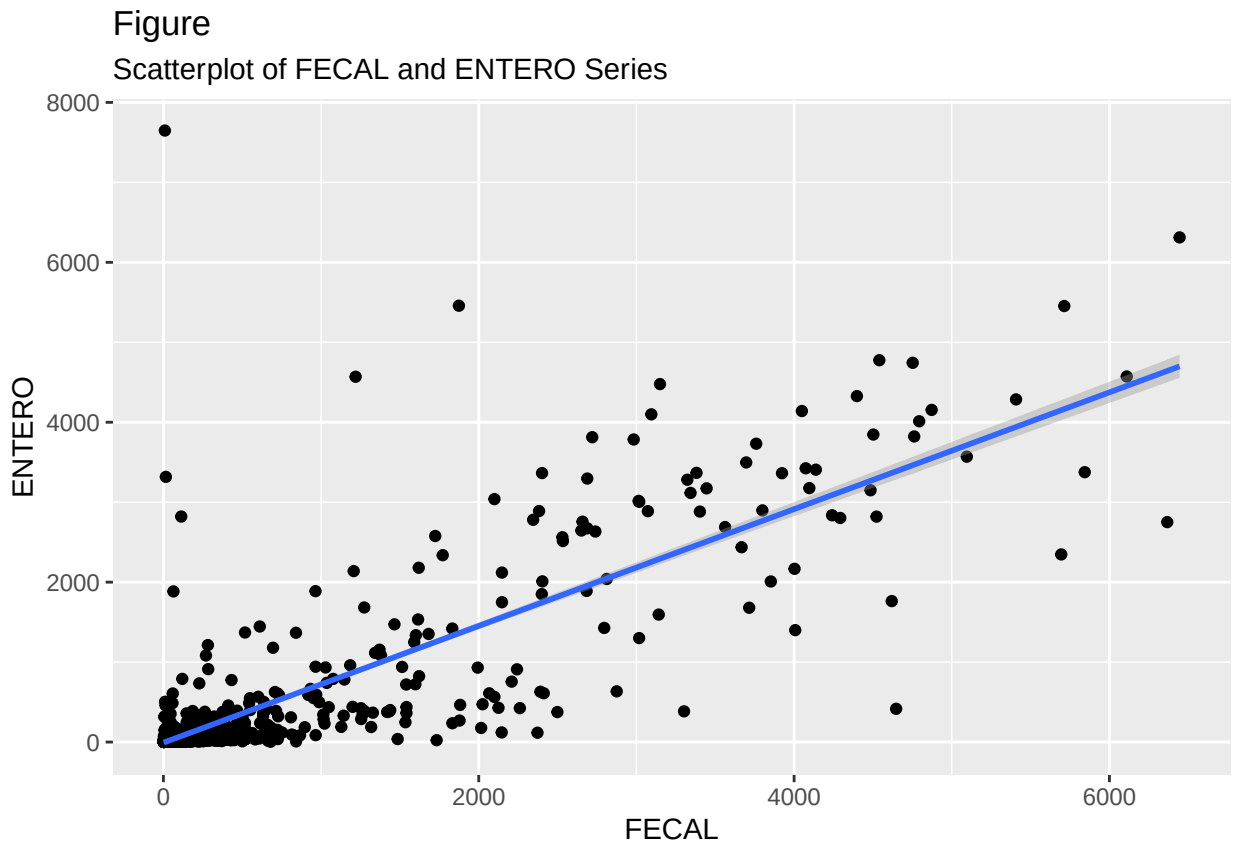

```
## Don't know how to automatically pick scale for object of type <zoo>. Defaulting
## to continuous.
## Don't know how to automatically pick scale for object of type <zoo>. Defaulting
## to continuous.
```



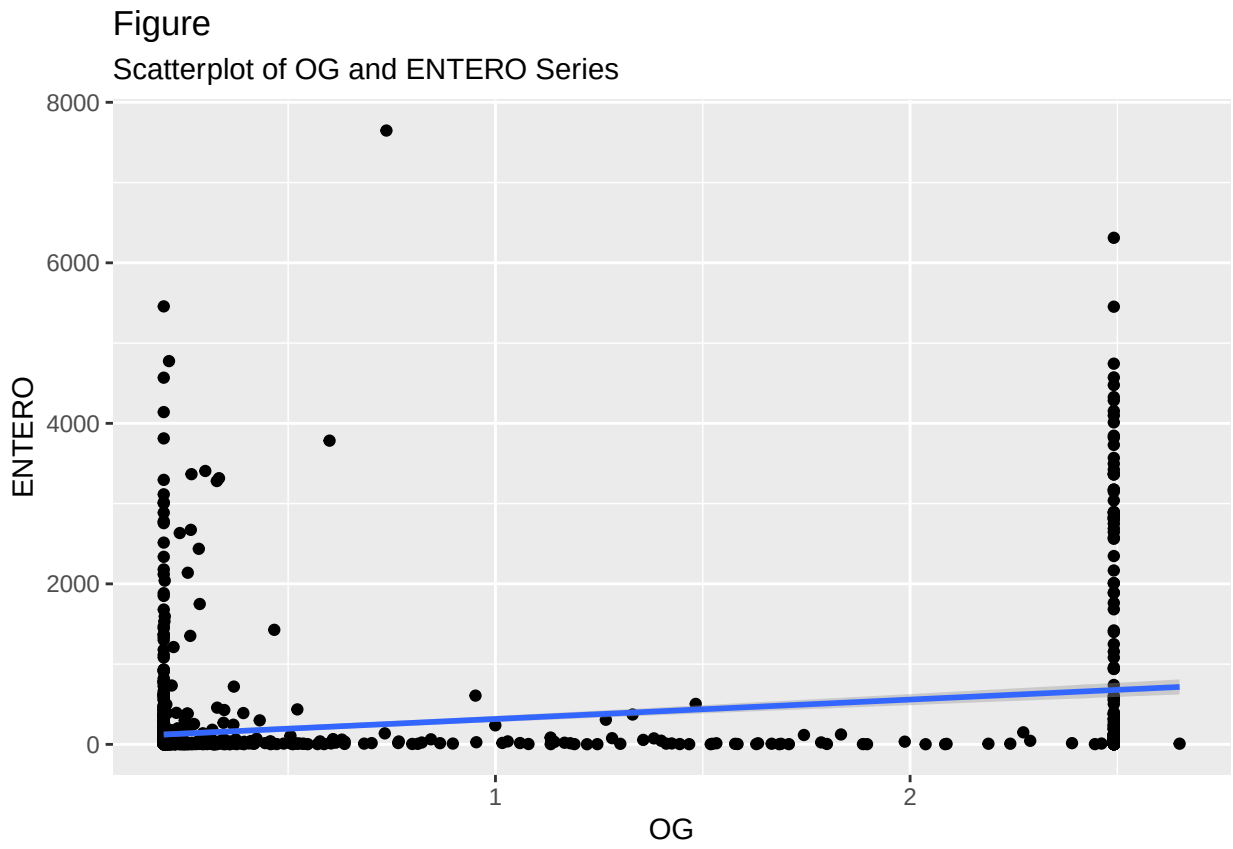

```
## Don't know how to automatically pick scale for object of type <zoo>. Defaulting
## to continuous.
## Don't know how to automatically pick scale for object of type <zoo>. Defaulting
## to continuous.
```



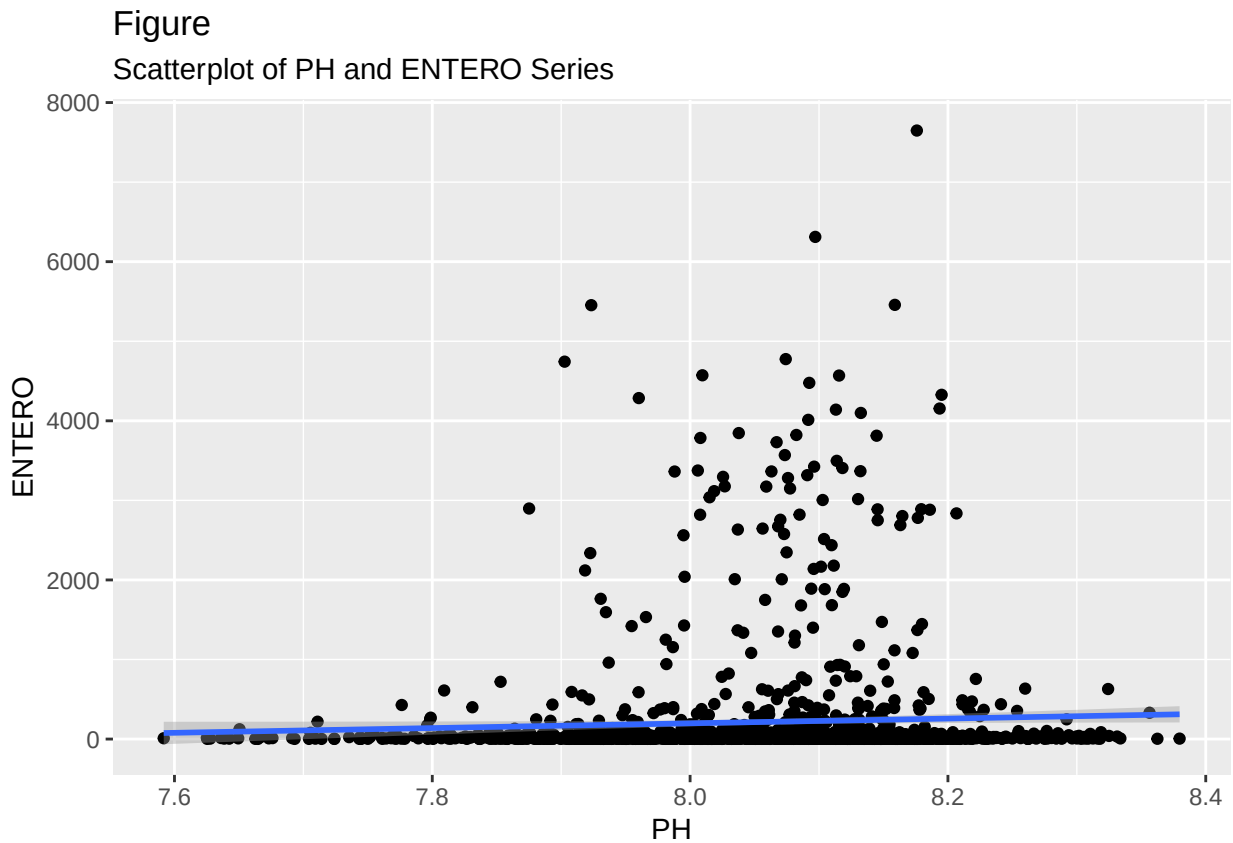

```
## Don't know how to automatically pick scale for object of type <zoo>. Defaulting
## to continuous.
## Don't know how to automatically pick scale for object of type <zoo>. Defaulting
## to continuous.
```



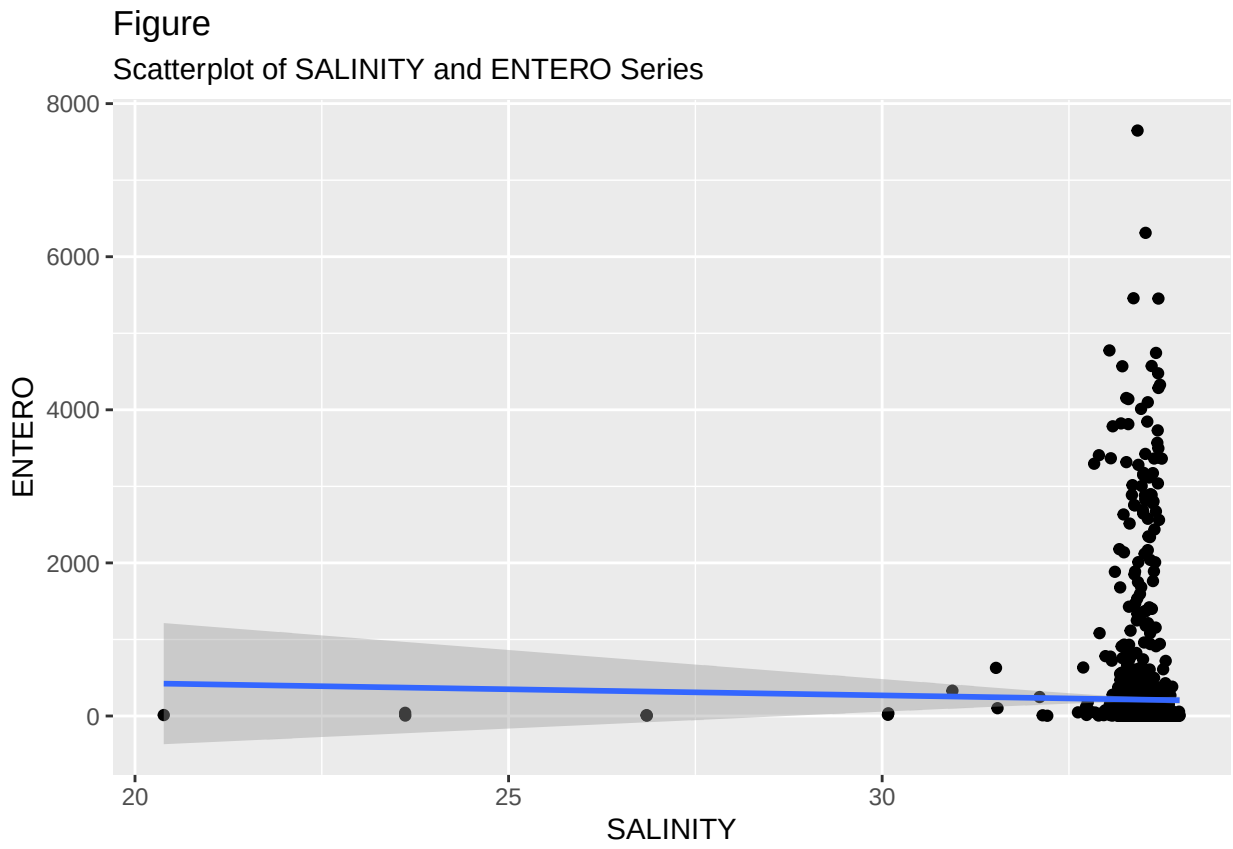

```
## Don't know how to automatically pick scale for object of type <zoo>. Defaulting
## to continuous.
## Don't know how to automatically pick scale for object of type <zoo>. Defaulting
## to continuous.
```



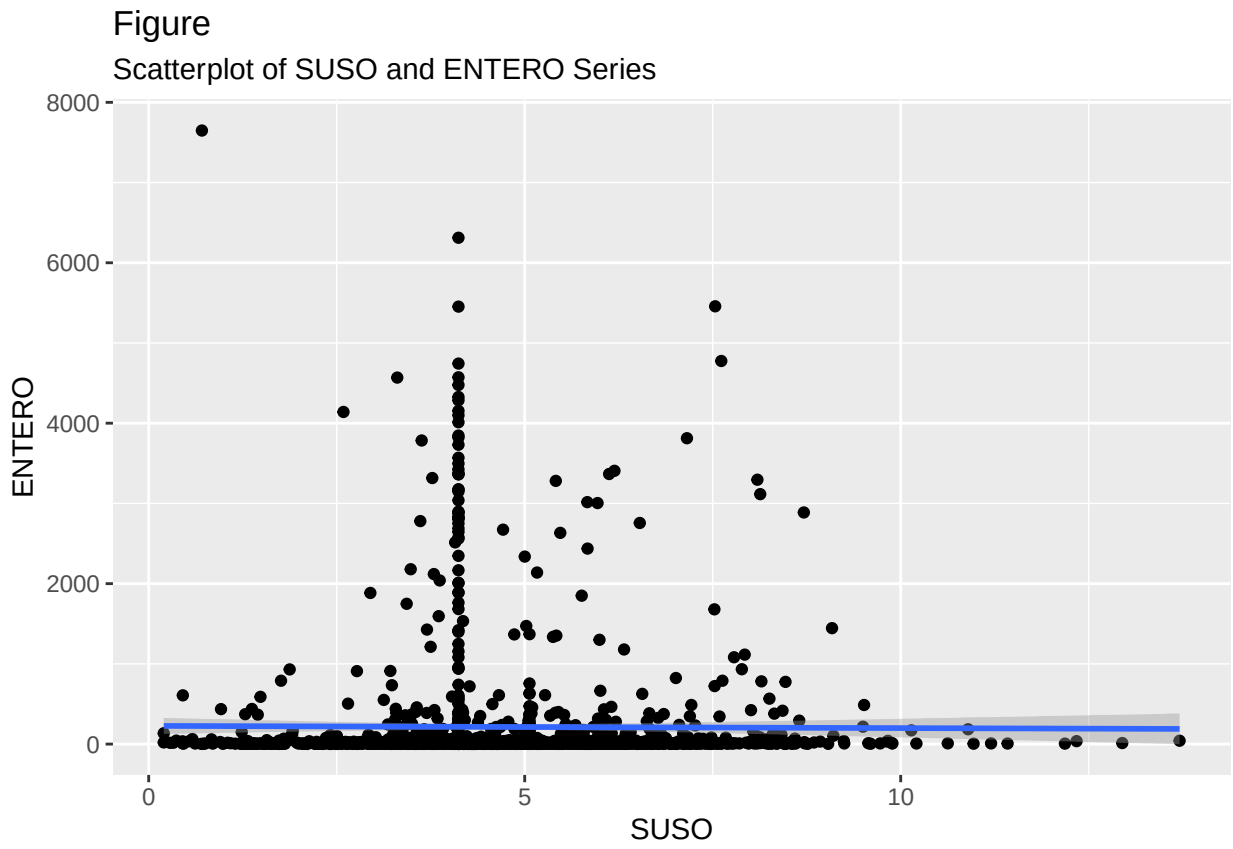

```
## Don't know how to automatically pick scale for object of type <zoo>. Defaulting
## to continuous.
## Don't know how to automatically pick scale for object of type <zoo>. Defaulting
## to continuous.
```



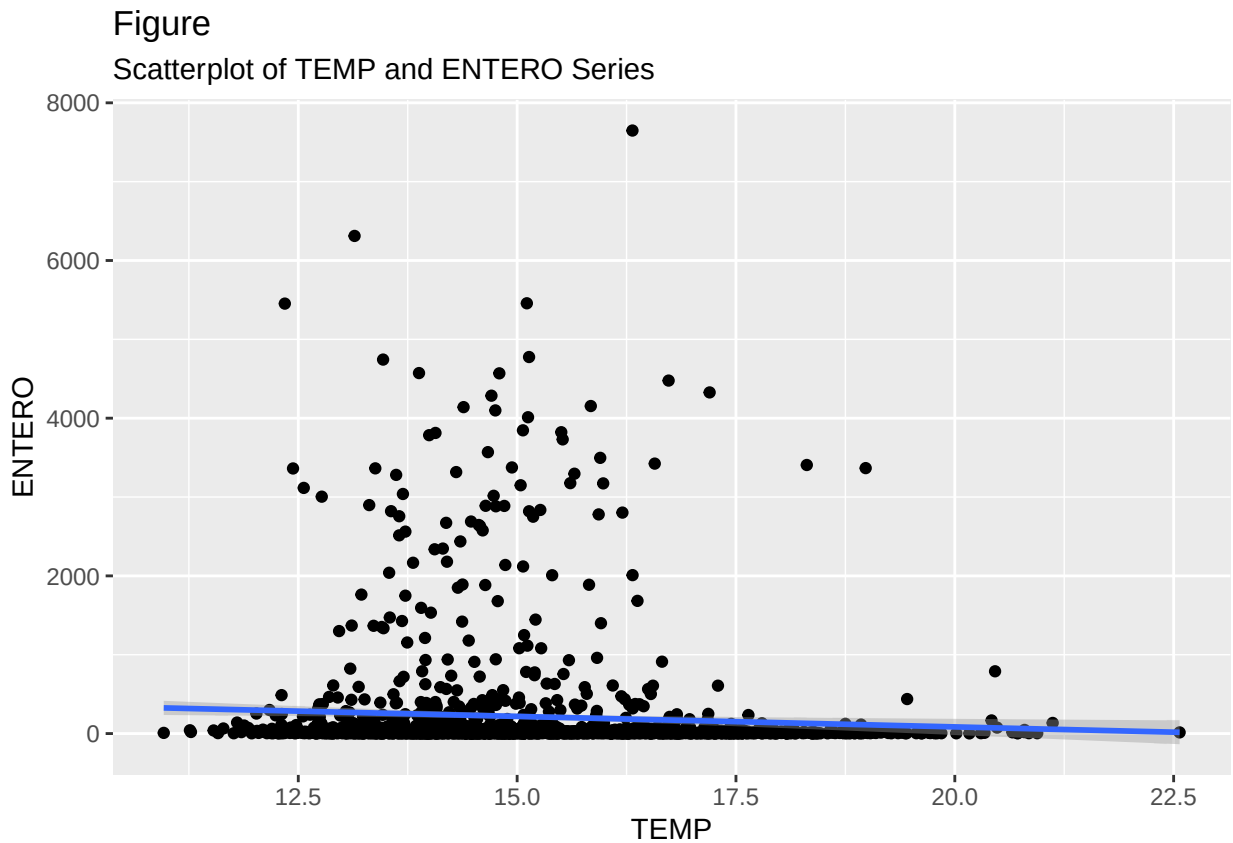

```
## Don't know how to automatically pick scale for object of type <zoo>. Defaulting
## to continuous.
## Don't know how to automatically pick scale for object of type <zoo>. Defaulting
## to continuous.
```




```
## Don't know how to automatically pick scale for object of type <zoo>. Defaulting
## to continuous.
## Don't know how to automatically pick scale for object of type <zoo>. Defaulting
## to continuous.
```



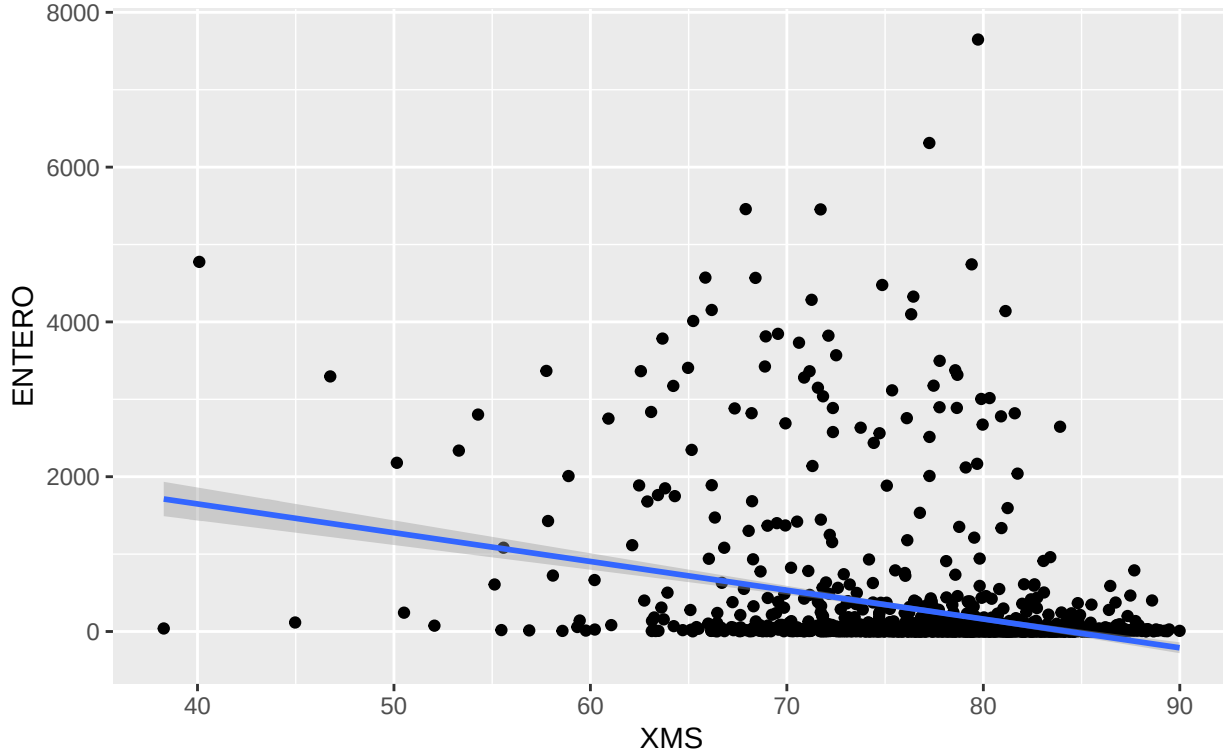

```
## Don't know how to automatically pick scale for object of type <zoo>. Defaulting
## to continuous.
## Don't know how to automatically pick scale for object of type <zoo>. Defaulting
## to continuous.
```




```
## Don't know how to automatically pick scale for object of type <zoo>. Defaulting
## to continuous.
## Don't know how to automatically pick scale for object of type <zoo>. Defaulting
## to continuous.
```

Figure

Scatterplot of XMS and ENTERO Series




```
# Excluding outliers
print(head(owt_df02_gb04_wkly02, 17))
```

```
##    date_sample CHLOROPHYLL DENSITY       DO      ENTERO     FECAL OG       PH
## 1   1990-11-19        1.07  23.854 6.980000          NA        NA NA 8.130000
## 2   1991-01-07          NA      NA       NA   25.384615  88.46154 NA       NA
## 3   1991-01-14          NA      NA 5.445417   58.129735 137.21730 NA 8.195000
## 4   1991-01-21          NA      NA       NA   23.205128  59.61538 NA       NA
## 5   1991-01-28          NA      NA       NA   31.818910  69.78365 NA       NA
## 6   1991-02-04          NA      NA       NA  154.230769 428.58974 NA       NA
## 7   1991-02-11          NA      NA       NA   16.838141  14.63141 NA       NA
## 8   1991-02-18          NA      NA 5.597500   45.317879 112.33029 NA 8.173333
## 9   1991-02-25          NA      NA       NA    9.083333  16.10737 NA       NA
## 10  1991-03-04          NA      NA       NA   16.512821  15.05128 NA       NA
## 11  1991-03-11          NA      NA 4.808333   43.496041 247.95270 NA 8.201667
## 12  1991-03-18          NA      NA       NA   32.542347 179.98990 NA       NA
## 13  1991-03-25          NA      NA       NA 1370.111538 517.44812 NA       NA
## 14  1991-04-01          NA      NA       NA   15.025641  33.15385 NA       NA
## 15  1991-04-08          NA      NA       NA   38.837607 136.90598 NA       NA
## 16  1991-04-15          NA      NA 4.730833   43.944524 190.35018 NA 8.138333
## 17  1991-04-22          NA      NA       NA   24.313390  77.44160 NA       NA
##    SALINITY SUSO     TEMP      XMS
## 1  33.59550   NA 19.37000 60.22500
## 2        NA   NA 14.45000 81.96154
## 3  33.50113   NA 14.07478 82.04876
## 4        NA   NA 14.54487 70.19231
```

```
## 5        NA   NA 14.28846 77.61167
## 6        NA   NA 14.23462 81.83333
## 7        NA   NA 14.46154 70.83333
## 8  33.51717   NA 14.00639 79.30243
## 9        NA   NA 14.05769 79.71518
## 10       NA   NA 14.24231 82.44872
## 11 33.48729   NA 13.93447 70.49667
## 12       NA   NA 12.97995 68.95260
## 13       NA   NA 13.11026 69.92308
## 14       NA   NA 13.46667 75.12719
## 15       NA   NA 13.19487 81.09818
## 16 33.55379   NA 13.33149 71.94475
## 17       NA   NA 12.97949 74.71053
```

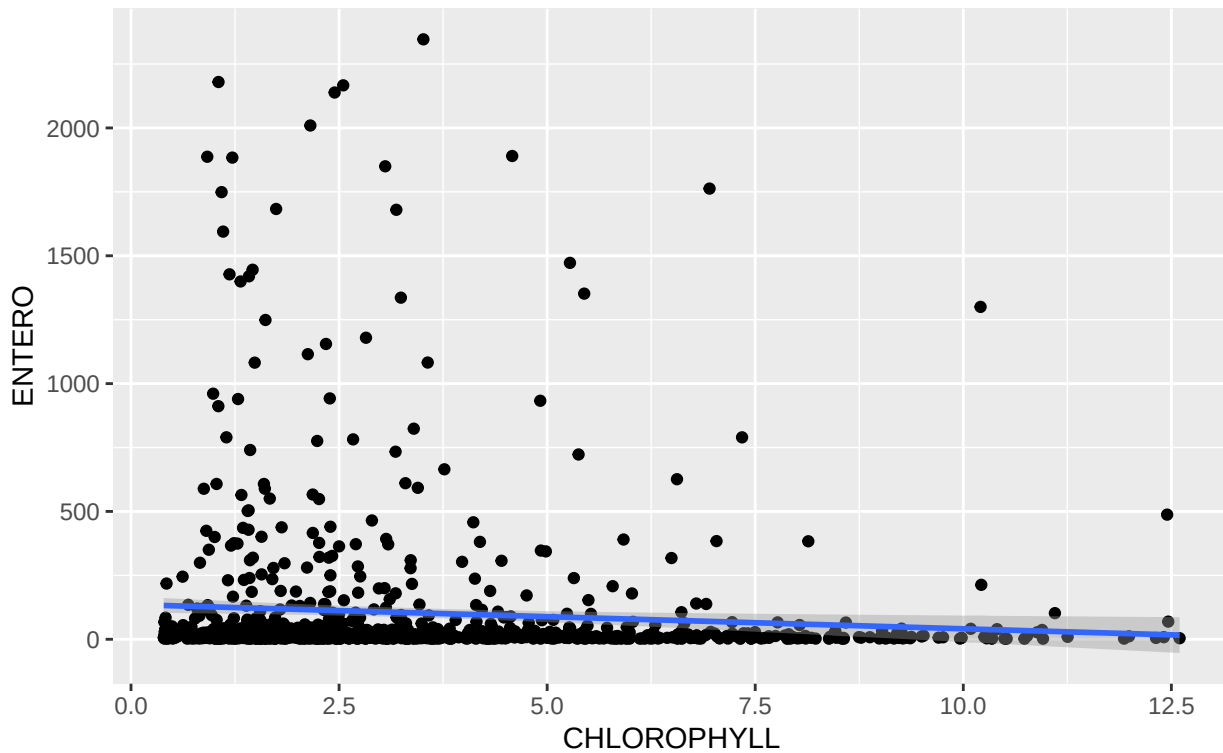
```
scatr(df = owt_df02_gb04_wkly02,
      y = "ENTERO",
      x_lst = param_lst03)
```

```
## Warning: Removed 618 rows containing non-finite values (`stat_smooth()`).
```

```
## Warning: Removed 618 rows containing missing values (`geom_point()`).
```

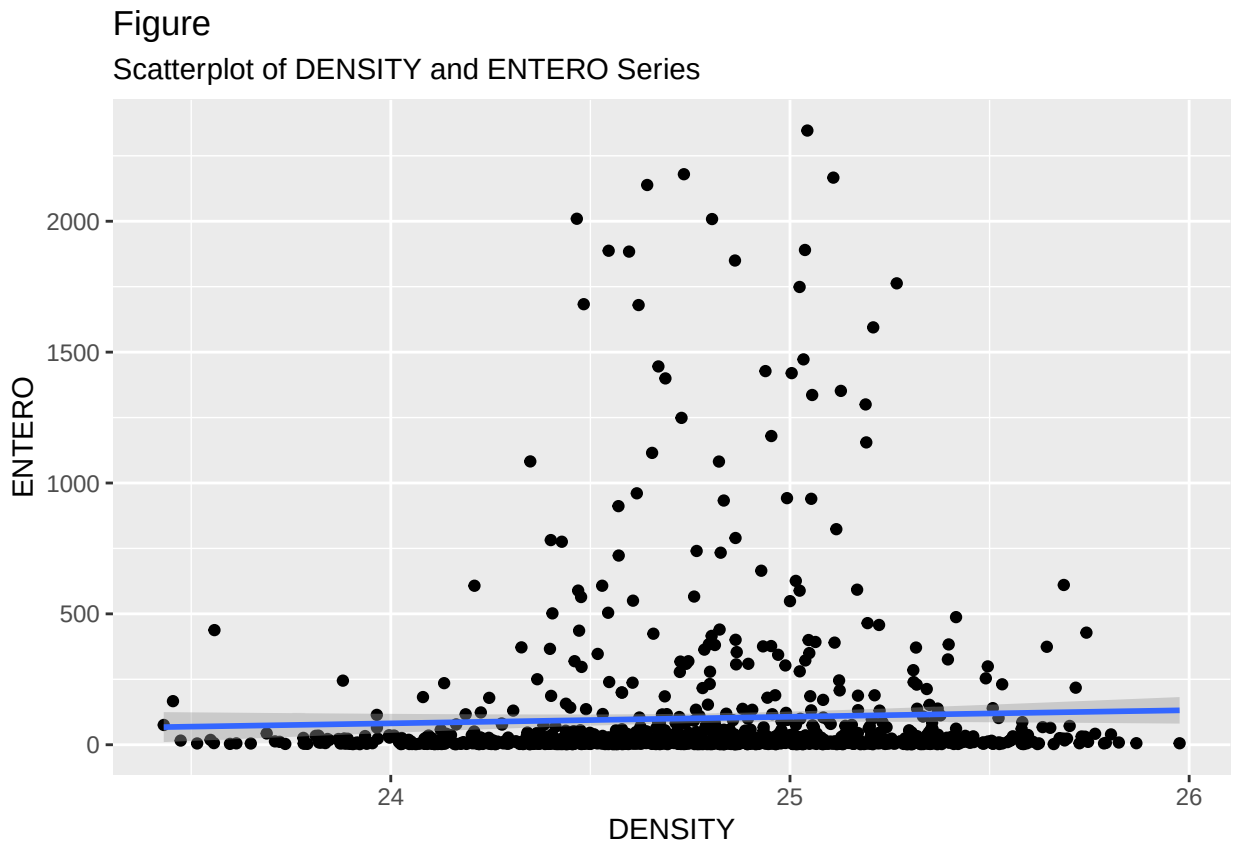
Figure

Scatterplot of CHLOROPHYLL and ENTERO Series




```
## Warning: Removed 579 rows containing non-finite values (`stat_smooth()`).
```

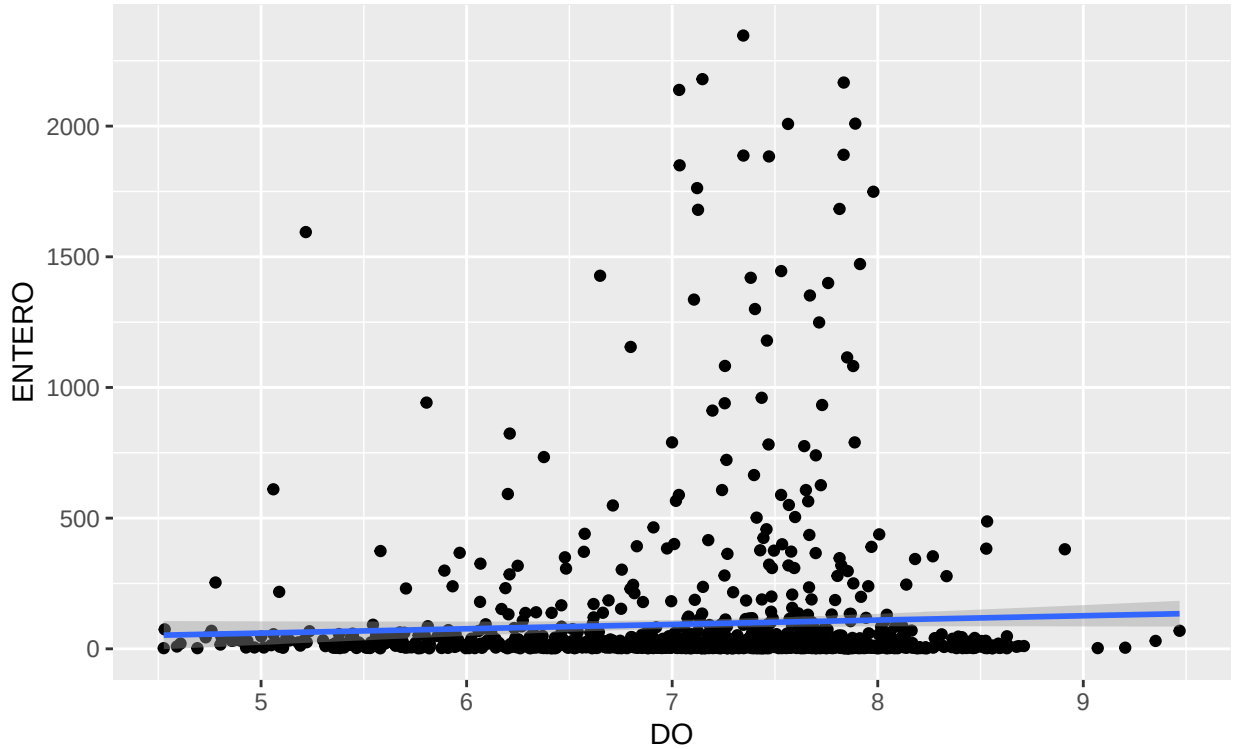
```
## Warning: Removed 579 rows containing missing values (`geom_point()`).
```




```
## Warning: Removed 473 rows containing non-finite values (`stat_smooth()`).
## Warning: Removed 473 rows containing missing values (`geom_point()`).
```

Figure

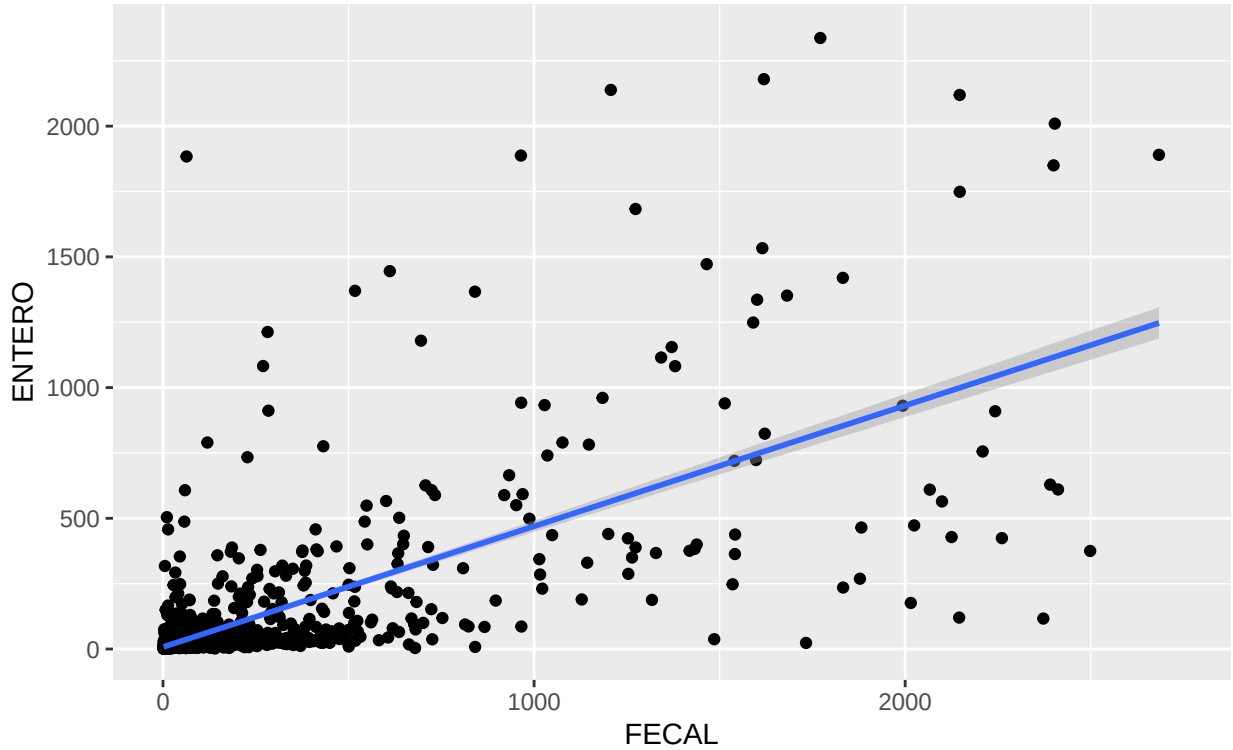
Scatterplot of DO and ENTERO Series




```
## Warning: Removed 71 rows containing non-finite values (`stat_smooth()`).
## Warning: Removed 71 rows containing missing values (`geom_point()`).
```

Figure

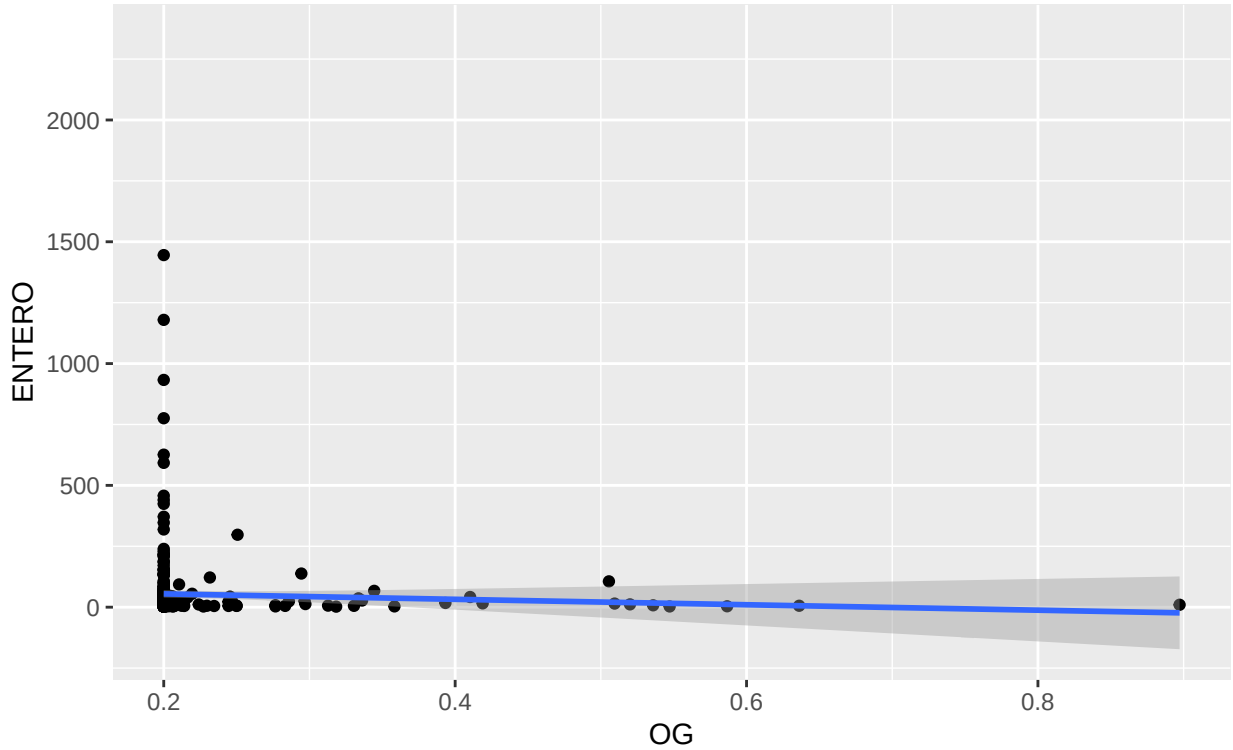
Scatterplot of FECAL and ENTERO Series




```
## Warning: Removed 1273 rows containing non-finite values (`stat_smooth()`).
## Warning: Removed 1273 rows containing missing values (`geom_point()`).
```

Figure

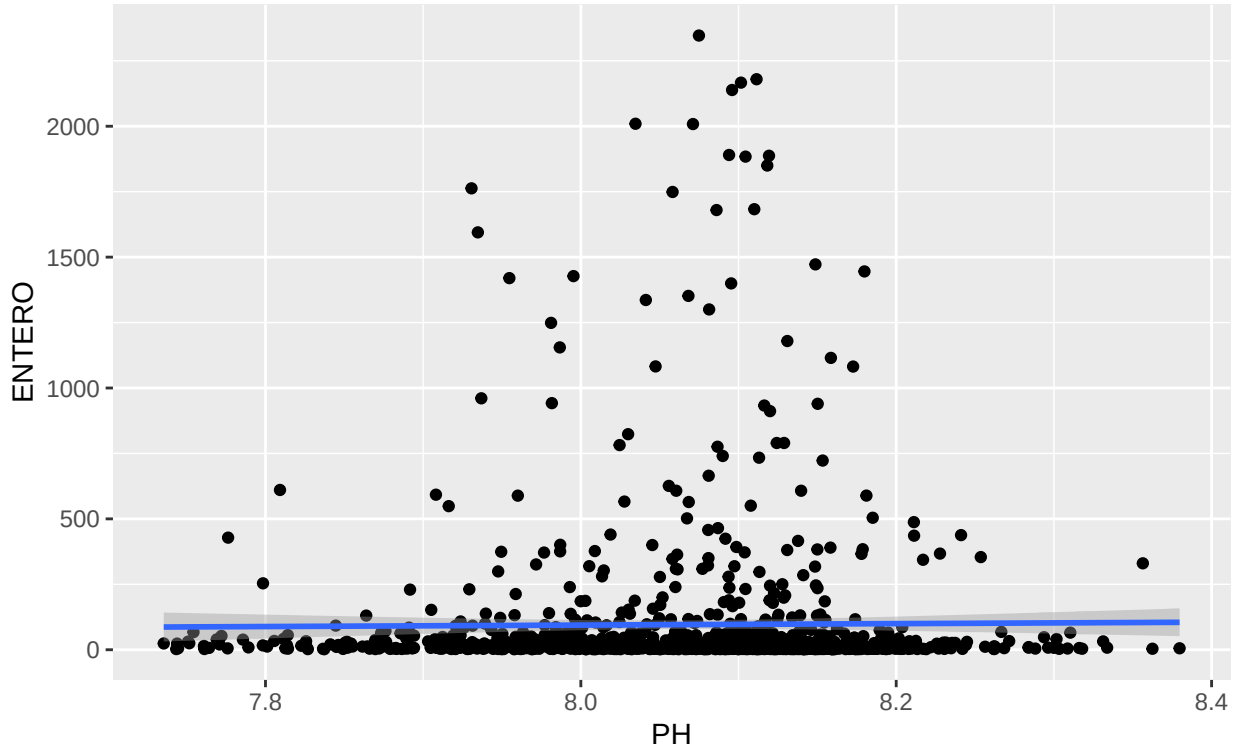
Scatterplot of OG and ENTERO Series




```
## Warning: Removed 476 rows containing non-finite values (`stat_smooth()`).
## Warning: Removed 476 rows containing missing values (`geom_point()`).
```

Figure

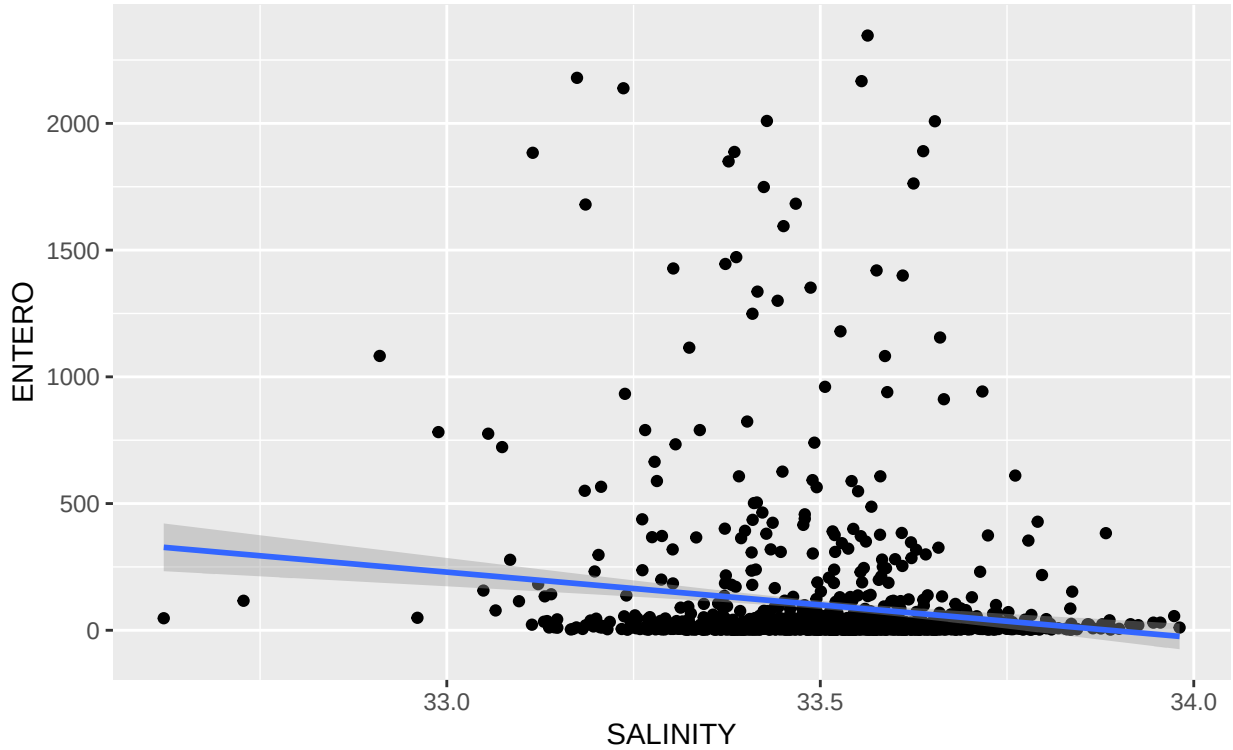
Scatterplot of PH and ENTERO Series




```
## Warning: Removed 474 rows containing non-finite values (`stat_smooth()`).
## Warning: Removed 474 rows containing missing values (`geom_point()`).
```

Figure

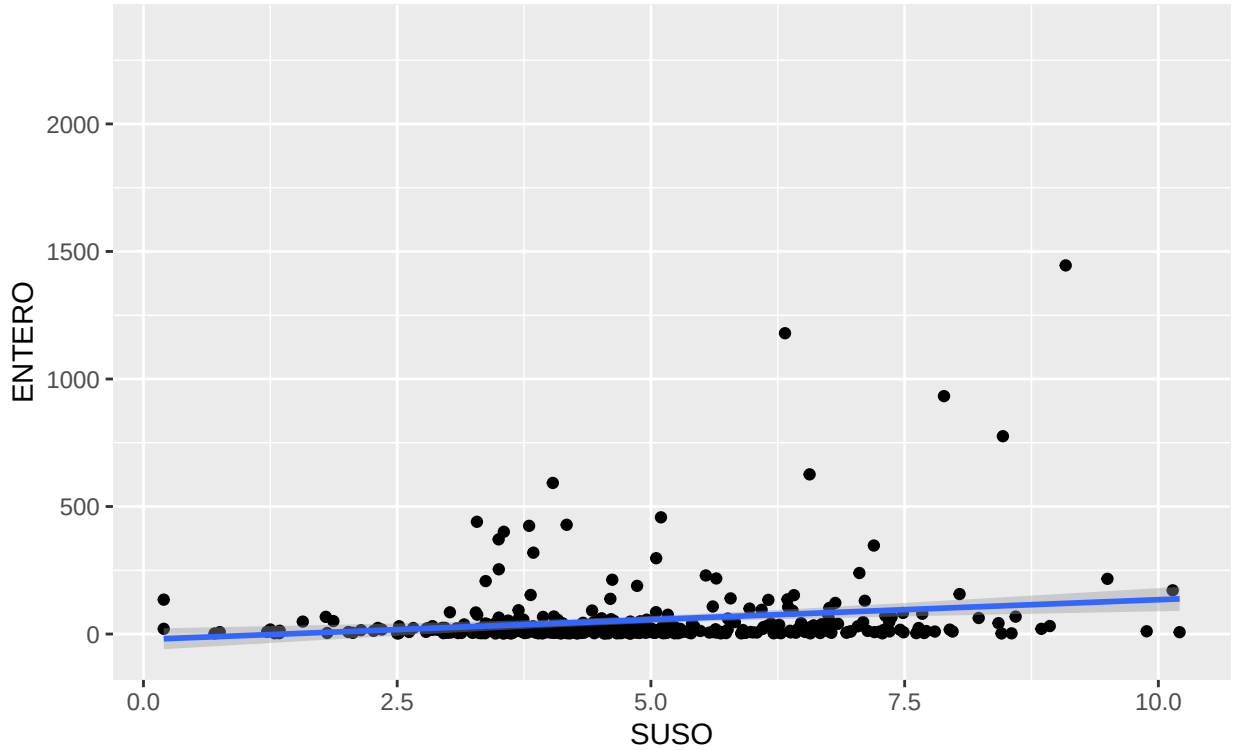
Scatterplot of SALINITY and ENTERO Series




```
## Warning: Removed 1255 rows containing non-finite values (`stat_smooth()`).
## Warning: Removed 1255 rows containing missing values (`geom_point()`).
```

Figure

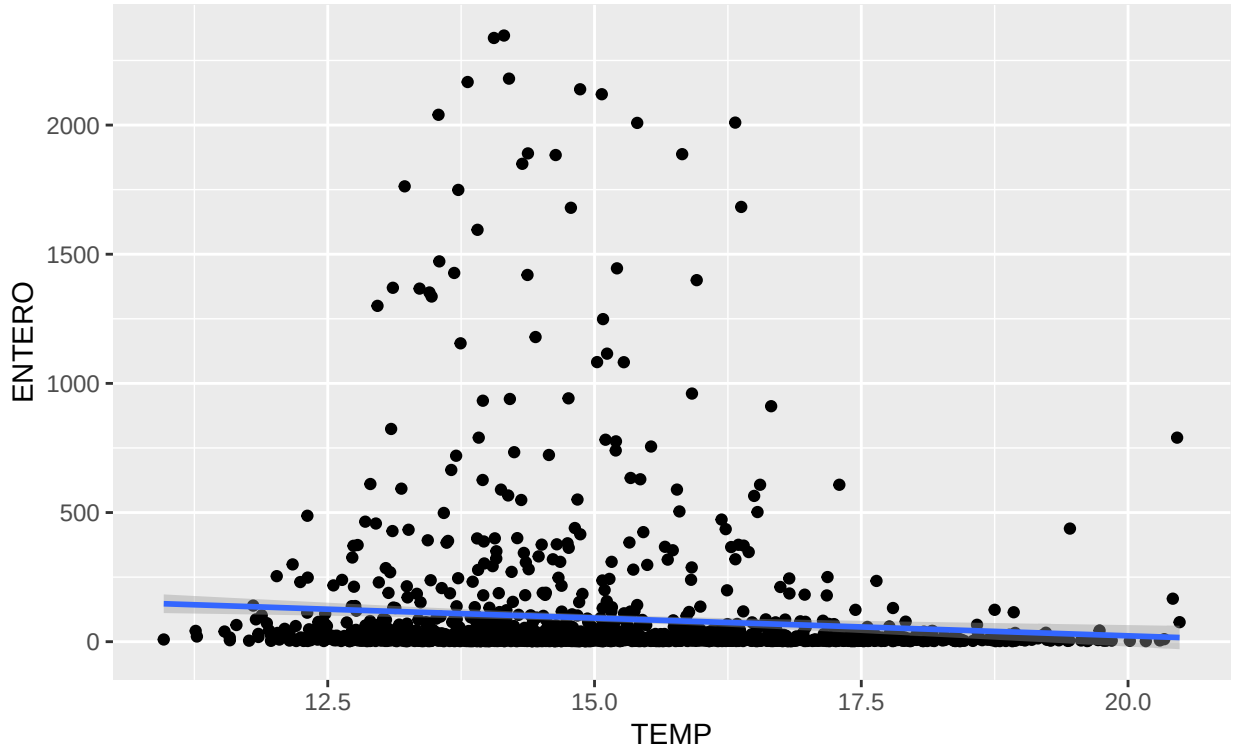
Scatterplot of SUSO and ENTERO Series



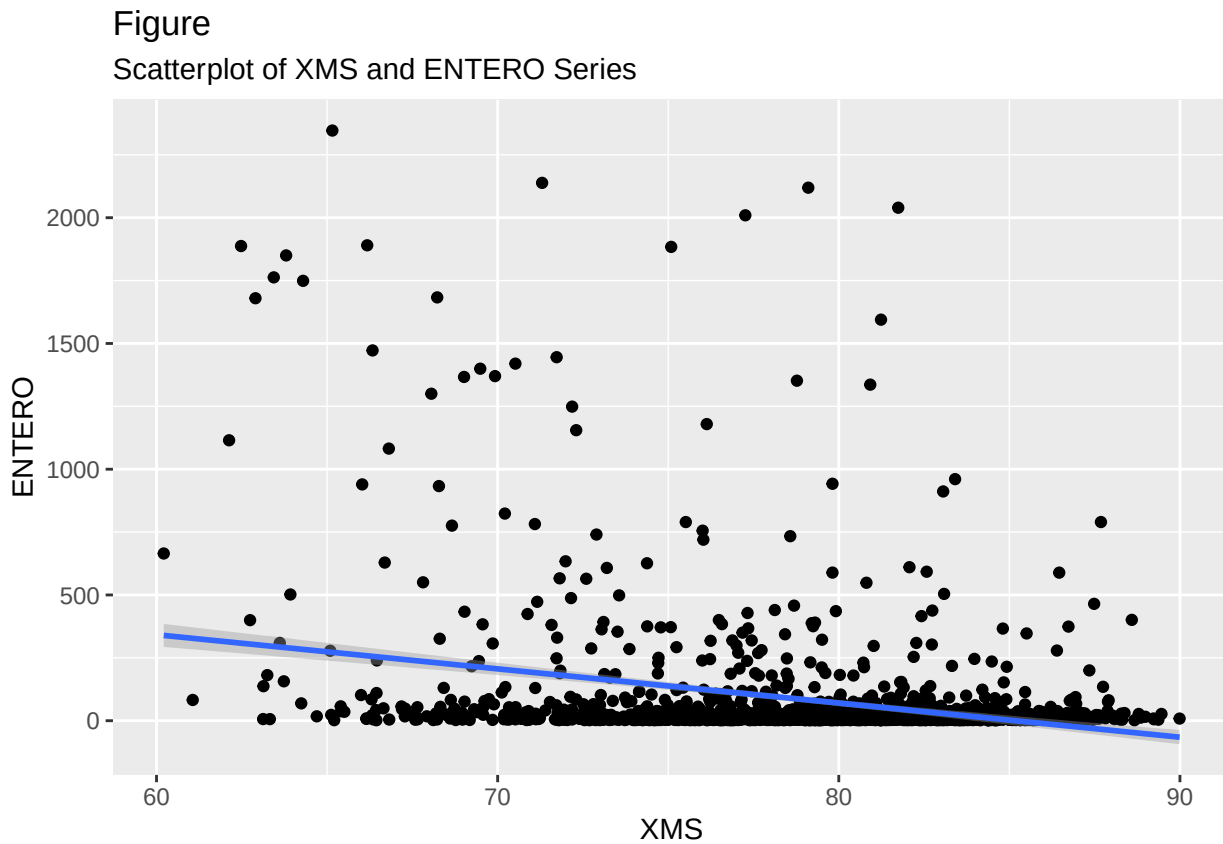

```
## Warning: Removed 132 rows containing non-finite values (`stat_smooth()`).
## Warning: Removed 132 rows containing missing values (`geom_point()`).
```

Figure

Scatterplot of TEMP and ENTERO Series




```
## Warning: Removed 146 rows containing non-finite values (`stat_smooth()`).
## Warning: Removed 146 rows containing missing values (`geom_point()`).
```



Define custom function to display time series plots at multiple agg levels

```
# i = parameter
# j = project
# k = depth
time_plt <- function(df = NA,
                     date = NA,
                     l1 = c(),
                     l2_name = NA,
                     l2 = c(),
                     l3_name = NA,
                     l3 = c()) {
  if(length(l3) == 0 & length(l2) == 0) {
    for(i in l1) {
      df_01a <- df
      par(mar = c(5,5,5,2))
      try(print(acf(df_01a[, i],
                    pl = TRUE,
                    na.action = na.pass,
                    main = paste0("ACF Plot for ", i))))
      plot <- ggplot(df_01a, aes(x = df_01a[, date], y = df_01a[, i], group = 1)) +
        geom_line() +
        labs(x = "Time",
             y = i,
             title = "Figure",
```

```
            subtitle = paste0("Time Series Plot for ", i))
      print(plot)
    }
  }
  if(length(l3) == 0) {
    for(i in l1) {
      for(j in l2) {
          df_01a <- df[df[, l2_name] == j, ]
          par(mar = c(5,5,5,2))
          try(print(acf(df_01a[, i],
                        pl = TRUE,
                        na.action = na.pass,
                        main = paste0("ACF Plot for ", i, " (", j, ")"))))
          plot <- ggplot(df_01a, aes(x = df_01a[, date], y = df_01a[, i], group = 1)) +
            geom_line() +
            labs(x = "Time",
                 y = i,
                 title = "Figure",
                 subtitle = paste0("Time Series Plot for ", i, " (", j, ")"))
          print(plot)
      }
    }
  }
  else {
    for(i in l1) {
      for(j in l2) {
        for(k in l3) {
          df_01a <- df[df[, l2_name] == j & df[, l3_name] == k, ]
          par(mar = c(5,5,5,2))
          try(print(acf(df_01a[, i],
                        pl = TRUE,
                        na.action = na.pass,
                        main = paste0("ACF Plot for ", i, " (", j, ": ", k, ")"))))
          plot <- ggplot(df_01a, aes(x = df_01a[, date], y = df_01a[, i], group = 1)) +
            geom_line() +
            labs(x = "Time",
                 y = i,
                 title = "Figure",
                 subtitle = paste0("Time Series Plot for ", i, " (", j, ": ", k, ")"))
          print(plot)
        }
      }
    }
  }
}
```

Setup reference value lists for time series plotting

```
param_lst04 <- c("CHLOROPHYLL",
                 "DENSITY",
                 "DO",
                 "ENTERO",
```

```
                 "FECAL",
                 "PH",
                 "SALINITY",
                 "TEMP",
                 "XMS")

param_lst05 <- c("ENTERO")

uniq_proj <- unique(owt_df02_gb07_mrgd$project)
uniq_depth <- unique(owt_df02_gb07_mrgd$depth_m_bin)
uniq_proj
```

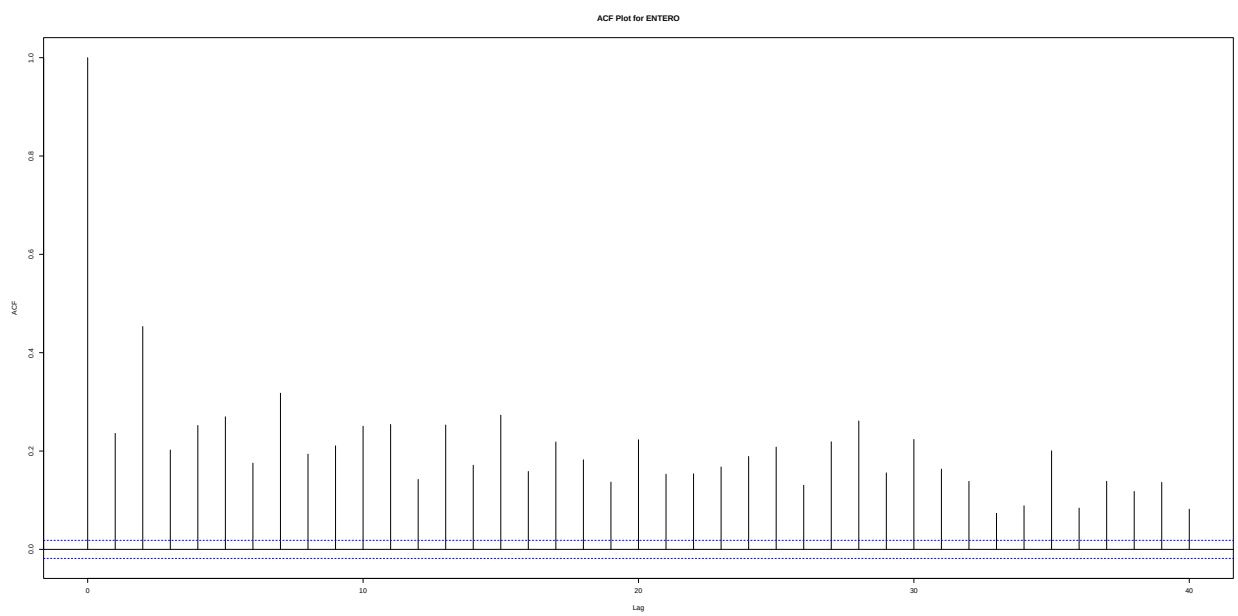
```
## [1] PLOO SBOO
## Levels: PLOO SBOO
```

```
uniq_depth
```

```
## [1] "[8,33)"    "[0,8)"     "[33,47)"   "[47,70)"   "[70,90)"   "Unknown"
## [7] "[112,120]" "[90,112)"
```

Run custom function on data aggregated by `date_sample` and `parameter`

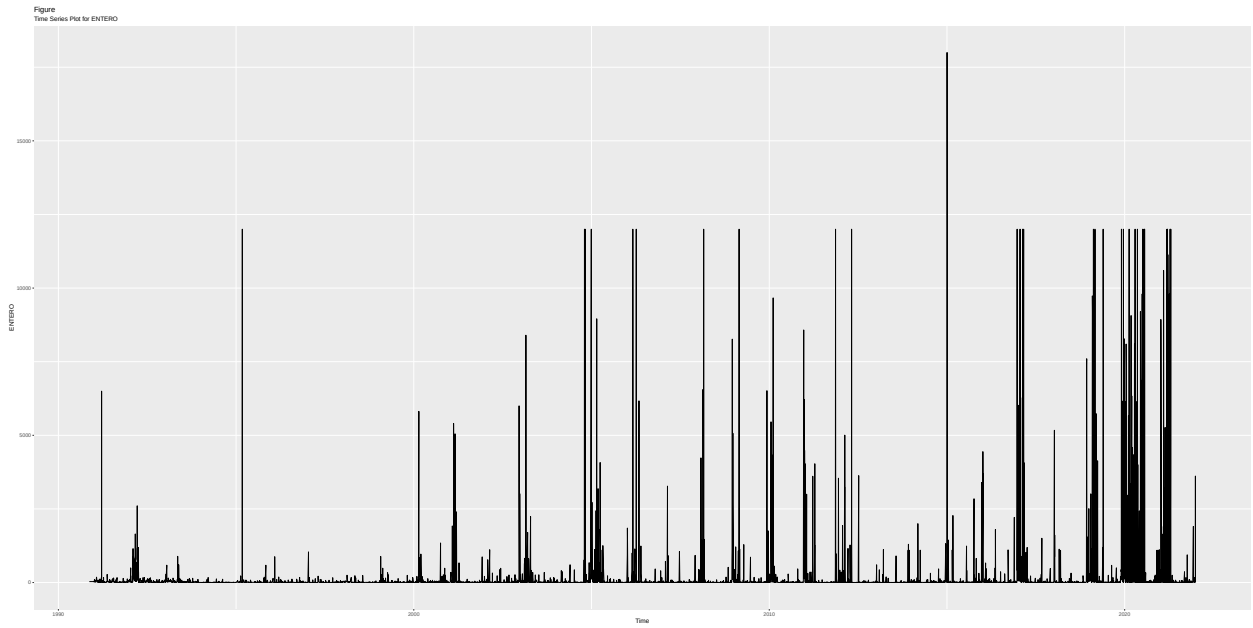
```
time_plt(df = owt_df02_gb04_mrgd,
         date = "date_sample",
         l1 = param_lst05)
```




```
##
## Autocorrelations of series 'df_01a[, i]', by lag
##
##     0     1     2     3     4     5     6     7     8     9    10    11    12
## 1.000 0.236 0.453 0.202 0.252 0.270 0.175 0.318 0.194 0.210 0.250 0.254 0.142
##    13    14    15    16    17    18    19    20    21    22    23    24    25
## 0.253 0.171 0.273 0.158 0.218 0.182 0.137 0.223 0.153 0.154 0.168 0.189 0.208
```

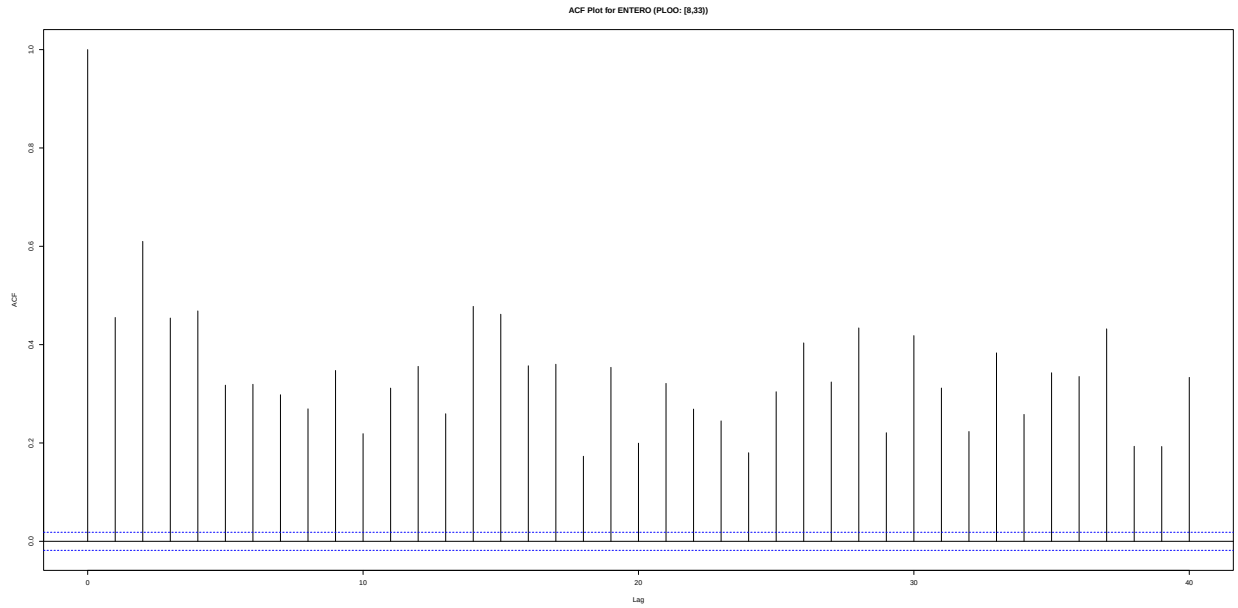
```
##    26    27    28    29    30    31    32    33    34    35    36    37    38
## 0.130 0.219 0.261 0.156 0.224 0.163 0.138 0.073 0.089 0.200 0.084 0.138 0.118
##    39    40
## 0.136 0.082
```

```
## Don't know how to automatically pick scale for object of type <zoo>. Defaulting
## to continuous.
```



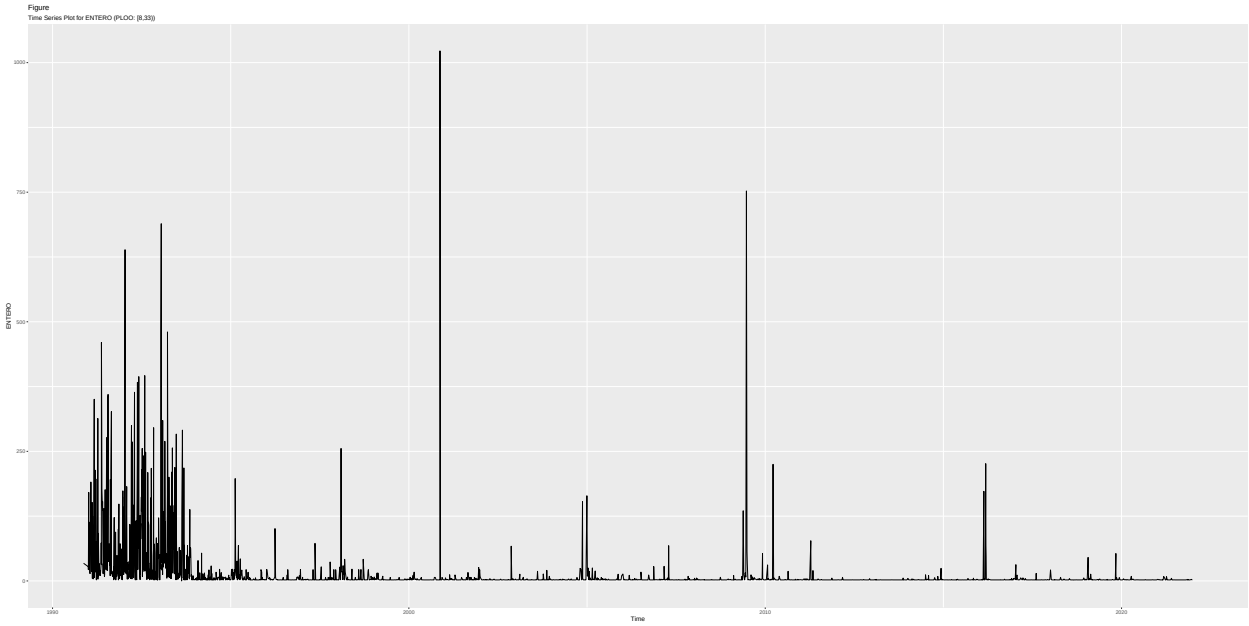
Run custom function on data aggregated by `date_sample`, `project`, `depth_m_bin` and `parameter`

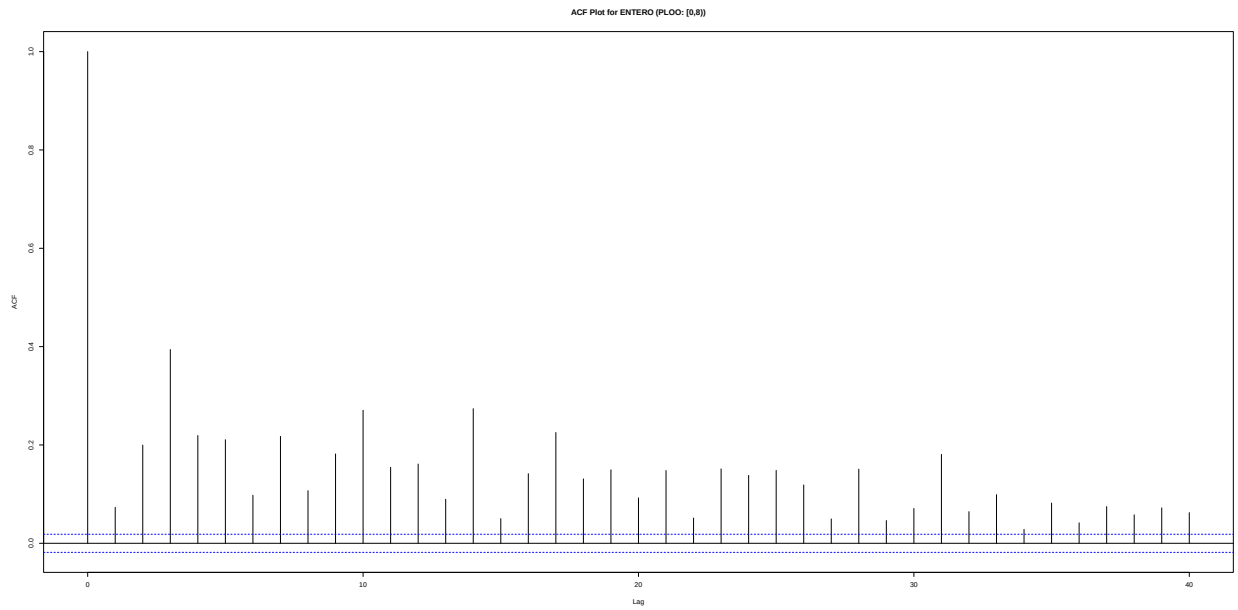
```
time_plt(df = owt_df02_gb07_mrgd,
         date = "date_sample",
         l1 = param_lst05,
         l2_name = "project",
         l2 = uniq_proj,
         l3_name = "depth_m_bin",
         l3 = uniq_depth)
```




```
##
## Autocorrelations of series 'df_01a[, i]', by lag
##
##     0     1     2     3     4     5     6     7     8     9    10    11    12
## 1.000 0.455 0.610 0.454 0.469 0.317 0.319 0.298 0.269 0.347 0.219 0.312 0.356
##    13    14    15    16    17    18    19    20    21    22    23    24    25
## 0.259 0.478 0.462 0.357 0.360 0.173 0.354 0.200 0.321 0.269 0.245 0.180 0.304
##    26    27    28    29    30    31    32    33    34    35    36    37    38
## 0.403 0.324 0.434 0.221 0.418 0.312 0.223 0.383 0.258 0.343 0.335 0.432 0.193
##    39    40
## 0.193 0.333
```

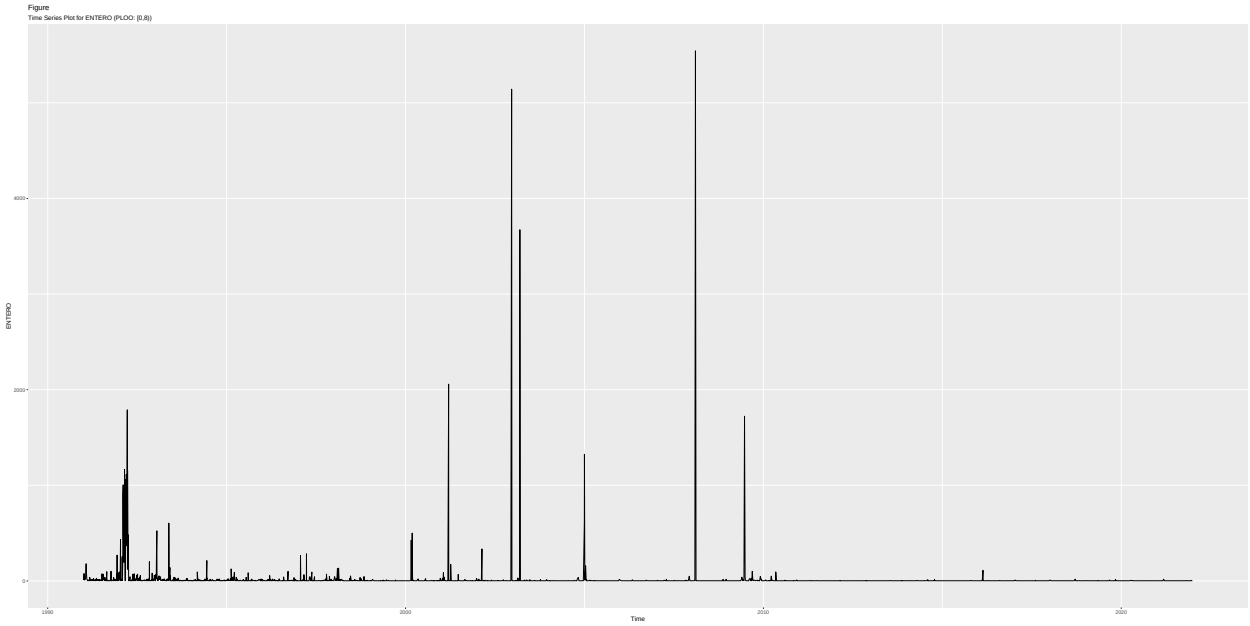
```
## Don't know how to automatically pick scale for object of type <zoo>. Defaulting
## to continuous.
```

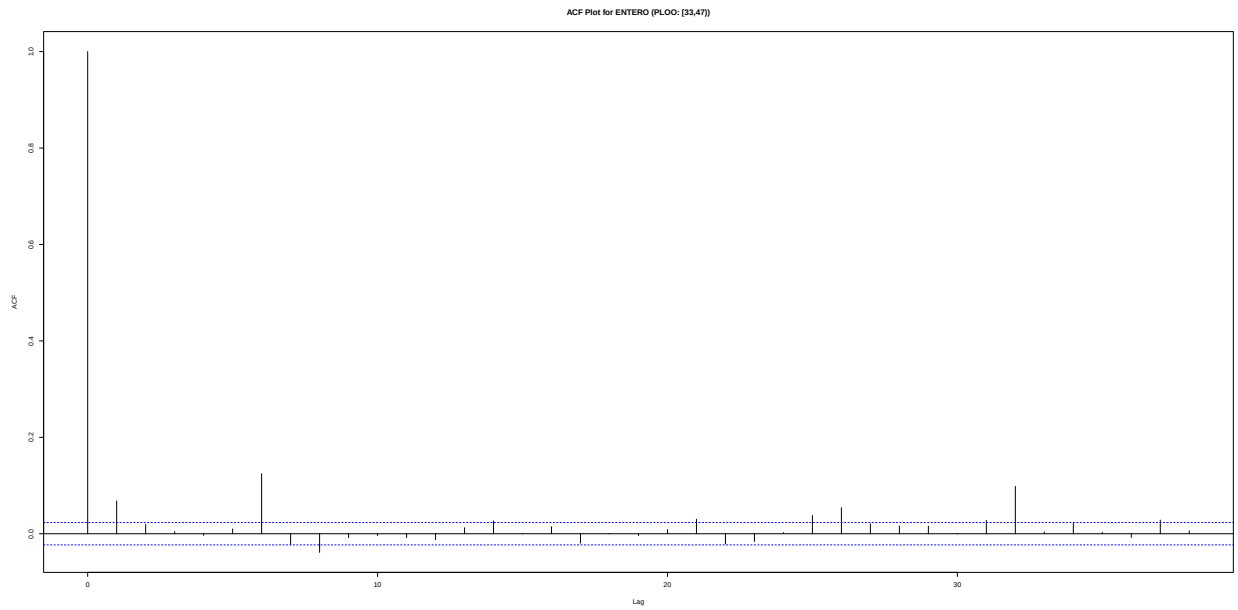





```
##
## Autocorrelations of series 'df_01a[, i]', by lag
##
##     0     1     2     3     4     5     6     7     8     9    10    11    12
## 1.000 0.073 0.200 0.394 0.219 0.211 0.098 0.217 0.107 0.182 0.271 0.155 0.161
##    13    14    15    16    17    18    19    20    21    22    23    24    25
## 0.090 0.274 0.050 0.142 0.225 0.131 0.150 0.092 0.148 0.051 0.151 0.138 0.148
##    26    27    28    29    30    31    32    33    34    35    36    37    38
## 0.119 0.050 0.151 0.046 0.071 0.181 0.064 0.099 0.028 0.082 0.042 0.075 0.058
##    39    40
## 0.072 0.062
```

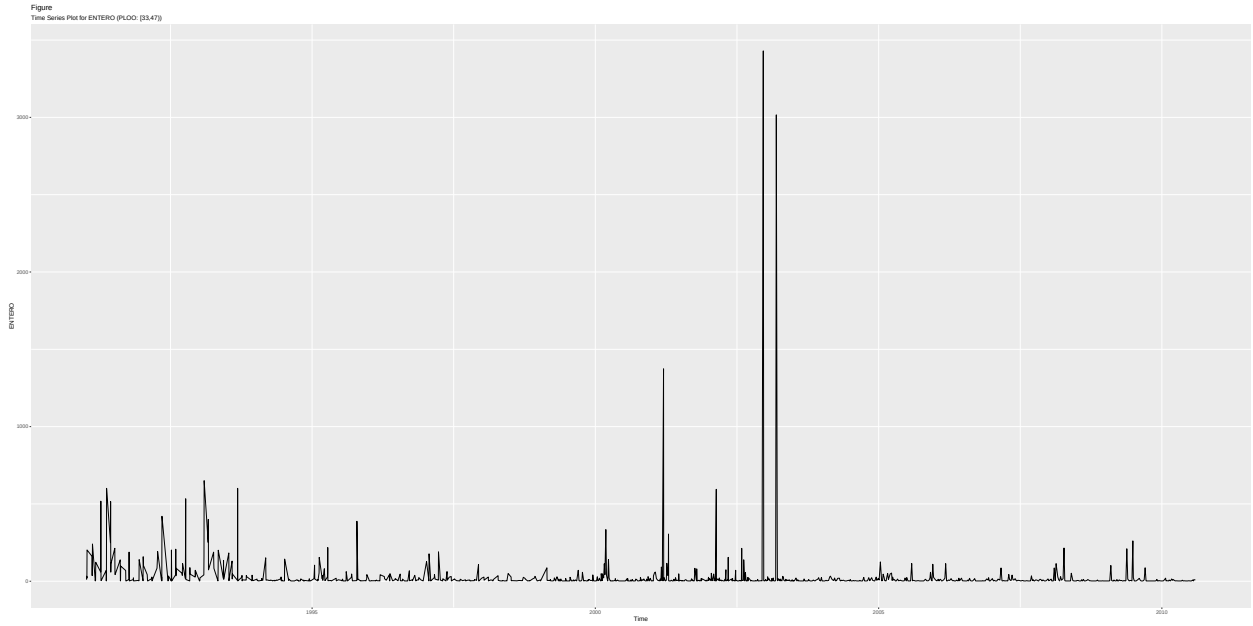
```
## Don't know how to automatically pick scale for object of type <zoo>. Defaulting
## to continuous.
```

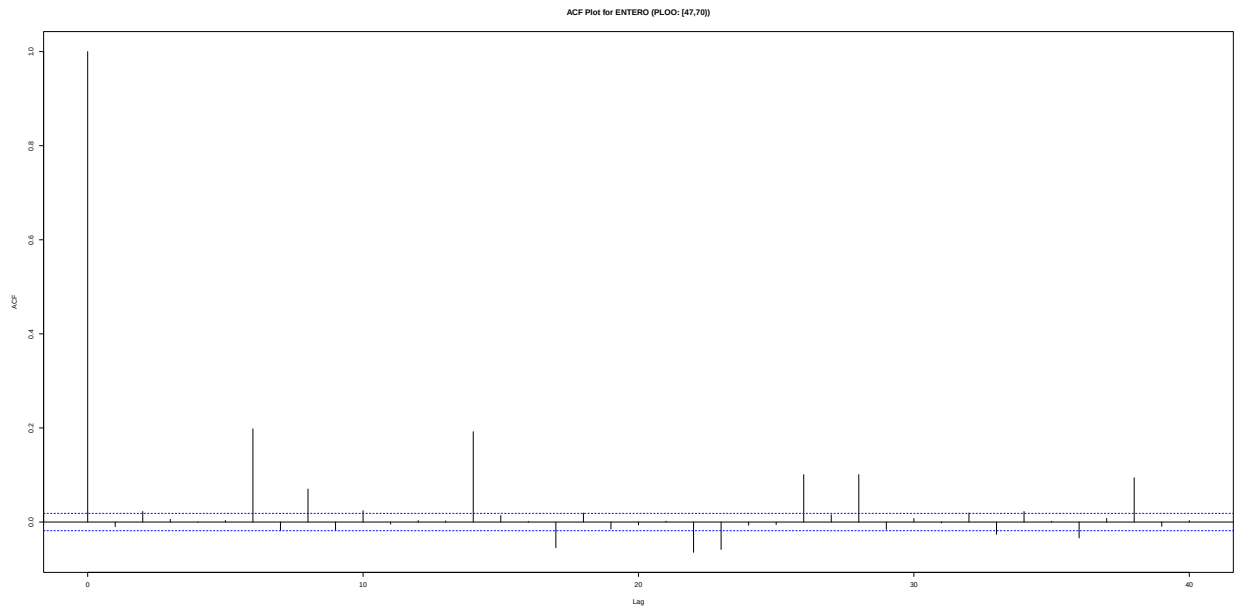





```
##
## Autocorrelations of series 'df_01a[, i]', by lag
##
##      0      1      2      3      4      5      6      7      8      9     10
##  1.000  0.068  0.019  0.004 -0.004  0.010  0.125 -0.022 -0.039 -0.008 -0.004
##     11     12     13     14     15     16     17     18     19     20     21
## -0.008 -0.012  0.012  0.027  0.000  0.015 -0.020  0.000 -0.004  0.009  0.030
##     22     23     24     25     26     27     28     29     30     31     32
## -0.021 -0.016  0.003  0.038  0.054  0.021  0.016  0.016 -0.001  0.028  0.098
##     33     34     35     36     37     38
##  0.004  0.022  0.003 -0.008  0.028  0.006
```

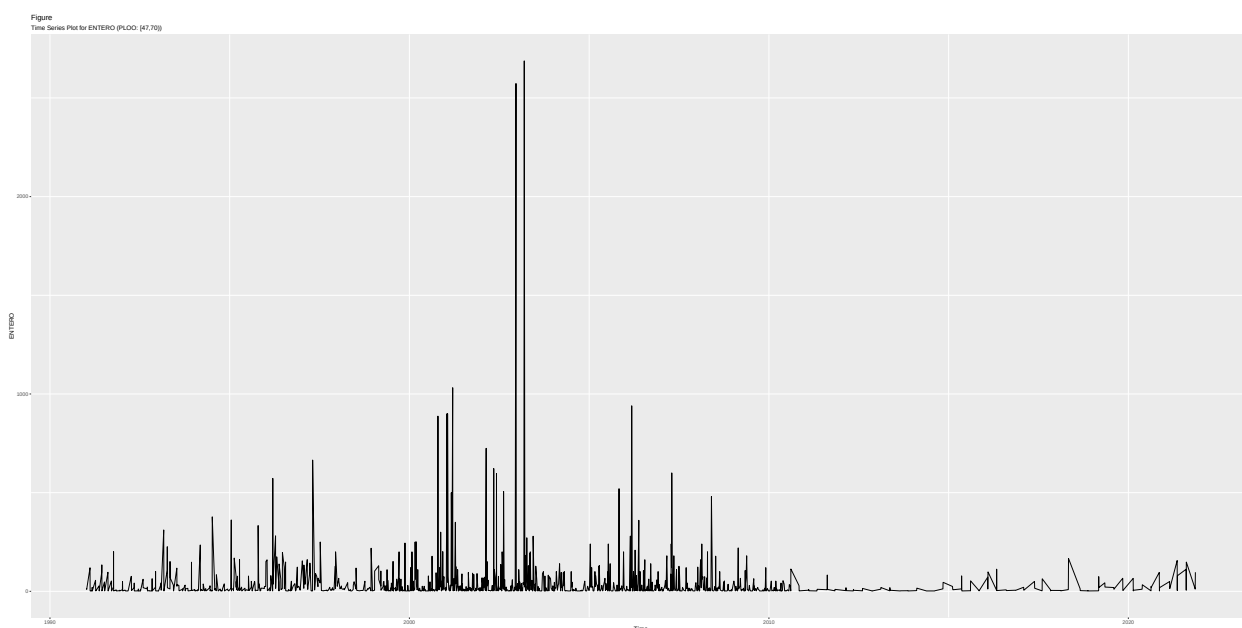
```
## Don't know how to automatically pick scale for object of type <zoo>. Defaulting
## to continuous.
```

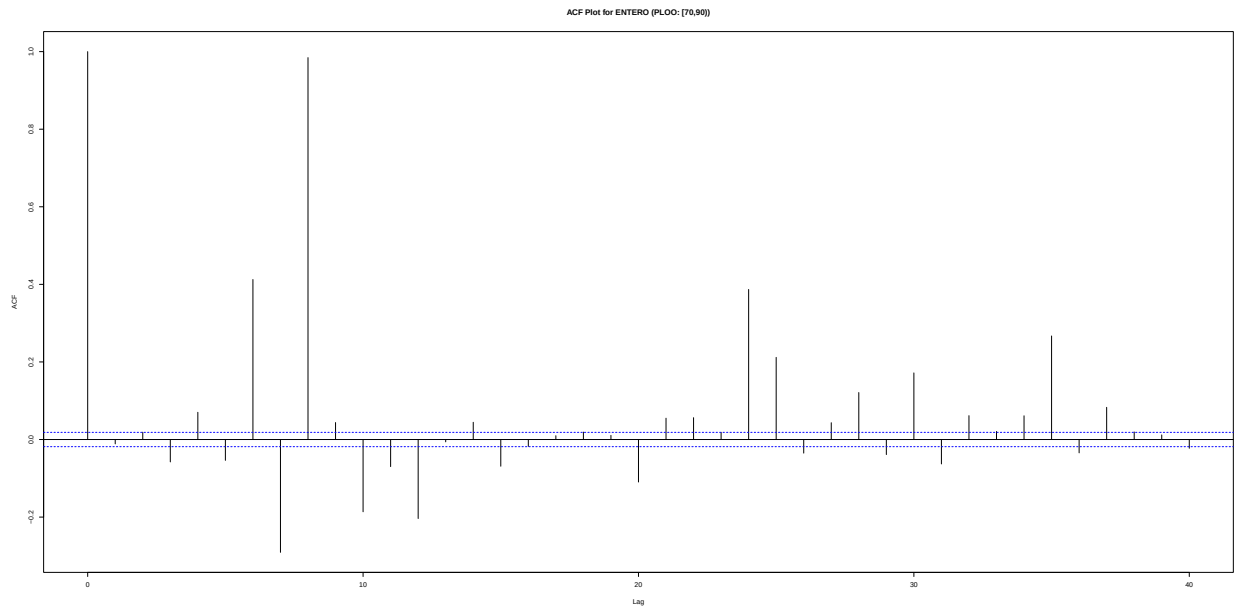





```
##
## Autocorrelations of series 'df_01a[, i]', by lag
##
##      0      1      2      3      4      5      6      7      8      9     10
##  1.000 -0.010  0.022  0.006  0.000  0.003  0.198 -0.018  0.070 -0.017  0.024
##     11     12     13     14     15     16     17     18     19     20     21
## -0.004  0.003  0.002  0.192  0.014  0.001 -0.054  0.019 -0.015 -0.006  0.002
##     22     23     24     25     26     27     28     29     30     31     32
## -0.064 -0.058 -0.007 -0.005  0.101  0.015  0.101 -0.016  0.008 -0.002  0.019
##     33     34     35     36     37     38     39     40
## -0.026  0.022  0.001 -0.034  0.008  0.094 -0.009  0.003
```

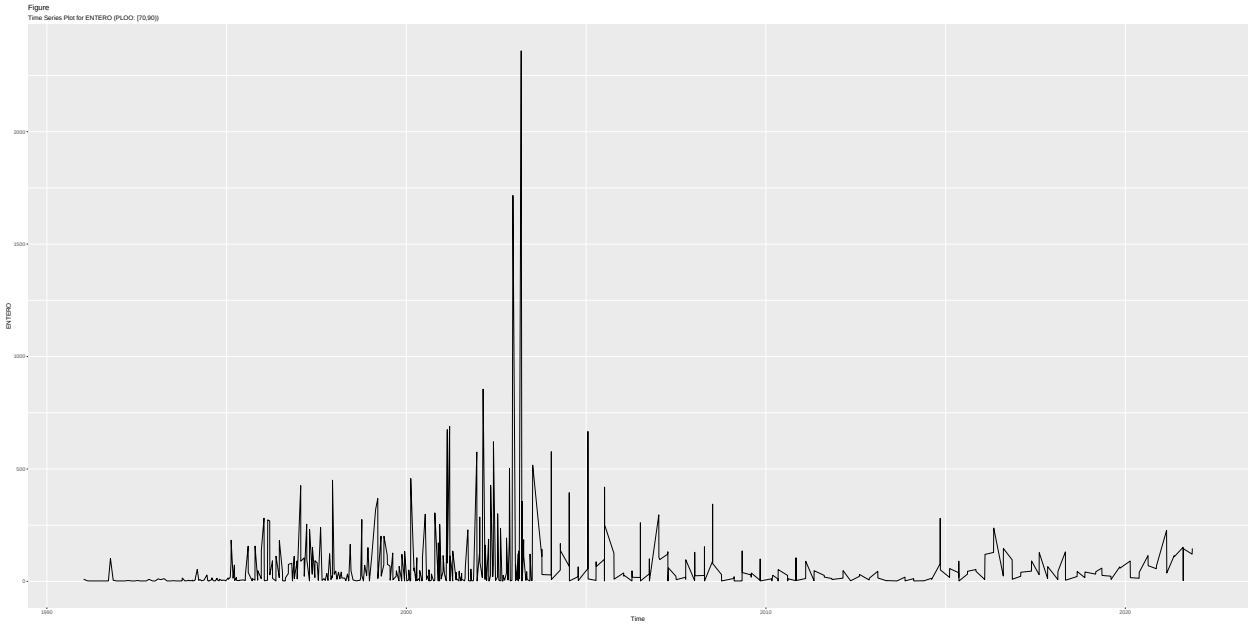
```
## Don't know how to automatically pick scale for object of type <zoo>. Defaulting
## to continuous.
```

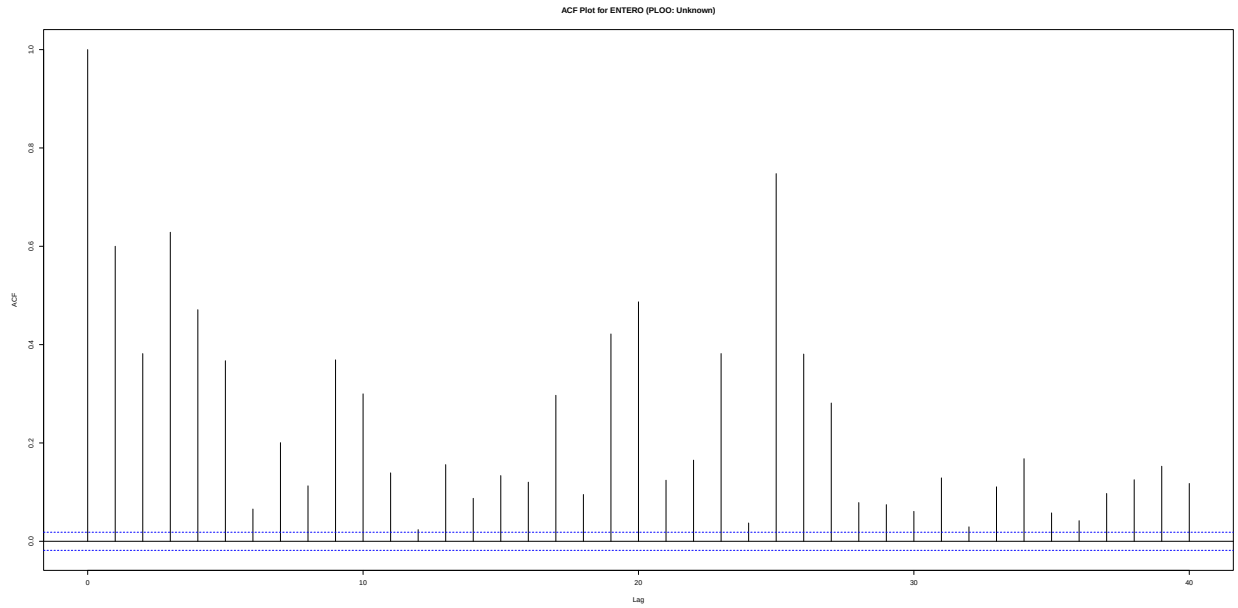





```
##
## Autocorrelations of series 'df_01a[, i]', by lag
##
##      0      1      2      3      4      5      6      7      8      9     10
##  1.000 -0.011  0.019 -0.058  0.070 -0.054  0.413 -0.291  0.985  0.044 -0.186
##     11     12     13     14     15     16     17     18     19     20     21
## -0.070 -0.204 -0.006  0.044 -0.069 -0.018  0.010  0.019  0.011 -0.110  0.055
##     22     23     24     25     26     27     28     29     30     31     32
##  0.056  0.019  0.387  0.212 -0.035  0.043  0.121 -0.039  0.172 -0.063  0.062
##     33     34     35     36     37     38     39     40
##  0.021  0.061  0.267 -0.034  0.083  0.020  0.012 -0.023
```

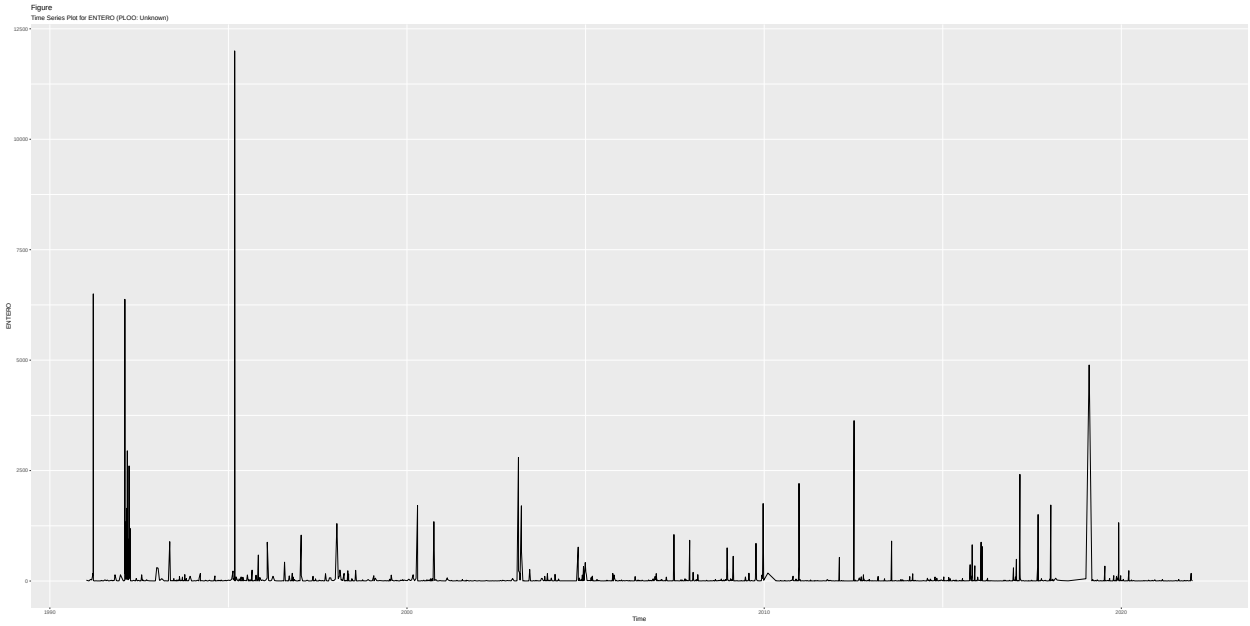
```
## Don't know how to automatically pick scale for object of type <zoo>. Defaulting
## to continuous.
```

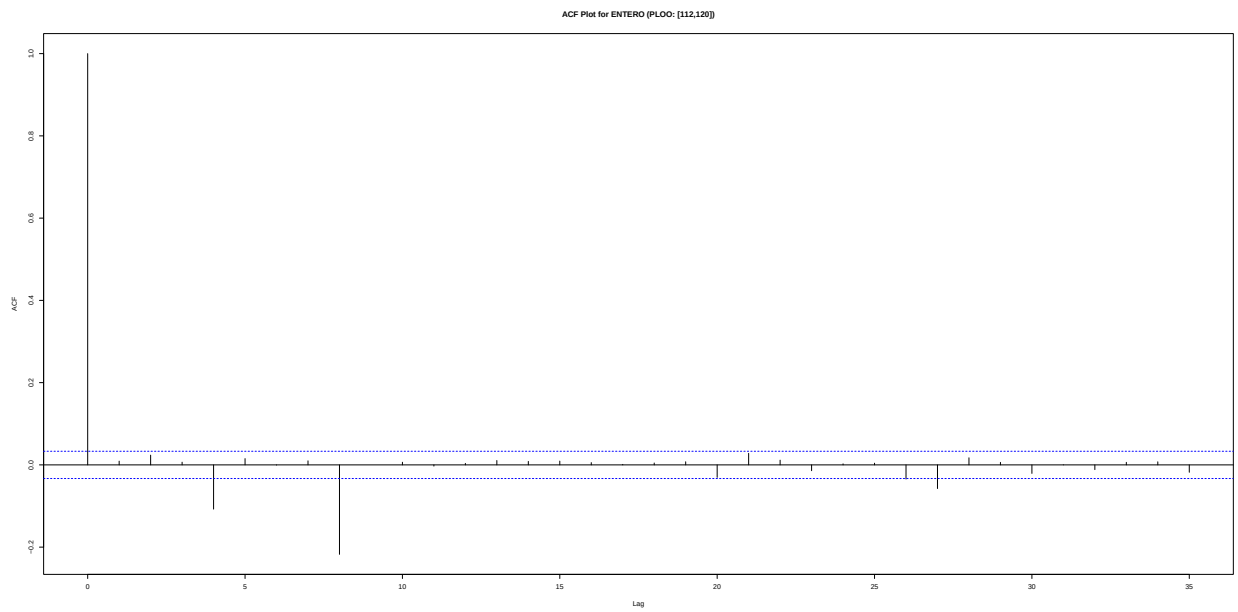





```
##
## Autocorrelations of series 'df_01a[, i]', by lag
##
##     0     1     2     3     4     5     6     7     8     9    10    11    12
## 1.000 0.600 0.382 0.628 0.471 0.367 0.066 0.201 0.113 0.369 0.300 0.139 0.024
##    13    14    15    16    17    18    19    20    21    22    23    24    25
## 0.156 0.087 0.134 0.120 0.297 0.095 0.422 0.487 0.124 0.165 0.382 0.037 0.748
##    26    27    28    29    30    31    32    33    34    35    36    37    38
## 0.381 0.281 0.079 0.074 0.061 0.129 0.029 0.111 0.168 0.058 0.042 0.097 0.125
##    39    40
## 0.153 0.118
```

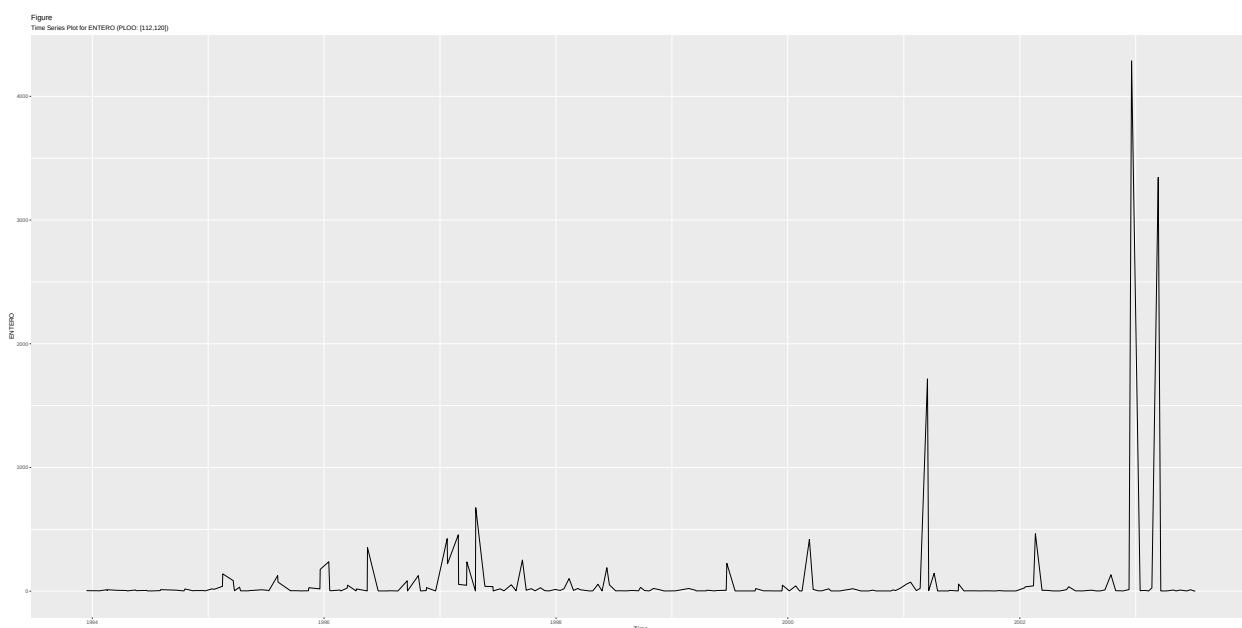
```
## Don't know how to automatically pick scale for object of type <zoo>. Defaulting
## to continuous.
```

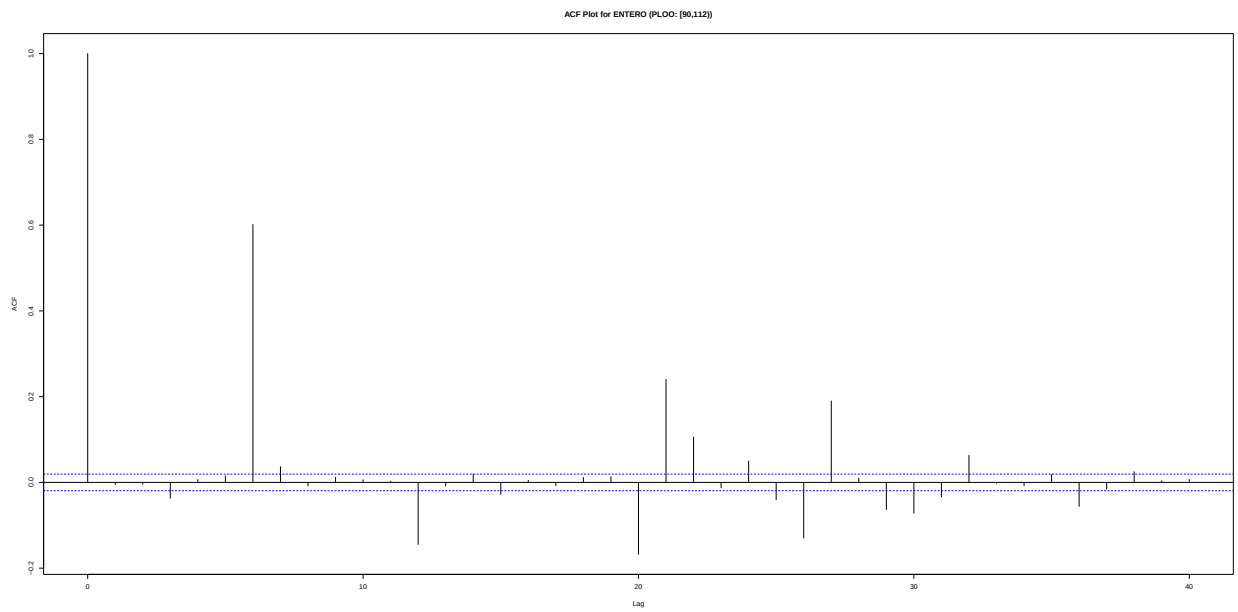





```
##
## Autocorrelations of series 'df_01a[, i]', by lag
##
##      0      1      2      3      4      5      6      7      8      9     10
##  1.000  0.009  0.024  0.007 -0.108  0.015  0.000  0.010 -0.218     NA  0.006
##     11     12     13     14     15     16     17     18     19     20     21
## -0.003  0.004  0.011  0.008  0.009  0.006  0.001  0.005  0.008 -0.030  0.028
##     22     23     24     25     26     27     28     29     30     31     32
##  0.012 -0.014  0.003  0.004 -0.034 -0.058  0.017  0.006 -0.021  0.000 -0.012
##     33     34     35
##  0.006  0.007 -0.018
```

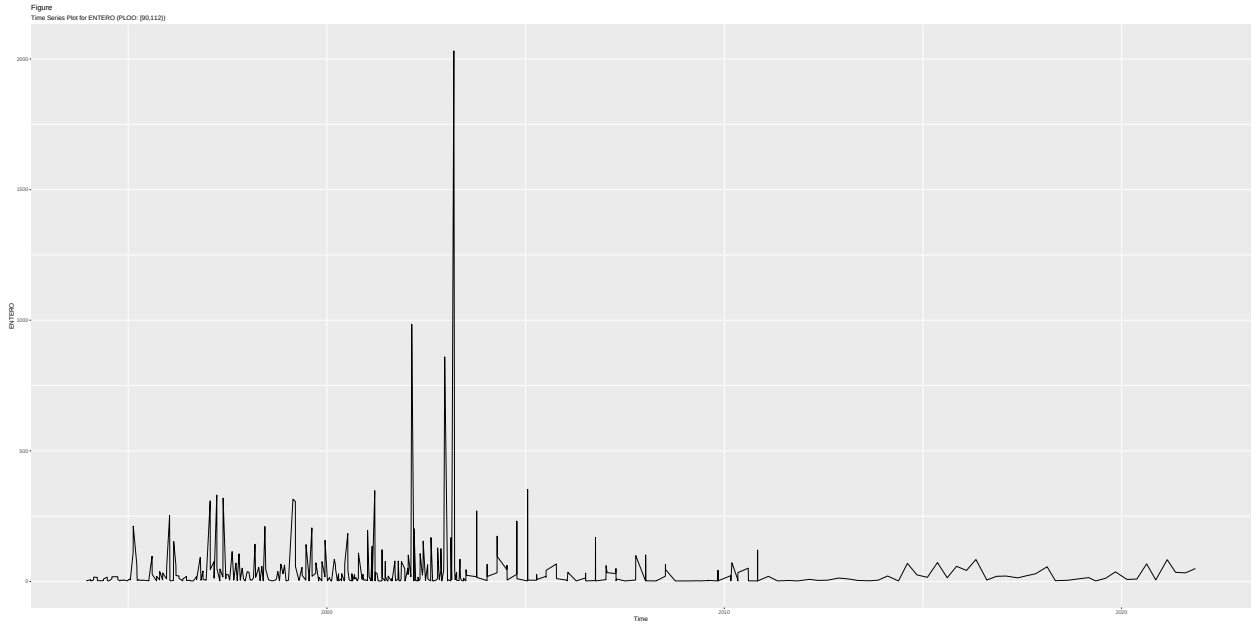
```
## Don't know how to automatically pick scale for object of type <zoo>. Defaulting
## to continuous.
```

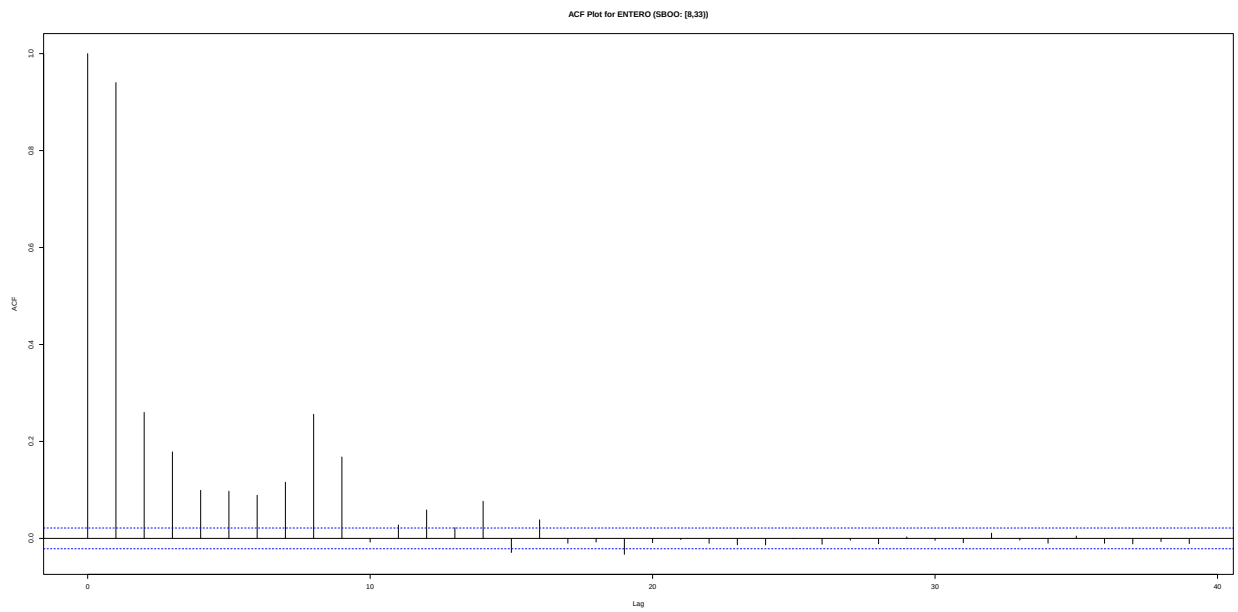





```
##
## Autocorrelations of series 'df_01a[, i]', by lag
##
##      0      1      2      3      4      5      6      7      8      9     10
##  1.000 -0.005 -0.004 -0.037  0.007  0.015  0.602  0.037 -0.008  0.012  0.006
##     11     12     13     14     15     16     17     18     19     20     21
##  0.002 -0.145 -0.008  0.020 -0.028  0.005 -0.007  0.011  0.013 -0.168  0.240
##     22     23     24     25     26     27     28     29     30     31     32
##  0.106 -0.012  0.050 -0.040 -0.130  0.190  0.010 -0.064 -0.072 -0.034  0.063
##     33     34     35     36     37     38     39     40
## -0.002 -0.008  0.018 -0.056 -0.016  0.025  0.004  0.007
```

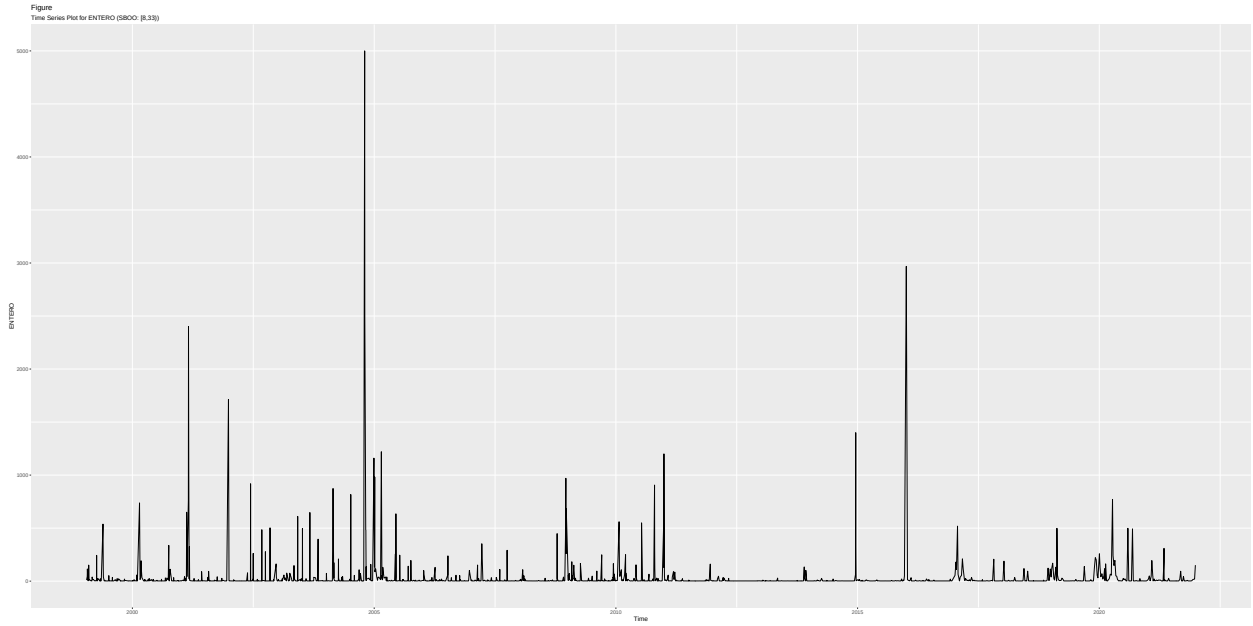
```
## Don't know how to automatically pick scale for object of type <zoo>. Defaulting
## to continuous.
```

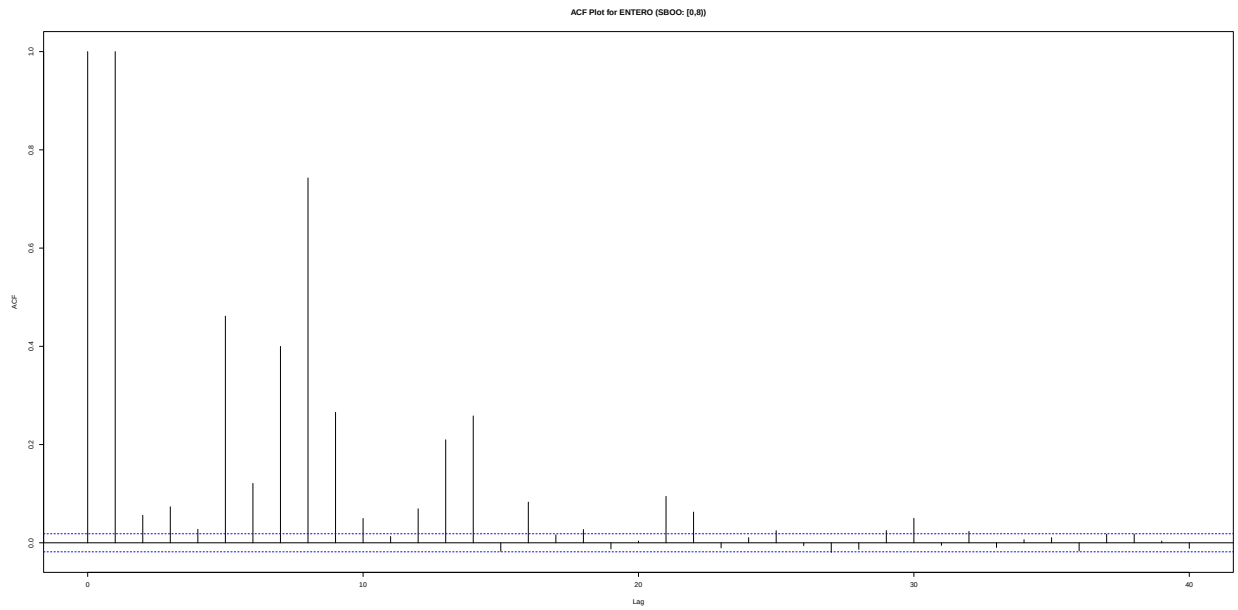





```
##
## Autocorrelations of series 'df_01a[, i]', by lag
##
##      0      1      2      3      4      5      6      7      8      9     10
##  1.000  0.940  0.260  0.178  0.099  0.097  0.089  0.116  0.256  0.168 -0.008
##     11     12     13     14     15     16     17     18     19     20     21
##  0.028  0.059  0.022  0.077 -0.029  0.038 -0.010 -0.008 -0.033 -0.009 -0.002
##     22     23     24     25     26     27     28     29     30     31     32
## -0.010 -0.013 -0.013 -0.001 -0.012 -0.004 -0.011  0.003 -0.004 -0.009  0.011
##     33     34     35     36     37     38     39
## -0.003 -0.010  0.005 -0.010 -0.011 -0.006 -0.011
```

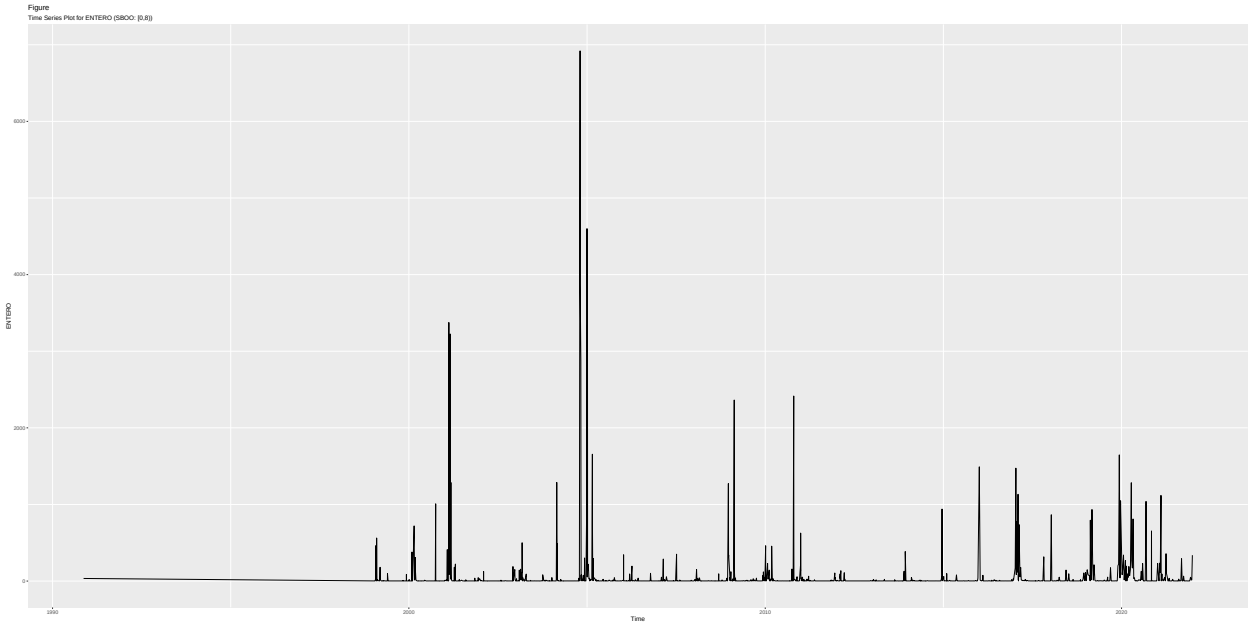
```
## Don't know how to automatically pick scale for object of type <zoo>. Defaulting
## to continuous.
```

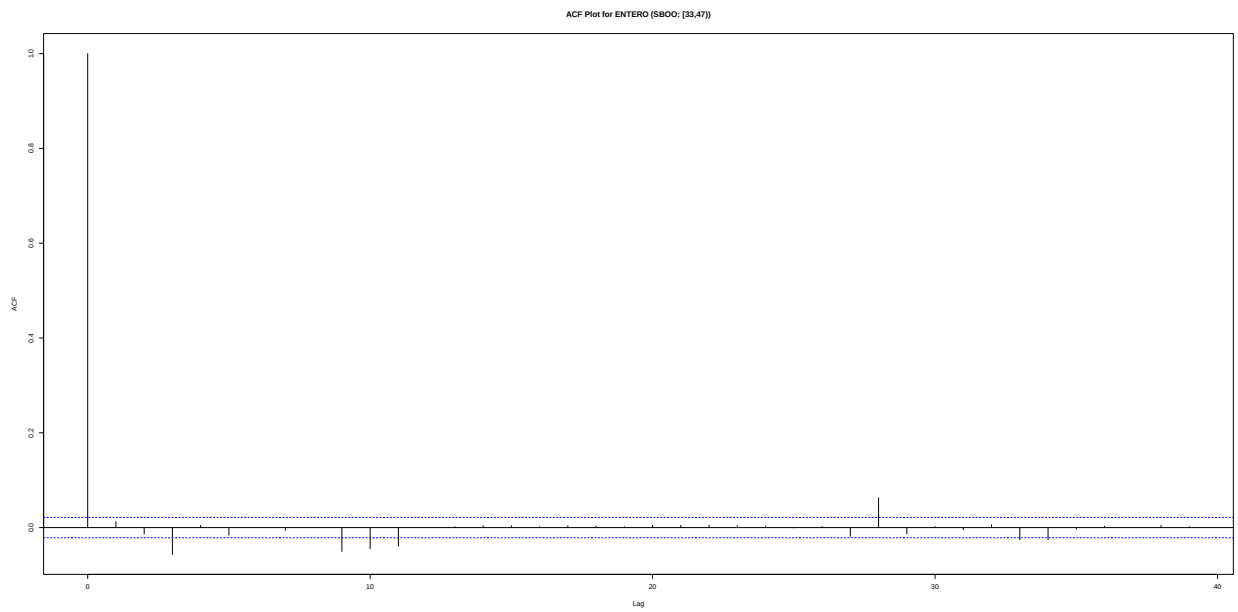





```
##
## Autocorrelations of series 'df_01a[, i]', by lag
##
##      0      1      2      3      4      5      6      7      8      9     10
##  1.000  1.000  0.056  0.073  0.027  0.461  0.121  0.400  0.743  0.266  0.050
##     11     12     13     14     15     16     17     18     19     20     21
##  0.013  0.069  0.210  0.258 -0.017  0.083  0.016  0.027 -0.013  0.004  0.095
##     22     23     24     25     26     27     28     29     30     31     32
##  0.063 -0.010  0.010  0.025 -0.006 -0.019 -0.013  0.025  0.050 -0.005  0.023
##     33     34     35     36     37     38     39     40
## -0.009  0.006  0.010 -0.016  0.017  0.018  0.004 -0.011
```

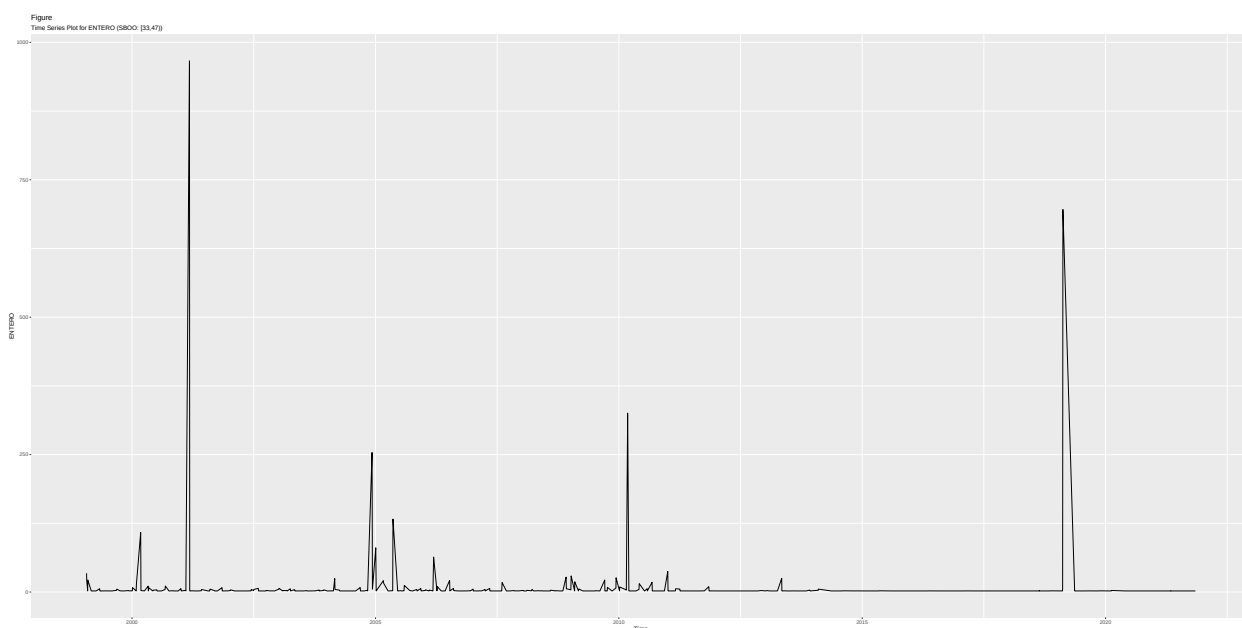
```
## Don't know how to automatically pick scale for object of type <zoo>. Defaulting
## to continuous.
```

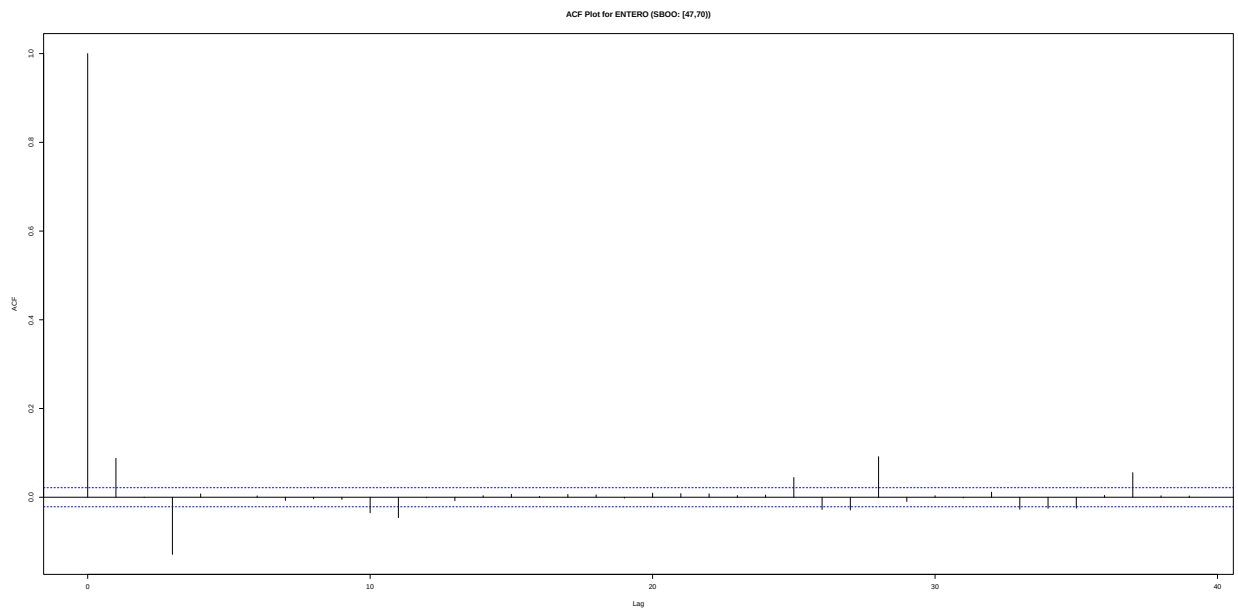





```
##
## Autocorrelations of series 'df_01a[, i]', by lag
##
##      0      1      2      3      4      5      6      7      8      9     10
##  1.000  0.012 -0.014 -0.056  0.005 -0.016  0.000 -0.005  0.001 -0.050 -0.045
##     11     12     13     14     15     16     17     18     19     20     21
## -0.039  0.000  0.002  0.004  0.004  0.002  0.004  0.003  0.002  0.005  0.005
##     22     23     24     25     26     27     28     29     30     31     32
##  0.005  0.004  0.003 -0.001  0.002 -0.018  0.063 -0.013  0.002 -0.005  0.006
##     33     34     35     36     37     38     39
## -0.026 -0.026 -0.003  0.003  0.000  0.005  0.002
```

```
## Don't know how to automatically pick scale for object of type <zoo>. Defaulting
## to continuous.
```

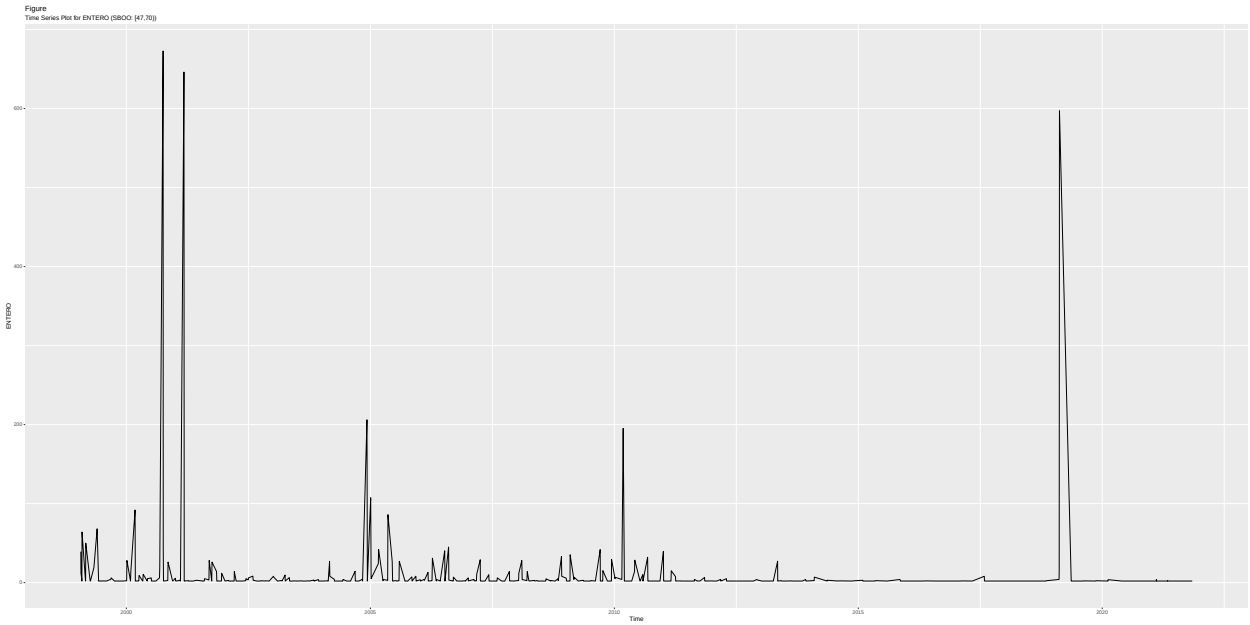




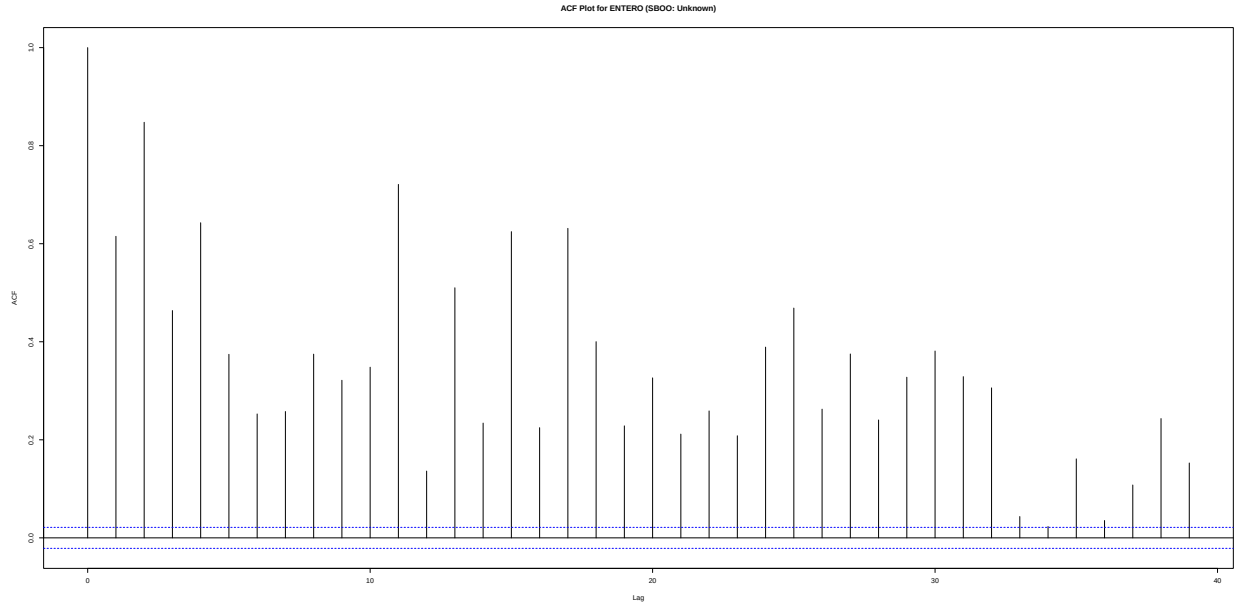

```
##
## Autocorrelations of series 'df_01a[, i]', by lag
##
##      0      1      2      3      4      5      6      7      8      9     10
##  1.000  0.088 -0.001 -0.129  0.008     NA  0.003 -0.007 -0.004 -0.005 -0.035
##     11     12     13     14     15     16     17     18     19     20     21
## -0.046 -0.001 -0.008  0.004  0.007  0.002  0.006  0.005 -0.002  0.009  0.008
##     22     23     24     25     26     27     28     29     30     31     32
##  0.008  0.004  0.005  0.044 -0.028 -0.029  0.091 -0.010  0.004 -0.001  0.011
##     33     34     35     36     37     38     39
## -0.027 -0.025 -0.024  0.004  0.055  0.003  0.003
```

```
## Don't know how to automatically pick scale for object of type <zoo>. Defaulting
## to continuous.
```

```
## Warning in as.ts.zoo(x): 'x' does not have an underlying regularity
```



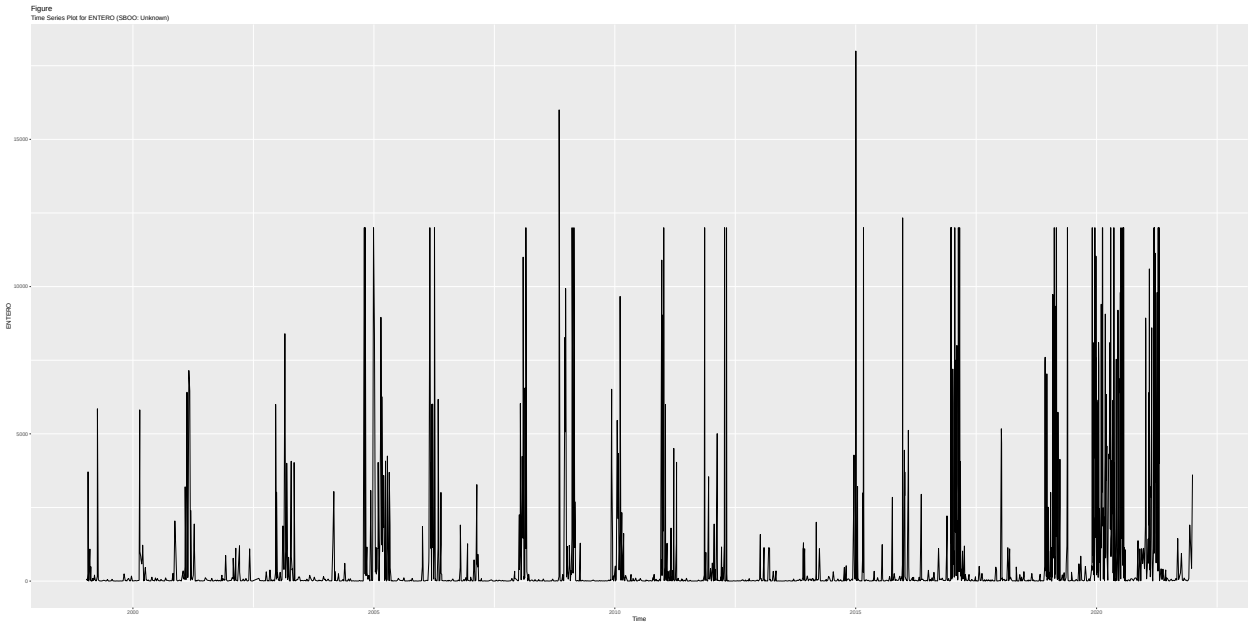

```
## Error in ts(coredata(x)) : 'ts' object must have one or more observations
```




```
##
## Autocorrelations of series 'df_01a[, i]', by lag
##
##     0     1     2     3     4     5     6     7     8     9    10    11    12
## 1.000 0.615 0.848 0.464 0.643 0.374 0.253 0.258 0.375 0.321 0.348 0.721 0.136
##    13    14    15    16    17    18    19    20    21    22    23    24    25
## 0.510 0.234 0.625 0.225 0.631 0.400 0.228 0.326 0.212 0.259 0.208 0.389 0.469
##    26    27    28    29    30    31    32    33    34    35    36    37    38
## 0.263 0.375 0.240 0.328 0.381 0.329 0.306 0.043 0.023 0.161 0.035 0.108 0.243
##    39
## 0.153
```

```
## Don't know how to automatically pick scale for object of type <zoo>. Defaulting
## to continuous.
```

```
## Warning in as.ts.zoo(x): 'x' does not have an underlying regularity
```




```
## Error in ts(coredata(x)) : 'ts' object must have one or more observations
## Warning in as.ts.zoo(x): 'x' does not have an underlying regularity
```

```
## Error in ts(coredata(x)) : 'ts' object must have one or more observations
```

Convert df's to `timetk` tibbles for data aggregated by `date_sample`, `project`, and `parameter`

```
# Citation: https://business-science.github.io/timetk/index.html
train_start <- "1999-01-18"
train_end <- "2021-01-04"
test_start <- "2021-01-11"
test_end <- ""

#++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
# Convert PLOO data for 01/18/1999 and 01/03/2022 to `timetk` TS tibble
owt_df02_gb09_ploo_wkly03_df01 <- owt_df02_gb09_wkly03[owt_df02_gb09_wkly03$project ==
↪  "PLOO" & owt_df02_gb09_wkly03$date_sample >= train_start, ]
owt_df02_gb09_ploo_wkly03_df02 <- owt_df02_gb09_ploo_wkly03_df01[, -c(2, 8, 11)]
#owt_df02_gb09_ploo_wkly03_df02$date_sample <-
↪  yearweek(owt_df02_gb09_ploo_wkly03_df02$date_sample, week_start =
↪  getOption("lubridate.week.end", 1))

owt_df02_gb09_ploo_wkly03_tb01 <- tibble(owt_df02_gb09_ploo_wkly03_df02)
owt_df02_gb09_ploo_wkly03_tb02 <- pad_by_time(.data = owt_df02_gb09_ploo_wkly03_tb01,
                                              .date_var = date_sample,
                                              .by = "week")

#-----------------------------------------------------------------------------------
# Convert PLOO data (excluding outliers) for 01/18/1999 and 01/03/2022 to `timetk` TS
↪  tibble
owt_df02_gb09_ploo_wkly02_df01 <- owt_df02_gb09_wkly02[owt_df02_gb09_wkly02$project ==
↪  "PLOO" & owt_df02_gb09_wkly02$date_sample >= train_start, ]
owt_df02_gb09_ploo_wkly02_df02 <- owt_df02_gb09_ploo_wkly02_df01[, -c(2, 8, 11)]

owt_df02_gb09_ploo_wkly02_tb01 <- tibble(owt_df02_gb09_ploo_wkly02_df02)
owt_df02_gb09_ploo_wkly02_tb02 <- pad_by_time(.data = owt_df02_gb09_ploo_wkly02_tb01,
```

```
                                                .date_var = date_sample,
                                                .by = "week")

#++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
# Convert SBOO data for 01/18/1999 and 01/03/2022 to `timetk` TS tibble
owt_df02_gb09_sboo_wkly03_df01 <- owt_df02_gb09_wkly03[owt_df02_gb09_wkly03$project ==
↪  "SBOO" & owt_df02_gb09_wkly03$date_sample >= train_start, ]
owt_df02_gb09_sboo_wkly03_df02 <- owt_df02_gb09_sboo_wkly03_df01[, -c(2, 8, 11)]

owt_df02_gb09_sboo_wkly03_tb01 <- tibble(owt_df02_gb09_sboo_wkly03_df02)
owt_df02_gb09_sboo_wkly03_tb02 <- pad_by_time(.data = owt_df02_gb09_sboo_wkly03_tb01,
                                                .date_var = date_sample,
                                                .by = "week")

#-----------------------------------------------------------------------------------
# Convert SBOO data (excluding outliers) for 01/18/1999 and 01/03/2022 to `timetk` TS
↪  tibble
owt_df02_gb09_sboo_wkly02_df01 <- owt_df02_gb09_wkly02[owt_df02_gb09_wkly02$project ==
↪  "SBOO" & owt_df02_gb09_wkly02$date_sample >= train_start, ]
owt_df02_gb09_sboo_wkly02_df02 <- owt_df02_gb09_sboo_wkly02_df01[, -c(2, 8, 11)]

owt_df02_gb09_sboo_wkly02_tb01 <- tibble(owt_df02_gb09_sboo_wkly02_df02)
owt_df02_gb09_sboo_wkly02_tb02 <- pad_by_time(.data = owt_df02_gb09_sboo_wkly02_tb01,
                                                .date_var = date_sample,
                                                .by = "week")
```

Partition tibbles for data aggregated by `date_sample`, `project`, and `parameter`

```
#++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
# PLOO All - Training partition (01/18/1999-01/04/2021)
owt_df02_gb09_ploo_wkly03_train_tb02 <- owt_df02_gb09_ploo_wkly03_tb02 %>%
  filter_by_time(date_sample,
                 .end_date = train_end)

# PLOO All - Test partition (01/11/2021-01/03/2022)
owt_df02_gb09_ploo_wkly03_test_tb02 <- owt_df02_gb09_ploo_wkly03_tb02 %>%
  filter_by_time(date_sample,
                 .start_date = test_start)

#-----------------------------------------------------------------------------------
# PLOO Excluding Outliers - Training partition (01/18/1999-01/04/2021)
owt_df02_gb09_ploo_wkly02_train_tb02 <- owt_df02_gb09_ploo_wkly02_tb02 %>%
  filter_by_time(date_sample,
                 .end_date = train_end)

# PLOO Excluding Outliers - Test partition (01/11/2021-01/03/2022)
owt_df02_gb09_ploo_wkly02_test_tb02 <- owt_df02_gb09_ploo_wkly02_tb02 %>%
  filter_by_time(date_sample,
                 .start_date = test_start)

#++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
# SBOO All - Training partition (01/18/1999-01/04/2021)
```

```r
owt_df02_gb09_sboo_wkly03_train_tb02 <- owt_df02_gb09_sboo_wkly03_tb02 %>%
  filter_by_time(date_sample,
                 .end_date = train_end)

# SBOO All - Test partition (01/11/2021-01/03/2022)
owt_df02_gb09_sboo_wkly03_test_tb02 <- owt_df02_gb09_sboo_wkly03_tb02 %>%
  filter_by_time(date_sample,
                 .start_date = test_start)

#-------------------------------------------------------------------------------
# SBOO Excluding Outliers - Training partition (01/18/1999-01/04/2021)
owt_df02_gb09_sboo_wkly02_train_tb02 <- owt_df02_gb09_sboo_wkly02_tb02 %>%
  filter_by_time(date_sample,
                 .end_date = train_end)

# SBOO Excluding Outliers - Test partition (01/11/2021-01/03/2022)
owt_df02_gb09_sboo_wkly02_test_tb02 <- owt_df02_gb09_sboo_wkly02_tb02 %>%
  filter_by_time(date_sample,
                 .start_date = test_start)
```

Display tibbles available for modeling

```r
# Data sets for modeling
#+++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
# PLOO All - Training partition (01/18/1999-01/04/2021)
print(head(owt_df02_gb09_ploo_wkly03_train_tb02, 10))
```

```
## # A tibble: 10 x 10
##    date_sample CHLOROPHYLL DENSITY    DO ENTERO  FECAL    PH SALIN~1  TEMP   XMS
##    <date>            <dbl>   <dbl> <dbl>  <dbl>  <dbl> <dbl>   <dbl> <dbl> <dbl>
##  1 1999-01-18         4.22    25.2  6.88  19.2   95.6   7.97    33.6  13.5  87.8
##  2 1999-01-25        NA       NA   NA      3.08   2.58 NA       NA    14.1  75.6
##  3 1999-02-01        NA       NA   NA     44.4   17.1  NA       NA    13.5  85.6
##  4 1999-02-08        NA       NA   NA      6.17   2.42 NA       NA    13.4  83.7
##  5 1999-02-15        NA       NA   NA     24.8    8.65 NA       NA    13.0  82.2
##  6 1999-02-22        NA       NA   NA      7.58  28.5  NA       NA    12.4  73.9
##  7 1999-03-01         3.22    25.8  5.94  48.3  324.    7.81    33.8  11.3  82.5
##  8 1999-03-08        NA       NA   NA      2      2.25 NA       NA    12.6  79.9
##  9 1999-03-15        NA       NA   NA      3.89   4.35 NA       NA    12.4  81.4
## 10 1999-03-22         4.78    25.7  6.64  43.4  331.    7.87    33.7  11.7  85.5
## # ... with abbreviated variable name 1: SALINITY
```

```r
print(dim(owt_df02_gb09_ploo_wkly03_train_tb02))
```

```
## [1] 1147   10
```

```r
# PLOO All - Test partition (01/11/2021-01/03/2022)
print(head(owt_df02_gb09_ploo_wkly03_test_tb02, 10))
```

```
## # A tibble: 10 x 10
##    date_sample CHLOROPHYLL DENSITY    DO ENTERO  FECAL    PH SALIN~1  TEMP   XMS
##    <date>            <dbl>   <dbl> <dbl>  <dbl>  <dbl> <dbl>   <dbl> <dbl> <dbl>
##  1 2021-01-11         1.08    25.1  6.61   3.17   4     7.98    33.6  13.9  72.3
##  2 2021-01-18         1.54    25.2  6.63   3.44   7.81  8.00    33.6  13.6  84.0
```

```
##  3 2021-01-25         1.62    25.0  7.32   2.12   3.21  8.05    33.6  14.4  73.8
##  4 2021-02-01         1.06    25.0  7.41   4.75   4.31  8.15    33.6  14.4  72.7
##  5 2021-02-08         1.95    24.9  7.59   3      3.17  8.15    33.5  14.4  78.8
##  6 2021-02-15         1.92    25.0  7.30   3.88   5.88  8.11    33.5  14.1  80.5
##  7 2021-02-22         2.08    25.1  7.30   2.12   2.67  8.06    33.6  14.0  73.6
##  8 2021-03-01         1.03    25.5  5.72  25.5    6.54  7.93    33.7  12.2  82.5
##  9 2021-03-08         1.51    25.1  7.37   2.25   3.5   8.08    33.6  14.0  82.2
## 10 2021-03-15         2.36    24.9  7.97   7.88 171.    8.14    33.5  14.6  74.1
## # ... with abbreviated variable name 1: SALINITY
```

```
print(dim(owt_df02_gb09_ploo_wkly03_test_tb02))
```

```
## [1] 52 10
```

```
#-----------------------------------------------------------------------------
# PLOO Excluding Outliers - Training partition (01/18/1999-01/04/2021)
print(head(owt_df02_gb09_ploo_wkly02_train_tb02, 10))
```

```
## # A tibble: 10 x 10
##    date_sample CHLOROPHYLL DENSITY    DO ENTERO  FECAL    PH SALIN~1  TEMP   XMS
##    <date>            <dbl>   <dbl> <dbl>  <dbl>  <dbl> <dbl>   <dbl> <dbl> <dbl>
##  1 1999-01-18         4.22    25.2  6.88  19.2   95.6   7.97    33.6  13.5  87.8
##  2 1999-01-25        NA       NA   NA      3.08   2.58 NA       NA    14.1  75.6
##  3 1999-02-01        NA       NA   NA     44.4   17.1  NA       NA    13.5  85.6
##  4 1999-02-08        NA       NA   NA      6.17   2.42 NA       NA    13.4  83.7
##  5 1999-02-15        NA       NA   NA     24.8    8.65 NA       NA    13.0  82.2
##  6 1999-02-22        NA       NA   NA      7.58  28.5  NA       NA    12.4  73.9
##  7 1999-03-01         3.22    25.8  5.94  48.3  324.    7.81    33.8  11.3  82.5
##  8 1999-03-08        NA       NA   NA      2      2.25 NA       NA    12.6  79.9
##  9 1999-03-15        NA       NA   NA      3.89   4.35 NA       NA    12.4  81.4
## 10 1999-03-22         4.78    25.7  6.64  43.4  331.    7.87    33.7  11.7  85.5
## # ... with abbreviated variable name 1: SALINITY
```

```
print(dim(owt_df02_gb09_ploo_wkly02_train_tb02))
```

```
## [1] 1147   10
```

```
# PLOO Excluding Outliers - Test partition (01/11/2021-01/03/2022)
print(head(owt_df02_gb09_ploo_wkly02_test_tb02, 10))
```

```
## # A tibble: 10 x 10
##    date_sample CHLOROPHYLL DENSITY    DO ENTERO  FECAL    PH SALIN~1  TEMP   XMS
##    <date>            <dbl>   <dbl> <dbl>  <dbl>  <dbl> <dbl>   <dbl> <dbl> <dbl>
##  1 2021-01-11         1.08    25.1  6.61   3.17   4     7.98    33.6  13.9  72.3
##  2 2021-01-18         1.54    25.2  6.63   3.44   7.81  8.00    33.6  13.6  84.0
##  3 2021-01-25         1.62    25.0  7.32   2.12   3.21  8.05    33.6  14.4  73.8
##  4 2021-02-01         1.06    25.0  7.41   4.75   4.31  8.15    33.6  14.4  72.7
##  5 2021-02-08         1.95    24.9  7.59   3      3.17  8.15    33.5  14.4  78.8
##  6 2021-02-15         1.92    25.0  7.30   3.88   5.88  8.11    33.5  14.1  80.5
##  7 2021-02-22         2.08    25.1  7.30   2.12   2.67  8.06    33.6  14.0  73.6
##  8 2021-03-01         1.03    25.5  5.72  25.5    6.54  7.93    33.7  12.2  82.5
##  9 2021-03-08         1.51    25.1  7.37   2.25   3.5   8.08    33.6  14.0  82.2
## 10 2021-03-15         2.36    24.9  7.97   7.88 171.    8.14    33.5  14.6  74.1
## # ... with abbreviated variable name 1: SALINITY
```

```r
print(dim(owt_df02_gb09_ploo_wkly02_test_tb02))
```

```
## [1] 52 10
```

```r
#++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
# SBOO All - Training partition (01/18/1999-01/04/2021)
print(head(owt_df02_gb09_sboo_wkly03_train_tb02, 10))
```

```
## # A tibble: 10 x 10
##    date_sample CHLOROPHYLL DENSITY    DO ENTERO FECAL    PH SALINITY  TEMP   XMS
##    <date>            <dbl>   <dbl> <dbl>  <dbl> <dbl> <dbl>    <dbl> <dbl> <dbl>
##  1 1999-01-18        NA       NA   NA      NA   243   NA        NA    NA    NA
##  2 1999-01-25        NA       NA   NA      39.3 161.  NA        NA    13.6  58.3
##  3 1999-02-01        NA       25.3  6.80  315.  330.   7.89     33.6  13.0  74.4
##  4 1999-02-08         5.27    25.2  8.39  115.  117.   8.02     33.5  13.2  79.6
##  5 1999-02-15        NA       NA   NA     208.  309.  NA        NA    12.6  73.0
##  6 1999-02-22        NA       NA   NA     248.   68.3 NA        NA    12.1  65.9
##  7 1999-03-01        NA       NA   NA      16.2 350.  NA        NA    NA    NA
##  8 1999-03-08        12.7     25.6  8.53   17.4 193.   7.97     33.7  12.3  77.1
##  9 1999-03-15        NA       NA   NA      91.2  70.8 NA        NA    12.1  76.7
## 10 1999-03-22        NA       NA   NA     109.  279.  NA        NA    11.7  78.7
```

```r
print(dim(owt_df02_gb09_sboo_wkly03_train_tb02))
```

```
## [1] 1147   10
```

```r
# SBOO All - Test partition (01/11/2021-01/03/2022)
print(head(owt_df02_gb09_sboo_wkly03_test_tb02, 10))
```

```
## # A tibble: 10 x 10
##    date_sample CHLOROPHYLL DENSITY    DO ENTERO  FECAL    PH SALIN~1  TEMP   XMS
##    <date>            <dbl>   <dbl> <dbl>  <dbl>  <dbl> <dbl>   <dbl> <dbl> <dbl>
##  1 2021-01-11         2.51    25.1  6.98 5.79e3 7.84e3  8.04    33.6  13.9  58.8
##  2 2021-01-18         3.37    25.1  7.66 2.00e2 4.75e2  8.07    33.6  13.7  72.1
##  3 2021-01-25         2.69    24.9  7.99 1.52e2 3.55e2  8.12    33.6  14.6  70.4
##  4 2021-02-01         1.54    25.1  7.08 9.63e2 1.57e3  8.15    33.6  13.9  58.4
##  5 2021-02-08         4.13    24.9  7.88 3.45e3 4.62e3  8.18    33.5  14.6  59.8
##  6 2021-02-15         2.45    25.0  7.53 3.92e2 8.33e2  8.09    33.5  14.1  77.7
##  7 2021-02-22         5.15    25.0  7.39 3.03e3 7.31e3  8.09    33.6  14.3  55.4
##  8 2021-03-01         2.57    25.3  6.12 8.91e2 1.42e3  7.95    33.6  13.0  63.7
##  9 2021-03-08         2.08    25.1  7.44 6.56e0 8.38e0  8.08    33.6  14.2  71.3
## 10 2021-03-15         4.71    24.8  8.59 3.60e3 4.25e3  8.23    33.5  14.9  59.6
## # ... with abbreviated variable name 1: SALINITY
```

```r
print(dim(owt_df02_gb09_sboo_wkly03_test_tb02))
```

```
## [1] 52 10
```

```r
#-----------------------------------------------------------------------------
# SBOO Excluding Outliers - Training partition (01/18/1999-01/04/2021)
print(head(owt_df02_gb09_sboo_wkly02_train_tb02, 10))
```

```
## # A tibble: 10 x 10
##    date_sample CHLOROPHYLL DENSITY    DO ENTERO FECAL    PH SALINITY  TEMP   XMS
##    <date>            <dbl>   <dbl> <dbl>  <dbl> <dbl> <dbl>    <dbl> <dbl> <dbl>
##  1 1999-01-18        NA       NA   NA      NA   243   NA        NA    NA    NA
```

```
##  2 1999-01-25        NA       NA   NA      39.3 161.  NA        NA    13.6  58.3
##  3 1999-02-01        NA       25.3  6.80  315.  330.   7.89     33.6  13.0  74.4
##  4 1999-02-08         5.27    25.2  8.39  115.  117.   8.02     33.5  13.2  79.6
##  5 1999-02-15        NA       NA   NA     208.  309.  NA        NA    12.6  73.0
##  6 1999-02-22        NA       NA   NA     248.   68.3 NA        NA    12.1  65.9
##  7 1999-03-01        NA       NA   NA      16.2 350.  NA        NA    NA    NA
##  8 1999-03-08        12.7     25.6  8.53   17.4 193.   7.97     33.7  12.3  77.1
##  9 1999-03-15        NA       NA   NA      91.2  70.8 NA        NA    12.1  76.7
## 10 1999-03-22        NA       NA   NA     109.  279.  NA        NA    11.7  78.7
```

```r
print(dim(owt_df02_gb09_sboo_wkly02_train_tb02))
```

```
## [1] 1147   10
```

```r
# SBOO Excluding Outliers - Test partition (01/11/2021-01/03/2022)
print(head(owt_df02_gb09_sboo_wkly02_test_tb02, 10))
```

```
## # A tibble: 10 x 10
##    date_sample CHLOROPH~1 DENSITY    DO ENTERO   FECAL    PH SALIN~2  TEMP   XMS
##    <date>           <dbl>   <dbl> <dbl>  <dbl>   <dbl> <dbl>   <dbl> <dbl> <dbl>
##  1 2021-01-11        2.51    25.1  6.98  NA      NA     8.04    33.6  13.9  58.8
##  2 2021-01-18        3.37    25.1  7.66 200.    475.    8.07    33.6  13.7  72.1
##  3 2021-01-25        2.69    24.9  7.99 152.    355.    8.12    33.6  14.6  70.4
##  4 2021-02-01        1.54    25.1  7.08 963.   1566.    8.15    33.6  13.9  58.4
##  5 2021-02-08        4.13    24.9  7.88  NA      NA     8.18    33.5  14.6  59.8
##  6 2021-02-15        2.45    25.0  7.53 392.    833.    8.09    33.5  14.1  77.7
##  7 2021-02-22        5.15    25.0  7.39  NA      NA     8.09    33.6  14.3  55.4
##  8 2021-03-01        2.57    25.3  6.12 891.   1419.    7.95    33.6  13.0  63.7
##  9 2021-03-08        2.08    25.1  7.44   6.56    8.38  8.08    33.6  14.2  71.3
## 10 2021-03-15        4.71    24.8  8.59  NA      NA     8.23    33.5  14.9  59.6
## # ... with abbreviated variable names 1: CHLOROPHYLL, 2: SALINITY
```

```r
print(dim(owt_df02_gb09_sboo_wkly02_test_tb02))
```

```
## [1] 52 10
```

Imputation using `timetk` `ts_impute_vec()` function

```r
# Impute missing values using TS imputation w/ seasonality
qk_imp <- function(df = NA) {
  df$CHLOROPHYLL <- ts_impute_vec(df$CHLOROPHYLL,
                                  period = 3,
                                  lambda = NULL)

  df$DENSITY <- ts_impute_vec(df$DENSITY,
                              period = 3,
                              lambda = NULL)

  df$DO <- ts_impute_vec(df$DO,
                         period = 3,
                         lambda = NULL)

  df$ENTERO <- ts_impute_vec(df$ENTERO,
                             period = 3,
                             lambda = NULL)
```

```r
  df$FECAL <- ts_impute_vec(df$FECAL,
                            period = 3,
                            lambda = NULL)

  df$PH <- ts_impute_vec(df$PH,
                         period = 3,
                         lambda = NULL)

  df$SALINITY <- ts_impute_vec(df$SALINITY,
                               period = 3,
                               lambda = NULL)

  df$TEMP <- ts_impute_vec(df$TEMP,
                           period = 3,
                           lambda = NULL)

  df$XMS <- ts_impute_vec(df$XMS,
                          period = 3,
                          lambda = NULL)
  return(df)
}
```

```r
# PLOO All - Training partition (01/18/1999-01/04/2021)
owt_df02_gb09_ploo_wkly03_train_tb03 <- qk_imp(df = owt_df02_gb09_ploo_wkly03_train_tb02)
print(head(owt_df02_gb09_ploo_wkly03_train_tb03, 10))
```

```
## # A tibble: 10 x 10
##    date_sample CHLOROPHYLL DENSITY    DO ENTERO  FECAL    PH SALIN~1  TEMP   XMS
##    <date>            <dbl>   <dbl> <dbl>  <dbl>  <dbl> <dbl>   <dbl> <dbl> <dbl>
##  1 1999-01-18         4.22    25.2  6.88  19.2   95.6   7.97    33.6  13.5  87.8
##  2 1999-01-25         3.88    25.2  6.86   3.08   2.58  7.96    33.6  14.1  75.6
##  3 1999-02-01         3.79    25.3  6.66  44.4   17.1   7.93    33.7  13.5  85.6
##  4 1999-02-08         3.72    25.5  6.41   6.17   2.42  7.89    33.7  13.4  83.7
##  5 1999-02-15         3.39    25.5  6.37  24.8    8.65  7.88    33.7  13.0  82.2
##  6 1999-02-22         3.30    25.6  6.18   7.58  28.5   7.85    33.8  12.4  73.9
##  7 1999-03-01         3.22    25.8  5.94  48.3  324.    7.81    33.8  11.3  82.5
##  8 1999-03-08         3.59    25.7  6.28   2      2.25  7.84    33.8  12.6  79.9
##  9 1999-03-15         4.18    25.6  6.48   3.89   4.35  7.86    33.8  12.4  81.4
## 10 1999-03-22         4.78    25.7  6.64  43.4  331.    7.87    33.7  11.7  85.5
## # ... with abbreviated variable name 1: SALINITY
```

```r
# PLOO All - Test partition (01/11/2021-01/03/2022)
owt_df02_gb09_ploo_wkly03_test_tb03 <- qk_imp(df = owt_df02_gb09_ploo_wkly03_test_tb02)
print(head(owt_df02_gb09_ploo_wkly03_test_tb03, 10))
```

```
## # A tibble: 10 x 10
##    date_sample CHLOROPHYLL DENSITY    DO ENTERO  FECAL    PH SALIN~1  TEMP   XMS
##    <date>            <dbl>   <dbl> <dbl>  <dbl>  <dbl> <dbl>   <dbl> <dbl> <dbl>
##  1 2021-01-11         1.08    25.1  6.61   3.17   4     7.98    33.6  13.9  72.3
##  2 2021-01-18         1.54    25.2  6.63   3.44   7.81  8.00    33.6  13.6  84.0
##  3 2021-01-25         1.62    25.0  7.32   2.12   3.21  8.05    33.6  14.4  73.8
##  4 2021-02-01         1.06    25.0  7.41   4.75   4.31  8.15    33.6  14.4  72.7
##  5 2021-02-08         1.95    24.9  7.59   3      3.17  8.15    33.5  14.4  78.8
```

```
##  6 2021-02-15         1.92    25.0  7.30   3.88   5.88  8.11    33.5  14.1  80.5
##  7 2021-02-22         2.08    25.1  7.30   2.12   2.67  8.06    33.6  14.0  73.6
##  8 2021-03-01         1.03    25.5  5.72  25.5    6.54  7.93    33.7  12.2  82.5
##  9 2021-03-08         1.51    25.1  7.37   2.25   3.5   8.08    33.6  14.0  82.2
## 10 2021-03-15         2.36    24.9  7.97   7.88 171.    8.14    33.5  14.6  74.1
## # ... with abbreviated variable name 1: SALINITY
```

```
#-------------------------------------------------------------------------------
# PLOO Excluding Outliers - Training partition (01/18/1999-01/04/2021)
owt_df02_gb09_ploo_wkly02_train_tb03 <- qk_imp(df = owt_df02_gb09_ploo_wkly02_train_tb02)
print(head(owt_df02_gb09_ploo_wkly02_train_tb03, 10))
```

```
## # A tibble: 10 x 10
##    date_sample CHLOROPHYLL DENSITY    DO ENTERO  FECAL    PH SALIN~1  TEMP   XMS
##    <date>            <dbl>   <dbl> <dbl>  <dbl>  <dbl> <dbl>   <dbl> <dbl> <dbl>
##  1 1999-01-18         4.22    25.2  6.88  19.2   95.6   7.97    33.6  13.5  87.8
##  2 1999-01-25         3.88    25.2  6.77   3.08   2.58  7.96    33.6  14.1  75.6
##  3 1999-02-01         3.79    25.3  6.60  44.4   17.1   7.93    33.6  13.5  85.6
##  4 1999-02-08         3.72    25.5  6.41   6.17   2.42  7.89    33.7  13.4  83.7
##  5 1999-02-15         3.39    25.5  6.29  24.8    8.65  7.87    33.7  13.0  82.2
##  6 1999-02-22         3.30    25.6  6.12   7.58  28.5   7.85    33.8  12.4  73.9
##  7 1999-03-01         3.22    25.8  5.94  48.3  324.    7.81    33.8  11.3  82.5
##  8 1999-03-08         3.57    25.7  6.20   2      2.25  7.84    33.8  12.6  79.9
##  9 1999-03-15         4.17    25.6  6.42   3.89   4.35  7.86    33.8  12.4  81.4
## 10 1999-03-22         4.78    25.7  6.64  43.4  331.    7.87    33.7  11.7  85.5
## # ... with abbreviated variable name 1: SALINITY
```

```
# PLOO Excluding Outliers - Test partition (01/11/2021-01/03/2022)
owt_df02_gb09_ploo_wkly02_test_tb03 <- qk_imp(df = owt_df02_gb09_ploo_wkly02_test_tb02)
print(head(owt_df02_gb09_ploo_wkly02_test_tb03, 10))
```

```
## # A tibble: 10 x 10
##    date_sample CHLOROPHYLL DENSITY    DO ENTERO  FECAL    PH SALIN~1  TEMP   XMS
##    <date>            <dbl>   <dbl> <dbl>  <dbl>  <dbl> <dbl>   <dbl> <dbl> <dbl>
##  1 2021-01-11         1.08    25.1  6.61   3.17   4     7.98    33.6  13.9  72.3
##  2 2021-01-18         1.54    25.2  6.63   3.44   7.81  8.00    33.6  13.6  84.0
##  3 2021-01-25         1.62    25.0  7.32   2.12   3.21  8.05    33.6  14.4  73.8
##  4 2021-02-01         1.06    25.0  7.41   4.75   4.31  8.15    33.6  14.4  72.7
##  5 2021-02-08         1.95    24.9  7.59   3      3.17  8.15    33.5  14.4  78.8
##  6 2021-02-15         1.92    25.0  7.30   3.88   5.88  8.11    33.5  14.1  80.5
##  7 2021-02-22         2.08    25.1  7.30   2.12   2.67  8.06    33.6  14.0  73.6
##  8 2021-03-01         1.03    25.5  5.72  25.5    6.54  7.93    33.7  12.2  82.5
##  9 2021-03-08         1.51    25.1  7.37   2.25   3.5   8.08    33.6  14.0  82.2
## 10 2021-03-15         2.36    24.9  7.97   7.88 171.    8.14    33.5  14.6  74.1
## # ... with abbreviated variable name 1: SALINITY
```

```
#+++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
# SBOO All - Training partition (01/18/1999-01/04/2021)
owt_df02_gb09_sboo_wkly03_train_tb03 <- qk_imp(df = owt_df02_gb09_sboo_wkly03_train_tb02)
print(head(owt_df02_gb09_sboo_wkly03_train_tb03, 10))
```

```
## # A tibble: 10 x 10
##    date_sample CHLOROPHYLL DENSITY    DO ENTERO FECAL    PH SALINITY  TEMP   XMS
##    <date>            <dbl>   <dbl> <dbl>  <dbl> <dbl> <dbl>    <dbl> <dbl> <dbl>
##  1 1999-01-18         5.26    25.3  6.85   35.7 243    7.89     33.6  13.7  59.6
```

```
##  2 1999-01-25         5.19    25.3  6.70   39.3 161.   7.90     33.6  13.6  58.3
##  3 1999-02-01         5.15    25.3  6.80  315.  330.   7.89     33.6  13.0  74.4
##  4 1999-02-08         5.27    25.2  8.39  115.  117.   8.02     33.5  13.2  79.6
##  5 1999-02-15         7.08    25.3  8.31  208.  309.   8.02     33.6  12.6  73.0
##  6 1999-02-22         8.93    25.4  8.48  248.   68.3  8.00     33.6  12.1  65.9
##  7 1999-03-01        10.9     25.5  8.61   16.2 350.   7.98     33.6  12.3  72.0
##  8 1999-03-08        12.7     25.6  8.53   17.4 193.   7.97     33.7  12.3  77.1
##  9 1999-03-15        10.4     25.4  8.43   91.2  70.8  7.97     33.7  12.1  76.7
## 10 1999-03-22         8.15    25.3  8.28  109.  279.   7.96     33.7  11.7  78.7
```

```
# SBOO All - Test partition (01/11/2021-01/03/2022)
owt_df02_gb09_sboo_wkly03_test_tb03 <- qk_imp(df = owt_df02_gb09_sboo_wkly03_test_tb02)
print(head(owt_df02_gb09_sboo_wkly03_test_tb03, 10))
```

```
## # A tibble: 10 x 10
##    date_sample CHLOROPHYLL DENSITY    DO ENTERO  FECAL    PH SALIN~1  TEMP   XMS
##    <date>            <dbl>   <dbl> <dbl>  <dbl>  <dbl> <dbl>   <dbl> <dbl> <dbl>
##  1 2021-01-11         2.51    25.1  6.98 5.79e3 7.84e3  8.04    33.6  13.9  58.8
##  2 2021-01-18         3.37    25.1  7.66 2.00e2 4.75e2  8.07    33.6  13.7  72.1
##  3 2021-01-25         2.69    24.9  7.99 1.52e2 3.55e2  8.12    33.6  14.6  70.4
##  4 2021-02-01         1.54    25.1  7.08 9.63e2 1.57e3  8.15    33.6  13.9  58.4
##  5 2021-02-08         4.13    24.9  7.88 3.45e3 4.62e3  8.18    33.5  14.6  59.8
##  6 2021-02-15         2.45    25.0  7.53 3.92e2 8.33e2  8.09    33.5  14.1  77.7
##  7 2021-02-22         5.15    25.0  7.39 3.03e3 7.31e3  8.09    33.6  14.3  55.4
##  8 2021-03-01         2.57    25.3  6.12 8.91e2 1.42e3  7.95    33.6  13.0  63.7
##  9 2021-03-08         2.08    25.1  7.44 6.56e0 8.38e0  8.08    33.6  14.2  71.3
## 10 2021-03-15         4.71    24.8  8.59 3.60e3 4.25e3  8.23    33.5  14.9  59.6
## # ... with abbreviated variable name 1: SALINITY
```

```
#-------------------------------------------------------------------------------
# SBOO Excluding Outliers - Training partition (01/18/1999-01/04/2021)
owt_df02_gb09_sboo_wkly02_train_tb03 <- qk_imp(df = owt_df02_gb09_sboo_wkly02_train_tb02)
print(head(owt_df02_gb09_sboo_wkly02_train_tb03, 10))
```

```
## # A tibble: 10 x 10
##    date_sample CHLOROPHYLL DENSITY    DO ENTERO FECAL    PH SALINITY  TEMP   XMS
##    <date>            <dbl>   <dbl> <dbl>  <dbl> <dbl> <dbl>    <dbl> <dbl> <dbl>
##  1 1999-01-18         5.27    25.3  6.87   39.9 243    7.89     33.6  13.7  59.9
##  2 1999-01-25         4.85    25.3  6.70   39.3 161.   7.90     33.6  13.6  58.3
##  3 1999-02-01         4.96    25.3  6.80  315.  330.   7.89     33.6  13.0  74.4
##  4 1999-02-08         5.27    25.2  8.39  115.  117.   8.02     33.5  13.2  79.6
##  5 1999-02-15         6.82    25.3  8.30  208.  309.   8.01     33.6  12.6  73.0
##  6 1999-02-22         8.90    25.4  8.48  248.   68.3  8.00     33.6  12.1  65.9
##  7 1999-03-01        11.2     25.4  8.62   16.2 350.   7.98     33.6  12.3  72.2
##  8 1999-03-08        12.7     25.6  8.53   17.4 193.   7.97     33.7  12.3  77.1
##  9 1999-03-15        10.4     25.4  8.43   91.2  70.8  7.97     33.7  12.1  76.7
## 10 1999-03-22         8.35    25.3  8.29  109.  279.   7.96     33.7  11.7  78.7
```

```
# SBOO Excluding Outliers - Test partition (01/11/2021-01/03/2022)
owt_df02_gb09_sboo_wkly02_test_tb03 <- qk_imp(df = owt_df02_gb09_sboo_wkly02_test_tb02)
print(head(owt_df02_gb09_sboo_wkly02_test_tb03, 10))
```

```
## # A tibble: 10 x 10
##    date_sample CHLOROPHYLL DENSITY    DO ENTERO  FECAL    PH SALIN~1  TEMP   XMS
##    <date>            <dbl>   <dbl> <dbl>  <dbl>  <dbl> <dbl>   <dbl> <dbl> <dbl>
```

```
## 1 2021-01-11         2.51    25.1  6.98 268.   5.06e2  8.04    33.6  13.9  58.8
## 2 2021-01-18         3.37    25.1  7.66 200.   4.75e2  8.07    33.6  13.7  72.1
## 3 2021-01-25         2.69    24.9  7.99 152.   3.55e2  8.12    33.6  14.6  70.4
## 4 2021-02-01         1.54    25.1  7.08 963.   1.57e3  8.15    33.6  13.9  58.4
## 5 2021-02-08         4.13    24.9  7.88 712.   1.30e3  8.18    33.5  14.6  59.8
## 6 2021-02-15         2.45    25.0  7.53 392.   8.33e2  8.09    33.5  14.1  77.7
## 7 2021-02-22         5.15    25.0  7.39 776.   1.28e3  8.09    33.6  14.3  55.4
## 8 2021-03-01         2.57    25.3  6.12 891.   1.42e3  7.95    33.6  13.0  63.7
## 9 2021-03-08         2.08    25.1  7.44   6.56 8.38e0  8.08    33.6  14.2  71.3
## 10 2021-03-15        4.71    24.8  8.59 496.   6.09e2  8.23    33.5  14.9  59.6
## # ... with abbreviated variable name 1: SALINITY
```

Modeling

Linear Regression Modeling

Create custom function to automate linear regression modeling

```r
lr_ts_mod <- function(tb_train = NA,
                      tb_test = NA,
                      date = NA,
                      param = NA,
                      ext_pred = c(),
                      train_start = c(),
                      test_start = c(),
                      freq = NA,
                      h = NA,
                      formula = NA) {
  # Function to perform TS linear regression w/ or w/o external variables
  #print(tb_train)
  #print(tb_test)
  tb_full01 <- rbind(tb_train, tb_test)
  #print(tb_full01)
  ts_full01 <- ts(tb_full01[, 2:10],
                  start = train_start,
                  freq = freq)
  #print(ts_full01)

  train_ts01 <- window(ts_full01, end = c(2021, 5))
  test_ts01 <- window(ts_full01, start = c(2021, 6))
  #print(tail(train_ts01))
  #print(colnames(train_ts01))
  #print(colnames(test_ts01))

  #print(train_ts01)
  #print(test_ts01)
  #print(test_ts01[, ext_pred])

  # TSLM Citation:
  # https://www.rdocumentation.org/packages/forecast/versions/8.19/topics/tslm
  lin_mod_fit <- tslm(formula = as.formula(formula),
                      data = train_ts01)
```

```
  lin_mod_prd <- forecast(lin_mod_fit,
                          h = h,
                          newdata = data.frame(test_ts01[, ext_pred]))

  #tb_train_s1 <- subset(x = tb_train, select = c(date, param))
  #tb_test_s1 <- subset(x = tb_test, select = c(date, param))

  print(lin_mod_prd)
  #print(tb_test[, param])
  print(accuracy(lin_mod_prd,
                 as.matrix(tb_test[, param])))

  # Multiple Object return() Citation:
  # https://www.geeksforgeeks.org/return-value-from-r-function/
  return(list(train_ts01[, param],
              test_ts01[, param],
              lin_mod_prd))
}
```

PLOO: Imputed, All - Including External Variables (Forecasting `ENTERO`)

```
# PLOO All: Imputed - Training partition (01/18/1999-01/04/2021)
#owt_df02_gb09_ploo_wkly03_train_tb03
# PLOO All: Imputed - Test partition (01/11/2021-01/03/2022)
#owt_df02_gb09_ploo_wkly03_test_tb03

owt_df02_gb09_ploo_wkly03_train_tb03 %>%
  plot_time_series(date_sample,
                   ENTERO)
```

```
owt_df02_gb09_ploo_wkly03_train_tb03 %>%
  plot_stl_diagnostics(date_sample,
                       ENTERO,
                       .frequency = "auto",
                       .trend = "auto")
```

```
## frequency = 13 observations per 1 quarter
```

```
## trend = 53 observations per 1 year
```

```
#print(lubridate::isoweek(ymd(train_start)))
#print(lubridate::isoweek(ymd(test_start)))

#print(tail(owt_df02_gb09_ploo_wkly03_train_tb02))
#print(head(owt_df02_gb09_ploo_wkly03_test_tb02))

m1v1_lin_out <- lr_ts_mod(tb_train = owt_df02_gb09_ploo_wkly03_train_tb03,
                          tb_test = owt_df02_gb09_ploo_wkly03_test_tb03,
                          date = "date_sample",
                          param = "ENTERO",
                          ext_pred = c("CHLOROPHYLL",
                                       "DENSITY",
                                       "DO",
                                       "FECAL",
```

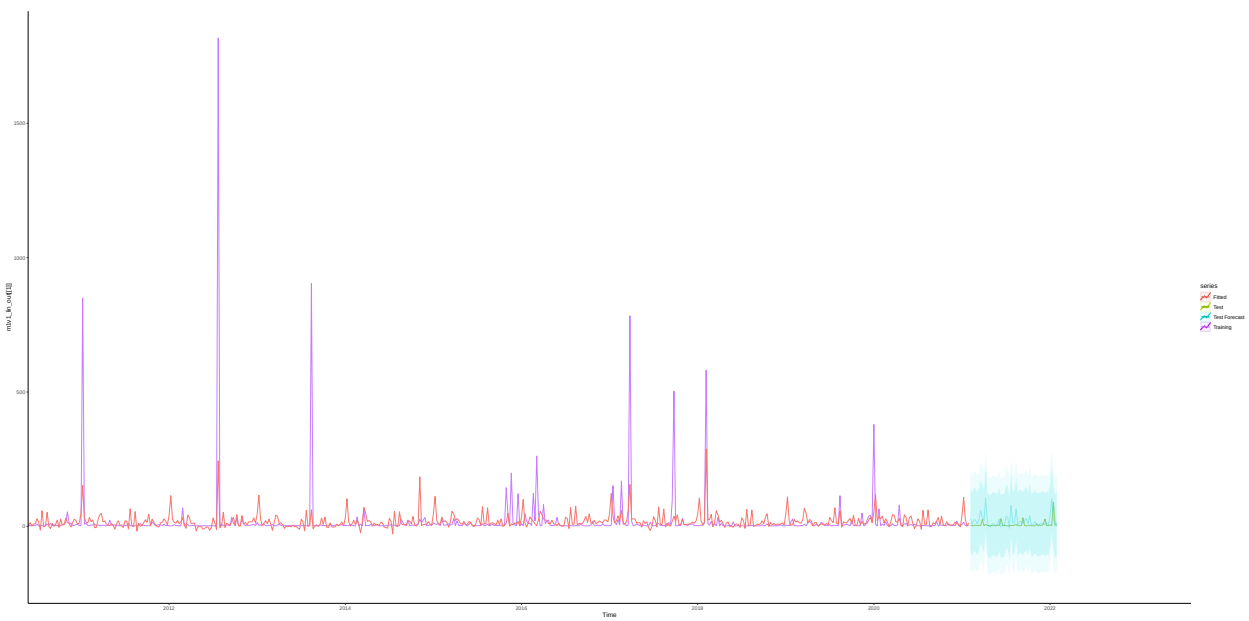
```r
                                        "PH",
                                        "SALINITY",
                                        "TEMP",
                                        "XMS"),
                            train_start = c(1999, lubridate::isoweek(ymd(train_start))),
                            test_start = c(2021, 6),
                            freq = 52,
                            h = 52,
                            formula = "ENTERO ~ trend + season + CHLOROPHYLL + DENSITY + DO
                            ↪  + FECAL + PH + SALINITY + TEMP + XMS")
```

```
##          Point Forecast      Lo 80    Hi 80      Lo 95    Hi 95
## 2021.096     29.4680279  -87.97340 146.9095 -150.23415 209.1702
## 2021.115      7.4653502 -109.93365 124.8644 -172.17192 187.1026
## 2021.135     24.3485243  -92.95329 141.6503 -155.14003 203.8371
## 2021.154     23.3998700  -93.96530 140.7650 -156.18563 202.9854
## 2021.173      9.8409381 -107.34956 127.0314 -169.47728 189.1592
## 2021.192     21.6933632  -95.48725 138.8740 -157.60973 200.9965
## 2021.212     58.4282465  -58.86386 175.7204 -121.04545 237.9019
## 2021.231     35.9361707  -81.53464 153.4070 -143.81097 215.6833
## 2021.250     21.6577231  -95.54228 138.8577 -157.67505 200.9905
## 2021.269    104.0456494  -13.41867 221.5100  -75.69157 283.7829
## 2021.288     15.1157139 -102.14898 132.3804 -164.31604 194.5475
## 2021.308     -1.9715247 -119.29318 115.3501 -181.49044 177.5474
## 2021.327      0.7637612 -116.60771 118.1352 -178.83137 180.3589
## 2021.346      9.4352817 -107.81352 126.6841 -169.97216 188.8427
## 2021.365      9.8876088 -107.28083 127.0561 -169.39687 189.1721
## 2021.385      3.0450184 -114.14350 120.2335 -176.27018 182.3602
## 2021.404      7.5140680 -109.80647 124.8346 -172.00314 187.0313
## 2021.423     26.0014362  -91.35884 143.3617 -153.57658 205.5795
## 2021.442     -0.7386557 -117.98935 116.5120 -180.14900 178.6717
## 2021.462      3.7781511 -113.36451 120.9208 -175.46688 183.0232
## 2021.481      0.9642838 -116.41144 118.3400 -178.63736 180.5659
## 2021.500     36.3200348  -80.94624 153.5863 -143.11413 215.7542
## 2021.519     34.1802522  -83.25204 151.6125 -145.50796 213.8685
## 2021.538     -6.9186153 -124.21905 110.3818 -186.40507 172.5678
## 2021.558     77.3585967  -40.11327 194.8305 -102.39017 257.1074
## 2021.577     11.4755034 -105.77118 128.7222 -167.92869 190.8797
## 2021.596     13.2590347 -103.93369 130.4518 -166.06260 192.5807
## 2021.615     64.7489345  -52.39421 181.8921 -114.49684 243.9947
## 2021.635      5.0722820 -112.13887 122.2834 -174.27755 184.4221
## 2021.654     18.6293788  -98.63286 135.8916 -160.79861 198.0574
## 2021.673     17.6142618  -99.87302 135.1015 -162.15809 197.3866
## 2021.692     10.3404587 -107.08947 127.7704 -169.34413 190.0250
## 2021.712     20.3485507  -96.85490 137.5520 -158.98949 199.6866
## 2021.731     29.4222818  -87.87739 146.7220 -150.06300 208.9076
## 2021.750     10.2053873 -107.29138 127.7022 -169.58147 189.9922
## 2021.769     39.3936280  -78.09263 156.8799 -140.37715 219.1644
## 2021.788      4.5437551 -112.93016 122.0177 -175.20815 184.2957
## 2021.808      7.0126751 -110.53367 124.5590 -172.85004 186.8754
## 2021.827     17.1021792 -100.48607 134.6904 -162.82466 197.0290
## 2021.846      8.6768013 -108.90284 126.2564 -171.23687 188.5905
## 2021.865      6.4066977 -111.10639 123.9198 -173.40513 186.2185
```

```
## 2021.885      6.8703892 -110.40029 124.1411 -172.57053 186.3113
## 2021.904     12.3824905 -105.31637 130.0814 -167.71361 192.4786
## 2021.923     11.9819734 -105.37078 129.3347 -167.58453 191.5485
## 2021.942      5.5885194 -112.27808 123.4551 -174.76424 185.9413
## 2021.962     13.5630803 -104.07625 131.2024 -166.44193 193.5681
## 2021.981      6.1574358 -111.34330 123.6582 -173.63550 185.9504
## 2022.000     38.5978583  -79.24010 156.4358 -141.71108 218.9068
## 2022.019    101.5686784  -16.19915 219.3365  -78.63295 281.7703
## 2022.038     28.4714562  -89.04633 145.9892 -151.34757 208.2905
## 2022.058      0.8251637 -116.57631 118.2266 -178.81589 180.4662
## 2022.077     12.6666412 -104.72084 130.0541 -166.95300 192.2863
##                         ME     RMSE      MAE       MPE     MAPE      MASE
## Training set -1.046722e-15 86.77428 28.51601 -201.2632 394.7822 0.8768111
## Test set     -1.359639e+01 30.01797 19.75175 -520.9396 564.2274 0.6073274
##                    ACF1
## Training set 0.00946572
## Test set             NA
```

```
#print(m1v1_lin_out[[3]])

# Autoplot Citation:
# USD. (n.d.). ADS 506 Lab 3.2.R [Module 3 course materials].
autoplot(m1v1_lin_out[[1]], series = 'Training') +
  autolayer(m1v1_lin_out[[2]], series = 'Test') +
  autolayer(m1v1_lin_out[[3]], series = 'Test Forecast', alpha = .3) +
  autolayer(m1v1_lin_out[[3]]$fitted, series = 'Fitted') +
  theme_classic() +
  coord_cartesian(#ylim = c(-50, 400),
                  xlim = c(2011, 2023))
```




```
summary(m1v1_lin_out[[3]])
```

```
##
## Forecast method: Linear regression model
```

```
##
## Model Information:
##
## Call:
## tslm(formula = as.formula(formula), data = train_ts01)
##
## Coefficients:
## (Intercept)        trend      season2      season3      season4      season5
##   570.24826      0.02487     66.67114    -21.37696    -36.12629    -29.12206
##     season6      season7      season8      season9     season10     season11
##   -14.04468    -29.91413    -21.67273    -29.07968    -40.74223    -25.73621
##    season12     season13     season14     season15     season16     season17
##    11.01291      5.96744    -20.16249    -20.45878    -22.42186    -34.73134
##    season18     season19     season20     season21     season22     season23
##   -30.49355    -25.85471    -32.51986    -33.84756    -25.75848    -21.82754
##    season24     season25     season26     season27     season28     season29
##   -35.33516    -38.07910    -35.25317     -6.16428    -15.81276    -46.54864
##    season30     season31     season32     season33     season34     season35
##    28.14340    -32.83728    -31.49919     22.09408    -38.20827    -30.32434
##    season36     season37     season38     season39     season40     season41
##   -25.65753    -30.56741    -23.12911    -10.87565    -27.90870     -0.39450
##    season42     season43     season44     season45     season46     season47
##   -35.55193    -34.93334    -22.74350    -36.29355    -34.33324    -32.74456
##    season48     season49     season50     season51     season52  CHLOROPHYLL
##   -29.80809    -28.64711    -23.51158    -24.64886    -32.16327      0.34342
##     DENSITY           DO        FECAL           PH     SALINITY         TEMP
##    38.85919     -0.56045      0.42542     54.67497    -60.46816      8.42882
##         XMS
##    -0.71608
##
##
## Error measures:
##                         ME     RMSE      MAE       MPE     MAPE      MASE
## Training set -1.046722e-15 86.77428 28.51601 -201.2632 394.7822 0.8737683
##                    ACF1
## Training set 0.00946572
##
## Forecasts:
##          Point Forecast      Lo 80    Hi 80      Lo 95    Hi 95
## 2021.096     29.4680279  -87.97340 146.9095 -150.23415 209.1702
## 2021.115      7.4653502 -109.93365 124.8644 -172.17192 187.1026
## 2021.135     24.3485243  -92.95329 141.6503 -155.14003 203.8371
## 2021.154     23.3998700  -93.96530 140.7650 -156.18563 202.9854
## 2021.173      9.8409381 -107.34956 127.0314 -169.47728 189.1592
## 2021.192     21.6933632  -95.48725 138.8740 -157.60973 200.9965
## 2021.212     58.4282465  -58.86386 175.7204 -121.04545 237.9019
## 2021.231     35.9361707  -81.53464 153.4070 -143.81097 215.6833
## 2021.250     21.6577231  -95.54228 138.8577 -157.67505 200.9905
## 2021.269    104.0456494  -13.41867 221.5100  -75.69157 283.7829
## 2021.288     15.1157139 -102.14898 132.3804 -164.31604 194.5475
## 2021.308     -1.9715247 -119.29318 115.3501 -181.49044 177.5474
## 2021.327      0.7637612 -116.60771 118.1352 -178.83137 180.3589
## 2021.346      9.4352817 -107.81352 126.6841 -169.97216 188.8427
## 2021.365      9.8876088 -107.28083 127.0561 -169.39687 189.1721
```

```
## 2021.385      3.0450184 -114.14350 120.2335 -176.27018 182.3602
## 2021.404      7.5140680 -109.80647 124.8346 -172.00314 187.0313
## 2021.423     26.0014362  -91.35884 143.3617 -153.57658 205.5795
## 2021.442     -0.7386557 -117.98935 116.5120 -180.14900 178.6717
## 2021.462      3.7781511 -113.36451 120.9208 -175.46688 183.0232
## 2021.481      0.9642838 -116.41144 118.3400 -178.63736 180.5659
## 2021.500     36.3200348  -80.94624 153.5863 -143.11413 215.7542
## 2021.519     34.1802522  -83.25204 151.6125 -145.50796 213.8685
## 2021.538     -6.9186153 -124.21905 110.3818 -186.40507 172.5678
## 2021.558     77.3585967  -40.11327 194.8305 -102.39017 257.1074
## 2021.577     11.4755034 -105.77118 128.7222 -167.92869 190.8797
## 2021.596     13.2590347 -103.93369 130.4518 -166.06260 192.5807
## 2021.615     64.7489345  -52.39421 181.8921 -114.49684 243.9947
## 2021.635      5.0722820 -112.13887 122.2834 -174.27755 184.4221
## 2021.654     18.6293788  -98.63286 135.8916 -160.79861 198.0574
## 2021.673     17.6142618  -99.87302 135.1015 -162.15809 197.3866
## 2021.692     10.3404587 -107.08947 127.7704 -169.34413 190.0250
## 2021.712     20.3485507  -96.85490 137.5520 -158.98949 199.6866
## 2021.731     29.4222818  -87.87739 146.7220 -150.06300 208.9076
## 2021.750     10.2053873 -107.29138 127.7022 -169.58147 189.9922
## 2021.769     39.3936280  -78.09263 156.8799 -140.37715 219.1644
## 2021.788      4.5437551 -112.93016 122.0177 -175.20815 184.2957
## 2021.808      7.0126751 -110.53367 124.5590 -172.85004 186.8754
## 2021.827     17.1021792 -100.48607 134.6904 -162.82466 197.0290
## 2021.846      8.6768013 -108.90284 126.2564 -171.23687 188.5905
## 2021.865      6.4066977 -111.10639 123.9198 -173.40513 186.2185
## 2021.885      6.8703892 -110.40029 124.1411 -172.57053 186.3113
## 2021.904     12.3824905 -105.31637 130.0814 -167.71361 192.4786
## 2021.923     11.9819734 -105.37078 129.3347 -167.58453 191.5485
## 2021.942      5.5885194 -112.27808 123.4551 -174.76424 185.9413
## 2021.962     13.5630803 -104.07625 131.2024 -166.44193 193.5681
## 2021.981      6.1574358 -111.34330 123.6582 -173.63550 185.9504
## 2022.000     38.5978583  -79.24010 156.4358 -141.71108 218.9068
## 2022.019    101.5686784  -16.19915 219.3365  -78.63295 281.7703
## 2022.038     28.4714562  -89.04633 145.9892 -151.34757 208.2905
## 2022.058      0.8251637 -116.57631 118.2266 -178.81589 180.4662
## 2022.077     12.6666412 -104.72084 130.0541 -166.95300 192.2863
```

PLOO: Imputed, Excluding Outliers - Including External Variables (Forecasting `ENTERO`)

```
# PLOO Excluding Outliers: Imputed - Training partition (01/18/1999-01/04/2021)
#owt_df02_gb09_ploo_wkly02_train_tb03
# PLOO Excluding Outliers: Imputed - Test partition (01/11/2021-01/03/2022)
#owt_df02_gb09_ploo_wkly02_test_tb03

owt_df02_gb09_ploo_wkly02_train_tb03 %>%
  plot_time_series(date_sample,
                   ENTERO)
```

```
owt_df02_gb09_ploo_wkly02_train_tb03 %>%
  plot_stl_diagnostics(date_sample,
                       ENTERO,
                       .frequency = "auto",
                       .trend = "auto")
```

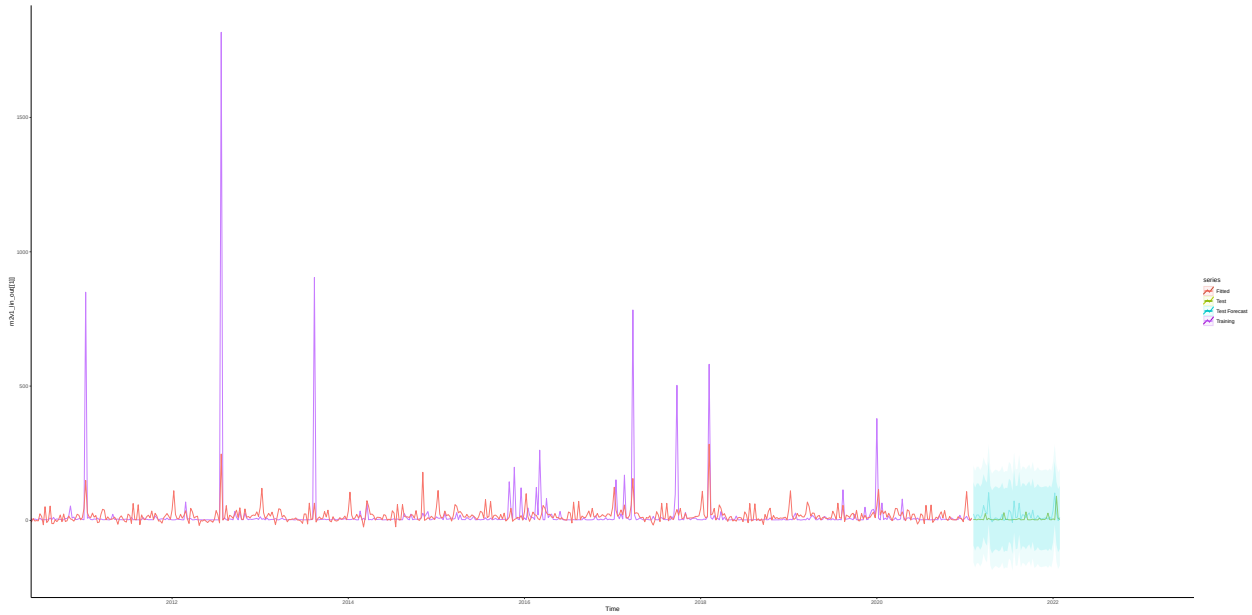
```
## frequency = 13 observations per 1 quarter
## trend = 53 observations per 1 year
```

```
m2v1_lin_out <- lr_ts_mod(tb_train = owt_df02_gb09_ploo_wkly02_train_tb03,
                          tb_test = owt_df02_gb09_ploo_wkly02_test_tb03,
                          date = "date_sample",
                          param = "ENTERO",
                          ext_pred = c("CHLOROPHYLL",
                                       "DENSITY",
                                       "DO",
                                       "FECAL",
                                       "PH",
                                       "SALINITY",
                                       "TEMP",
                                       "XMS"),
                          train_start = c(1999, lubridate::isoweek(ymd(train_start))),
                          test_start = c(2021, 6),
                          freq = 52,
                          h = 52,
                          formula = "ENTERO ~ trend + season + CHLOROPHYLL + DENSITY + DO
                          ↪  + FECAL + PH + SALINITY + TEMP + XMS")
```

```
##          Point Forecast      Lo 80    Hi 80      Lo 95    Hi 95
## 2021.096     24.2918214  -93.17017 141.7538 -155.44182 204.0255
## 2021.115      4.9027823 -112.51926 122.3248 -174.76974 184.5753
## 2021.135     20.3174627  -96.99865 137.6336 -159.19298 199.8279
## 2021.154     20.3769823  -96.99447 137.7484 -159.21812 199.9721
## 2021.173      8.2850284 -108.91208 125.4821 -171.04332 187.6134
## 2021.192     19.5146098  -97.67703 136.7062 -159.80536 198.8346
## 2021.212     55.1373452  -62.16457 172.4393 -124.35136 234.6260
## 2021.231     33.2545388  -84.24426 150.7533 -146.53543 213.0445
## 2021.250     23.4533801  -93.74827 140.6550 -155.88192 202.7887
## 2021.269    103.3003644  -14.16383 220.7646  -76.43666 283.0374
## 2021.288     12.0106577 -105.26060 129.2819 -167.43115 191.4525
## 2021.308     -5.3522353 -122.68154 111.9771 -184.88286 174.1784
## 2021.327      3.6094779 -113.75807 120.9770 -175.97967 183.1986
## 2021.346      9.6756462 -107.59628 126.9476 -169.76718 189.1185
## 2021.365      7.2843518 -109.88922 124.4579 -172.00798 186.5767
## 2021.385      1.9348547 -115.26357 119.1333 -177.39551 181.2652
## 2021.404      7.3168285 -110.00560 124.6393 -172.20326 186.8369
## 2021.423     22.9862070  -94.35294 140.3254 -156.55947 202.5319
## 2021.442     -0.5008495 -117.76090 116.7592 -179.92550 178.9238
## 2021.462      4.6632922 -112.47928 121.8059 -174.58161 183.9082
## 2021.481      2.6358012 -114.75302 120.0246 -176.98589 182.2575
## 2021.500     37.9537846  -79.33810 155.2457 -141.51957 217.4271
## 2021.519     30.1517554  -87.35057 147.6541 -149.64362 209.9471
## 2021.538     -7.4481895 -124.74606 109.8497 -186.93072 172.0343
## 2021.558     72.4441698  -45.04822 189.9366 -107.33600 252.2243
## 2021.577      9.6889927 -107.56416 126.9421 -169.72511 189.1031
## 2021.596     12.5907657 -104.60866 129.7902 -166.74113 191.9227
## 2021.615     64.0293987  -53.11569 181.1745 -115.21934 243.2781
## 2021.635      5.3048771 -111.90548 122.5152 -174.04374 184.6535
```

```
## 2021.654     21.4573252  -95.81112 138.7258 -157.98018 200.8948
## 2021.673     18.8427738  -98.65586 136.3414 -160.94695 198.6325
## 2021.692      9.9949824 -107.43631 127.4263 -169.69170 189.6817
## 2021.712     20.8338278  -96.38546 138.0531 -158.52845 200.1961
## 2021.731     28.1233994  -89.17837 145.4252 -151.36509 207.6119
## 2021.750      8.3785499 -109.15580 125.9129 -171.46582 188.2229
## 2021.769     38.1730304  -79.33998 155.6860 -141.63869 217.9848
## 2021.788      3.3254726 -114.17029 120.8212 -176.45986 183.1108
## 2021.808      7.7254556 -109.82480 125.2757 -172.14326 187.5942
## 2021.827     18.1941473  -99.41124 135.7995 -161.75892 198.1472
## 2021.846      8.4106520 -109.19158 126.0129 -171.53758 188.3589
## 2021.865      5.8309091 -111.71381 123.3756 -174.02932 185.6911
## 2021.885      7.0293792 -110.25205 124.3108 -172.42798 186.4867
## 2021.904      8.6491917 -109.07817 126.3766 -171.49052 188.7889
## 2021.923      9.8730096 -107.50148 127.2475 -169.72675 189.4728
## 2021.942      4.0254122 -113.87745 121.9283 -176.38283 184.4337
## 2021.962     12.9785344 -104.69052 130.6476 -167.07195 193.0290
## 2021.981      4.7061594 -112.85137 122.2637 -175.17368 184.5860
## 2022.000     35.9851031  -81.93069 153.9009 -144.44293 216.4131
## 2022.019    102.0493988  -15.72552 219.8243  -78.16308 282.2619
## 2022.038     26.2551581  -91.28878 143.7991 -153.60388 206.1142
## 2022.058     -0.7352182 -118.14393 116.6735 -180.38735 178.9169
## 2022.077     11.5191875 -105.89270 128.9311 -168.13780 191.1762
##                         ME     RMSE      MAE       MPE     MAPE      MASE
## Training set -3.071546e-16 86.77712 28.67443 -201.1468 395.1431 0.8816822
## Test set     -1.247129e+01 29.36381 18.89189 -489.1608 535.6733 0.5808884
##                    ACF1
## Training set 0.008521948
## Test set              NA
```

```
autoplot(m2v1_lin_out[[1]], series = 'Training') +
  autolayer(m2v1_lin_out[[2]], series = 'Test') +
  autolayer(m2v1_lin_out[[3]], series = 'Test Forecast', alpha = .3) +
  autolayer(m2v1_lin_out[[3]]$fitted, series = 'Fitted') +
  theme_classic() +
  coord_cartesian(#ylim = c(-50, 400),
                  xlim = c(2011, 2023))
```




```
summary(m2v1_lin_out[[3]])
```

```
##
## Forecast method: Linear regression model
##
## Model Information:
##
## Call:
## tslm(formula = as.formula(formula), data = train_ts01)
##
## Coefficients:
## (Intercept)        trend      season2      season3      season4      season5
##   566.52070      0.01909     67.86909    -22.10525    -36.58812    -30.60997
##     season6      season7      season8      season9     season10     season11
##   -15.42820    -30.86519    -23.29226    -30.79680    -41.70029    -26.92888
##    season12     season13     season14     season15     season16     season17
##    10.55011      6.55161    -18.54021    -19.75047    -20.62650    -31.81568
##    season18     season19     season20     season21     season22     season23
##   -27.18784    -22.71148    -30.11554    -30.27887    -23.13177    -18.84428
##    season24     season25     season26     season27     season28     season29
##   -33.20013    -33.77937    -30.24041     -3.40619    -12.38781    -42.98687
##    season30     season31     season32     season33     season34     season35
##    31.31994    -31.11144    -30.20355     23.67099    -36.19962    -24.34365
##    season36     season37     season38     season39     season40     season41
##   -21.12460    -28.03628    -20.73011     -9.02166    -26.50083      1.68746
##    season42     season43     season44     season45     season46     season47
##   -34.03457    -33.75832    -20.19064    -34.22012    -32.25841    -31.69945
##    season48     season49     season50     season51     season52  CHLOROPHYLL
##   -28.60027    -28.30176    -23.36001    -24.36158    -32.13873     -1.18342
##     DENSITY           DO        FECAL           PH     SALINITY         TEMP
##    41.73314      2.54420      0.42466     56.87757    -63.89572      8.20753
##         XMS
##    -0.49305
##
```

```
##
## Error measures:
##                         ME     RMSE      MAE       MPE     MAPE      MASE
## Training set -3.071546e-16 86.77712 28.67443 -201.1468 395.1431 0.8786224
##                     ACF1
## Training set 0.008521948
##
## Forecasts:
##          Point Forecast      Lo 80    Hi 80      Lo 95    Hi 95
## 2021.096     24.2918214  -93.17017 141.7538 -155.44182 204.0255
## 2021.115      4.9027823 -112.51926 122.3248 -174.76974 184.5753
## 2021.135     20.3174627  -96.99865 137.6336 -159.19298 199.8279
## 2021.154     20.3769823  -96.99447 137.7484 -159.21812 199.9721
## 2021.173      8.2850284 -108.91208 125.4821 -171.04332 187.6134
## 2021.192     19.5146098  -97.67703 136.7062 -159.80536 198.8346
## 2021.212     55.1373452  -62.16457 172.4393 -124.35136 234.6260
## 2021.231     33.2545388  -84.24426 150.7533 -146.53543 213.0445
## 2021.250     23.4533801  -93.74827 140.6550 -155.88192 202.7887
## 2021.269    103.3003644  -14.16383 220.7646  -76.43666 283.0374
## 2021.288     12.0106577 -105.26060 129.2819 -167.43115 191.4525
## 2021.308     -5.3522353 -122.68154 111.9771 -184.88286 174.1784
## 2021.327      3.6094779 -113.75807 120.9770 -175.97967 183.1986
## 2021.346      9.6756462 -107.59628 126.9476 -169.76718 189.1185
## 2021.365      7.2843518 -109.88922 124.4579 -172.00798 186.5767
## 2021.385      1.9348547 -115.26357 119.1333 -177.39551 181.2652
## 2021.404      7.3168285 -110.00560 124.6393 -172.20326 186.8369
## 2021.423     22.9862070  -94.35294 140.3254 -156.55947 202.5319
## 2021.442     -0.5008495 -117.76090 116.7592 -179.92550 178.9238
## 2021.462      4.6632922 -112.47928 121.8059 -174.58161 183.9082
## 2021.481      2.6358012 -114.75302 120.0246 -176.98589 182.2575
## 2021.500     37.9537846  -79.33810 155.2457 -141.51957 217.4271
## 2021.519     30.1517554  -87.35057 147.6541 -149.64362 209.9471
## 2021.538     -7.4481895 -124.74606 109.8497 -186.93072 172.0343
## 2021.558     72.4441698  -45.04822 189.9366 -107.33600 252.2243
## 2021.577      9.6889927 -107.56416 126.9421 -169.72511 189.1031
## 2021.596     12.5907657 -104.60866 129.7902 -166.74113 191.9227
## 2021.615     64.0293987  -53.11569 181.1745 -115.21934 243.2781
## 2021.635      5.3048771 -111.90548 122.5152 -174.04374 184.6535
## 2021.654     21.4573252  -95.81112 138.7258 -157.98018 200.8948
## 2021.673     18.8427738  -98.65586 136.3414 -160.94695 198.6325
## 2021.692      9.9949824 -107.43631 127.4263 -169.69170 189.6817
## 2021.712     20.8338278  -96.38546 138.0531 -158.52845 200.1961
## 2021.731     28.1233994  -89.17837 145.4252 -151.36509 207.6119
## 2021.750      8.3785499 -109.15580 125.9129 -171.46582 188.2229
## 2021.769     38.1730304  -79.33998 155.6860 -141.63869 217.9848
## 2021.788      3.3254726 -114.17029 120.8212 -176.45986 183.1108
## 2021.808      7.7254556 -109.82480 125.2757 -172.14326 187.5942
## 2021.827     18.1941473  -99.41124 135.7995 -161.75892 198.1472
## 2021.846      8.4106520 -109.19158 126.0129 -171.53758 188.3589
## 2021.865      5.8309091 -111.71381 123.3756 -174.02932 185.6911
## 2021.885      7.0293792 -110.25205 124.3108 -172.42798 186.4867
## 2021.904      8.6491917 -109.07817 126.3766 -171.49052 188.7889
## 2021.923      9.8730096 -107.50148 127.2475 -169.72675 189.4728
## 2021.942      4.0254122 -113.87745 121.9283 -176.38283 184.4337
```

```
## 2021.962     12.9785344 -104.69052 130.6476 -167.07195 193.0290
## 2021.981      4.7061594 -112.85137 122.2637 -175.17368 184.5860
## 2022.000     35.9851031  -81.93069 153.9009 -144.44293 216.4131
## 2022.019    102.0493988  -15.72552 219.8243  -78.16308 282.2619
## 2022.038     26.2551581  -91.28878 143.7991 -153.60388 206.1142
## 2022.058     -0.7352182 -118.14393 116.6735 -180.38735 178.9169
## 2022.077     11.5191875 -105.89270 128.9311 -168.13780 191.1762
```

SBOO: Imputed, All - Including External Variables (Forecasting ENTERO)

```
# SBOO All: Imputed - Training partition (01/18/1999-01/04/2021)
#owt_df02_gb09_sboo_wkly03_train_tb03
# SBOO All: Imputed - Test partition (01/11/2021-01/03/2022)
#owt_df02_gb09_sboo_wkly03_test_tb03

owt_df02_gb09_sboo_wkly03_train_tb03 %>%
  plot_time_series(date_sample,
                   ENTERO)
```

```
owt_df02_gb09_sboo_wkly03_train_tb03 %>%
  plot_stl_diagnostics(date_sample,
                       ENTERO,
                       .frequency = "auto",
                       .trend = "auto")
```

```
## frequency = 13 observations per 1 quarter
```

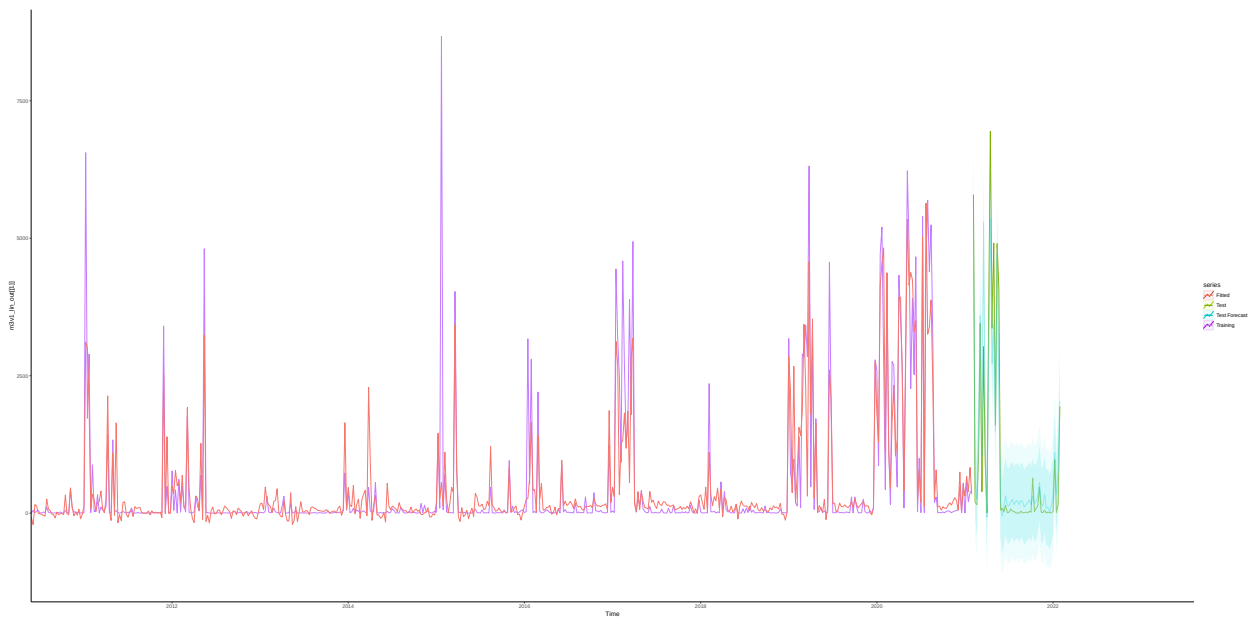
```
## trend = 53 observations per 1 year
```

```
m3v1_lin_out <- lr_ts_mod(tb_train = owt_df02_gb09_sboo_wkly03_train_tb03,
                          tb_test = owt_df02_gb09_sboo_wkly03_test_tb03,
                          date = "date_sample",
                          param = "ENTERO",
                          ext_pred = c("CHLOROPHYLL",
                                       "DENSITY",
                                       "DO",
                                       "FECAL",
                                       "PH",
                                       "SALINITY",
                                       "TEMP",
                                       "XMS"),
                          train_start = c(1999, lubridate::isoweek(ymd(train_start))),
                          test_start = c(2021, 6),
                          freq = 52,
                          h = 52,
                          formula = "ENTERO ~ trend + season + CHLOROPHYLL + DENSITY + DO
                          ↪  + FECAL + PH + SALINITY + TEMP + XMS")
```

```
##          Point Forecast      Lo 80     Hi 80       Lo 95     Hi 95
## 2021.096     5801.68275 5103.12390 6500.2416  4732.78777 6870.5777
## 2021.115      613.66951  -71.35680 1298.6958  -434.51874 1661.8578
## 2021.135      256.39699 -428.24078  941.0348  -791.19674 1303.9907
## 2021.154     1434.03951  748.57957 2119.4994   385.18774 2482.8913
## 2021.173     3592.83105 2905.49836 4280.1637  2541.11370 4644.5484
## 2021.192     1034.78148  350.14153 1719.4214   -12.81559 2082.3785
```

```
## 2021.212     5293.06731 4598.69367 5987.4409  4230.57631 6355.5583
## 2021.231     1120.00407  433.92651 1806.0816    70.20725 2169.8009
## 2021.250      -76.65877 -761.19533  607.8778 -1124.09763  970.7801
## 2021.269     2982.52536 2294.68036 3670.3704  1930.02410 4035.0266
## 2021.288     5358.63325 4657.35806 6059.9084  4285.58189 6431.6846
## 2021.308     2725.02712 2036.80358 3413.2507  1671.94664 3778.1076
## 2021.327     3443.09651 2750.45638 4135.7366  2383.25802 4502.9350
## 2021.346     1489.33880  804.41493 2174.2627   441.30730 2537.3703
## 2021.365     4740.92494 4048.75430 5433.0956  3681.80484 5800.0450
## 2021.385     2283.04579 1596.79524 2969.2963  1232.98427 3333.1073
## 2021.404      233.97172 -452.64330  920.5867  -816.64748 1284.5909
## 2021.423      -54.75073 -739.72895  630.2275 -1102.86540  993.3639
## 2021.442      121.23137 -567.43501  809.8977  -932.52671 1174.9894
## 2021.462      313.65886 -372.43727  999.7550  -736.16638 1363.4841
## 2021.481      149.02770 -536.13529  834.1907  -899.36969 1197.4251
## 2021.500      130.79897 -553.95266  815.5506  -916.96899 1178.5669
## 2021.519      203.90110 -485.35152  893.1537  -850.75401 1258.5562
## 2021.538      247.58318 -438.40845  933.5748  -802.08214 1297.2485
## 2021.558      155.68109 -529.57563  840.9378  -892.85972 1204.2219
## 2021.577      214.30489 -470.54810  899.1579  -833.61817 1262.2280
## 2021.596      225.17207 -459.80489  910.1490  -822.94067 1273.2848
## 2021.615      155.03140 -529.94171  840.0045  -893.07544 1203.1382
## 2021.635      228.01771 -456.80787  912.8433  -819.86340 1275.8988
## 2021.654      208.03571 -476.57932  892.6507  -839.52323 1255.5947
## 2021.673      107.93657 -578.41147  794.2846  -942.27411 1158.1473
## 2021.692      156.67617 -528.54058  841.8929  -891.80349 1205.1558
## 2021.712      184.43735 -500.67401  869.5487  -863.88104 1232.7557
## 2021.731      246.17742 -438.61660  930.9714  -801.65540 1294.0103
## 2021.750      156.81105 -528.81650  842.4386  -892.29718 1205.9193
## 2021.769      309.22242 -376.15847  994.6033  -739.50840 1357.9532
## 2021.788      178.40081 -508.88625  865.6879  -873.24672 1230.0483
## 2021.808      211.59358 -474.81162  897.9988  -838.70457 1261.8917
## 2021.827      312.78000 -376.39401 1001.9540  -741.75483 1367.3148
## 2021.846      557.09652 -128.97868 1243.1717  -492.69668 1606.8897
## 2021.865      176.79566 -510.48585  864.0772  -874.84337 1228.4347
## 2021.885      129.77258 -555.07072  814.6159  -918.13564 1177.6808
## 2021.904      341.93195 -345.92050 1029.7844  -710.58071 1394.4446
## 2021.923       94.51956 -594.07779  783.1169  -959.13289 1148.1720
## 2021.942      104.48815 -583.26606  792.2424  -947.87419 1156.8505
## 2021.962       21.49827 -666.41098  709.4075 -1031.10129 1074.0978
## 2021.981      139.22373 -548.18872  826.6362  -912.61566 1191.0631
## 2022.000      309.36129 -378.15401  996.8766  -742.63548 1361.3581
## 2022.019     1100.82360  411.58417 1790.0630    46.18867 2155.4585
## 2022.038      334.23006 -352.43866 1020.8988  -716.47132 1384.9314
## 2022.058      775.02158   87.61685 1462.4263  -276.80600 1826.8492
## 2022.077     2041.32067 1354.89344 2727.7479   990.98880 3091.6525
##                         ME     RMSE      MAE         MPE      MAPE      MASE
## Training set -2.998788e-15 506.8252 220.4953   -3.930906 1165.3447 0.5455759
## Test set     -6.012224e+01 558.4625 327.0337 -907.847612  970.4077 0.8091859
##                     ACF1
## Training set 0.009563594
## Test set              NA
```

```r
autoplot(m3v1_lin_out[[1]], series = 'Training') +
  autolayer(m3v1_lin_out[[2]], series = 'Test') +
  autolayer(m3v1_lin_out[[3]], series = 'Test Forecast', alpha = .3) +
  autolayer(m3v1_lin_out[[3]]$fitted, series = 'Fitted') +
  theme_classic() +
  coord_cartesian(#ylim = c(-50, 400),
                  xlim = c(2011, 2023))
```




```r
summary(m3v1_lin_out[[3]])
```

```
##
## Forecast method: Linear regression model
##
## Model Information:
##
## Call:
## tslm(formula = as.formula(formula), data = train_ts01)
##
## Coefficients:
## (Intercept)        trend      season2      season3      season4      season5
##   9968.5071       0.1491     -32.6756    -128.9393     236.0108    -204.9225
##     season6      season7      season8      season9     season10     season11
##    -98.4207     -19.3807    -302.6474     -56.2837     -27.8692     179.9122
##    season12     season13     season14     season15     season16     season17
##   -244.5132    -253.5372    -389.2049    -365.1314    -198.7332    -325.1748
##    season18     season19     season20     season21     season22     season23
##   -310.9846    -221.5305    -341.7518    -286.6543    -181.6924    -381.3937
##    season24     season25     season26     season27     season28     season29
##   -131.5418     -59.3853    -165.0153    -144.7574    -123.4365    -145.0994
##    season30     season31     season32     season33     season34     season35
##   -171.8793     -65.1013    -102.5399    -109.7631    -112.5281    -156.7857
##    season36     season37     season38     season39     season40     season41
##   -176.3867    -150.0919    -154.8852    -164.6777    -167.0776    -179.5270
```

```
##    season42     season43     season44     season45     season46     season47
##   -190.8826    -172.5472    -169.8456    -176.9456    -201.5565    -173.0299
##    season48     season49     season50     season51     season52  CHLOROPHYLL
##   -137.7666    -222.9988    -255.6710    -297.5341    -182.6593      -7.9164
##     DENSITY           DO        FECAL           PH     SALINITY         TEMP
##    -65.6198       8.2910       0.7018    -228.9458    -168.0713     -14.6016
##         XMS
##     -7.4523
##
##
## Error measures:
##                         ME     RMSE      MAE       MPE     MAPE      MASE
## Training set -2.998788e-15 506.8252 220.4953 -3.930906 1165.345 0.4499963
##                     ACF1
## Training set 0.009563594
##
## Forecasts:
##          Point Forecast      Lo 80     Hi 80       Lo 95     Hi 95
## 2021.096     5801.68275 5103.12390 6500.2416  4732.78777 6870.5777
## 2021.115      613.66951  -71.35680 1298.6958  -434.51874 1661.8578
## 2021.135      256.39699 -428.24078  941.0348  -791.19674 1303.9907
## 2021.154     1434.03951  748.57957 2119.4994   385.18774 2482.8913
## 2021.173     3592.83105 2905.49836 4280.1637  2541.11370 4644.5484
## 2021.192     1034.78148  350.14153 1719.4214   -12.81559 2082.3785
## 2021.212     5293.06731 4598.69367 5987.4409  4230.57631 6355.5583
## 2021.231     1120.00407  433.92651 1806.0816    70.20725 2169.8009
## 2021.250      -76.65877 -761.19533  607.8778 -1124.09763  970.7801
## 2021.269     2982.52536 2294.68036 3670.3704  1930.02410 4035.0266
## 2021.288     5358.63325 4657.35806 6059.9084  4285.58189 6431.6846
## 2021.308     2725.02712 2036.80358 3413.2507  1671.94664 3778.1076
## 2021.327     3443.09651 2750.45638 4135.7366  2383.25802 4502.9350
## 2021.346     1489.33880  804.41493 2174.2627   441.30730 2537.3703
## 2021.365     4740.92494 4048.75430 5433.0956  3681.80484 5800.0450
## 2021.385     2283.04579 1596.79524 2969.2963  1232.98427 3333.1073
## 2021.404      233.97172 -452.64330  920.5867  -816.64748 1284.5909
## 2021.423      -54.75073 -739.72895  630.2275 -1102.86540  993.3639
## 2021.442      121.23137 -567.43501  809.8977  -932.52671 1174.9894
## 2021.462      313.65886 -372.43727  999.7550  -736.16638 1363.4841
## 2021.481      149.02770 -536.13529  834.1907  -899.36969 1197.4251
## 2021.500      130.79897 -553.95266  815.5506  -916.96899 1178.5669
## 2021.519      203.90110 -485.35152  893.1537  -850.75401 1258.5562
## 2021.538      247.58318 -438.40845  933.5748  -802.08214 1297.2485
## 2021.558      155.68109 -529.57563  840.9378  -892.85972 1204.2219
## 2021.577      214.30489 -470.54810  899.1579  -833.61817 1262.2280
## 2021.596      225.17207 -459.80489  910.1490  -822.94067 1273.2848
## 2021.615      155.03140 -529.94171  840.0045  -893.07544 1203.1382
## 2021.635      228.01771 -456.80787  912.8433  -819.86340 1275.8988
## 2021.654      208.03571 -476.57932  892.6507  -839.52323 1255.5947
## 2021.673      107.93657 -578.41147  794.2846  -942.27411 1158.1473
## 2021.692      156.67617 -528.54058  841.8929  -891.80349 1205.1558
## 2021.712      184.43735 -500.67401  869.5487  -863.88104 1232.7557
## 2021.731      246.17742 -438.61660  930.9714  -801.65540 1294.0103
## 2021.750      156.81105 -528.81650  842.4386  -892.29718 1205.9193
## 2021.769      309.22242 -376.15847  994.6033  -739.50840 1357.9532
```

```
## 2021.788      178.40081 -508.88625  865.6879  -873.24672 1230.0483
## 2021.808      211.59358 -474.81162  897.9988  -838.70457 1261.8917
## 2021.827      312.78000 -376.39401 1001.9540  -741.75483 1367.3148
## 2021.846      557.09652 -128.97868 1243.1717  -492.69668 1606.8897
## 2021.865      176.79566 -510.48585  864.0772  -874.84337 1228.4347
## 2021.885      129.77258 -555.07072  814.6159  -918.13564 1177.6808
## 2021.904      341.93195 -345.92050 1029.7844  -710.58071 1394.4446
## 2021.923       94.51956 -594.07779  783.1169  -959.13289 1148.1720
## 2021.942      104.48815 -583.26606  792.2424  -947.87419 1156.8505
## 2021.962       21.49827 -666.41098  709.4075 -1031.10129 1074.0978
## 2021.981      139.22373 -548.18872  826.6362  -912.61566 1191.0631
## 2022.000      309.36129 -378.15401  996.8766  -742.63548 1361.3581
## 2022.019     1100.82360  411.58417 1790.0630    46.18867 2155.4585
## 2022.038      334.23006 -352.43866 1020.8988  -716.47132 1384.9314
## 2022.058      775.02158   87.61685 1462.4263  -276.80600 1826.8492
## 2022.077     2041.32067 1354.89344 2727.7479   990.98880 3091.6525
```

SBOO: Imputed, Excluding Outliers - Including External Variables (Forecasting ENTERO)

```r
# SBOO Excluding Outliers: Imputed - Training partition (01/18/1999-01/04/2021)
#owt_df02_gb09_sboo_wkly02_train_tb03
# SBOO Excluding Outliers: Imputed - Test partition (01/11/2021-01/03/2022)
#owt_df02_gb09_sboo_wkly02_test_tb03

owt_df02_gb09_sboo_wkly02_train_tb03 %>%
  plot_time_series(date_sample,
                   ENTERO)
```

```r
owt_df02_gb09_sboo_wkly02_train_tb03 %>%
  plot_stl_diagnostics(date_sample,
                       ENTERO,
                       .frequency = "auto",
                       .trend = "auto")
```

```
## frequency = 13 observations per 1 quarter
```

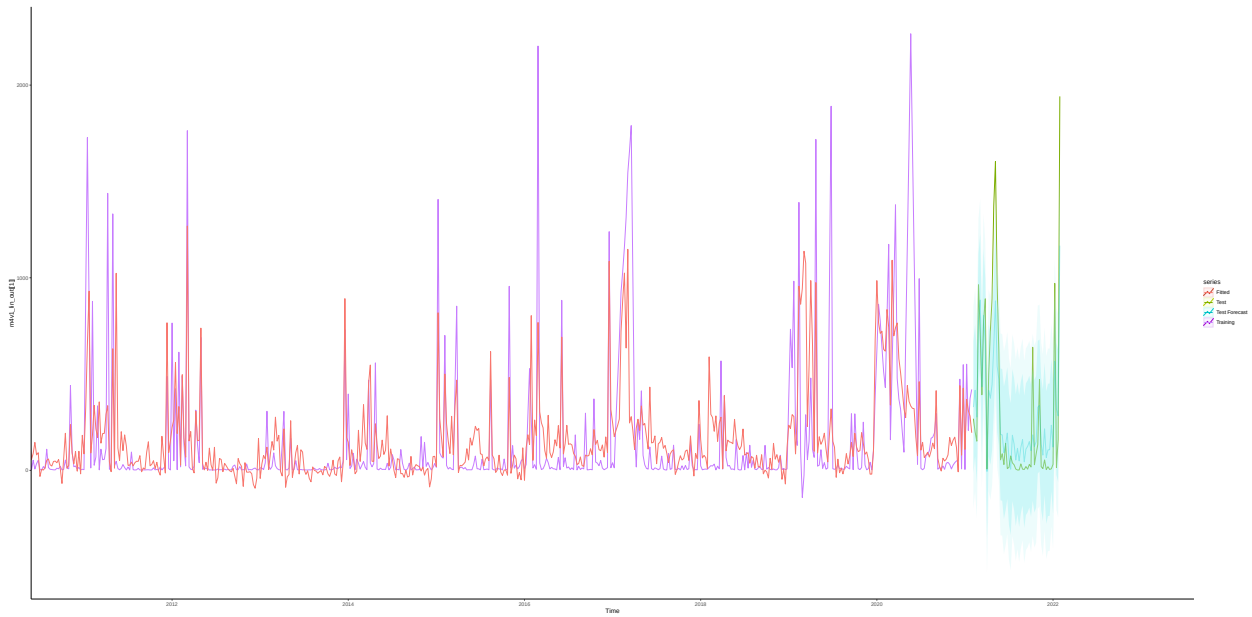
```
## trend = 53 observations per 1 year
```

```r
m4v1_lin_out <- lr_ts_mod(tb_train = owt_df02_gb09_sboo_wkly02_train_tb03,
                          tb_test = owt_df02_gb09_sboo_wkly02_test_tb03,
                          date = "date_sample",
                          param = "ENTERO",
                          ext_pred = c("CHLOROPHYLL",
                                       "DENSITY",
                                       "DO",
                                       "FECAL",
                                       "PH",
                                       "SALINITY",
                                       "TEMP",
                                       "XMS"),
                          train_start = c(1999, lubridate::isoweek(ymd(train_start))),
                          test_start = c(2021, 6),
                          freq = 52,
                          h = 52,
                          formula = "ENTERO ~ trend + season + CHLOROPHYLL + DENSITY + DO
                          ↪  + FECAL + PH + SALINITY + TEMP + XMS")
```

```
##          Point Forecast      Lo 80     Hi 80      Lo 95     Hi 95
## 2021.096     328.579212  -13.85744  671.0159 -195.39785  852.5563
## 2021.115     415.817329   73.91323  757.7214 -107.34485  938.9795
## 2021.135     276.622148  -64.96889  618.2132 -246.06101  799.3053
## 2021.154     782.226753  439.19071 1125.2628  257.33253 1307.1210
## 2021.173     884.389967  542.47802 1226.3019  361.21578 1407.5642
## 2021.192     433.971340   92.07520  775.8675  -89.17866  957.1213
## 2021.212     804.613955  462.00034 1147.2276  280.36612 1328.8618
## 2021.231     655.836992  313.02120  998.6528  131.27978 1180.3942
## 2021.250      -5.280339 -346.98084  336.4202 -528.13100  517.5703
## 2021.269     415.180072   72.89840  757.4617 -108.55986  938.9200
## 2021.288     374.550579   30.02199  719.0792 -152.62746  901.7286
## 2021.308     444.501128  102.17003  786.8322  -79.31442  968.3167
## 2021.327     643.969930  299.39761  988.5422  116.72499 1171.2149
## 2021.346     879.742355  535.65679 1223.8279  353.24222 1406.2425
## 2021.365     541.970641  199.85146  884.0898   18.47935 1065.4619
## 2021.385     472.606250  130.54437  814.6681  -50.79736  996.0099
## 2021.404     187.129094 -155.37969  529.6379 -336.95834  711.2165
## 2021.423     184.083771 -157.64121  525.8087 -338.80433  706.9719
## 2021.442      91.432632 -252.46972  435.3350 -434.78716  617.6524
## 2021.462     134.631652 -207.85191  477.1152 -389.41720  658.6805
## 2021.481     193.570829 -148.29371  535.4354 -329.53083  716.6725
## 2021.500      56.536691 -285.10934  398.1827 -466.23061  579.3040
## 2021.519       6.176224 -336.00992  348.3624 -517.41753  529.7700
## 2021.538     182.614613 -159.71561  524.9448 -341.19960  706.4288
## 2021.558     137.164301 -204.80048  479.1291 -386.09074  660.4193
## 2021.577      53.421233 -288.32964  395.1721 -469.50649  576.3490
## 2021.596     114.920179 -226.88117  456.7215 -408.08479  637.9251
## 2021.615      48.840847 -292.98721  390.6689 -474.20499  571.8867
## 2021.635     119.293456 -222.43518  461.0221 -403.60024  642.1872
## 2021.654     159.778854 -182.02297  501.5807 -363.22683  682.7845
## 2021.673      44.292194 -298.21089  386.7953 -479.78653  568.3709
## 2021.692     110.331331 -231.60614  452.2688 -412.88192  633.5446
## 2021.712     124.644389 -217.30221  466.5910 -398.58282  647.8716
## 2021.731     149.272854 -192.45454  491.0002 -373.61894  672.1647
## 2021.750     101.894205 -240.24754  444.0360 -421.63162  625.4200
## 2021.769     184.361732 -157.79508  526.5185 -339.18713  707.9106
## 2021.788     124.461260 -218.50474  467.4273 -400.32579  649.2483
## 2021.808     148.370544 -194.16584  490.9069 -375.75913  672.5002
## 2021.827     327.842739  -16.32666  672.0121 -198.78568  854.4712
## 2021.846     336.676912   -6.02420  679.3780 -187.70482  861.0586
## 2021.865     137.021702 -205.81632  479.8597 -387.56952  661.6129
## 2021.885      79.113959 -262.68863  420.9165 -443.89289  602.1208
## 2021.904     215.443377 -127.77561  558.6624 -309.73078  740.6175
## 2021.923      66.569991 -277.16863  410.3086 -459.39928  592.5393
## 2021.942     106.341905 -236.92140  449.6052 -418.90006  631.5839
## 2021.962     107.611363 -235.86000  451.0827 -417.94897  633.1717
## 2021.981     234.481737 -108.66648  577.6300 -290.58413  759.5476
## 2022.000     120.963269 -222.40221  464.3287 -404.43503  646.3616
## 2022.019     565.273282  220.50373  910.0428   37.72654 1092.8200
## 2022.038     318.880581  -23.60629  661.3675 -205.17333  842.9345
## 2022.058     282.790080  -60.20735  625.7875 -242.04505  807.6252
```

```
## 2022.077    1166.493195  820.68563 1512.3008  637.35815 1695.6282
##                        ME     RMSE      MAE       MPE     MAPE      MASE
## Training set 1.257115e-14 252.9268 131.7942 -416.3427 828.0949 0.8154878
## Test set     2.250579e+01 249.7221 176.5312 -573.1820 603.3266 1.0923018
##                   ACF1
## Training set 0.3185982
## Test set            NA
```

```
autoplot(m4v1_lin_out[[1]], series = 'Training') +
  autolayer(m4v1_lin_out[[2]], series = 'Test') +
  autolayer(m4v1_lin_out[[3]], series = 'Test Forecast', alpha = .3) +
  autolayer(m4v1_lin_out[[3]]$fitted, series = 'Fitted') +
  theme_classic() +
  coord_cartesian(#ylim = c(-50, 400),
                  xlim = c(2011, 2023))
```




```
summary(m4v1_lin_out[[3]])
```

```
##
## Forecast method: Linear regression model
##
## Model Information:
##
## Call:
## tslm(formula = as.formula(formula), data = train_ts01)
##
## Coefficients:
## (Intercept)        trend      season2      season3      season4      season5
##   1.132e+04    6.964e-02    2.816e+01    7.040e+01    2.186e+01   -4.172e+01
##     season6      season7      season8      season9     season10     season11
##  -6.058e+01    1.317e+02    2.653e+01    3.840e+01    2.094e+02    6.160e+01
##    season12     season13     season14     season15     season16     season17
##   9.932e+01   -3.406e+01   -1.130e+02   -3.840e+00   -9.550e+01   -5.590e+01
##    season18     season19     season20     season21     season22     season23
```

```
##  -4.587e+01   -2.817e+00   -2.644e+01    4.028e+01    2.584e+01    4.764e+01
##    season24     season25     season26     season27     season28     season29
##   7.138e-01    5.009e+00    6.930e+01   -3.577e+01   -5.507e+01   -2.167e+01
##    season30     season31     season32     season33     season34     season35
##  -1.513e+01   -5.060e+01   -3.650e+01   -3.183e+01   -2.637e+01   -3.140e+01
##    season36     season37     season38     season39     season40     season41
##  -4.765e+01   -2.689e+01   -3.760e+01   -4.059e+01   -4.512e+01   -5.418e+01
##    season42     season43     season44     season45     season46     season47
##  -4.104e+01   -4.196e+01    1.677e+01   -4.208e+01   -5.494e+01   -2.804e+01
##    season48     season49     season50     season51     season52  CHLOROPHYLL
##  -4.030e+01   -6.690e+01   -6.090e+01   -4.679e+01    1.070e+02    1.390e+00
##     DENSITY           DO        FECAL           PH     SALINITY         TEMP
##  -1.081e+02    2.303e+01    3.628e-01   -3.638e+02   -1.492e+02   -1.722e+01
##         XMS
##  -7.965e+00
##
##
## Error measures:
##                        ME     RMSE      MAE       MPE     MAPE      MASE
## Training set 1.257115e-14 252.9268 131.7942 -416.3427 828.0949 0.6621506
##                   ACF1
## Training set 0.3185982
##
## Forecasts:
##          Point Forecast      Lo 80     Hi 80      Lo 95     Hi 95
## 2021.096     328.579212  -13.85744  671.0159 -195.39785  852.5563
## 2021.115     415.817329   73.91323  757.7214 -107.34485  938.9795
## 2021.135     276.622148  -64.96889  618.2132 -246.06101  799.3053
## 2021.154     782.226753  439.19071 1125.2628  257.33253 1307.1210
## 2021.173     884.389967  542.47802 1226.3019  361.21578 1407.5642
## 2021.192     433.971340   92.07520  775.8675  -89.17866  957.1213
## 2021.212     804.613955  462.00034 1147.2276  280.36612 1328.8618
## 2021.231     655.836992  313.02120  998.6528  131.27978 1180.3942
## 2021.250      -5.280339 -346.98084  336.4202 -528.13100  517.5703
## 2021.269     415.180072   72.89840  757.4617 -108.55986  938.9200
## 2021.288     374.550579   30.02199  719.0792 -152.62746  901.7286
## 2021.308     444.501128  102.17003  786.8322  -79.31442  968.3167
## 2021.327     643.969930  299.39761  988.5422  116.72499 1171.2149
## 2021.346     879.742355  535.65679 1223.8279  353.24222 1406.2425
## 2021.365     541.970641  199.85146  884.0898   18.47935 1065.4619
## 2021.385     472.606250  130.54437  814.6681  -50.79736  996.0099
## 2021.404     187.129094 -155.37969  529.6379 -336.95834  711.2165
## 2021.423     184.083771 -157.64121  525.8087 -338.80433  706.9719
## 2021.442      91.432632 -252.46972  435.3350 -434.78716  617.6524
## 2021.462     134.631652 -207.85191  477.1152 -389.41720  658.6805
## 2021.481     193.570829 -148.29371  535.4354 -329.53083  716.6725
## 2021.500      56.536691 -285.10934  398.1827 -466.23061  579.3040
## 2021.519       6.176224 -336.00992  348.3624 -517.41753  529.7700
## 2021.538     182.614613 -159.71561  524.9448 -341.19960  706.4288
## 2021.558     137.164301 -204.80048  479.1291 -386.09074  660.4193
## 2021.577      53.421233 -288.32964  395.1721 -469.50649  576.3490
## 2021.596     114.920179 -226.88117  456.7215 -408.08479  637.9251
## 2021.615      48.840847 -292.98721  390.6689 -474.20499  571.8867
## 2021.635     119.293456 -222.43518  461.0221 -403.60024  642.1872
```

```
## 2021.654     159.778854 -182.02297  501.5807 -363.22683  682.7845
## 2021.673      44.292194 -298.21089  386.7953 -479.78653  568.3709
## 2021.692     110.331331 -231.60614  452.2688 -412.88192  633.5446
## 2021.712     124.644389 -217.30221  466.5910 -398.58282  647.8716
## 2021.731     149.272854 -192.45454  491.0002 -373.61894  672.1647
## 2021.750     101.894205 -240.24754  444.0360 -421.63162  625.4200
## 2021.769     184.361732 -157.79508  526.5185 -339.18713  707.9106
## 2021.788     124.461260 -218.50474  467.4273 -400.32579  649.2483
## 2021.808     148.370544 -194.16584  490.9069 -375.75913  672.5002
## 2021.827     327.842739  -16.32666  672.0121 -198.78568  854.4712
## 2021.846     336.676912   -6.02420  679.3780 -187.70482  861.0586
## 2021.865     137.021702 -205.81632  479.8597 -387.56952  661.6129
## 2021.885      79.113959 -262.68863  420.9165 -443.89289  602.1208
## 2021.904     215.443377 -127.77561  558.6624 -309.73078  740.6175
## 2021.923      66.569991 -277.16863  410.3086 -459.39928  592.5393
## 2021.942     106.341905 -236.92140  449.6052 -418.90006  631.5839
## 2021.962     107.611363 -235.86000  451.0827 -417.94897  633.1717
## 2021.981     234.481737 -108.66648  577.6300 -290.58413  759.5476
## 2022.000     120.963269 -222.40221  464.3287 -404.43503  646.3616
## 2022.019     565.273282  220.50373  910.0428   37.72654 1092.8200
## 2022.038     318.880581  -23.60629  661.3675 -205.17333  842.9345
## 2022.058     282.790080  -60.20735  625.7875 -242.04505  807.6252
## 2022.077    1166.493195  820.68563 1512.3008  637.35815 1695.6282
```

PLOO: Imputed, All - Excluding External Variables (Forecasting ENTERO)

```
# PLOO All: Imputed - Training partition (01/18/1999-01/04/2021)
#owt_df02_gb09_ploo_wkly03_train_tb03
# PLOO All: Imputed - Test partition (01/11/2021-01/03/2022)
#owt_df02_gb09_ploo_wkly03_test_tb03

owt_df02_gb09_ploo_wkly03_train_tb03 %>%
  plot_time_series(date_sample,
                   ENTERO)
```

```
owt_df02_gb09_ploo_wkly03_train_tb03 %>%
  plot_stl_diagnostics(date_sample,
                       ENTERO,
                       .frequency = "auto",
                       .trend = "auto")
```

```
## frequency = 13 observations per 1 quarter
```

```
## trend = 53 observations per 1 year
```

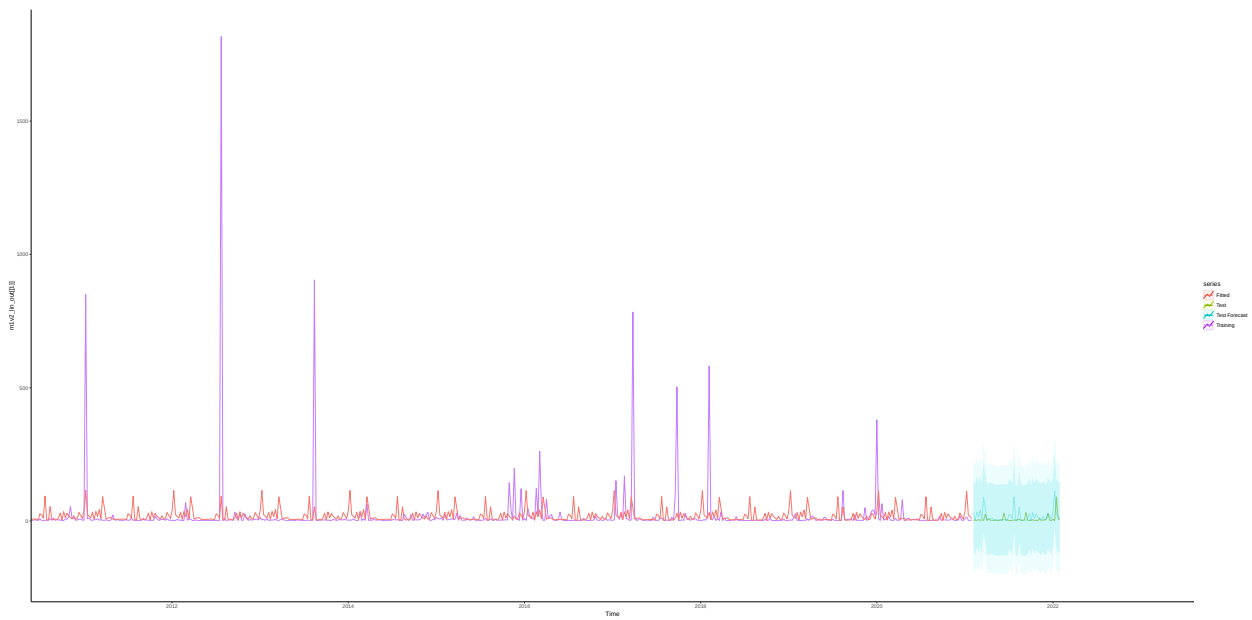
```
m1v2_lin_out <- lr_ts_mod(tb_train = owt_df02_gb09_ploo_wkly03_train_tb03,
                          tb_test = owt_df02_gb09_ploo_wkly03_test_tb03,
                          date = "date_sample",
                          param = "ENTERO",
                          ext_pred = c(),
                          train_start = c(1999, lubridate::isoweek(ymd(train_start))),
                          test_start = c(2021, 6),
                          freq = 52,
```

```r
                          h = 52,
                          formula = "ENTERO ~ trend + season")
```

```
##          Point Forecast      Lo 80    Hi 80      Lo 95    Hi 95
## 2021.096      31.331803 -101.64498 164.3086 -172.14094 234.8045
## 2021.115       4.302301 -128.67448 137.2791 -199.17044 207.7750
## 2021.135      33.703312  -99.27347 166.6801 -169.76943 237.1761
## 2021.154      14.998167 -117.97861 147.9749 -188.47458 218.4709
## 2021.173      40.653966  -92.32282 173.6307 -162.81878 244.1267
## 2021.192       7.007151 -125.96963 139.9839 -196.46559 210.4799
## 2021.212      88.519522  -44.45726 221.4963 -114.95322 291.9923
## 2021.231      49.044027  -83.93275 182.0208 -154.42872 252.5168
## 2021.250       6.036971 -126.93981 139.0138 -197.43577 209.5097
## 2021.269       8.278971 -124.69781 141.2558 -195.19377 211.7517
## 2021.288      10.043557 -122.93322 143.0203 -193.42919 213.5163
## 2021.308      10.682352 -122.29443 143.6591 -192.79039 214.1551
## 2021.327       4.857298 -128.11948 137.8341 -198.61545 208.3300
## 2021.346       3.025773 -129.95101 136.0026 -200.44697 206.4985
## 2021.365       4.569212 -128.40757 137.5460 -198.90353 208.0420
## 2021.385       3.331238 -129.64554 136.3080 -200.14151 206.8040
## 2021.404       4.751147 -128.22563 137.7279 -198.72160 208.2239
## 2021.423       4.699702 -128.27708 137.6765 -198.77304 208.1724
## 2021.442       5.424837 -127.55194 138.4016 -198.04791 208.8976
## 2021.462       4.265666 -128.71112 137.2424 -199.20708 207.7384
## 2021.481       2.103409 -130.87337 135.0802 -201.36934 205.5762
## 2021.500      24.901248 -108.07553 157.8780 -178.57150 228.3740
## 2021.519      20.047630 -112.92915 153.0244 -183.42512 223.5204
## 2021.538       8.125095 -124.85169 141.1019 -195.34765 211.5978
## 2021.558      90.552122  -42.42466 223.5289 -112.92062 294.0249
## 2021.577       1.571738 -131.40504 134.5485 -201.90101 205.0445
## 2021.596       1.410258 -131.56652 134.3870 -202.06249 204.8830
## 2021.615      51.512138  -81.46464 184.4889 -151.96061 254.9849
## 2021.635       6.311073 -126.66571 139.2879 -197.16167 209.7838
## 2021.654       1.732176 -131.24461 134.7090 -201.74057 205.2049
## 2021.673       4.162844 -128.81394 137.1396 -199.30990 207.6356
## 2021.692       2.181399 -130.79538 135.1582 -201.29135 205.6541
## 2021.712       9.481749 -123.49503 142.4585 -193.99100 212.9545
## 2021.731      27.946536 -105.03025 160.9233 -175.52621 231.4193
## 2021.750       2.369407 -130.60737 135.3462 -201.10334 205.8422
## 2021.769      32.641045 -100.33574 165.6178 -170.83170 236.1138
## 2021.788       9.908255 -123.06853 142.8850 -193.56449 213.3810
## 2021.808      26.645200 -106.33158 159.6220 -176.82754 230.1179
## 2021.827      16.343268 -116.63351 149.3200 -187.12948 219.8160
## 2021.846      10.198280 -122.77850 143.1751 -193.27447 213.6710
## 2021.865       5.262885 -127.71390 138.2397 -198.20986 208.7356
## 2021.885      17.303312 -115.67347 150.2801 -186.16943 220.7761
## 2021.904       5.138069 -127.83871 138.1149 -198.33468 208.6108
## 2021.923       5.871000 -127.10578 138.8478 -197.60174 209.3437
## 2021.942      29.550092 -103.42669 162.5269 -173.92265 233.0228
## 2021.962      19.309940 -113.66684 152.2867 -184.16280 222.7827
## 2021.981       7.380134 -125.59665 140.3569 -196.09261 210.8529
## 2022.000      35.721709  -97.25507 168.6985 -167.75104 239.1945
## 2022.019     112.367221  -20.60956 245.3440  -91.10552 315.8400
```

```
## 2022.038      22.192098 -110.67535 155.0595 -181.11335 225.4975
## 2022.058      15.489225 -117.37822 148.3567 -187.81622 218.7947
## 2022.077       9.327051 -123.54039 142.1945 -193.97839 212.6325
##                         ME     RMSE      MAE       MPE     MAPE      MASE
## Training set  3.739460e-16 98.91472 27.58437 -378.3600 400.8285 0.8481648
## Test set     -1.168561e+01 29.06294 16.71202 -490.5666 509.6556 0.5138615
##                    ACF1
## Training set 0.02162603
## Test set             NA
```

```
autoplot(m1v2_lin_out[[1]], series = 'Training') +
  autolayer(m1v2_lin_out[[2]], series = 'Test') +
  autolayer(m1v2_lin_out[[3]], series = 'Test Forecast', alpha = .3) +
  autolayer(m1v2_lin_out[[3]]$fitted, series = 'Fitted') +
  theme_classic() +
  coord_cartesian(#ylim = c(-50, 400),
                  xlim = c(2011, 2023))
```




```
summary(m1v2_lin_out[[3]])
```

```
##
## Forecast method: Linear regression model
##
## Model Information:
##
## Call:
## tslm(formula = as.formula(formula), data = train_ts01)
##
## Coefficients:
## (Intercept)        trend      season2      season3      season4      season5
##   40.822117    -0.004268    76.649781   -13.521074   -20.219680   -26.377586
##     season6      season7      season8      season9     season10     season11
##   -4.590507   -31.615742    -2.210463   -20.911339     4.748728   -28.893819
##    season12     season13     season14     season15     season16     season17
```

```
##   52.622820    13.151594   -29.851194   -27.604926   -25.836072   -25.193009
##    season18     season19     season20     season21     season22     season23
##  -31.013795   -32.841052   -31.293345   -32.527051   -31.102873   -31.150050
##    season24     season25     season26     season27     season28     season29
##  -30.420647   -31.575550   -33.733539   -10.931432   -15.780782   -27.699048
##    season30     season31     season32     season33     season34     season35
##   54.732247   -34.243870   -34.401081    15.705067   -29.491730   -34.066359
##    season36     season37     season38     season39     season40     season41
##  -31.631422   -33.608599   -26.303982    -7.834926   -33.407788    -3.131881
##    season42     season43     season44     season45     season46     season47
##  -25.860403    -9.119190   -19.416854   -25.557574   -30.488701   -18.444005
##    season48     season49     season50     season51     season52
##  -30.604981   -29.867781    -6.184421   -16.420304   -28.345843
##
##
## Error measures:
##                       ME     RMSE      MAE     MPE     MAPE      MASE
## Training set 3.73946e-16 98.91472 27.58437 -378.36 400.8285 0.8452214
##                    ACF1
## Training set 0.02162603
##
## Forecasts:
##          Point Forecast      Lo 80    Hi 80      Lo 95    Hi 95
## 2021.096      31.331803 -101.64498 164.3086 -172.14094 234.8045
## 2021.115       4.302301 -128.67448 137.2791 -199.17044 207.7750
## 2021.135      33.703312  -99.27347 166.6801 -169.76943 237.1761
## 2021.154      14.998167 -117.97861 147.9749 -188.47458 218.4709
## 2021.173      40.653966  -92.32282 173.6307 -162.81878 244.1267
## 2021.192       7.007151 -125.96963 139.9839 -196.46559 210.4799
## 2021.212      88.519522  -44.45726 221.4963 -114.95322 291.9923
## 2021.231      49.044027  -83.93275 182.0208 -154.42872 252.5168
## 2021.250       6.036971 -126.93981 139.0138 -197.43577 209.5097
## 2021.269       8.278971 -124.69781 141.2558 -195.19377 211.7517
## 2021.288      10.043557 -122.93322 143.0203 -193.42919 213.5163
## 2021.308      10.682352 -122.29443 143.6591 -192.79039 214.1551
## 2021.327       4.857298 -128.11948 137.8341 -198.61545 208.3300
## 2021.346       3.025773 -129.95101 136.0026 -200.44697 206.4985
## 2021.365       4.569212 -128.40757 137.5460 -198.90353 208.0420
## 2021.385       3.331238 -129.64554 136.3080 -200.14151 206.8040
## 2021.404       4.751147 -128.22563 137.7279 -198.72160 208.2239
## 2021.423       4.699702 -128.27708 137.6765 -198.77304 208.1724
## 2021.442       5.424837 -127.55194 138.4016 -198.04791 208.8976
## 2021.462       4.265666 -128.71112 137.2424 -199.20708 207.7384
## 2021.481       2.103409 -130.87337 135.0802 -201.36934 205.5762
## 2021.500      24.901248 -108.07553 157.8780 -178.57150 228.3740
## 2021.519      20.047630 -112.92915 153.0244 -183.42512 223.5204
## 2021.538       8.125095 -124.85169 141.1019 -195.34765 211.5978
## 2021.558      90.552122  -42.42466 223.5289 -112.92062 294.0249
## 2021.577       1.571738 -131.40504 134.5485 -201.90101 205.0445
## 2021.596       1.410258 -131.56652 134.3870 -202.06249 204.8830
## 2021.615      51.512138  -81.46464 184.4889 -151.96061 254.9849
## 2021.635       6.311073 -126.66571 139.2879 -197.16167 209.7838
## 2021.654       1.732176 -131.24461 134.7090 -201.74057 205.2049
## 2021.673       4.162844 -128.81394 137.1396 -199.30990 207.6356
```

```
## 2021.692       2.181399 -130.79538 135.1582 -201.29135 205.6541
## 2021.712       9.481749 -123.49503 142.4585 -193.99100 212.9545
## 2021.731      27.946536 -105.03025 160.9233 -175.52621 231.4193
## 2021.750       2.369407 -130.60737 135.3462 -201.10334 205.8422
## 2021.769      32.641045 -100.33574 165.6178 -170.83170 236.1138
## 2021.788       9.908255 -123.06853 142.8850 -193.56449 213.3810
## 2021.808      26.645200 -106.33158 159.6220 -176.82754 230.1179
## 2021.827      16.343268 -116.63351 149.3200 -187.12948 219.8160
## 2021.846      10.198280 -122.77850 143.1751 -193.27447 213.6710
## 2021.865       5.262885 -127.71390 138.2397 -198.20986 208.7356
## 2021.885      17.303312 -115.67347 150.2801 -186.16943 220.7761
## 2021.904       5.138069 -127.83871 138.1149 -198.33468 208.6108
## 2021.923       5.871000 -127.10578 138.8478 -197.60174 209.3437
## 2021.942      29.550092 -103.42669 162.5269 -173.92265 233.0228
## 2021.962      19.309940 -113.66684 152.2867 -184.16280 222.7827
## 2021.981       7.380134 -125.59665 140.3569 -196.09261 210.8529
## 2022.000      35.721709  -97.25507 168.6985 -167.75104 239.1945
## 2022.019     112.367221  -20.60956 245.3440  -91.10552 315.8400
## 2022.038      22.192098 -110.67535 155.0595 -181.11335 225.4975
## 2022.058      15.489225 -117.37822 148.3567 -187.81622 218.7947
## 2022.077       9.327051 -123.54039 142.1945 -193.97839 212.6325
```

PLOO: Imputed, Excluding Outliers - Excluding External Variables (Forecasting ENTERO)

```
# PLOO Excluding Outliers: Imputed - Training partition (01/18/1999-01/04/2021)
#owt_df02_gb09_ploo_wkly02_train_tb03
# PLOO Excluding Outliers: Imputed - Test partition (01/11/2021-01/03/2022)
#owt_df02_gb09_ploo_wkly02_test_tb03

owt_df02_gb09_ploo_wkly02_train_tb03 %>%
  plot_time_series(date_sample,
                   ENTERO)
```

```
owt_df02_gb09_ploo_wkly02_train_tb03 %>%
  plot_stl_diagnostics(date_sample,
                       ENTERO,
                       .frequency = "auto",
                       .trend = "auto")
```

```
## frequency = 13 observations per 1 quarter
```

```
## trend = 53 observations per 1 year
```

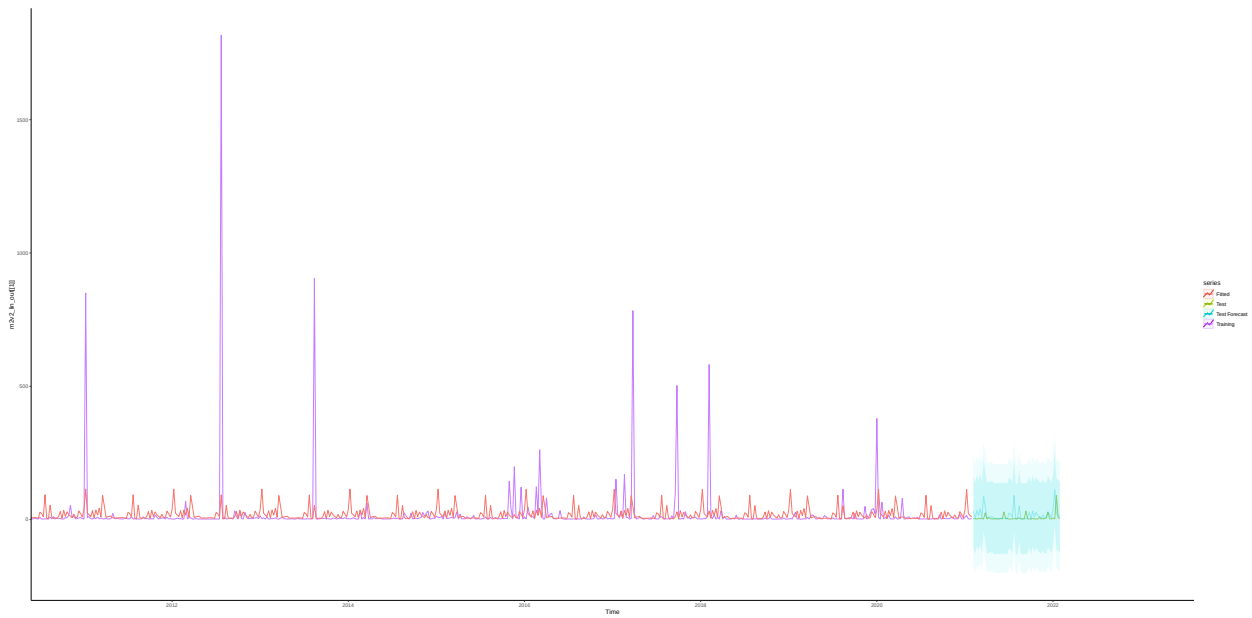
```
m2v2_lin_out <- lr_ts_mod(tb_train = owt_df02_gb09_ploo_wkly02_train_tb03,
                          tb_test = owt_df02_gb09_ploo_wkly02_test_tb03,
                          date = "date_sample",
                          param = "ENTERO",
                          ext_pred = c(),
                          train_start = c(1999, lubridate::isoweek(ymd(train_start))),
                          test_start = c(2021, 6),
                          freq = 52,
                          h = 52,
                          formula = "ENTERO ~ trend + season")
```

```
##          Point Forecast      Lo 80    Hi 80      Lo 95    Hi 95
```

```
## 2021.096      31.331803 -101.64498 164.3086 -172.14094 234.8045
## 2021.115       4.302301 -128.67448 137.2791 -199.17044 207.7750
## 2021.135      33.703312  -99.27347 166.6801 -169.76943 237.1761
## 2021.154      14.998167 -117.97861 147.9749 -188.47458 218.4709
## 2021.173      40.653966  -92.32282 173.6307 -162.81878 244.1267
## 2021.192       7.007151 -125.96963 139.9839 -196.46559 210.4799
## 2021.212      88.519522  -44.45726 221.4963 -114.95322 291.9923
## 2021.231      49.044027  -83.93275 182.0208 -154.42872 252.5168
## 2021.250       6.036971 -126.93981 139.0138 -197.43577 209.5097
## 2021.269       8.278971 -124.69781 141.2558 -195.19377 211.7517
## 2021.288      10.043557 -122.93322 143.0203 -193.42919 213.5163
## 2021.308      10.682352 -122.29443 143.6591 -192.79039 214.1551
## 2021.327       4.857298 -128.11948 137.8341 -198.61545 208.3300
## 2021.346       3.025773 -129.95101 136.0026 -200.44697 206.4985
## 2021.365       4.569212 -128.40757 137.5460 -198.90353 208.0420
## 2021.385       3.331238 -129.64554 136.3080 -200.14151 206.8040
## 2021.404       4.751147 -128.22563 137.7279 -198.72160 208.2239
## 2021.423       4.699702 -128.27708 137.6765 -198.77304 208.1724
## 2021.442       5.424837 -127.55194 138.4016 -198.04791 208.8976
## 2021.462       4.265666 -128.71112 137.2424 -199.20708 207.7384
## 2021.481       2.103409 -130.87337 135.0802 -201.36934 205.5762
## 2021.500      24.901248 -108.07553 157.8780 -178.57150 228.3740
## 2021.519      20.047630 -112.92915 153.0244 -183.42512 223.5204
## 2021.538       8.125095 -124.85169 141.1019 -195.34765 211.5978
## 2021.558      90.552122  -42.42466 223.5289 -112.92062 294.0249
## 2021.577       1.571738 -131.40504 134.5485 -201.90101 205.0445
## 2021.596       1.410258 -131.56652 134.3870 -202.06249 204.8830
## 2021.615      51.512138  -81.46464 184.4889 -151.96061 254.9849
## 2021.635       6.311073 -126.66571 139.2879 -197.16167 209.7838
## 2021.654       1.732176 -131.24461 134.7090 -201.74057 205.2049
## 2021.673       4.162844 -128.81394 137.1396 -199.30990 207.6356
## 2021.692       2.181399 -130.79538 135.1582 -201.29135 205.6541
## 2021.712       9.481749 -123.49503 142.4585 -193.99100 212.9545
## 2021.731      27.946536 -105.03025 160.9233 -175.52621 231.4193
## 2021.750       2.369407 -130.60737 135.3462 -201.10334 205.8422
## 2021.769      32.641045 -100.33574 165.6178 -170.83170 236.1138
## 2021.788       9.908255 -123.06853 142.8850 -193.56449 213.3810
## 2021.808      26.645200 -106.33158 159.6220 -176.82754 230.1179
## 2021.827      16.343268 -116.63351 149.3200 -187.12948 219.8160
## 2021.846      10.198280 -122.77850 143.1751 -193.27447 213.6710
## 2021.865       5.262885 -127.71390 138.2397 -198.20986 208.7356
## 2021.885      17.303312 -115.67347 150.2801 -186.16943 220.7761
## 2021.904       5.138069 -127.83871 138.1149 -198.33468 208.6108
## 2021.923       5.871000 -127.10578 138.8478 -197.60174 209.3437
## 2021.942      29.550092 -103.42669 162.5269 -173.92265 233.0228
## 2021.962      19.309940 -113.66684 152.2867 -184.16280 222.7827
## 2021.981       7.380134 -125.59665 140.3569 -196.09261 210.8529
## 2022.000      35.721709  -97.25507 168.6985 -167.75104 239.1945
## 2022.019     112.367221  -20.60956 245.3440  -91.10552 315.8400
## 2022.038      22.192098 -110.67535 155.0595 -181.11335 225.4975
## 2022.058      15.489225 -117.37822 148.3567 -187.81622 218.7947
## 2022.077       9.327051 -123.54039 142.1945 -193.97839 212.6325
##                         ME     RMSE      MAE       MPE     MAPE      MASE
## Training set  3.739460e-16 98.91472 27.58437 -378.3600 400.8285 0.8481648
```

```
## Test set     -1.168561e+01 29.06294 16.71202 -490.5666 509.6556 0.5138615
##                    ACF1
## Training set 0.02162603
## Test set             NA
```

```
autoplot(m2v2_lin_out[[1]], series = 'Training') +
  autolayer(m2v2_lin_out[[2]], series = 'Test') +
  autolayer(m2v2_lin_out[[3]], series = 'Test Forecast', alpha = .3) +
  autolayer(m2v2_lin_out[[3]]$fitted, series = 'Fitted') +
  theme_classic() +
  coord_cartesian(#ylim = c(-50, 400),
                  xlim = c(2011, 2023))
```




```
summary(m2v2_lin_out[[3]])
```

```
##
## Forecast method: Linear regression model
##
## Model Information:
##
## Call:
## tslm(formula = as.formula(formula), data = train_ts01)
##
## Coefficients:
## (Intercept)        trend      season2      season3      season4      season5
##   40.822117    -0.004268    76.649781   -13.521074   -20.219680   -26.377586
##     season6      season7      season8      season9     season10     season11
##   -4.590507   -31.615742    -2.210463   -20.911339     4.748728   -28.893819
##    season12     season13     season14     season15     season16     season17
##   52.622820    13.151594   -29.851194   -27.604926   -25.836072   -25.193009
##    season18     season19     season20     season21     season22     season23
##  -31.013795   -32.841052   -31.293345   -32.527051   -31.102873   -31.150050
##    season24     season25     season26     season27     season28     season29
##  -30.420647   -31.575550   -33.733539   -10.931432   -15.780782   -27.699048
```

```
##    season30     season31     season32     season33     season34     season35
##   54.732247   -34.243870   -34.401081    15.705067   -29.491730   -34.066359
##    season36     season37     season38     season39     season40     season41
##  -31.631422   -33.608599   -26.303982    -7.834926   -33.407788    -3.131881
##    season42     season43     season44     season45     season46     season47
##  -25.860403    -9.119190   -19.416854   -25.557574   -30.488701   -18.444005
##    season48     season49     season50     season51     season52
##  -30.604981   -29.867781    -6.184421   -16.420304   -28.345843
##
##
## Error measures:
##                       ME     RMSE      MAE     MPE     MAPE      MASE
## Training set 3.73946e-16 98.91472 27.58437 -378.36 400.8285 0.8452214
##                    ACF1
## Training set 0.02162603
##
## Forecasts:
##          Point Forecast      Lo 80    Hi 80      Lo 95    Hi 95
## 2021.096      31.331803 -101.64498 164.3086 -172.14094 234.8045
## 2021.115       4.302301 -128.67448 137.2791 -199.17044 207.7750
## 2021.135      33.703312  -99.27347 166.6801 -169.76943 237.1761
## 2021.154      14.998167 -117.97861 147.9749 -188.47458 218.4709
## 2021.173      40.653966  -92.32282 173.6307 -162.81878 244.1267
## 2021.192       7.007151 -125.96963 139.9839 -196.46559 210.4799
## 2021.212      88.519522  -44.45726 221.4963 -114.95322 291.9923
## 2021.231      49.044027  -83.93275 182.0208 -154.42872 252.5168
## 2021.250       6.036971 -126.93981 139.0138 -197.43577 209.5097
## 2021.269       8.278971 -124.69781 141.2558 -195.19377 211.7517
## 2021.288      10.043557 -122.93322 143.0203 -193.42919 213.5163
## 2021.308      10.682352 -122.29443 143.6591 -192.79039 214.1551
## 2021.327       4.857298 -128.11948 137.8341 -198.61545 208.3300
## 2021.346       3.025773 -129.95101 136.0026 -200.44697 206.4985
## 2021.365       4.569212 -128.40757 137.5460 -198.90353 208.0420
## 2021.385       3.331238 -129.64554 136.3080 -200.14151 206.8040
## 2021.404       4.751147 -128.22563 137.7279 -198.72160 208.2239
## 2021.423       4.699702 -128.27708 137.6765 -198.77304 208.1724
## 2021.442       5.424837 -127.55194 138.4016 -198.04791 208.8976
## 2021.462       4.265666 -128.71112 137.2424 -199.20708 207.7384
## 2021.481       2.103409 -130.87337 135.0802 -201.36934 205.5762
## 2021.500      24.901248 -108.07553 157.8780 -178.57150 228.3740
## 2021.519      20.047630 -112.92915 153.0244 -183.42512 223.5204
## 2021.538       8.125095 -124.85169 141.1019 -195.34765 211.5978
## 2021.558      90.552122  -42.42466 223.5289 -112.92062 294.0249
## 2021.577       1.571738 -131.40504 134.5485 -201.90101 205.0445
## 2021.596       1.410258 -131.56652 134.3870 -202.06249 204.8830
## 2021.615      51.512138  -81.46464 184.4889 -151.96061 254.9849
## 2021.635       6.311073 -126.66571 139.2879 -197.16167 209.7838
## 2021.654       1.732176 -131.24461 134.7090 -201.74057 205.2049
## 2021.673       4.162844 -128.81394 137.1396 -199.30990 207.6356
## 2021.692       2.181399 -130.79538 135.1582 -201.29135 205.6541
## 2021.712       9.481749 -123.49503 142.4585 -193.99100 212.9545
## 2021.731      27.946536 -105.03025 160.9233 -175.52621 231.4193
## 2021.750       2.369407 -130.60737 135.3462 -201.10334 205.8422
## 2021.769      32.641045 -100.33574 165.6178 -170.83170 236.1138
```

```
## 2021.788       9.908255 -123.06853 142.8850 -193.56449 213.3810
## 2021.808      26.645200 -106.33158 159.6220 -176.82754 230.1179
## 2021.827      16.343268 -116.63351 149.3200 -187.12948 219.8160
## 2021.846      10.198280 -122.77850 143.1751 -193.27447 213.6710
## 2021.865       5.262885 -127.71390 138.2397 -198.20986 208.7356
## 2021.885      17.303312 -115.67347 150.2801 -186.16943 220.7761
## 2021.904       5.138069 -127.83871 138.1149 -198.33468 208.6108
## 2021.923       5.871000 -127.10578 138.8478 -197.60174 209.3437
## 2021.942      29.550092 -103.42669 162.5269 -173.92265 233.0228
## 2021.962      19.309940 -113.66684 152.2867 -184.16280 222.7827
## 2021.981       7.380134 -125.59665 140.3569 -196.09261 210.8529
## 2022.000      35.721709  -97.25507 168.6985 -167.75104 239.1945
## 2022.019     112.367221  -20.60956 245.3440  -91.10552 315.8400
## 2022.038      22.192098 -110.67535 155.0595 -181.11335 225.4975
## 2022.058      15.489225 -117.37822 148.3567 -187.81622 218.7947
## 2022.077       9.327051 -123.54039 142.1945 -193.97839 212.6325
```

SBOO: Imputed, All - Excluding External Variables (Forecasting ENTERO)

```r
# SBOO All: Imputed - Training partition (01/18/1999-01/04/2021)
#owt_df02_gb09_sboo_wkly03_train_tb03
# SBOO All: Imputed - Test partition (01/11/2021-01/03/2022)
#owt_df02_gb09_sboo_wkly03_test_tb03

owt_df02_gb09_sboo_wkly03_train_tb03 %>%
  plot_time_series(date_sample,
                   ENTERO)
```

```r
owt_df02_gb09_sboo_wkly03_train_tb03 %>%
  plot_stl_diagnostics(date_sample,
                       ENTERO,
                       .frequency = "auto",
                       .trend = "auto")
```

```
## frequency = 13 observations per 1 quarter
```

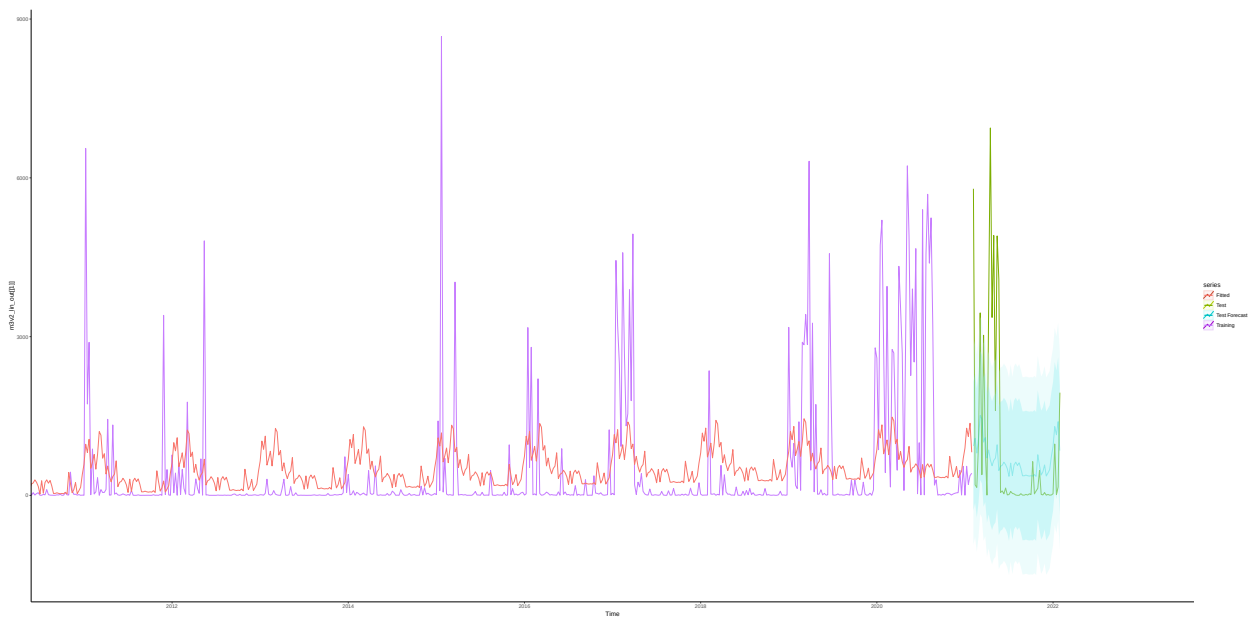
```
## trend = 53 observations per 1 year
```

```r
m3v2_lin_out <- lr_ts_mod(tb_train = owt_df02_gb09_sboo_wkly03_train_tb03,
                          tb_test = owt_df02_gb09_sboo_wkly03_test_tb03,
                          date = "date_sample",
                          param = "ENTERO",
                          ext_pred = c(),
                          train_start = c(1999, lubridate::isoweek(ymd(train_start))),
                          test_start = c(2021, 6),
                          freq = 52,
                          h = 52,
                          formula = "ENTERO ~ trend + season")
```

```
##          Point Forecast      Lo 80    Hi 80      Lo 95    Hi 95
## 2021.096       933.9135 -283.24496 2151.072  -928.5062 2796.333
## 2021.115      1078.7367 -138.42179 2295.895  -783.6830 2941.156
## 2021.135       800.2559 -416.90261 2017.414 -1062.1638 2662.676
## 2021.154      1077.3259 -139.83257 2294.484  -785.0938 2939.746
## 2021.173      1510.0825  292.92405 2727.241  -352.3372 3372.502
```

```
## 2021.192      1442.0468  224.88834 2659.205  -420.3729 3304.467
## 2021.212      1006.8347 -210.32378 2223.993  -855.5850 2869.254
## 2021.231      1092.1371 -125.02136 2309.296  -770.2826 2954.557
## 2021.250       708.2144 -508.94410 1925.373 -1154.2053 2570.634
## 2021.269       859.4173 -357.74117 2076.576 -1003.0024 2721.837
## 2021.288       669.8676 -547.29088 1887.026 -1192.5521 2532.287
## 2021.308       561.4273 -655.73122 1778.586 -1300.9924 2423.847
## 2021.327       661.0793 -556.07921 1878.238 -1201.3404 2523.499
## 2021.346       706.0926 -511.06583 1923.251 -1156.3270 2568.512
## 2021.365       957.1243 -260.03420 2174.283  -905.2954 2819.544
## 2021.385       469.5212 -747.63727 1686.680 -1392.8985 2331.941
## 2021.404       551.4139 -665.74462 1768.572 -1311.0058 2413.834
## 2021.423       569.1475 -648.01098 1786.306 -1293.2722 2431.567
## 2021.442       627.5533 -589.60514 1844.712 -1234.8664 2489.973
## 2021.462       581.3083 -635.85022 1798.467 -1281.1114 2443.728
## 2021.481       505.0179 -712.14054 1722.176 -1357.4018 2367.438
## 2021.500       360.1879 -856.97056 1577.346 -1502.2318 2222.608
## 2021.519       611.6455 -605.51297 1828.804 -1250.7742 2474.065
## 2021.538       376.7316 -840.42688 1593.890 -1485.6881 2239.151
## 2021.558       578.6659 -638.49255 1795.824 -1283.7538 2441.086
## 2021.577       628.3976 -588.76084 1845.556 -1234.0221 2490.817
## 2021.596       565.2740 -651.88451 1782.432 -1297.1457 2427.694
## 2021.615       616.3201 -600.83841 1833.479 -1246.0996 2478.740
## 2021.635       511.0615 -706.09695 1728.220 -1351.3582 2373.481
## 2021.654       371.1697 -845.98877 1588.328 -1491.2500 2233.589
## 2021.673       371.5091 -845.64940 1588.668 -1490.9106 2233.929
## 2021.692       383.9902 -833.16830 1601.149 -1478.4295 2246.410
## 2021.712       372.5186 -844.63991 1589.677 -1489.9011 2234.938
## 2021.731       365.9208 -851.23764 1583.079 -1496.4989 2228.341
## 2021.750       372.0077 -845.15073 1589.166 -1490.4119 2234.427
## 2021.769       366.3518 -850.80667 1583.510 -1496.0679 2228.771
## 2021.788       394.3269 -822.83160 1611.485 -1468.0928 2256.747
## 2021.808       360.4414 -856.71709 1577.600 -1501.9783 2222.861
## 2021.827       768.5797 -448.57877 1985.738 -1093.8400 2630.999
## 2021.846       562.8895 -654.26893 1780.048 -1299.5301 2425.309
## 2021.865       385.2560 -831.90252 1602.414 -1477.1637 2247.676
## 2021.885       445.9096 -771.24887 1663.068 -1416.5101 2308.329
## 2021.904       576.8165 -640.34200 1793.975 -1285.6032 2439.236
## 2021.923       366.5346 -850.62383 1583.693 -1495.8850 2228.954
## 2021.942       423.8983 -793.26020 1641.057 -1438.5214 2286.318
## 2021.962       487.1430 -730.01543 1704.302 -1375.2766 2349.563
## 2021.981       731.0454 -486.11309 1948.204 -1131.3743 2593.465
## 2022.000       923.4524 -293.70608 2140.611  -938.9673 2785.872
## 2022.019      1301.4385   84.28001 2518.597  -560.9812 3163.858
## 2022.038      1144.9914  -71.16632 2361.149  -715.8970 3005.880
## 2022.058      1394.0872  177.92955 2610.245  -466.8011 3254.976
## 2022.077       846.2787 -369.87902 2062.436 -1014.6097 2707.167
##                        ME      RMSE       MAE       MPE     MAPE     MASE
## Training set 2.091498e-14  905.3827  482.0386 -2744.347 3518.457 1.192717
## Test set     2.722014e+02 1686.6494 1062.7625 -3264.586 3297.939 2.629614
##                   ACF1
## Training set 0.3235555
## Test set            NA
```

```r
autoplot(m3v2_lin_out[[1]], series = 'Training') +
  autolayer(m3v2_lin_out[[2]], series = 'Test') +
  autolayer(m3v2_lin_out[[3]], series = 'Test Forecast', alpha = .3) +
  autolayer(m3v2_lin_out[[3]]$fitted, series = 'Fitted') +
  theme_classic() +
  coord_cartesian(#ylim = c(-50, 400),
                  xlim = c(2011, 2023))
```




```r
summary(m3v2_lin_out[[3]])
```

```
##
## Forecast method: Linear regression model
##
## Model Information:
##
## Call:
## tslm(formula = as.formula(formula), data = train_ts01)
##
## Coefficients:
## (Intercept)        trend      season2      season3      season4      season5
##     225.589        0.584      377.402      220.371      468.883      -79.510
##     season6      season7      season8      season9     season10     season11
##      37.908      182.148      -96.917      179.569      611.742      543.122
##    season12     season13     season14     season15     season16     season17
##     107.326      192.044     -192.463      -41.844     -231.977     -341.002
##    season18     season19     season20     season21     season22     season23
##    -241.934     -197.504       52.943     -435.244     -353.935     -336.785
##    season24     season25     season26     season27     season28     season29
##    -278.963     -325.793     -402.667     -548.081     -297.207     -532.705
##    season30     season31     season32     season33     season34     season35
##    -331.355     -282.207     -345.915     -295.453     -401.295     -541.771
##    season36     season37     season38     season39     season40     season41
##    -542.016     -530.118     -542.174     -549.356     -543.853     -550.093
```

```
##    season42     season43     season44     season45     season46     season47
##    -522.702     -557.171     -149.617     -355.891     -534.109     -474.039
##    season48     season49     season50     season51     season52
##    -343.716     -554.582     -497.802     -435.141     -191.823
##
##
## Error measures:
##                        ME     RMSE      MAE       MPE     MAPE      MASE
## Training set 2.091498e-14 905.3827 482.0386 -2744.347 3518.457 0.9837651
##                   ACF1
## Training set 0.3235555
##
## Forecasts:
##          Point Forecast      Lo 80    Hi 80      Lo 95    Hi 95
## 2021.096       933.9135 -283.24496 2151.072  -928.5062 2796.333
## 2021.115      1078.7367 -138.42179 2295.895  -783.6830 2941.156
## 2021.135       800.2559 -416.90261 2017.414 -1062.1638 2662.676
## 2021.154      1077.3259 -139.83257 2294.484  -785.0938 2939.746
## 2021.173      1510.0825  292.92405 2727.241  -352.3372 3372.502
## 2021.192      1442.0468  224.88834 2659.205  -420.3729 3304.467
## 2021.212      1006.8347 -210.32378 2223.993  -855.5850 2869.254
## 2021.231      1092.1371 -125.02136 2309.296  -770.2826 2954.557
## 2021.250       708.2144 -508.94410 1925.373 -1154.2053 2570.634
## 2021.269       859.4173 -357.74117 2076.576 -1003.0024 2721.837
## 2021.288       669.8676 -547.29088 1887.026 -1192.5521 2532.287
## 2021.308       561.4273 -655.73122 1778.586 -1300.9924 2423.847
## 2021.327       661.0793 -556.07921 1878.238 -1201.3404 2523.499
## 2021.346       706.0926 -511.06583 1923.251 -1156.3270 2568.512
## 2021.365       957.1243 -260.03420 2174.283  -905.2954 2819.544
## 2021.385       469.5212 -747.63727 1686.680 -1392.8985 2331.941
## 2021.404       551.4139 -665.74462 1768.572 -1311.0058 2413.834
## 2021.423       569.1475 -648.01098 1786.306 -1293.2722 2431.567
## 2021.442       627.5533 -589.60514 1844.712 -1234.8664 2489.973
## 2021.462       581.3083 -635.85022 1798.467 -1281.1114 2443.728
## 2021.481       505.0179 -712.14054 1722.176 -1357.4018 2367.438
## 2021.500       360.1879 -856.97056 1577.346 -1502.2318 2222.608
## 2021.519       611.6455 -605.51297 1828.804 -1250.7742 2474.065
## 2021.538       376.7316 -840.42688 1593.890 -1485.6881 2239.151
## 2021.558       578.6659 -638.49255 1795.824 -1283.7538 2441.086
## 2021.577       628.3976 -588.76084 1845.556 -1234.0221 2490.817
## 2021.596       565.2740 -651.88451 1782.432 -1297.1457 2427.694
## 2021.615       616.3201 -600.83841 1833.479 -1246.0996 2478.740
## 2021.635       511.0615 -706.09695 1728.220 -1351.3582 2373.481
## 2021.654       371.1697 -845.98877 1588.328 -1491.2500 2233.589
## 2021.673       371.5091 -845.64940 1588.668 -1490.9106 2233.929
## 2021.692       383.9902 -833.16830 1601.149 -1478.4295 2246.410
## 2021.712       372.5186 -844.63991 1589.677 -1489.9011 2234.938
## 2021.731       365.9208 -851.23764 1583.079 -1496.4989 2228.341
## 2021.750       372.0077 -845.15073 1589.166 -1490.4119 2234.427
## 2021.769       366.3518 -850.80667 1583.510 -1496.0679 2228.771
## 2021.788       394.3269 -822.83160 1611.485 -1468.0928 2256.747
## 2021.808       360.4414 -856.71709 1577.600 -1501.9783 2222.861
## 2021.827       768.5797 -448.57877 1985.738 -1093.8400 2630.999
## 2021.846       562.8895 -654.26893 1780.048 -1299.5301 2425.309
```

```
## 2021.865       385.2560 -831.90252 1602.414 -1477.1637 2247.676
## 2021.885       445.9096 -771.24887 1663.068 -1416.5101 2308.329
## 2021.904       576.8165 -640.34200 1793.975 -1285.6032 2439.236
## 2021.923       366.5346 -850.62383 1583.693 -1495.8850 2228.954
## 2021.942       423.8983 -793.26020 1641.057 -1438.5214 2286.318
## 2021.962       487.1430 -730.01543 1704.302 -1375.2766 2349.563
## 2021.981       731.0454 -486.11309 1948.204 -1131.3743 2593.465
## 2022.000       923.4524 -293.70608 2140.611  -938.9673 2785.872
## 2022.019      1301.4385   84.28001 2518.597  -560.9812 3163.858
## 2022.038      1144.9914  -71.16632 2361.149  -715.8970 3005.880
## 2022.058      1394.0872  177.92955 2610.245  -466.8011 3254.976
## 2022.077       846.2787 -369.87902 2062.436 -1014.6097 2707.167
```

SBOO: Imputed, Excluding Outliers - Excluding External Variables (Forecasting ENTERO)

```
# SBOO Excluding Outliers: Imputed - Training partition (01/18/1999-01/04/2021)
#owt_df02_gb09_sboo_wkly02_train_tb03
# SBOO Excluding Outliers: Imputed - Test partition (01/11/2021-01/03/2022)
#owt_df02_gb09_sboo_wkly02_test_tb03

owt_df02_gb09_sboo_wkly02_train_tb03 %>%
  plot_time_series(date_sample,
                   ENTERO)
```

```
owt_df02_gb09_sboo_wkly02_train_tb03 %>%
  plot_stl_diagnostics(date_sample,
                       ENTERO,
                       .frequency = "auto",
                       .trend = "auto")
```

```
## frequency = 13 observations per 1 quarter
```

```
## trend = 53 observations per 1 year
```

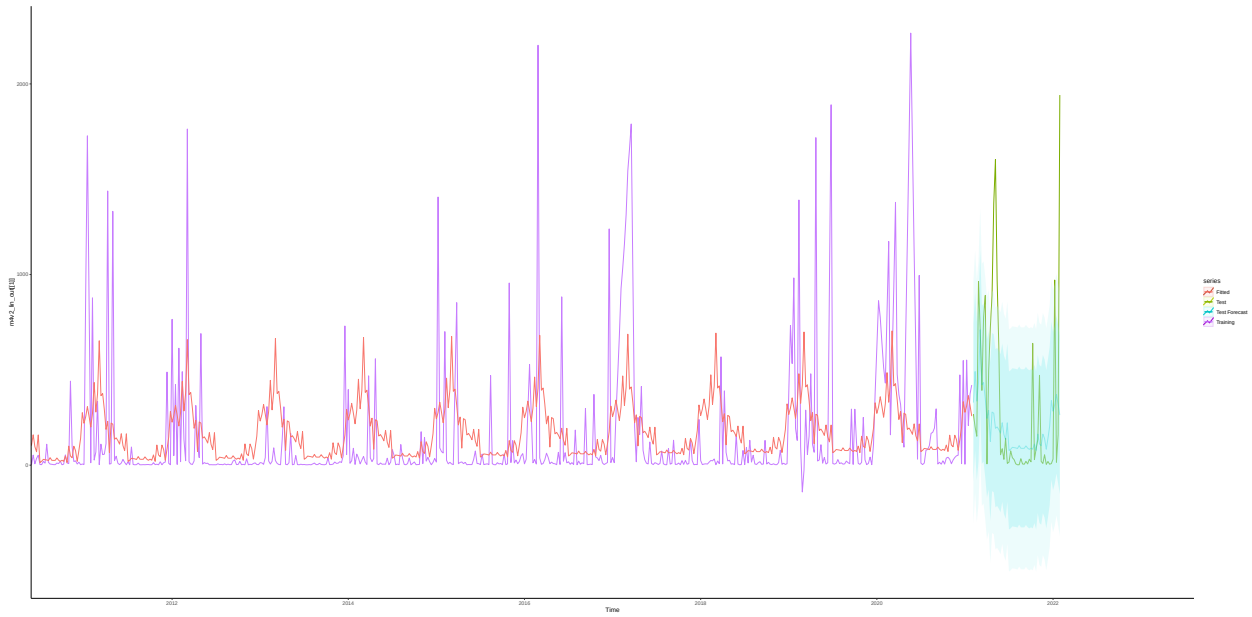
```
m4v2_lin_out <- lr_ts_mod(tb_train = owt_df02_gb09_sboo_wkly02_train_tb03,
                          tb_test = owt_df02_gb09_sboo_wkly02_test_tb03,
                          date = "date_sample",
                          param = "ENTERO",
                          ext_pred = c(),
                          train_start = c(1999, lubridate::isoweek(ymd(train_start))),
                          test_start = c(2021, 6),
                          freq = 52,
                          h = 52,
                          formula = "ENTERO ~ trend + season")
```

```
##          Point Forecast       Lo 80     Hi 80      Lo 95     Hi 95
## 2021.096      328.27252  -86.450263  742.9953 -306.31032  962.8554
## 2021.115      490.95556   76.232773  905.6783 -143.62728 1125.5384
## 2021.135      336.04459  -78.678190  750.7674 -298.53824  970.6274
## 2021.154      432.36500   17.642222  847.0878 -202.21783 1066.9478
## 2021.173      709.99258  295.269801 1124.7154   75.40975 1344.5754
## 2021.192      421.96145    7.238666  836.6842 -212.62139 1056.5443
## 2021.212      433.25602   18.533242  847.9788 -201.32681 1067.8389
## 2021.231      349.30200  -65.420787  764.0248 -285.28084  983.8848
## 2021.250      245.24129 -169.481492  659.9641 -389.34155  879.8241
```

```
## 2021.269      287.00523 -127.717553  701.7280 -347.57761  921.5881
## 2021.288      124.03171 -290.691077  538.7545 -510.55113  758.6145
## 2021.308      278.34388 -136.378897  693.0667 -356.23895  912.9267
## 2021.327      272.62793 -142.094852  687.3507 -361.95490  907.2108
## 2021.346      193.37749 -221.345297  608.1003 -441.20535  827.9603
## 2021.365      200.66792 -214.054862  615.3907 -433.91491  835.2508
## 2021.385      186.46409 -228.258690  601.1869 -448.11874  821.0469
## 2021.404      167.73822 -246.984564  582.4610 -466.84462  802.3211
## 2021.423      222.50992 -192.212867  637.2327 -412.07292  857.0928
## 2021.442      160.28511 -254.437674  575.0079 -474.29773  794.8679
## 2021.462      133.35616 -281.366620  548.0789 -501.22667  767.9390
## 2021.481      221.93456 -192.788224  636.6573 -412.64828  856.5174
## 2021.500       77.10454 -337.618244  491.8273 -557.47830  711.6874
## 2021.519       83.34826 -331.374518  498.0710 -551.23457  717.9311
## 2021.538       93.64455 -321.078231  508.3673 -540.93828  728.2274
## 2021.558       91.96050 -322.762284  506.6833 -542.62234  726.5433
## 2021.577       90.44087 -324.281916  505.1636 -544.14197  725.0237
## 2021.596       87.37918 -327.343607  502.1020 -547.20366  721.9620
## 2021.615      102.47814 -312.244640  517.2009 -532.10469  737.0610
## 2021.635       88.62067 -326.102116  503.3434 -545.96217  723.2035
## 2021.654       88.08633 -326.636455  502.8091 -546.49651  722.6692
## 2021.673       88.42570 -326.297080  503.1485 -546.15713  723.0085
## 2021.692      100.90680 -313.815983  515.6296 -533.67604  735.4896
## 2021.712       89.43519 -325.287588  504.1580 -545.14764  724.0180
## 2021.731       82.83747 -331.885316  497.5602 -551.74537  717.4203
## 2021.750       88.92437 -325.798412  503.6472 -545.65846  723.5072
## 2021.769       83.26843 -331.454348  497.9912 -551.31440  717.8513
## 2021.788      111.24350 -303.479284  525.9663 -523.33934  745.8263
## 2021.808       77.35802 -337.364767  492.0808 -557.22482  711.9409
## 2021.827      163.34576 -251.377025  578.0685 -471.23708  797.9286
## 2021.846      111.07170 -303.651085  525.7945 -523.51114  745.6545
## 2021.865      102.17259 -312.550196  516.8954 -532.41025  736.7554
## 2021.885      162.82623 -251.896548  577.5490 -471.75660  797.4091
## 2021.904      139.66199 -275.060795  554.3848 -494.92085  774.2448
## 2021.923       83.45127 -331.271508  498.1741 -551.13156  718.0341
## 2021.942      140.81490 -273.907880  555.5377 -493.76793  775.3977
## 2021.962      204.05967 -210.663109  618.7825 -430.52316  838.6425
## 2021.981      338.55431  -76.168468  753.2771 -296.02852  973.1371
## 2022.000      283.12774 -131.595043  697.8505 -351.45510  917.7106
## 2022.019      316.84349  -97.879294  731.5663 -317.73935  951.4263
## 2022.038      370.36768  -44.014108  784.7495 -263.69338 1004.4287
## 2022.058      319.16816  -95.213622  733.5499 -314.89290  953.2292
## 2022.077      262.90003 -151.481756  677.2818 -371.16103  896.9611
##                        ME     RMSE      MAE        MPE      MAPE     MASE
## Training set 3.250492e-14 308.4913 170.2934 -1106.7267 1236.1387 1.053705
## Test set     1.062070e+02 436.4987 271.1846  -756.8449  795.3771 1.677978
##                    ACF1
## Training set 0.3150918
## Test set            NA
```

```
autoplot(m4v2_lin_out[[1]], series = 'Training') +
  autolayer(m4v2_lin_out[[2]], series = 'Test') +
  autolayer(m4v2_lin_out[[3]], series = 'Test Forecast', alpha = .3) +
  autolayer(m4v2_lin_out[[3]]$fitted, series = 'Fitted') +
```

```
  theme_classic() +
  coord_cartesian(#ylim = c(-50, 400),
                  xlim = c(2011, 2023))
```




```
summary(m4v2_lin_out[[3]])
```

```
##
## Forecast method: Linear regression model
##
## Model Information:
##
## Call:
## tslm(formula = as.formula(formula), data = train_ts01)
##
## Coefficients:
## (Intercept)        trend      season2      season3      season4      season5
##    150.9575       0.1106      33.6051      87.0187      35.7086     -20.6701
##     season6      season7      season8      season9     season10     season11
##     50.3431     212.9155      57.8940     154.1038     431.6208     143.4790
##    season12     season13     season14     season15     season16     season17
##    154.6630      70.5984     -33.5729       8.0804    -155.0037      -0.8022
##    season18     season19     season20     season21     season22     season23
##     -6.6287     -85.9898     -78.8099     -93.1244    -111.9608     -57.2997
##    season24     season25     season26     season27     season28     season29
##   -119.6352    -146.6747     -58.2069    -203.1475    -197.0144    -186.8287
##    season30     season31     season32     season33     season34     season35
##   -188.6234    -190.2536    -193.4259    -178.4375    -192.4056    -193.0506
##    season36     season37     season38     season39     season40     season41
##   -192.8218    -180.4513    -192.0335    -198.7418    -192.7655    -198.5321
##    season42     season43     season44     season45     season46     season47
##   -170.6676    -204.6637    -118.7866    -171.1712    -180.1809    -119.6379
##    season48     season49     season50     season51     season52
##   -142.9127    -199.2341    -141.9810     -78.8469      55.5372
```

```
##
##
## Error measures:
##                        ME     RMSE      MAE       MPE     MAPE      MASE
## Training set 3.250492e-14 308.4913 170.2934 -1106.727 1236.139 0.8555755
##                   ACF1
## Training set 0.3150918
##
## Forecasts:
##          Point Forecast       Lo 80     Hi 80      Lo 95     Hi 95
## 2021.096      328.27252  -86.450263  742.9953 -306.31032  962.8554
## 2021.115      490.95556   76.232773  905.6783 -143.62728 1125.5384
## 2021.135      336.04459  -78.678190  750.7674 -298.53824  970.6274
## 2021.154      432.36500   17.642222  847.0878 -202.21783 1066.9478
## 2021.173      709.99258  295.269801 1124.7154   75.40975 1344.5754
## 2021.192      421.96145    7.238666  836.6842 -212.62139 1056.5443
## 2021.212      433.25602   18.533242  847.9788 -201.32681 1067.8389
## 2021.231      349.30200  -65.420787  764.0248 -285.28084  983.8848
## 2021.250      245.24129 -169.481492  659.9641 -389.34155  879.8241
## 2021.269      287.00523 -127.717553  701.7280 -347.57761  921.5881
## 2021.288      124.03171 -290.691077  538.7545 -510.55113  758.6145
## 2021.308      278.34388 -136.378897  693.0667 -356.23895  912.9267
## 2021.327      272.62793 -142.094852  687.3507 -361.95490  907.2108
## 2021.346      193.37749 -221.345297  608.1003 -441.20535  827.9603
## 2021.365      200.66792 -214.054862  615.3907 -433.91491  835.2508
## 2021.385      186.46409 -228.258690  601.1869 -448.11874  821.0469
## 2021.404      167.73822 -246.984564  582.4610 -466.84462  802.3211
## 2021.423      222.50992 -192.212867  637.2327 -412.07292  857.0928
## 2021.442      160.28511 -254.437674  575.0079 -474.29773  794.8679
## 2021.462      133.35616 -281.366620  548.0789 -501.22667  767.9390
## 2021.481      221.93456 -192.788224  636.6573 -412.64828  856.5174
## 2021.500       77.10454 -337.618244  491.8273 -557.47830  711.6874
## 2021.519       83.34826 -331.374518  498.0710 -551.23457  717.9311
## 2021.538       93.64455 -321.078231  508.3673 -540.93828  728.2274
## 2021.558       91.96050 -322.762284  506.6833 -542.62234  726.5433
## 2021.577       90.44087 -324.281916  505.1636 -544.14197  725.0237
## 2021.596       87.37918 -327.343607  502.1020 -547.20366  721.9620
## 2021.615      102.47814 -312.244640  517.2009 -532.10469  737.0610
## 2021.635       88.62067 -326.102116  503.3434 -545.96217  723.2035
## 2021.654       88.08633 -326.636455  502.8091 -546.49651  722.6692
## 2021.673       88.42570 -326.297080  503.1485 -546.15713  723.0085
## 2021.692      100.90680 -313.815983  515.6296 -533.67604  735.4896
## 2021.712       89.43519 -325.287588  504.1580 -545.14764  724.0180
## 2021.731       82.83747 -331.885316  497.5602 -551.74537  717.4203
## 2021.750       88.92437 -325.798412  503.6472 -545.65846  723.5072
## 2021.769       83.26843 -331.454348  497.9912 -551.31440  717.8513
## 2021.788      111.24350 -303.479284  525.9663 -523.33934  745.8263
## 2021.808       77.35802 -337.364767  492.0808 -557.22482  711.9409
## 2021.827      163.34576 -251.377025  578.0685 -471.23708  797.9286
## 2021.846      111.07170 -303.651085  525.7945 -523.51114  745.6545
## 2021.865      102.17259 -312.550196  516.8954 -532.41025  736.7554
## 2021.885      162.82623 -251.896548  577.5490 -471.75660  797.4091
## 2021.904      139.66199 -275.060795  554.3848 -494.92085  774.2448
## 2021.923       83.45127 -331.271508  498.1741 -551.13156  718.0341
```

```
## 2021.942      140.81490 -273.907880  555.5377 -493.76793  775.3977
## 2021.962      204.05967 -210.663109  618.7825 -430.52316  838.6425
## 2021.981      338.55431  -76.168468  753.2771 -296.02852  973.1371
## 2022.000      283.12774 -131.595043  697.8505 -351.45510  917.7106
## 2022.019      316.84349  -97.879294  731.5663 -317.73935  951.4263
## 2022.038      370.36768  -44.014108  784.7495 -263.69338 1004.4287
## 2022.058      319.16816  -95.213622  733.5499 -314.89290  953.2292
## 2022.077      262.90003 -151.481756  677.2818 -371.16103  896.9611
```

PLOO All: Imputed - Excluding External Variables (Forecasting DENSITY)

```
# PLOO All: Imputed - Training partition (01/18/1999-01/04/2021)
#owt_df02_gb09_ploo_wkly03_train_tb03
# PLOO All: Imputed - Test partition (01/11/2021-01/03/2022)
#owt_df02_gb09_ploo_wkly03_test_tb03

owt_df02_gb09_ploo_wkly03_train_tb03 %>%
  plot_time_series(date_sample,
                   DENSITY)
```

```
owt_df02_gb09_ploo_wkly03_train_tb03 %>%
  plot_stl_diagnostics(date_sample,
                       DENSITY,
                       .frequency = "auto",
                       .trend = "auto")
```

```
## frequency = 13 observations per 1 quarter
```

```
## trend = 53 observations per 1 year
```

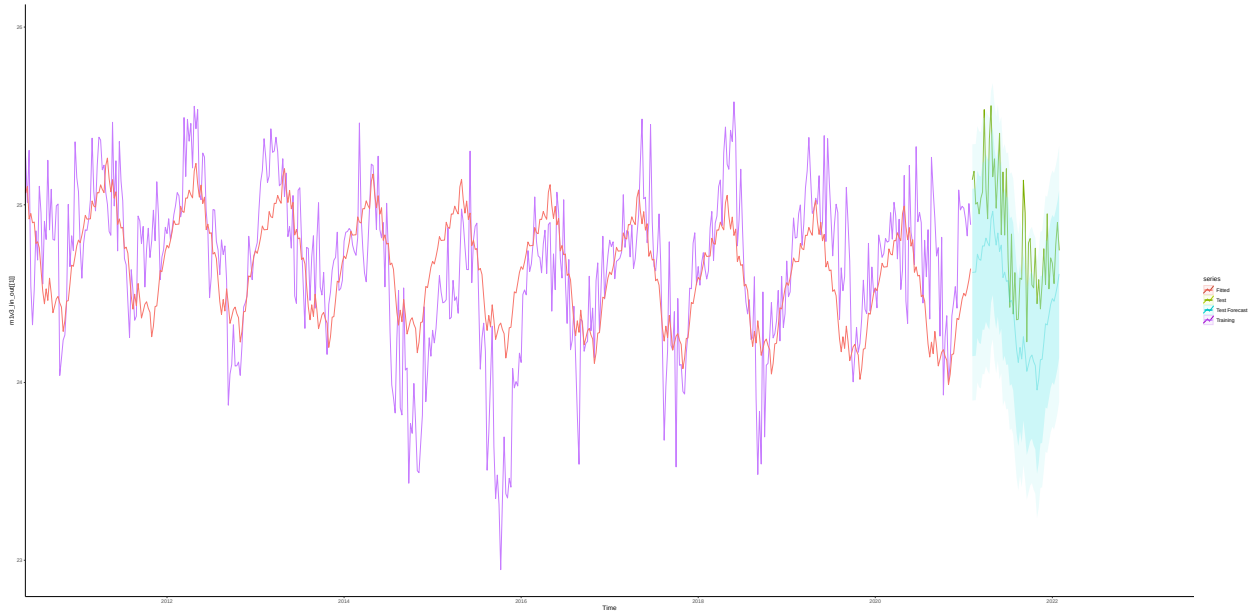
```
m1v3_lin_out <- lr_ts_mod(tb_train = owt_df02_gb09_ploo_wkly03_train_tb03,
                          tb_test = owt_df02_gb09_ploo_wkly03_test_tb03,
                          date = "date_sample",
                          param = "DENSITY",
                          ext_pred = c(),
                          train_start = c(1999, lubridate::isoweek(ymd(train_start))),
                          test_start = c(2021, 6),
                          freq = 52,
                          h = 52,
                          formula = "DENSITY ~ trend + season")
```

```
##          Point Forecast    Lo 80    Hi 80    Lo 95    Hi 95
## 2021.096       24.61928 24.14830 25.09026 23.89862 25.33995
## 2021.115       24.62068 24.14970 25.09166 23.90002 25.34134
## 2021.135       24.62137 24.15039 25.09235 23.90071 25.34203
## 2021.154       24.72223 24.25125 25.19321 24.00157 25.44289
## 2021.173       24.69325 24.22227 25.16422 23.97258 25.41391
## 2021.192       24.68773 24.21676 25.15871 23.96707 25.40840
## 2021.212       24.76884 24.29786 25.23982 24.04817 25.48950
## 2021.231       24.76754 24.29656 25.23852 24.04688 25.48820
## 2021.250       24.81270 24.34172 25.28368 24.09204 25.53336
## 2021.269       24.78669 24.31571 25.25767 24.06603 25.50735
## 2021.288       24.76880 24.29783 25.23978 24.04814 25.48947
```

```
## 2021.308       24.92098 24.45000 25.39196 24.20032 25.64164
## 2021.327       24.96343 24.49245 25.43441 24.24277 25.68409
## 2021.346       24.84798 24.37700 25.31895 24.12731 25.56864
## 2021.365       24.77327 24.30229 25.24425 24.05261 25.49393
## 2021.385       24.84135 24.37038 25.31233 24.12069 25.56202
## 2021.404       24.73742 24.26645 25.20840 24.01676 25.45809
## 2021.423       24.77362 24.30264 25.24460 24.05296 25.49428
## 2021.442       24.59032 24.11934 25.06130 23.86966 25.31098
## 2021.462       24.62119 24.15021 25.09217 23.90053 25.34185
## 2021.481       24.56927 24.09829 25.04024 23.84860 25.28993
## 2021.500       24.57347 24.10249 25.04445 23.85281 25.29414
## 2021.519       24.45299 23.98201 24.92396 23.73232 25.17365
## 2021.538       24.46228 23.99130 24.93326 23.74162 25.18294
## 2021.558       24.42796 23.95698 24.89894 23.70730 25.14863
## 2021.577       24.30486 23.83388 24.77584 23.58420 25.02552
## 2021.596       24.18565 23.71467 24.65663 23.46499 24.90631
## 2021.615       24.11329 23.64231 24.58427 23.39263 24.83396
## 2021.635       24.19758 23.72660 24.66856 23.47691 24.91824
## 2021.654       24.13256 23.66158 24.60354 23.41190 24.85322
## 2021.673       24.25747 23.78650 24.72845 23.53681 24.97814
## 2021.692       24.17137 23.70039 24.64235 23.45071 24.89203
## 2021.712       24.06301 23.59203 24.53398 23.34234 24.78367
## 2021.731       24.10062 23.62964 24.57160 23.37996 24.82129
## 2021.750       24.14084 23.66986 24.61182 23.42018 24.86150
## 2021.769       24.15478 23.68380 24.62576 23.43412 24.87544
## 2021.788       24.11814 23.64716 24.58912 23.39748 24.83880
## 2021.808       24.09499 23.62402 24.56597 23.37433 24.81566
## 2021.827       23.95799 23.48701 24.42897 23.23733 24.67865
## 2021.846       24.01710 23.54612 24.48807 23.29643 24.73776
## 2021.865       24.12818 23.65720 24.59916 23.40752 24.84884
## 2021.885       24.13095 23.65997 24.60193 23.41029 24.85161
## 2021.904       24.22479 23.75381 24.69576 23.50412 24.94545
## 2021.923       24.33052 23.85954 24.80150 23.60986 25.05118
## 2021.942       24.32422 23.85324 24.79520 23.60356 25.04488
## 2021.962       24.38038 23.90940 24.85136 23.65972 25.10104
## 2021.981       24.43953 23.96856 24.91051 23.71887 25.16020
## 2022.000       24.47185 24.00087 24.94283 23.75119 25.19251
## 2022.019       24.45727 23.98629 24.92825 23.73661 25.17794
## 2022.038       24.49848 24.02788 24.96907 23.77841 25.21855
## 2022.058       24.54748 24.07689 25.01807 23.82741 25.26755
## 2022.077       24.61118 24.14059 25.08177 23.89111 25.33125
##                         ME      RMSE       MAE         MPE     MAPE     MASE
## Training set -1.556207e-17 0.3503373 0.2742432 -0.02019261 1.110196 1.320782
## Test set      3.777035e-01 0.4351803 0.3804691  1.51503645 1.526371 1.832377
##                   ACF1
## Training set 0.7064924
## Test set            NA
```

```
autoplot(m1v3_lin_out[[1]], series = 'Training') +
  autolayer(m1v3_lin_out[[2]], series = 'Test') +
  autolayer(m1v3_lin_out[[3]], series = 'Test Forecast', alpha = .3) +
  autolayer(m1v3_lin_out[[3]]$fitted, series = 'Fitted') +
  theme_classic() +
  coord_cartesian(#ylim = c(-50, 400),
```

```
                    xlim = c(2011, 2023))
```




```
summary(m1v3_lin_out[[3]])
```

```
##
## Forecast method: Linear regression model
##
## Model Information:
##
## Call:
## tslm(formula = as.formula(formula), data = train_ts01)
##
## Coefficients:
## (Intercept)        trend      season2      season3      season4      season5
##  25.1605258   -0.0005763   -0.0139985    0.0277806    0.0773615    0.1416388
##     season6      season7      season8      season9     season10     season11
##   0.1203487    0.1223233    0.1235907    0.2250269    0.1966168    0.1916811
##    season12     season13     season14     season15     season16     season17
##   0.2733601    0.2726401    0.3183751    0.2929450    0.2756329    0.4283849
##    season18     season19     season20     season21     season22     season23
##   0.4714110    0.3565331    0.2824009    0.3510641    0.2477110    0.2844833
##    season24     season25     season26     season27     season28     season29
##   0.1017596    0.1332048    0.0818576    0.0866414   -0.0332705   -0.0234003
##    season30     season31     season32     season33     season34     season35
##  -0.0571402   -0.1796645   -0.2983021   -0.3700808   -0.2852211   -0.3496621
##    season36     season37     season38     season39     season40     season41
##  -0.2241718   -0.3097002   -0.4174868   -0.3792932   -0.3384987   -0.3239866
##    season42     season43     season44     season45     season46     season47
##  -0.3600467   -0.3826167   -0.5190471   -0.4593628   -0.3477045   -0.3443540
##    season48     season49     season50     season51     season52
##  -0.2499449   -0.1436323   -0.1493562   -0.0926189   -0.0328901
##
##
```

```
## Error measures:
##                         ME      RMSE       MAE         MPE     MAPE      MASE
## Training set -1.556207e-17 0.3503373 0.2742432 -0.02019261 1.110196 0.8194057
##                   ACF1
## Training set 0.7064924
##
## Forecasts:
##          Point Forecast    Lo 80    Hi 80    Lo 95    Hi 95
## 2021.096       24.61928 24.14830 25.09026 23.89862 25.33995
## 2021.115       24.62068 24.14970 25.09166 23.90002 25.34134
## 2021.135       24.62137 24.15039 25.09235 23.90071 25.34203
## 2021.154       24.72223 24.25125 25.19321 24.00157 25.44289
## 2021.173       24.69325 24.22227 25.16422 23.97258 25.41391
## 2021.192       24.68773 24.21676 25.15871 23.96707 25.40840
## 2021.212       24.76884 24.29786 25.23982 24.04817 25.48950
## 2021.231       24.76754 24.29656 25.23852 24.04688 25.48820
## 2021.250       24.81270 24.34172 25.28368 24.09204 25.53336
## 2021.269       24.78669 24.31571 25.25767 24.06603 25.50735
## 2021.288       24.76880 24.29783 25.23978 24.04814 25.48947
## 2021.308       24.92098 24.45000 25.39196 24.20032 25.64164
## 2021.327       24.96343 24.49245 25.43441 24.24277 25.68409
## 2021.346       24.84798 24.37700 25.31895 24.12731 25.56864
## 2021.365       24.77327 24.30229 25.24425 24.05261 25.49393
## 2021.385       24.84135 24.37038 25.31233 24.12069 25.56202
## 2021.404       24.73742 24.26645 25.20840 24.01676 25.45809
## 2021.423       24.77362 24.30264 25.24460 24.05296 25.49428
## 2021.442       24.59032 24.11934 25.06130 23.86966 25.31098
## 2021.462       24.62119 24.15021 25.09217 23.90053 25.34185
## 2021.481       24.56927 24.09829 25.04024 23.84860 25.28993
## 2021.500       24.57347 24.10249 25.04445 23.85281 25.29414
## 2021.519       24.45299 23.98201 24.92396 23.73232 25.17365
## 2021.538       24.46228 23.99130 24.93326 23.74162 25.18294
## 2021.558       24.42796 23.95698 24.89894 23.70730 25.14863
## 2021.577       24.30486 23.83388 24.77584 23.58420 25.02552
## 2021.596       24.18565 23.71467 24.65663 23.46499 24.90631
## 2021.615       24.11329 23.64231 24.58427 23.39263 24.83396
## 2021.635       24.19758 23.72660 24.66856 23.47691 24.91824
## 2021.654       24.13256 23.66158 24.60354 23.41190 24.85322
## 2021.673       24.25747 23.78650 24.72845 23.53681 24.97814
## 2021.692       24.17137 23.70039 24.64235 23.45071 24.89203
## 2021.712       24.06301 23.59203 24.53398 23.34234 24.78367
## 2021.731       24.10062 23.62964 24.57160 23.37996 24.82129
## 2021.750       24.14084 23.66986 24.61182 23.42018 24.86150
## 2021.769       24.15478 23.68380 24.62576 23.43412 24.87544
## 2021.788       24.11814 23.64716 24.58912 23.39748 24.83880
## 2021.808       24.09499 23.62402 24.56597 23.37433 24.81566
## 2021.827       23.95799 23.48701 24.42897 23.23733 24.67865
## 2021.846       24.01710 23.54612 24.48807 23.29643 24.73776
## 2021.865       24.12818 23.65720 24.59916 23.40752 24.84884
## 2021.885       24.13095 23.65997 24.60193 23.41029 24.85161
## 2021.904       24.22479 23.75381 24.69576 23.50412 24.94545
## 2021.923       24.33052 23.85954 24.80150 23.60986 25.05118
## 2021.942       24.32422 23.85324 24.79520 23.60356 25.04488
## 2021.962       24.38038 23.90940 24.85136 23.65972 25.10104
```

```
## 2021.981       24.43953 23.96856 24.91051 23.71887 25.16020
## 2022.000       24.47185 24.00087 24.94283 23.75119 25.19251
## 2022.019       24.45727 23.98629 24.92825 23.73661 25.17794
## 2022.038       24.49848 24.02788 24.96907 23.77841 25.21855
## 2022.058       24.54748 24.07689 25.01807 23.82741 25.26755
## 2022.077       24.61118 24.14059 25.08177 23.89111 25.33125
```

PLOO Excluding Outliers: Imputed - Excluding External Variables (Forecasting DENSITY)

```
# PLOO Excluding Outliers: Imputed - Training partition (01/18/1999-01/04/2021)
#owt_df02_gb09_ploo_wkly02_train_tb03
# PLOO Excluding Outliers: Imputed - Test partition (01/11/2021-01/03/2022)
#owt_df02_gb09_ploo_wkly02_test_tb03

owt_df02_gb09_ploo_wkly02_train_tb03 %>%
  plot_time_series(date_sample,
                   DENSITY)
```

```
owt_df02_gb09_ploo_wkly02_train_tb03 %>%
  plot_stl_diagnostics(date_sample,
                       DENSITY,
                       .frequency = "auto",
                       .trend = "auto")
```

```
## frequency = 13 observations per 1 quarter
```

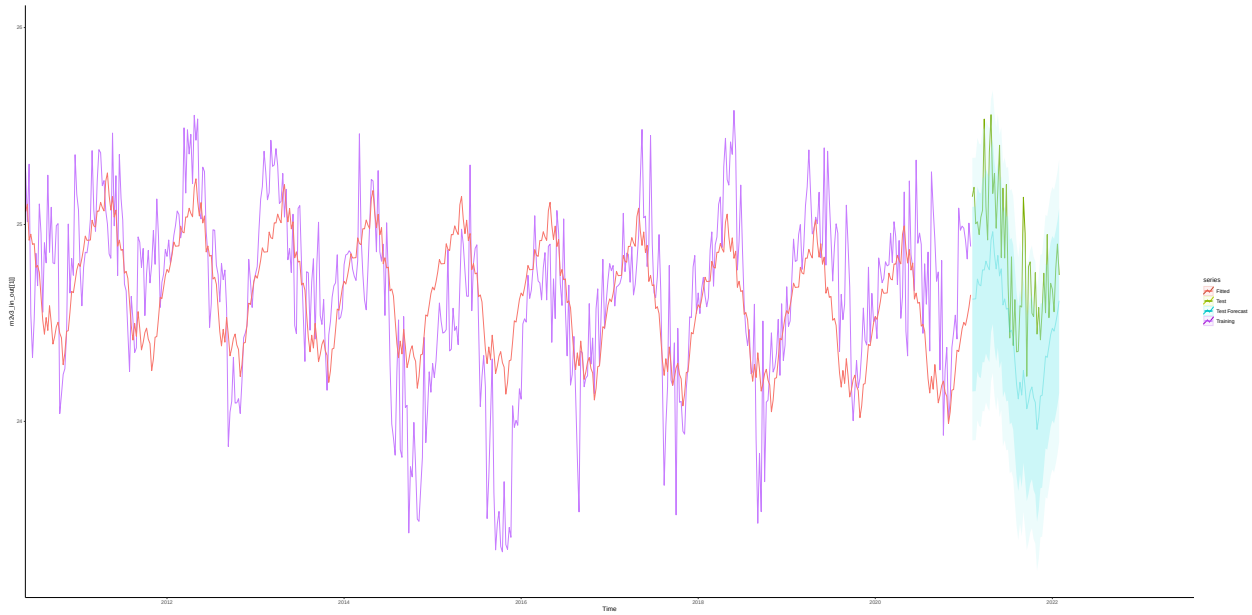
```
## trend = 53 observations per 1 year
```

```
m2v3_lin_out <- lr_ts_mod(tb_train = owt_df02_gb09_ploo_wkly02_train_tb03,
                          tb_test = owt_df02_gb09_ploo_wkly02_test_tb03,
                          date = "date_sample",
                          param = "DENSITY",
                          ext_pred = c(),
                          train_start = c(1999, lubridate::isoweek(ymd(train_start))),
                          test_start = c(2021, 6),
                          freq = 52,
                          h = 52,
                          formula = "DENSITY ~ trend + season")
```

```
##          Point Forecast    Lo 80    Hi 80    Lo 95    Hi 95
## 2021.096       24.62052 24.15192 25.08912 23.90350 25.33755
## 2021.115       24.62161 24.15301 25.09021 23.90459 25.33864
## 2021.135       24.62236 24.15376 25.09096 23.90533 25.33938
## 2021.154       24.72307 24.25447 25.19167 24.00604 25.44009
## 2021.173       24.69416 24.22556 25.16276 23.97713 25.41118
## 2021.192       24.68878 24.22018 25.15738 23.97176 25.40581
## 2021.212       24.76969 24.30109 25.23829 24.05266 25.48671
## 2021.231       24.76855 24.29995 25.23715 24.05153 25.48558
## 2021.250       24.81395 24.34535 25.28255 24.09693 25.53097
## 2021.269       24.78765 24.31905 25.25625 24.07063 25.50468
## 2021.288       24.76996 24.30136 25.23856 24.05294 25.48698
## 2021.308       24.92103 24.45243 25.38963 24.20400 25.63805
## 2021.327       24.96334 24.49474 25.43194 24.24632 25.68036
## 2021.346       24.84875 24.38015 25.31735 24.13172 25.56577
## 2021.365       24.77431 24.30571 25.24291 24.05729 25.49134
```

```
## 2021.385       24.84255 24.37395 25.31115 24.12553 25.55957
## 2021.404       24.73852 24.26992 25.20712 24.02150 25.45554
## 2021.423       24.77479 24.30619 25.24339 24.05777 25.49181
## 2021.442       24.59125 24.12265 25.05985 23.87423 25.30827
## 2021.462       24.62219 24.15359 25.09079 23.90516 25.33921
## 2021.481       24.57024 24.10164 25.03884 23.85321 25.28726
## 2021.500       24.57441 24.10581 25.04301 23.85739 25.29143
## 2021.519       24.45388 23.98528 24.92248 23.73686 25.17090
## 2021.538       24.46326 23.99466 24.93186 23.74624 25.18029
## 2021.558       24.42762 23.95902 24.89622 23.71060 25.14464
## 2021.577       24.30603 23.83743 24.77463 23.58901 25.02305
## 2021.596       24.18700 23.71840 24.65560 23.46997 24.90402
## 2021.615       24.11431 23.64571 24.58291 23.39729 24.83133
## 2021.635       24.19879 23.73019 24.66739 23.48177 24.91581
## 2021.654       24.13354 23.66494 24.60214 23.41652 24.85056
## 2021.673       24.25866 23.79006 24.72726 23.54163 24.97568
## 2021.692       24.17253 23.70393 24.64113 23.45551 24.88956
## 2021.712       24.06405 23.59545 24.53265 23.34703 24.78108
## 2021.731       24.10180 23.63320 24.57040 23.38478 24.81882
## 2021.750       24.15227 23.68367 24.62087 23.43525 24.86930
## 2021.769       24.17512 23.70652 24.64372 23.45810 24.89214
## 2021.788       24.11936 23.65076 24.58796 23.40234 24.83638
## 2021.808       24.09634 23.62774 24.56494 23.37932 24.81336
## 2021.827       23.95923 23.49063 24.42783 23.24220 24.67625
## 2021.846       24.01816 23.54956 24.48676 23.30114 24.73519
## 2021.865       24.12897 23.66037 24.59757 23.41195 24.84599
## 2021.885       24.13209 23.66349 24.60069 23.41507 24.84911
## 2021.904       24.22602 23.75742 24.69462 23.50899 24.94304
## 2021.923       24.33152 23.86292 24.80012 23.61449 25.04854
## 2021.942       24.32518 23.85658 24.79378 23.60816 25.04220
## 2021.962       24.38124 23.91264 24.84984 23.66422 25.09826
## 2021.981       24.44044 23.97184 24.90904 23.72342 25.15746
## 2022.000       24.47284 24.00424 24.94144 23.75582 25.18987
## 2022.019       24.45831 23.98971 24.92691 23.74128 25.17533
## 2022.038       24.49959 24.03138 24.96781 23.78316 25.21603
## 2022.058       24.54926 24.08105 25.01748 23.83283 25.26570
## 2022.077       24.61276 24.14455 25.08098 23.89633 25.32920
##                        ME      RMSE       MAE         MPE     MAPE     MASE
## Training set 2.796938e-17 0.3485679 0.2736529 -0.01996944 1.107586 1.321202
## Test set     3.761243e-01 0.4336376 0.3789111  1.50865787 1.520078 1.829391
##                   ACF1
## Training set 0.7046418
## Test set            NA
```

```
autoplot(m2v3_lin_out[[1]], series = 'Training') +
  autolayer(m2v3_lin_out[[2]], series = 'Test') +
  autolayer(m2v3_lin_out[[3]], series = 'Test Forecast', alpha = .3) +
  autolayer(m2v3_lin_out[[3]]$fitted, series = 'Fitted') +
  theme_classic() +
  coord_cartesian(#ylim = c(-50, 400),
                  xlim = c(2011, 2023))
```




```
summary(m2v3_lin_out[[3]])
```

```
##
## Forecast method: Linear regression model
##
## Model Information:
##
## Call:
## tslm(formula = as.formula(formula), data = train_ts01)
##
## Coefficients:
## (Intercept)        trend      season2      season3      season4      season5
##  25.1592432   -0.0005744   -0.0139648    0.0278971    0.0781413    0.1422164
##     season6      season7      season8      season9     season10     season11
##   0.1206828    0.1223464    0.1236649    0.2249494    0.1966133    0.1918159
##    season12     season13     season14     season15     season16     season17
##   0.2732921    0.2727331    0.3187065    0.2929821    0.2758615    0.4275024
##    season18     season19     season20     season21     season22     season23
##   0.4703928    0.3563714    0.2825144    0.3513254    0.2478709    0.2847145
##    season24     season25     season26     season27     season28     season29
##   0.1017506    0.1332591    0.0818842    0.0866295   -0.0333260   -0.0233663
##    season30     season31     season32     season33     season34     season35
##  -0.0584356   -0.1794493   -0.2979102   -0.3700239   -0.2849689   -0.3496441
##    season36     season37     season38     season39     season40     season41
##  -0.2239530   -0.3095001   -0.4174060   -0.3790865   -0.3280387   -0.3046191
##    season42     season43     season44     season45     season46     season47
##  -0.3598039   -0.3822471   -0.5187880   -0.4592765   -0.3478977   -0.3441984
##    season48     season49     season50     season51     season52
##  -0.2496997   -0.1436264   -0.1493883   -0.0927520   -0.0329772
##
##
## Error measures:
##                        ME      RMSE       MAE         MPE     MAPE      MASE
## Training set 2.796938e-17 0.3485679 0.2736529 -0.01996944 1.107586 0.8203458
```

```
##                   ACF1
## Training set 0.7046418
##
## Forecasts:
##          Point Forecast    Lo 80    Hi 80    Lo 95    Hi 95
## 2021.096       24.62052 24.15192 25.08912 23.90350 25.33755
## 2021.115       24.62161 24.15301 25.09021 23.90459 25.33864
## 2021.135       24.62236 24.15376 25.09096 23.90533 25.33938
## 2021.154       24.72307 24.25447 25.19167 24.00604 25.44009
## 2021.173       24.69416 24.22556 25.16276 23.97713 25.41118
## 2021.192       24.68878 24.22018 25.15738 23.97176 25.40581
## 2021.212       24.76969 24.30109 25.23829 24.05266 25.48671
## 2021.231       24.76855 24.29995 25.23715 24.05153 25.48558
## 2021.250       24.81395 24.34535 25.28255 24.09693 25.53097
## 2021.269       24.78765 24.31905 25.25625 24.07063 25.50468
## 2021.288       24.76996 24.30136 25.23856 24.05294 25.48698
## 2021.308       24.92103 24.45243 25.38963 24.20400 25.63805
## 2021.327       24.96334 24.49474 25.43194 24.24632 25.68036
## 2021.346       24.84875 24.38015 25.31735 24.13172 25.56577
## 2021.365       24.77431 24.30571 25.24291 24.05729 25.49134
## 2021.385       24.84255 24.37395 25.31115 24.12553 25.55957
## 2021.404       24.73852 24.26992 25.20712 24.02150 25.45554
## 2021.423       24.77479 24.30619 25.24339 24.05777 25.49181
## 2021.442       24.59125 24.12265 25.05985 23.87423 25.30827
## 2021.462       24.62219 24.15359 25.09079 23.90516 25.33921
## 2021.481       24.57024 24.10164 25.03884 23.85321 25.28726
## 2021.500       24.57441 24.10581 25.04301 23.85739 25.29143
## 2021.519       24.45388 23.98528 24.92248 23.73686 25.17090
## 2021.538       24.46326 23.99466 24.93186 23.74624 25.18029
## 2021.558       24.42762 23.95902 24.89622 23.71060 25.14464
## 2021.577       24.30603 23.83743 24.77463 23.58901 25.02305
## 2021.596       24.18700 23.71840 24.65560 23.46997 24.90402
## 2021.615       24.11431 23.64571 24.58291 23.39729 24.83133
## 2021.635       24.19879 23.73019 24.66739 23.48177 24.91581
## 2021.654       24.13354 23.66494 24.60214 23.41652 24.85056
## 2021.673       24.25866 23.79006 24.72726 23.54163 24.97568
## 2021.692       24.17253 23.70393 24.64113 23.45551 24.88956
## 2021.712       24.06405 23.59545 24.53265 23.34703 24.78108
## 2021.731       24.10180 23.63320 24.57040 23.38478 24.81882
## 2021.750       24.15227 23.68367 24.62087 23.43525 24.86930
## 2021.769       24.17512 23.70652 24.64372 23.45810 24.89214
## 2021.788       24.11936 23.65076 24.58796 23.40234 24.83638
## 2021.808       24.09634 23.62774 24.56494 23.37932 24.81336
## 2021.827       23.95923 23.49063 24.42783 23.24220 24.67625
## 2021.846       24.01816 23.54956 24.48676 23.30114 24.73519
## 2021.865       24.12897 23.66037 24.59757 23.41195 24.84599
## 2021.885       24.13209 23.66349 24.60069 23.41507 24.84911
## 2021.904       24.22602 23.75742 24.69462 23.50899 24.94304
## 2021.923       24.33152 23.86292 24.80012 23.61449 25.04854
## 2021.942       24.32518 23.85658 24.79378 23.60816 25.04220
## 2021.962       24.38124 23.91264 24.84984 23.66422 25.09826
## 2021.981       24.44044 23.97184 24.90904 23.72342 25.15746
## 2022.000       24.47284 24.00424 24.94144 23.75582 25.18987
## 2022.019       24.45831 23.98971 24.92691 23.74128 25.17533
```

```
## 2022.038       24.49959 24.03138 24.96781 23.78316 25.21603
## 2022.058       24.54926 24.08105 25.01748 23.83283 25.26570
## 2022.077       24.61276 24.14455 25.08098 23.89633 25.32920
```

SBOO All: Imputed - Excluding External Variables (Forecasting DENSITY)

```
# SBOO All: Imputed - Training partition (01/18/1999-01/04/2021)
#owt_df02_gb09_sboo_wkly03_train_tb03
# SBOO All: Imputed - Test partition (01/11/2021-01/03/2022)
#owt_df02_gb09_sboo_wkly03_test_tb03

owt_df02_gb09_sboo_wkly03_train_tb03 %>%
  plot_time_series(date_sample,
                   DENSITY)
```

```
owt_df02_gb09_sboo_wkly03_train_tb03 %>%
  plot_stl_diagnostics(date_sample,
                       DENSITY,
                       .frequency = "auto",
                       .trend = "auto")
```

```
## frequency = 13 observations per 1 quarter
```

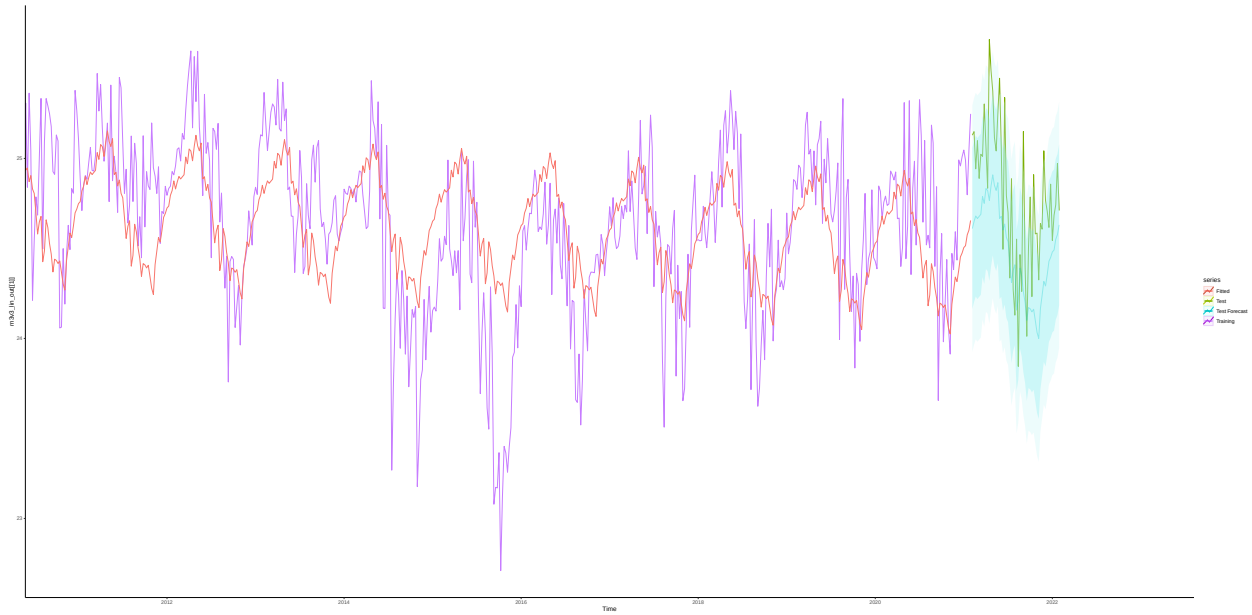
```
## trend = 53 observations per 1 year
```

```
m3v3_lin_out <- lr_ts_mod(tb_train = owt_df02_gb09_sboo_wkly03_train_tb03,
                          tb_test = owt_df02_gb09_sboo_wkly03_test_tb03,
                          date = "date_sample",
                          param = "DENSITY",
                          ext_pred = c(),
                          train_start = c(1999, lubridate::isoweek(ymd(train_start))),
                          test_start = c(2021, 6),
                          freq = 52,
                          h = 52,
                          formula = "DENSITY ~ trend + season")
```

```
##          Point Forecast    Lo 80    Hi 80    Lo 95    Hi 95
## 2021.096       24.61029 24.16308 25.05750 23.92600 25.29458
## 2021.115       24.64918 24.20197 25.09639 23.96489 25.33347
## 2021.135       24.67998 24.23277 25.12719 23.99569 25.36427
## 2021.154       24.66614 24.21894 25.11335 23.98185 25.35043
## 2021.173       24.67792 24.23071 25.12512 23.99363 25.36221
## 2021.192       24.68955 24.24234 25.13675 24.00526 25.37384
## 2021.212       24.78825 24.34104 25.23546 24.10396 25.47254
## 2021.231       24.75038 24.30317 25.19758 24.06609 25.43467
## 2021.250       24.83259 24.38538 25.27980 24.14830 25.51688
## 2021.269       24.82156 24.37435 25.26877 24.13727 25.50585
## 2021.288       24.76667 24.31947 25.21388 24.08238 25.45096
## 2021.308       24.84750 24.40029 25.29471 24.16321 25.53179
## 2021.327       24.90888 24.46167 25.35609 24.22459 25.59317
## 2021.346       24.84963 24.40242 25.29684 24.16534 25.53392
## 2021.365       24.82233 24.37512 25.26953 24.13804 25.50662
## 2021.385       24.86546 24.41825 25.31266 24.18117 25.54975
## 2021.404       24.66662 24.21942 25.11383 23.98233 25.35091
## 2021.423       24.67834 24.23113 25.12555 23.99405 25.36263
```

```
## 2021.442       24.60235 24.15514 25.04956 23.91806 25.28664
## 2021.462       24.63589 24.18868 25.08310 23.95160 25.32018
## 2021.481       24.56139 24.11419 25.00860 23.87710 25.24568
## 2021.500       24.53740 24.09019 24.98461 23.85311 25.22169
## 2021.519       24.42848 23.98127 24.87568 23.74419 25.11277
## 2021.538       24.31120 23.86399 24.75840 23.62691 24.99549
## 2021.558       24.37824 23.93103 24.82545 23.69395 25.06253
## 2021.577       24.40936 23.96215 24.85656 23.72507 25.09365
## 2021.596       24.15733 23.71012 24.60454 23.47304 24.84162
## 2021.615       24.21716 23.76995 24.66437 23.53287 24.90145
## 2021.635       24.39042 23.94321 24.83763 23.70613 25.07471
## 2021.654       24.34769 23.90048 24.79489 23.66340 25.03198
## 2021.673       24.25803 23.81082 24.70524 23.57374 24.94232
## 2021.692       24.20028 23.75307 24.64749 23.51599 24.88457
## 2021.712       24.10070 23.65349 24.54791 23.41641 24.78499
## 2021.731       24.17145 23.72424 24.61865 23.48716 24.85574
## 2021.750       24.16460 23.71740 24.61181 23.48031 24.84889
## 2021.769       24.14770 23.70049 24.59491 23.46341 24.83199
## 2021.788       24.16217 23.71496 24.60938 23.47788 24.84646
## 2021.808       24.09908 23.65187 24.54629 23.41479 24.78337
## 2021.827       24.03389 23.58668 24.48110 23.34960 24.71818
## 2021.846       24.00000 23.55280 24.44721 23.31571 24.68429
## 2021.865       24.16625 23.71904 24.61346 23.48196 24.85054
## 2021.885       24.24024 23.79303 24.68745 23.55595 24.92453
## 2021.904       24.31694 23.86974 24.76415 23.63265 25.00123
## 2021.923       24.29148 23.84427 24.73869 23.60719 24.97577
## 2021.942       24.35397 23.90676 24.80118 23.66968 25.03826
## 2021.962       24.42848 23.98127 24.87568 23.74419 25.11277
## 2021.981       24.45013 24.00292 24.89734 23.76584 25.13442
## 2022.000       24.48038 24.03318 24.92759 23.79609 25.16467
## 2022.019       24.49092 24.04371 24.93813 23.80663 25.17521
## 2022.038       24.55072 24.10388 24.99756 23.86699 25.23445
## 2022.058       24.57700 24.13016 25.02385 23.89328 25.26073
## 2022.077       24.63107 24.18423 25.07791 23.94734 25.31480
##                         ME      RMSE       MAE         MPE     MAPE     MASE
## Training set -2.798007e-17 0.3326557 0.2541997 -0.01841579 1.032368 1.263408
## Test set      3.166582e-01 0.4235576 0.3602488  1.26390269 1.444778 1.790487
##                   ACF1
## Training set 0.6520061
## Test set            NA
```

```
autoplot(m3v3_lin_out[[1]], series = 'Training') +
  autolayer(m3v3_lin_out[[2]], series = 'Test') +
  autolayer(m3v3_lin_out[[3]], series = 'Test Forecast', alpha = .3) +
  autolayer(m3v3_lin_out[[3]]$fitted, series = 'Fitted') +
  theme_classic() +
  coord_cartesian(#ylim = c(-50, 400),
                  xlim = c(2011, 2023))
```




```r
summary(m3v3_lin_out[[3]])
```

```
##
## Forecast method: Linear regression model
##
## Model Information:
##
## Call:
## tslm(formula = as.formula(formula), data = train_ts01)
##
## Coefficients:
## (Intercept)        trend      season2      season3      season4      season5
##  25.0417603   -0.0004698    0.0110090    0.0712780    0.0980308    0.1525658
##     season6      season7      season8      season9     season10     season11
##   0.1078284    0.1471860    0.1784557    0.1650903    0.1773321    0.1894318
##    season12     season13     season14     season15     season16     season17
##   0.2886061    0.2512015    0.3338875    0.3233242    0.2689084    0.3502046
##    season18     season19     season20     season21     season22     season23
##   0.4120513    0.3532771    0.3264399    0.3700406    0.1716783    0.1838657
##    season24     season25     season26     season27     season28     season29
##   0.1083453    0.1423525    0.0683264    0.0448021   -0.0636511   -0.1804622
##    season30     season31     season32     season33     season34     season35
##  -0.1129465   -0.0813626   -0.3329194   -0.2726196   -0.0988885   -0.1411537
##    season36     season37     season38     season39     season40     season41
##  -0.2303418   -0.2876174   -0.3867274   -0.3155147   -0.3218860   -0.3383215
##    season42     season43     season44     season45     season46     season47
##  -0.3233811   -0.3860008   -0.4507198   -0.4841374   -0.3174195   -0.2429598
##    season48     season49     season50     season51     season52
##  -0.1657881   -0.1907846   -0.1278259   -0.0528468   -0.0307239
##
##
## Error measures:
##                        ME      RMSE       MAE         MPE     MAPE      MASE
## Training set -2.798007e-17 0.3326557 0.2541997 -0.01841579 1.032368 0.7493704
```

```
##                   ACF1
## Training set 0.6520061
##
## Forecasts:
##          Point Forecast    Lo 80    Hi 80    Lo 95    Hi 95
## 2021.096       24.61029 24.16308 25.05750 23.92600 25.29458
## 2021.115       24.64918 24.20197 25.09639 23.96489 25.33347
## 2021.135       24.67998 24.23277 25.12719 23.99569 25.36427
## 2021.154       24.66614 24.21894 25.11335 23.98185 25.35043
## 2021.173       24.67792 24.23071 25.12512 23.99363 25.36221
## 2021.192       24.68955 24.24234 25.13675 24.00526 25.37384
## 2021.212       24.78825 24.34104 25.23546 24.10396 25.47254
## 2021.231       24.75038 24.30317 25.19758 24.06609 25.43467
## 2021.250       24.83259 24.38538 25.27980 24.14830 25.51688
## 2021.269       24.82156 24.37435 25.26877 24.13727 25.50585
## 2021.288       24.76667 24.31947 25.21388 24.08238 25.45096
## 2021.308       24.84750 24.40029 25.29471 24.16321 25.53179
## 2021.327       24.90888 24.46167 25.35609 24.22459 25.59317
## 2021.346       24.84963 24.40242 25.29684 24.16534 25.53392
## 2021.365       24.82233 24.37512 25.26953 24.13804 25.50662
## 2021.385       24.86546 24.41825 25.31266 24.18117 25.54975
## 2021.404       24.66662 24.21942 25.11383 23.98233 25.35091
## 2021.423       24.67834 24.23113 25.12555 23.99405 25.36263
## 2021.442       24.60235 24.15514 25.04956 23.91806 25.28664
## 2021.462       24.63589 24.18868 25.08310 23.95160 25.32018
## 2021.481       24.56139 24.11419 25.00860 23.87710 25.24568
## 2021.500       24.53740 24.09019 24.98461 23.85311 25.22169
## 2021.519       24.42848 23.98127 24.87568 23.74419 25.11277
## 2021.538       24.31120 23.86399 24.75840 23.62691 24.99549
## 2021.558       24.37824 23.93103 24.82545 23.69395 25.06253
## 2021.577       24.40936 23.96215 24.85656 23.72507 25.09365
## 2021.596       24.15733 23.71012 24.60454 23.47304 24.84162
## 2021.615       24.21716 23.76995 24.66437 23.53287 24.90145
## 2021.635       24.39042 23.94321 24.83763 23.70613 25.07471
## 2021.654       24.34769 23.90048 24.79489 23.66340 25.03198
## 2021.673       24.25803 23.81082 24.70524 23.57374 24.94232
## 2021.692       24.20028 23.75307 24.64749 23.51599 24.88457
## 2021.712       24.10070 23.65349 24.54791 23.41641 24.78499
## 2021.731       24.17145 23.72424 24.61865 23.48716 24.85574
## 2021.750       24.16460 23.71740 24.61181 23.48031 24.84889
## 2021.769       24.14770 23.70049 24.59491 23.46341 24.83199
## 2021.788       24.16217 23.71496 24.60938 23.47788 24.84646
## 2021.808       24.09908 23.65187 24.54629 23.41479 24.78337
## 2021.827       24.03389 23.58668 24.48110 23.34960 24.71818
## 2021.846       24.00000 23.55280 24.44721 23.31571 24.68429
## 2021.865       24.16625 23.71904 24.61346 23.48196 24.85054
## 2021.885       24.24024 23.79303 24.68745 23.55595 24.92453
## 2021.904       24.31694 23.86974 24.76415 23.63265 25.00123
## 2021.923       24.29148 23.84427 24.73869 23.60719 24.97577
## 2021.942       24.35397 23.90676 24.80118 23.66968 25.03826
## 2021.962       24.42848 23.98127 24.87568 23.74419 25.11277
## 2021.981       24.45013 24.00292 24.89734 23.76584 25.13442
## 2022.000       24.48038 24.03318 24.92759 23.79609 25.16467
## 2022.019       24.49092 24.04371 24.93813 23.80663 25.17521
```

```
## 2022.038       24.55072 24.10388 24.99756 23.86699 25.23445
## 2022.058       24.57700 24.13016 25.02385 23.89328 25.26073
## 2022.077       24.63107 24.18423 25.07791 23.94734 25.31480
```

SBOO Excluding Outliers: Imputed - Excluding External Variables (Forecasting DENSITY)

```
# SBOO Excluding Outliers: Imputed - Training partition (01/18/1999-01/04/2021)
#owt_df02_gb09_sboo_wkly02_train_tb03
# SBOO Excluding Outliers: Imputed - Test partition (01/11/2021-01/03/2022)
#owt_df02_gb09_sboo_wkly02_test_tb03

owt_df02_gb09_sboo_wkly02_train_tb03 %>%
  plot_time_series(date_sample,
                   DENSITY)
```

```
owt_df02_gb09_sboo_wkly02_train_tb03 %>%
  plot_stl_diagnostics(date_sample,
                       DENSITY,
                       .frequency = "auto",
                       .trend = "auto")
```

```
## frequency = 13 observations per 1 quarter
```

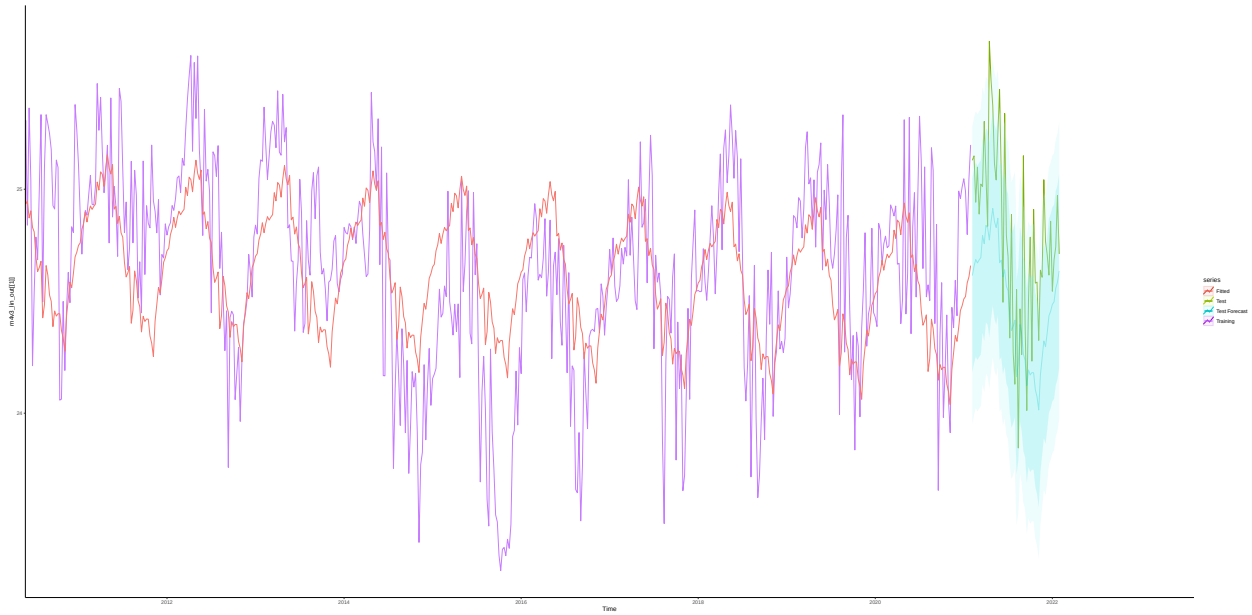
```
## trend = 53 observations per 1 year
```

```
m4v3_lin_out <- lr_ts_mod(tb_train = owt_df02_gb09_sboo_wkly02_train_tb03,
                          tb_test = owt_df02_gb09_sboo_wkly02_test_tb03,
                          date = "date_sample",
                          param = "DENSITY",
                          ext_pred = c(),
                          train_start = c(1999, lubridate::isoweek(ymd(train_start))),
                          test_start = c(2021, 6),
                          freq = 52,
                          h = 52,
                          formula = "DENSITY ~ trend + season")
```

```
##          Point Forecast    Lo 80    Hi 80    Lo 95    Hi 95
## 2021.096       24.61448 24.18115 25.04781 23.95143 25.27754
## 2021.115       24.65566 24.22233 25.08899 23.99260 25.31871
## 2021.135       24.68606 24.25273 25.11939 24.02300 25.34911
## 2021.154       24.67092 24.23759 25.10425 24.00787 25.33397
## 2021.173       24.68433 24.25100 25.11766 24.02128 25.34739
## 2021.192       24.69499 24.26166 25.12832 24.03194 25.35804
## 2021.212       24.79328 24.35995 25.22661 24.13023 25.45634
## 2021.231       24.75665 24.32332 25.18998 24.09359 25.41970
## 2021.250       24.83837 24.40504 25.27170 24.17531 25.50142
## 2021.269       24.82758 24.39425 25.26091 24.16453 25.49063
## 2021.288       24.77328 24.33995 25.20661 24.11023 25.43634
## 2021.308       24.85462 24.42129 25.28795 24.19156 25.51767
## 2021.327       24.91436 24.48104 25.34769 24.25131 25.57742
## 2021.346       24.85562 24.42229 25.28895 24.19256 25.51867
## 2021.365       24.82874 24.39541 25.26207 24.16569 25.49180
## 2021.385       24.87047 24.43714 25.30380 24.20741 25.53352
## 2021.404       24.67180 24.23847 25.10513 24.00875 25.33486
## 2021.423       24.68351 24.25018 25.11684 24.02046 25.34657
```

```
## 2021.442       24.60840 24.17507 25.04173 23.94535 25.27146
## 2021.462       24.64028 24.20695 25.07361 23.97723 25.30334
## 2021.481       24.56644 24.13311 24.99977 23.90339 25.22950
## 2021.500       24.54641 24.11308 24.97974 23.88335 25.20946
## 2021.519       24.43417 24.00084 24.86750 23.77112 25.09723
## 2021.538       24.36886 23.93553 24.80219 23.70580 25.03191
## 2021.558       24.38770 23.95437 24.82103 23.72465 25.05076
## 2021.577       24.41513 23.98180 24.84846 23.75207 25.07818
## 2021.596       24.16261 23.72928 24.59594 23.49955 24.82566
## 2021.615       24.22035 23.78702 24.65368 23.55729 24.88340
## 2021.635       24.39576 23.96243 24.82909 23.73271 25.05881
## 2021.654       24.35330 23.91997 24.78663 23.69024 25.01635
## 2021.673       24.26404 23.83071 24.69737 23.60098 24.92709
## 2021.692       24.23649 23.80316 24.66982 23.57344 24.89955
## 2021.712       24.12363 23.69030 24.55696 23.46058 24.78669
## 2021.731       24.19332 23.75999 24.62665 23.53027 24.85637
## 2021.750       24.17063 23.73730 24.60396 23.50758 24.83369
## 2021.769       24.18128 23.74795 24.61461 23.51823 24.84434
## 2021.788       24.18073 23.74740 24.61406 23.51768 24.84379
## 2021.808       24.10536 23.67203 24.53869 23.44230 24.76841
## 2021.827       24.07347 23.64014 24.50680 23.41042 24.73653
## 2021.846       24.01429 23.58096 24.44762 23.35124 24.67734
## 2021.865       24.17209 23.73876 24.60542 23.50904 24.83515
## 2021.885       24.24588 23.81255 24.67921 23.58283 24.90893
## 2021.904       24.32280 23.88947 24.75613 23.65974 24.98585
## 2021.923       24.29679 23.86346 24.73012 23.63374 24.95984
## 2021.942       24.35968 23.92635 24.79301 23.69662 25.02273
## 2021.962       24.43463 24.00130 24.86796 23.77158 25.09769
## 2021.981       24.45538 24.02205 24.88871 23.79233 25.11843
## 2022.000       24.48591 24.05258 24.91924 23.82286 25.14896
## 2022.019       24.49705 24.06372 24.93038 23.83400 25.16010
## 2022.038       24.55800 24.12502 24.99097 23.89549 25.22051
## 2022.058       24.58437 24.15140 25.01735 23.92186 25.24688
## 2022.077       24.63507 24.20210 25.06804 23.97256 25.29758
##                        ME      RMSE       MAE         MPE     MAPE     MASE
## Training set 1.537781e-17 0.3223322 0.2498774 -0.01720746 1.013680 1.259573
## Test set     3.070166e-01 0.4160535 0.3528652  1.22485103 1.415072 1.778710
##                   ACF1
## Training set 0.6443114
## Test set            NA
```

```
autoplot(m4v3_lin_out[[1]], series = 'Training') +
  autolayer(m4v3_lin_out[[2]], series = 'Test') +
  autolayer(m4v3_lin_out[[3]], series = 'Test Forecast', alpha = .3) +
  autolayer(m4v3_lin_out[[3]]$fitted, series = 'Fitted') +
  theme_classic() +
  coord_cartesian(#ylim = c(-50, 400),
                  xlim = c(2011, 2023))
```




```r
summary(m4v3_lin_out[[3]])
```

```
##
## Forecast method: Linear regression model
##
## Model Information:
##
## Call:
## tslm(formula = as.formula(formula), data = train_ts01)
##
## Coefficients:
## (Intercept)        trend      season2      season3      season4      season5
##  25.0356824   -0.0004601    0.0116001    0.0730078    0.0998429    0.1509991
##     season6      season7      season8      season9     season10     season11
##   0.1069505    0.1485823    0.1794448    0.1647678    0.1786420    0.1897574
##    season12     season13     season14     season15     season16     season17
##   0.2885086    0.2523327    0.3345139    0.3241873    0.2703485    0.3521452
##    season18     season19     season20     season21     season22     season23
##   0.4123527    0.3540656    0.3276523    0.3698347    0.1716294    0.1838007
##    season24     season25     season26     season27     season28     season29
##   0.1091518    0.1414890    0.0681124    0.0485362   -0.0632368   -0.1280942
##    season30     season31     season32     season33     season34     season35
##  -0.1087901   -0.0809060   -0.3329658   -0.2747655   -0.0988908   -0.1408935
##    season36     season37     season38     season39     season40     season41
##  -0.2296922   -0.2567784   -0.3691782   -0.2990309   -0.3212594   -0.3101461
##    season42     season43     season44     season45     season46     season47
##  -0.3102373   -0.3851553   -0.4165798   -0.4753008   -0.3170392   -0.2427899
##    season48     season49     season50     season51     season52
##  -0.1654119   -0.1909596   -0.1276126   -0.0521993   -0.0309902
##
##
## Error measures:
##                        ME      RMSE       MAE         MPE    MAPE      MASE
## Training set 1.537781e-17 0.3223322 0.2498774 -0.01720746 1.01368 0.7490735
```

```
##                   ACF1
## Training set 0.6443114
##
## Forecasts:
##          Point Forecast    Lo 80    Hi 80    Lo 95    Hi 95
## 2021.096       24.61448 24.18115 25.04781 23.95143 25.27754
## 2021.115       24.65566 24.22233 25.08899 23.99260 25.31871
## 2021.135       24.68606 24.25273 25.11939 24.02300 25.34911
## 2021.154       24.67092 24.23759 25.10425 24.00787 25.33397
## 2021.173       24.68433 24.25100 25.11766 24.02128 25.34739
## 2021.192       24.69499 24.26166 25.12832 24.03194 25.35804
## 2021.212       24.79328 24.35995 25.22661 24.13023 25.45634
## 2021.231       24.75665 24.32332 25.18998 24.09359 25.41970
## 2021.250       24.83837 24.40504 25.27170 24.17531 25.50142
## 2021.269       24.82758 24.39425 25.26091 24.16453 25.49063
## 2021.288       24.77328 24.33995 25.20661 24.11023 25.43634
## 2021.308       24.85462 24.42129 25.28795 24.19156 25.51767
## 2021.327       24.91436 24.48104 25.34769 24.25131 25.57742
## 2021.346       24.85562 24.42229 25.28895 24.19256 25.51867
## 2021.365       24.82874 24.39541 25.26207 24.16569 25.49180
## 2021.385       24.87047 24.43714 25.30380 24.20741 25.53352
## 2021.404       24.67180 24.23847 25.10513 24.00875 25.33486
## 2021.423       24.68351 24.25018 25.11684 24.02046 25.34657
## 2021.442       24.60840 24.17507 25.04173 23.94535 25.27146
## 2021.462       24.64028 24.20695 25.07361 23.97723 25.30334
## 2021.481       24.56644 24.13311 24.99977 23.90339 25.22950
## 2021.500       24.54641 24.11308 24.97974 23.88335 25.20946
## 2021.519       24.43417 24.00084 24.86750 23.77112 25.09723
## 2021.538       24.36886 23.93553 24.80219 23.70580 25.03191
## 2021.558       24.38770 23.95437 24.82103 23.72465 25.05076
## 2021.577       24.41513 23.98180 24.84846 23.75207 25.07818
## 2021.596       24.16261 23.72928 24.59594 23.49955 24.82566
## 2021.615       24.22035 23.78702 24.65368 23.55729 24.88340
## 2021.635       24.39576 23.96243 24.82909 23.73271 25.05881
## 2021.654       24.35330 23.91997 24.78663 23.69024 25.01635
## 2021.673       24.26404 23.83071 24.69737 23.60098 24.92709
## 2021.692       24.23649 23.80316 24.66982 23.57344 24.89955
## 2021.712       24.12363 23.69030 24.55696 23.46058 24.78669
## 2021.731       24.19332 23.75999 24.62665 23.53027 24.85637
## 2021.750       24.17063 23.73730 24.60396 23.50758 24.83369
## 2021.769       24.18128 23.74795 24.61461 23.51823 24.84434
## 2021.788       24.18073 23.74740 24.61406 23.51768 24.84379
## 2021.808       24.10536 23.67203 24.53869 23.44230 24.76841
## 2021.827       24.07347 23.64014 24.50680 23.41042 24.73653
## 2021.846       24.01429 23.58096 24.44762 23.35124 24.67734
## 2021.865       24.17209 23.73876 24.60542 23.50904 24.83515
## 2021.885       24.24588 23.81255 24.67921 23.58283 24.90893
## 2021.904       24.32280 23.88947 24.75613 23.65974 24.98585
## 2021.923       24.29679 23.86346 24.73012 23.63374 24.95984
## 2021.942       24.35968 23.92635 24.79301 23.69662 25.02273
## 2021.962       24.43463 24.00130 24.86796 23.77158 25.09769
## 2021.981       24.45538 24.02205 24.88871 23.79233 25.11843
## 2022.000       24.48591 24.05258 24.91924 23.82286 25.14896
## 2022.019       24.49705 24.06372 24.93038 23.83400 25.16010
```

```
## 2022.038       24.55800 24.12502 24.99097 23.89549 25.22051
## 2022.058       24.58437 24.15140 25.01735 23.92186 25.24688
## 2022.077       24.63507 24.20210 25.06804 23.97256 25.29758
```

PLOO All: Imputed - Excluding External Variables (Forecasting PH)

```
# PLOO All: Imputed - Training partition (01/18/1999-01/04/2021)
#owt_df02_gb09_ploo_wkly03_train_tb03
# PLOO All: Imputed - Test partition (01/11/2021-01/03/2022)
#owt_df02_gb09_ploo_wkly03_test_tb03

owt_df02_gb09_ploo_wkly03_train_tb03 %>%
  plot_time_series(date_sample,
                   PH)
```

```
owt_df02_gb09_ploo_wkly03_train_tb03 %>%
  plot_stl_diagnostics(date_sample,
                       PH,
                       .frequency = "auto",
                       .trend = "auto")
```

```
## frequency = 13 observations per 1 quarter
```

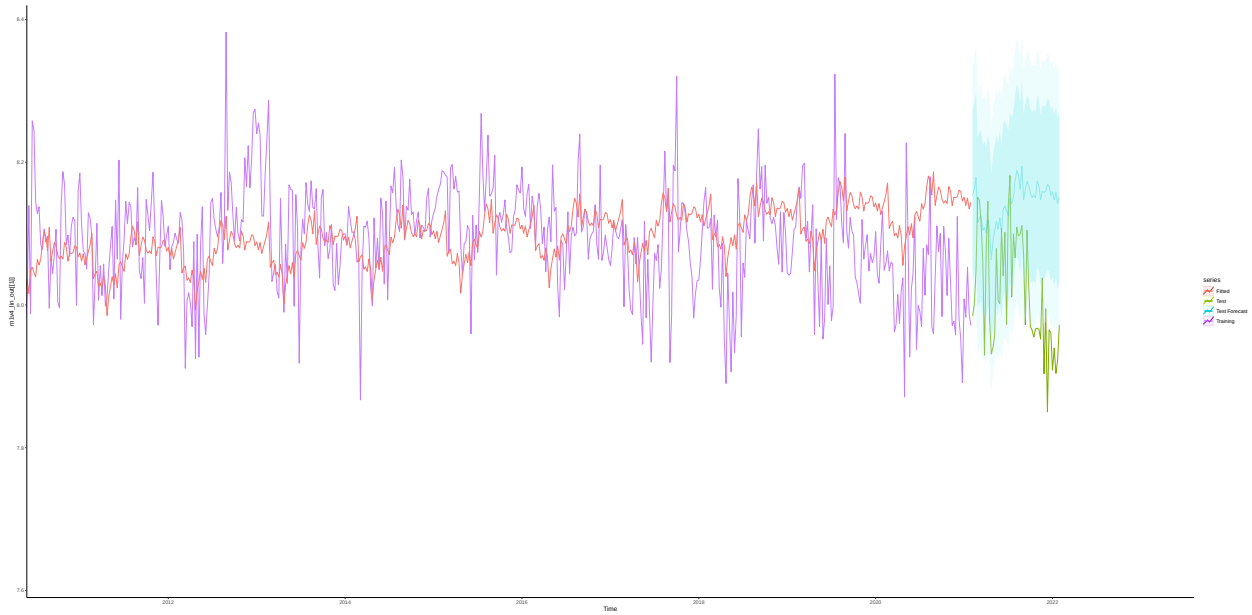
```
## trend = 53 observations per 1 year
```

```
m1v4_lin_out <- lr_ts_mod(tb_train = owt_df02_gb09_ploo_wkly03_train_tb03,
                          tb_test = owt_df02_gb09_ploo_wkly03_test_tb03,
                          date = "date_sample",
                          param = "PH",
                          ext_pred = c(),
                          train_start = c(1999, lubridate::isoweek(ymd(train_start))),
                          test_start = c(2021, 6),
                          freq = 52,
                          h = 52,
                          formula = "PH ~ trend + season")
```

```
##          Point Forecast    Lo 80    Hi 80    Lo 95    Hi 95
## 2021.096       8.152664 8.032622 8.272705 7.968984 8.336344
## 2021.115       8.162232 8.042190 8.282273 7.978552 8.345912
## 2021.135       8.178741 8.058699 8.298782 7.995061 8.362421
## 2021.154       8.115119 7.995078 8.235161 7.931439 8.298799
## 2021.173       8.121785 8.001743 8.241826 7.938105 8.305465
## 2021.192       8.124910 8.004869 8.244952 7.941230 8.308590
## 2021.212       8.104772 7.984730 8.224813 7.921092 8.288452
## 2021.231       8.108103 7.988061 8.228144 7.924423 8.291783
## 2021.250       8.101635 7.981594 8.221677 7.917955 8.285315
## 2021.269       8.118970 7.998929 8.239012 7.935290 8.302650
## 2021.288       8.105608 7.985567 8.225650 7.921928 8.289288
## 2021.308       8.063330 7.943288 8.183371 7.879650 8.247010
## 2021.327       8.090080 7.970039 8.210122 7.906400 8.273760
## 2021.346       8.104200 7.984158 8.224242 7.920520 8.287880
## 2021.365       8.117617 7.997576 8.237659 7.933937 8.301297
## 2021.385       8.106113 7.986071 8.226154 7.922433 8.289793
```

```
## 2021.404       8.121581 8.001539 8.241622 7.937901 8.305261
## 2021.423       8.101911 7.981870 8.221953 7.918231 8.285591
## 2021.442       8.134162 8.014120 8.254203 7.950482 8.317842
## 2021.462       8.138630 8.018588 8.258671 7.954950 8.322310
## 2021.481       8.131610 8.011568 8.251651 7.947930 8.315290
## 2021.500       8.125141 8.005100 8.245183 7.941461 8.308821
## 2021.519       8.149701 8.029659 8.269742 7.966021 8.333381
## 2021.538       8.141860 8.021818 8.261901 7.958180 8.325540
## 2021.558       8.149860 8.029818 8.269901 7.966180 8.333540
## 2021.577       8.173744 8.053702 8.293785 7.990064 8.357424
## 2021.596       8.188443 8.068402 8.308485 8.004763 8.372123
## 2021.615       8.181349 8.061307 8.301391 7.997669 8.365029
## 2021.635       8.162175 8.042134 8.282217 7.978495 8.345855
## 2021.654       8.194435 8.074393 8.314476 8.010755 8.378115
## 2021.673       8.147336 8.027294 8.267377 7.963656 8.331016
## 2021.692       8.161219 8.041177 8.281261 7.977539 8.344899
## 2021.712       8.173107 8.053065 8.293148 7.989427 8.356787
## 2021.731       8.168633 8.048591 8.288674 7.984953 8.352313
## 2021.750       8.155928 8.035887 8.275970 7.972248 8.339608
## 2021.769       8.150462 8.030421 8.270504 7.966782 8.334142
## 2021.788       8.153941 8.033899 8.273982 7.970261 8.337621
## 2021.808       8.150070 8.030029 8.270112 7.966390 8.333750
## 2021.827       8.173687 8.053645 8.293728 7.990007 8.357367
## 2021.846       8.166918 8.046877 8.286960 7.983238 8.350598
## 2021.865       8.147175 8.027134 8.267217 7.963495 8.330855
## 2021.885       8.159049 8.039008 8.279091 7.975369 8.342729
## 2021.904       8.157913 8.037872 8.277955 7.974233 8.341593
## 2021.923       8.159354 8.039312 8.279395 7.975674 8.343034
## 2021.942       8.168660 8.048619 8.288702 7.984980 8.352340
## 2021.962       8.166768 8.046727 8.286810 7.983088 8.350448
## 2021.981       8.153389 8.033347 8.273430 7.969709 8.337069
## 2022.000       8.158520 8.038478 8.278561 7.974840 8.342200
## 2022.019       8.147277 8.027236 8.267319 7.963597 8.330957
## 2022.038       8.157615 8.037672 8.277557 7.974086 8.341144
## 2022.058       8.142275 8.022333 8.262218 7.958746 8.325804
## 2022.077       8.151615 8.031672 8.271558 7.968086 8.335144
##                         ME       RMSE        MAE         MPE      MAPE     MASE
## Training set -9.269220e-18 0.08929282 0.07080095 -0.01237585 0.8807666 1.277369
## Test set     -1.245855e-01 0.15000693 0.12993314 -1.56348438 1.6290748 2.344214
##                   ACF1
## Training set 0.6564464
## Test set            NA
```

```
autoplot(m1v4_lin_out[[1]], series = 'Training') +
  autolayer(m1v4_lin_out[[2]], series = 'Test') +
  autolayer(m1v4_lin_out[[3]], series = 'Test Forecast', alpha = .3) +
  autolayer(m1v4_lin_out[[3]]$fitted, series = 'Fitted') +
  theme_classic() +
  coord_cartesian(#ylim = c(-50, 400),
                  xlim = c(2011, 2023))
```




```
summary(m1v4_lin_out[[3]])
```

```
##
## Forecast method: Linear regression model
##
## Model Information:
##
## Call:
## tslm(formula = as.formula(formula), data = train_ts01)
##
## Coefficients:
## (Intercept)        trend      season2      season3      season4      season5
##   7.9792102    0.0001500   -0.0113925   -0.0012053   -0.0166947   -0.0075052
##     season6      season7      season8      season9     season10     season11
##   0.0011960    0.0106141    0.0269733   -0.0367986   -0.0302831   -0.0273073
##    season12     season13     season14     season15     season16     season17
##  -0.0475963   -0.0444153   -0.0510328   -0.0338475   -0.0473597   -0.0897882
##    season18     season19     season20     season21     season22     season23
##  -0.0631879   -0.0492182   -0.0359508   -0.0476054   -0.0322878   -0.0521070
##    season24     season25     season26     season27     season28     season29
##  -0.0200069   -0.0156886   -0.0228587   -0.0294771   -0.0050681   -0.0130589
##    season30     season31     season32     season33     season34     season35
##  -0.0052088    0.0185250    0.0330742    0.0258301    0.0065064    0.0386156
##    season36     season37     season38     season39     season40     season41
##  -0.0086332    0.0050999    0.0168375    0.0122134   -0.0006408   -0.0062569
##    season42     season43     season44     season45     season46     season47
##  -0.0029286   -0.0069489    0.0165172    0.0095988   -0.0102944    0.0014298
##    season48     season49     season50     season51     season52
##   0.0001438    0.0014341    0.0105906    0.0085482   -0.0049809
##
##
## Error measures:
##                        ME       RMSE        MAE         MPE      MAPE      MASE
## Training set -9.26922e-18 0.08929282 0.07080095 -0.01237585 0.8807666 0.8898097
```

```
##                    ACF1
## Training set 0.6564464
##
## Forecasts:
##          Point Forecast    Lo 80    Hi 80    Lo 95    Hi 95
## 2021.096       8.152664 8.032622 8.272705 7.968984 8.336344
## 2021.115       8.162232 8.042190 8.282273 7.978552 8.345912
## 2021.135       8.178741 8.058699 8.298782 7.995061 8.362421
## 2021.154       8.115119 7.995078 8.235161 7.931439 8.298799
## 2021.173       8.121785 8.001743 8.241826 7.938105 8.305465
## 2021.192       8.124910 8.004869 8.244952 7.941230 8.308590
## 2021.212       8.104772 7.984730 8.224813 7.921092 8.288452
## 2021.231       8.108103 7.988061 8.228144 7.924423 8.291783
## 2021.250       8.101635 7.981594 8.221677 7.917955 8.285315
## 2021.269       8.118970 7.998929 8.239012 7.935290 8.302650
## 2021.288       8.105608 7.985567 8.225650 7.921928 8.289288
## 2021.308       8.063330 7.943288 8.183371 7.879650 8.247010
## 2021.327       8.090080 7.970039 8.210122 7.906400 8.273760
## 2021.346       8.104200 7.984158 8.224242 7.920520 8.287880
## 2021.365       8.117617 7.997576 8.237659 7.933937 8.301297
## 2021.385       8.106113 7.986071 8.226154 7.922433 8.289793
## 2021.404       8.121581 8.001539 8.241622 7.937901 8.305261
## 2021.423       8.101911 7.981870 8.221953 7.918231 8.285591
## 2021.442       8.134162 8.014120 8.254203 7.950482 8.317842
## 2021.462       8.138630 8.018588 8.258671 7.954950 8.322310
## 2021.481       8.131610 8.011568 8.251651 7.947930 8.315290
## 2021.500       8.125141 8.005100 8.245183 7.941461 8.308821
## 2021.519       8.149701 8.029659 8.269742 7.966021 8.333381
## 2021.538       8.141860 8.021818 8.261901 7.958180 8.325540
## 2021.558       8.149860 8.029818 8.269901 7.966180 8.333540
## 2021.577       8.173744 8.053702 8.293785 7.990064 8.357424
## 2021.596       8.188443 8.068402 8.308485 8.004763 8.372123
## 2021.615       8.181349 8.061307 8.301391 7.997669 8.365029
## 2021.635       8.162175 8.042134 8.282217 7.978495 8.345855
## 2021.654       8.194435 8.074393 8.314476 8.010755 8.378115
## 2021.673       8.147336 8.027294 8.267377 7.963656 8.331016
## 2021.692       8.161219 8.041177 8.281261 7.977539 8.344899
## 2021.712       8.173107 8.053065 8.293148 7.989427 8.356787
## 2021.731       8.168633 8.048591 8.288674 7.984953 8.352313
## 2021.750       8.155928 8.035887 8.275970 7.972248 8.339608
## 2021.769       8.150462 8.030421 8.270504 7.966782 8.334142
## 2021.788       8.153941 8.033899 8.273982 7.970261 8.337621
## 2021.808       8.150070 8.030029 8.270112 7.966390 8.333750
## 2021.827       8.173687 8.053645 8.293728 7.990007 8.357367
## 2021.846       8.166918 8.046877 8.286960 7.983238 8.350598
## 2021.865       8.147175 8.027134 8.267217 7.963495 8.330855
## 2021.885       8.159049 8.039008 8.279091 7.975369 8.342729
## 2021.904       8.157913 8.037872 8.277955 7.974233 8.341593
## 2021.923       8.159354 8.039312 8.279395 7.975674 8.343034
## 2021.942       8.168660 8.048619 8.288702 7.984980 8.352340
## 2021.962       8.166768 8.046727 8.286810 7.983088 8.350448
## 2021.981       8.153389 8.033347 8.273430 7.969709 8.337069
## 2022.000       8.158520 8.038478 8.278561 7.974840 8.342200
## 2022.019       8.147277 8.027236 8.267319 7.963597 8.330957
```

```
## 2022.038       8.157615 8.037672 8.277557 7.974086 8.341144
## 2022.058       8.142275 8.022333 8.262218 7.958746 8.325804
## 2022.077       8.151615 8.031672 8.271558 7.968086 8.335144
```

PLOO Excluding Outliers: Imputed - Excluding External Variables (Forecasting PH)

```
# PLOO Excluding Outliers: Imputed - Training partition (01/18/1999-01/04/2021)
#owt_df02_gb09_ploo_wkly02_train_tb03
# PLOO Excluding Outliers: Imputed - Test partition (01/11/2021-01/03/2022)
#owt_df02_gb09_ploo_wkly02_test_tb03

owt_df02_gb09_ploo_wkly02_train_tb03 %>%
  plot_time_series(date_sample,
                   PH)
```

```
owt_df02_gb09_ploo_wkly02_train_tb03 %>%
  plot_stl_diagnostics(date_sample,
                       PH,
                       .frequency = "auto",
                       .trend = "auto")
```

```
## frequency = 13 observations per 1 quarter
```

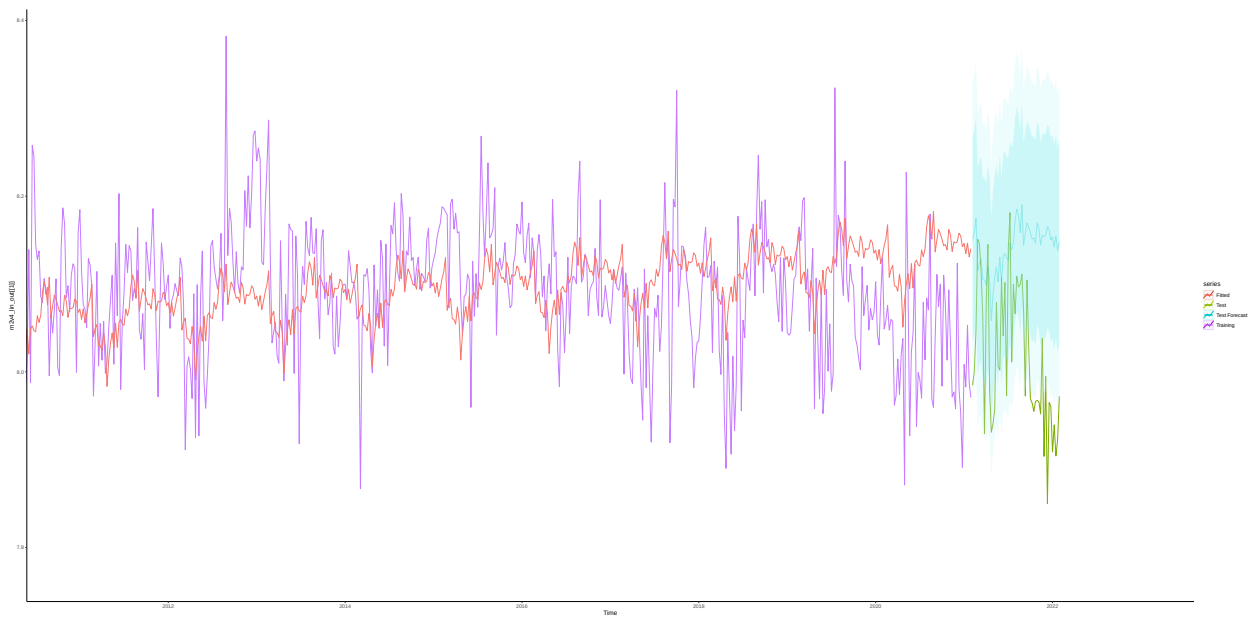
```
## trend = 53 observations per 1 year
```

```
m2v4_lin_out <- lr_ts_mod(tb_train = owt_df02_gb09_ploo_wkly02_train_tb03,
                          tb_test = owt_df02_gb09_ploo_wkly02_test_tb03,
                          date = "date_sample",
                          param = "PH",
                          ext_pred = c(),
                          train_start = c(1999, lubridate::isoweek(ymd(train_start))),
                          test_start = c(2021, 6),
                          freq = 52,
                          h = 52,
                          formula = "PH ~ trend + season")
```

```
##          Point Forecast    Lo 80    Hi 80    Lo 95    Hi 95
## 2021.096       8.150967 8.034804 8.267129 7.973222 8.328711
## 2021.115       8.158797 8.042635 8.274960 7.981053 8.336542
## 2021.135       8.174858 8.058696 8.291021 7.997114 8.352603
## 2021.154       8.115035 7.998873 8.231198 7.937291 8.292780
## 2021.173       8.124301 8.008139 8.240464 7.946557 8.302046
## 2021.192       8.128639 8.012477 8.244802 7.950895 8.306384
## 2021.212       8.105430 7.989268 8.221593 7.927686 8.283175
## 2021.231       8.104659 7.988496 8.220821 7.926914 8.282403
## 2021.250       8.099254 7.983092 8.215417 7.921510 8.276999
## 2021.269       8.118779 8.002617 8.234942 7.941035 8.296524
## 2021.288       8.104518 7.988355 8.220680 7.926773 8.282262
## 2021.308       8.058426 7.942264 8.174589 7.880682 8.236171
## 2021.327       8.088605 7.972442 8.204767 7.910860 8.266349
## 2021.346       8.107510 7.991347 8.223672 7.929765 8.285254
## 2021.365       8.119174 8.003011 8.235336 7.941429 8.296918
## 2021.385       8.102420 7.986257 8.218582 7.924675 8.280164
## 2021.404       8.130639 8.014476 8.246801 7.952894 8.308383
## 2021.423       8.102903 7.986740 8.219065 7.925158 8.280647
```

```
## 2021.442       8.131596 8.015433 8.247758 7.953851 8.309340
## 2021.462       8.134702 8.018540 8.250865 7.956958 8.312447
## 2021.481       8.129282 8.013120 8.245445 7.951538 8.307027
## 2021.500       8.127939 8.011776 8.244101 7.950194 8.305683
## 2021.519       8.146308 8.030146 8.262470 7.968563 8.324052
## 2021.538       8.138693 8.022530 8.254855 7.960948 8.316437
## 2021.558       8.146851 8.030688 8.263013 7.969106 8.324595
## 2021.577       8.172710 8.056547 8.288872 7.994965 8.350454
## 2021.596       8.185252 8.069090 8.301415 8.007508 8.362997
## 2021.615       8.177830 8.061668 8.293993 8.000086 8.355575
## 2021.635       8.158597 8.042434 8.274759 7.980852 8.336341
## 2021.654       8.190133 8.073970 8.306295 8.012388 8.367877
## 2021.673       8.144030 8.027868 8.260192 7.966285 8.321774
## 2021.692       8.157621 8.041458 8.273783 7.979876 8.335365
## 2021.712       8.169602 8.053439 8.285764 7.991857 8.347346
## 2021.731       8.164819 8.048657 8.280982 7.987075 8.342564
## 2021.750       8.158244 8.042082 8.274406 7.980500 8.335989
## 2021.769       8.151238 8.035076 8.267401 7.973494 8.328983
## 2021.788       8.152377 8.036215 8.268540 7.974633 8.330122
## 2021.808       8.146488 8.030326 8.262651 7.968744 8.324233
## 2021.827       8.169563 8.053400 8.285725 7.991818 8.347307
## 2021.846       8.163050 8.046887 8.279212 7.985305 8.340794
## 2021.865       8.144514 8.028351 8.260676 7.966769 8.322258
## 2021.885       8.155472 8.039310 8.271634 7.977727 8.333216
## 2021.904       8.154209 8.038047 8.270372 7.976465 8.331954
## 2021.923       8.155564 8.039402 8.271726 7.977820 8.333309
## 2021.942       8.165335 8.049172 8.281497 7.987590 8.343079
## 2021.962       8.162480 8.046317 8.278642 7.984735 8.340224
## 2021.981       8.150077 8.033914 8.266239 7.972332 8.327821
## 2022.000       8.153662 8.037499 8.269824 7.975917 8.331406
## 2022.019       8.142154 8.025991 8.258316 7.964409 8.319898
## 2022.038       8.154161 8.038094 8.270227 7.976562 8.331759
## 2022.058       8.138294 8.022227 8.254361 7.960695 8.315892
## 2022.077       8.147688 8.031621 8.263755 7.970089 8.325286
##                         ME       RMSE        MAE         MPE      MAPE     MASE
## Training set -1.104657e-17 0.08640738 0.06927462 -0.01155372 0.8610721 1.276506
## Test set     -1.225481e-01 0.14774555 0.12779428 -1.53798322 1.6023184 2.354833
##                   ACF1
## Training set 0.6478792
## Test set            NA
```

```
autoplot(m2v4_lin_out[[1]], series = 'Training') +
  autolayer(m2v4_lin_out[[2]], series = 'Test') +
  autolayer(m2v4_lin_out[[3]], series = 'Test Forecast', alpha = .3) +
  autolayer(m2v4_lin_out[[3]]$fitted, series = 'Fitted') +
  theme_classic() +
  coord_cartesian(#ylim = c(-50, 400),
                  xlim = c(2011, 2023))
```




```
summary(m2v4_lin_out[[3]])
```

```
##
## Forecast method: Linear regression model
##
## Model Information:
##
## Call:
## tslm(formula = as.formula(formula), data = train_ts01)
##
## Coefficients:
## (Intercept)        trend      season2      season3      season4      season5
##   7.9815006    0.0001441   -0.0116517    0.0002109   -0.0158001   -0.0065501
##     season6      season7      season8      season9     season10     season11
##   0.0040766    0.0117627    0.0276796   -0.0322873   -0.0231654   -0.0189713
##    season12     season13     season14     season15     season16     season17
##  -0.0423245   -0.0432401   -0.0487886   -0.0294078   -0.0438132   -0.0900486
##    season18     season19     season20     season21     season22     season23
##  -0.0600143   -0.0412534   -0.0297337   -0.0466314   -0.0185566   -0.0464367
##    season24     season25     season26     season27     season28     season29
##  -0.0178877   -0.0149252   -0.0204894   -0.0219769   -0.0037518   -0.0115109
##    season30     season31     season32     season33     season34     season35
##  -0.0034972    0.0222177    0.0346162    0.0270503    0.0076727    0.0390644
##    season36     season37     season38     season39     season40     season41
##  -0.0071824    0.0062641    0.0181014    0.0131747    0.0064554   -0.0006943
##    season42     season43     season44     season45     season46     season47
##   0.0003004   -0.0057324    0.0171976    0.0105407   -0.0081395    0.0026749
##    season48     season49     season50     season51     season52
##   0.0012681    0.0024788    0.0121054    0.0091062   -0.0034408
##
##
## Error measures:
##                         ME       RMSE        MAE         MPE      MAPE
## Training set -1.104657e-17 0.08640738 0.06927462 -0.01155372 0.8610721
```

```
##                    MASE      ACF1
## Training set 0.8953634 0.6478792
##
## Forecasts:
##          Point Forecast    Lo 80    Hi 80    Lo 95    Hi 95
## 2021.096       8.150967 8.034804 8.267129 7.973222 8.328711
## 2021.115       8.158797 8.042635 8.274960 7.981053 8.336542
## 2021.135       8.174858 8.058696 8.291021 7.997114 8.352603
## 2021.154       8.115035 7.998873 8.231198 7.937291 8.292780
## 2021.173       8.124301 8.008139 8.240464 7.946557 8.302046
## 2021.192       8.128639 8.012477 8.244802 7.950895 8.306384
## 2021.212       8.105430 7.989268 8.221593 7.927686 8.283175
## 2021.231       8.104659 7.988496 8.220821 7.926914 8.282403
## 2021.250       8.099254 7.983092 8.215417 7.921510 8.276999
## 2021.269       8.118779 8.002617 8.234942 7.941035 8.296524
## 2021.288       8.104518 7.988355 8.220680 7.926773 8.282262
## 2021.308       8.058426 7.942264 8.174589 7.880682 8.236171
## 2021.327       8.088605 7.972442 8.204767 7.910860 8.266349
## 2021.346       8.107510 7.991347 8.223672 7.929765 8.285254
## 2021.365       8.119174 8.003011 8.235336 7.941429 8.296918
## 2021.385       8.102420 7.986257 8.218582 7.924675 8.280164
## 2021.404       8.130639 8.014476 8.246801 7.952894 8.308383
## 2021.423       8.102903 7.986740 8.219065 7.925158 8.280647
## 2021.442       8.131596 8.015433 8.247758 7.953851 8.309340
## 2021.462       8.134702 8.018540 8.250865 7.956958 8.312447
## 2021.481       8.129282 8.013120 8.245445 7.951538 8.307027
## 2021.500       8.127939 8.011776 8.244101 7.950194 8.305683
## 2021.519       8.146308 8.030146 8.262470 7.968563 8.324052
## 2021.538       8.138693 8.022530 8.254855 7.960948 8.316437
## 2021.558       8.146851 8.030688 8.263013 7.969106 8.324595
## 2021.577       8.172710 8.056547 8.288872 7.994965 8.350454
## 2021.596       8.185252 8.069090 8.301415 8.007508 8.362997
## 2021.615       8.177830 8.061668 8.293993 8.000086 8.355575
## 2021.635       8.158597 8.042434 8.274759 7.980852 8.336341
## 2021.654       8.190133 8.073970 8.306295 8.012388 8.367877
## 2021.673       8.144030 8.027868 8.260192 7.966285 8.321774
## 2021.692       8.157621 8.041458 8.273783 7.979876 8.335365
## 2021.712       8.169602 8.053439 8.285764 7.991857 8.347346
## 2021.731       8.164819 8.048657 8.280982 7.987075 8.342564
## 2021.750       8.158244 8.042082 8.274406 7.980500 8.335989
## 2021.769       8.151238 8.035076 8.267401 7.973494 8.328983
## 2021.788       8.152377 8.036215 8.268540 7.974633 8.330122
## 2021.808       8.146488 8.030326 8.262651 7.968744 8.324233
## 2021.827       8.169563 8.053400 8.285725 7.991818 8.347307
## 2021.846       8.163050 8.046887 8.279212 7.985305 8.340794
## 2021.865       8.144514 8.028351 8.260676 7.966769 8.322258
## 2021.885       8.155472 8.039310 8.271634 7.977727 8.333216
## 2021.904       8.154209 8.038047 8.270372 7.976465 8.331954
## 2021.923       8.155564 8.039402 8.271726 7.977820 8.333309
## 2021.942       8.165335 8.049172 8.281497 7.987590 8.343079
## 2021.962       8.162480 8.046317 8.278642 7.984735 8.340224
## 2021.981       8.150077 8.033914 8.266239 7.972332 8.327821
## 2022.000       8.153662 8.037499 8.269824 7.975917 8.331406
## 2022.019       8.142154 8.025991 8.258316 7.964409 8.319898
```

```
## 2022.038       8.154161 8.038094 8.270227 7.976562 8.331759
## 2022.058       8.138294 8.022227 8.254361 7.960695 8.315892
## 2022.077       8.147688 8.031621 8.263755 7.970089 8.325286
```

SBOO All: Imputed - Excluding External Variables (Forecasting PH)

```
# SBOO All: Imputed - Training partition (01/18/1999-01/04/2021)
#owt_df02_gb09_sboo_wkly03_train_tb03
# SBOO All: Imputed - Test partition (01/11/2021-01/03/2022)
#owt_df02_gb09_sboo_wkly03_test_tb03

owt_df02_gb09_sboo_wkly03_train_tb03 %>%
  plot_time_series(date_sample,
                   PH)
```

```
owt_df02_gb09_sboo_wkly03_train_tb03 %>%
  plot_stl_diagnostics(date_sample,
                       PH,
                       .frequency = "auto",
                       .trend = "auto")
```

```
## frequency = 13 observations per 1 quarter
```

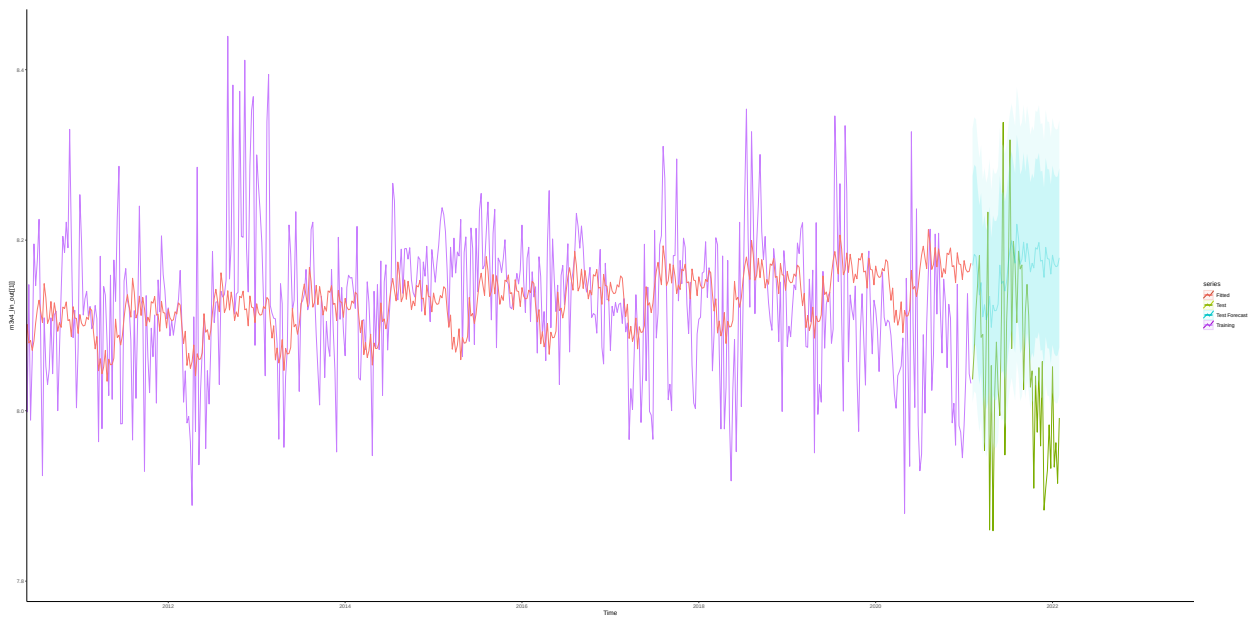
```
## trend = 53 observations per 1 year
```

```
m3v4_lin_out <- lr_ts_mod(tb_train = owt_df02_gb09_sboo_wkly03_train_tb03,
                          tb_test = owt_df02_gb09_sboo_wkly03_test_tb03,
                          date = "date_sample",
                          param = "PH",
                          ext_pred = c(),
                          train_start = c(1999, lubridate::isoweek(ymd(train_start))),
                          test_start = c(2021, 6),
                          freq = 52,
                          h = 52,
                          formula = "PH ~ trend + season")
```

```
##          Point Forecast    Lo 80    Hi 80    Lo 95    Hi 95
## 2021.096       8.170310 8.065223 8.275397 8.009513 8.331107
## 2021.115       8.183372 8.078286 8.288459 8.022575 8.344169
## 2021.135       8.180848 8.075761 8.285934 8.020051 8.341645
## 2021.154       8.155613 8.050526 8.260699 7.994815 8.316410
## 2021.173       8.135751 8.030664 8.240838 7.974954 8.296548
## 2021.192       8.150171 8.045085 8.255258 7.989374 8.310968
## 2021.212       8.110065 8.004978 8.215151 7.949268 8.270862
## 2021.231       8.124223 8.019137 8.229310 7.963426 8.285020
## 2021.250       8.106575 8.001488 8.211662 7.945778 8.267372
## 2021.269       8.114596 8.009510 8.219683 7.953799 8.275393
## 2021.288       8.134020 8.028934 8.239107 7.973223 8.294817
## 2021.308       8.097782 7.992695 8.202869 7.936985 8.258579
## 2021.327       8.123734 8.018648 8.228821 7.962937 8.284531
## 2021.346       8.117076 8.011989 8.222163 7.956279 8.277873
## 2021.365       8.117711 8.012624 8.222797 7.956914 8.278508
## 2021.385       8.124883 8.019796 8.229969 7.964086 8.285680
## 2021.404       8.170687 8.065600 8.275774 8.009890 8.331484
## 2021.423       8.148958 8.043872 8.254045 7.988161 8.309755
```

```
## 2021.442       8.151902 8.046815 8.256988 7.991104 8.312699
## 2021.462       8.140302 8.035215 8.245389 7.979505 8.301099
## 2021.481       8.151369 8.046282 8.256456 7.990572 8.312166
## 2021.500       8.172404 8.067317 8.277490 8.011607 8.333201
## 2021.519       8.188708 8.083622 8.293795 8.027911 8.349505
## 2021.538       8.199297 8.094211 8.304384 8.038500 8.360094
## 2021.558       8.185384 8.080297 8.290470 8.024587 8.346181
## 2021.577       8.172992 8.067906 8.278079 8.012195 8.333789
## 2021.596       8.218667 8.113581 8.323754 8.057870 8.379464
## 2021.615       8.202242 8.097156 8.307329 8.041445 8.363039
## 2021.635       8.171993 8.066906 8.277080 8.011196 8.332790
## 2021.654       8.177704 8.072617 8.282791 8.016907 8.338501
## 2021.673       8.197638 8.092551 8.302725 8.036841 8.358435
## 2021.692       8.174987 8.069900 8.280074 8.014190 8.335784
## 2021.712       8.196122 8.091035 8.301209 8.035325 8.356919
## 2021.731       8.183012 8.077925 8.288099 8.022215 8.343809
## 2021.750       8.162744 8.057657 8.267831 8.001947 8.323541
## 2021.769       8.172865 8.067778 8.277952 8.012068 8.333662
## 2021.788       8.167346 8.062260 8.272433 8.006549 8.328143
## 2021.808       8.191087 8.086000 8.296173 8.030290 8.351884
## 2021.827       8.189401 8.084315 8.294488 8.028604 8.350198
## 2021.846       8.197240 8.092153 8.302326 8.036443 8.358037
## 2021.865       8.175355 8.070268 8.280442 8.014558 8.336152
## 2021.885       8.176395 8.071308 8.281481 8.015598 8.337192
## 2021.904       8.156394 8.051307 8.261480 7.995597 8.317191
## 2021.923       8.191555 8.086469 8.296642 8.030758 8.352353
## 2021.942       8.178355 8.073268 8.283441 8.017558 8.339152
## 2021.962       8.177791 8.072704 8.282878 8.016994 8.338588
## 2021.981       8.160223 8.055136 8.265309 7.999426 8.321020
## 2022.000       8.182348 8.077262 8.287435 8.021551 8.343145
## 2022.019       8.172164 8.067077 8.277250 8.011367 8.332961
## 2022.038       8.168929 8.063928 8.273929 8.008264 8.329593
## 2022.058       8.169766 8.064765 8.274766 8.009101 8.330431
## 2022.077       8.179305 8.074304 8.284305 8.018640 8.339969
##                         ME       RMSE        MAE          MPE      MAPE
## Training set  7.593386e-17 0.07816866 0.06033009 -0.009313191 0.7453154
## Test set     -1.079938e-01 0.15322399 0.12694409 -1.358164499 1.5867912
##                   MASE      ACF1
## Training set 0.9956236 0.4193761
## Test set     2.0949500        NA
```

```
autoplot(m3v4_lin_out[[1]], series = 'Training') +
  autolayer(m3v4_lin_out[[2]], series = 'Test') +
  autolayer(m3v4_lin_out[[3]], series = 'Test Forecast', alpha = .3) +
  autolayer(m3v4_lin_out[[3]]$fitted, series = 'Fitted') +
  theme_classic() +
  coord_cartesian(#ylim = c(-50, 400),
                  xlim = c(2011, 2023))
```




```
summary(m3v4_lin_out[[3]])
```

```
##
## Forecast method: Linear regression model
##
## Model Information:
##
## Call:
## tslm(formula = as.formula(formula), data = train_ts01)
##
## Coefficients:
## (Intercept)        trend      season2      season3      season4      season5
##   8.0368835    0.0001217   -0.0103065   -0.0136633   -0.0129479   -0.0035307
##     season6      season7      season8      season9     season10     season11
##  -0.0063173    0.0066232    0.0039769   -0.0213799   -0.0413630   -0.0270645
##    season12     season13     season14     season15     season16     season17
##  -0.0672929   -0.0532560   -0.0710262   -0.0631263   -0.0438243   -0.0801844
##    season18     season19     season20     season21     season22     season23
##  -0.0543537   -0.0611338   -0.0606209   -0.0535703   -0.0078879   -0.0297383
##    season24     season25     season26     season27     season28     season29
##  -0.0269168   -0.0386381   -0.0276928   -0.0067797    0.0094032    0.0198705
##    season30     season31     season32     season33     season34     season35
##   0.0058349   -0.0066782    0.0388753    0.0223285   -0.0080427   -0.0024534
##    season36     season37     season38     season39     season40     season41
##   0.0173590   -0.0054138    0.0155995    0.0023678   -0.0180221   -0.0080228
##    season42     season43     season44     season45     season46     season47
##  -0.0136630    0.0099554    0.0081485    0.0158650   -0.0061413   -0.0052233
##    season48     season49     season50     season51     season52
##  -0.0253460    0.0096940   -0.0036287   -0.0043141   -0.0220040
##
##
## Error measures:
##                        ME       RMSE        MAE          MPE      MAPE
## Training set 7.593386e-17 0.07816866 0.06033009 -0.009313191 0.7453154
```

```
##                    MASE      ACF1
## Training set 0.7376559 0.4193761
##
## Forecasts:
##          Point Forecast    Lo 80    Hi 80    Lo 95    Hi 95
## 2021.096       8.170310 8.065223 8.275397 8.009513 8.331107
## 2021.115       8.183372 8.078286 8.288459 8.022575 8.344169
## 2021.135       8.180848 8.075761 8.285934 8.020051 8.341645
## 2021.154       8.155613 8.050526 8.260699 7.994815 8.316410
## 2021.173       8.135751 8.030664 8.240838 7.974954 8.296548
## 2021.192       8.150171 8.045085 8.255258 7.989374 8.310968
## 2021.212       8.110065 8.004978 8.215151 7.949268 8.270862
## 2021.231       8.124223 8.019137 8.229310 7.963426 8.285020
## 2021.250       8.106575 8.001488 8.211662 7.945778 8.267372
## 2021.269       8.114596 8.009510 8.219683 7.953799 8.275393
## 2021.288       8.134020 8.028934 8.239107 7.973223 8.294817
## 2021.308       8.097782 7.992695 8.202869 7.936985 8.258579
## 2021.327       8.123734 8.018648 8.228821 7.962937 8.284531
## 2021.346       8.117076 8.011989 8.222163 7.956279 8.277873
## 2021.365       8.117711 8.012624 8.222797 7.956914 8.278508
## 2021.385       8.124883 8.019796 8.229969 7.964086 8.285680
## 2021.404       8.170687 8.065600 8.275774 8.009890 8.331484
## 2021.423       8.148958 8.043872 8.254045 7.988161 8.309755
## 2021.442       8.151902 8.046815 8.256988 7.991104 8.312699
## 2021.462       8.140302 8.035215 8.245389 7.979505 8.301099
## 2021.481       8.151369 8.046282 8.256456 7.990572 8.312166
## 2021.500       8.172404 8.067317 8.277490 8.011607 8.333201
## 2021.519       8.188708 8.083622 8.293795 8.027911 8.349505
## 2021.538       8.199297 8.094211 8.304384 8.038500 8.360094
## 2021.558       8.185384 8.080297 8.290470 8.024587 8.346181
## 2021.577       8.172992 8.067906 8.278079 8.012195 8.333789
## 2021.596       8.218667 8.113581 8.323754 8.057870 8.379464
## 2021.615       8.202242 8.097156 8.307329 8.041445 8.363039
## 2021.635       8.171993 8.066906 8.277080 8.011196 8.332790
## 2021.654       8.177704 8.072617 8.282791 8.016907 8.338501
## 2021.673       8.197638 8.092551 8.302725 8.036841 8.358435
## 2021.692       8.174987 8.069900 8.280074 8.014190 8.335784
## 2021.712       8.196122 8.091035 8.301209 8.035325 8.356919
## 2021.731       8.183012 8.077925 8.288099 8.022215 8.343809
## 2021.750       8.162744 8.057657 8.267831 8.001947 8.323541
## 2021.769       8.172865 8.067778 8.277952 8.012068 8.333662
## 2021.788       8.167346 8.062260 8.272433 8.006549 8.328143
## 2021.808       8.191087 8.086000 8.296173 8.030290 8.351884
## 2021.827       8.189401 8.084315 8.294488 8.028604 8.350198
## 2021.846       8.197240 8.092153 8.302326 8.036443 8.358037
## 2021.865       8.175355 8.070268 8.280442 8.014558 8.336152
## 2021.885       8.176395 8.071308 8.281481 8.015598 8.337192
## 2021.904       8.156394 8.051307 8.261480 7.995597 8.317191
## 2021.923       8.191555 8.086469 8.296642 8.030758 8.352353
## 2021.942       8.178355 8.073268 8.283441 8.017558 8.339152
## 2021.962       8.177791 8.072704 8.282878 8.016994 8.338588
## 2021.981       8.160223 8.055136 8.265309 7.999426 8.321020
## 2022.000       8.182348 8.077262 8.287435 8.021551 8.343145
## 2022.019       8.172164 8.067077 8.277250 8.011367 8.332961
```

```
## 2022.038       8.168929 8.063928 8.273929 8.008264 8.329593
## 2022.058       8.169766 8.064765 8.274766 8.009101 8.330431
## 2022.077       8.179305 8.074304 8.284305 8.018640 8.339969
```

SBOO Excluding Outliers: Imputed - Excluding External Variables (Forecasting PH)

```
# SBOO Excluding Outliers: Imputed - Training partition (01/18/1999-01/04/2021)
#owt_df02_gb09_sboo_wkly02_train_tb03
# SBOO Excluding Outliers: Imputed - Test partition (01/11/2021-01/03/2022)
#owt_df02_gb09_sboo_wkly02_test_tb03

owt_df02_gb09_sboo_wkly02_train_tb03 %>%
  plot_time_series(date_sample,
                   PH)
```

```
owt_df02_gb09_sboo_wkly02_train_tb03 %>%
  plot_stl_diagnostics(date_sample,
                       PH,
                       .frequency = "auto",
                       .trend = "auto")
```

```
## frequency = 13 observations per 1 quarter
```

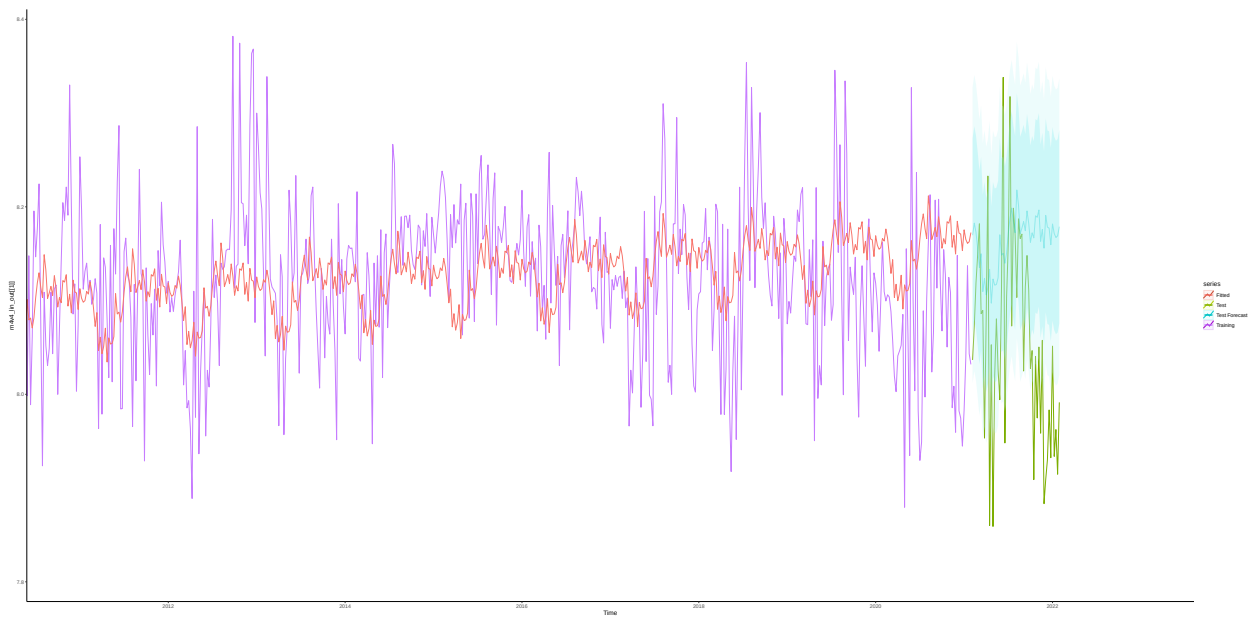
```
## trend = 53 observations per 1 year
```

```
m4v4_lin_out <- lr_ts_mod(tb_train = owt_df02_gb09_sboo_wkly02_train_tb03,
                          tb_test = owt_df02_gb09_sboo_wkly02_test_tb03,
                          date = "date_sample",
                          param = "PH",
                          ext_pred = c(),
                          train_start = c(1999, lubridate::isoweek(ymd(train_start))),
                          test_start = c(2021, 6),
                          freq = 52,
                          h = 52,
                          formula = "PH ~ trend + season")
```

```
##          Point Forecast    Lo 80    Hi 80    Lo 95    Hi 95
## 2021.096       8.169729 8.066500 8.272958 8.011775 8.327684
## 2021.115       8.182674 8.079445 8.285903 8.024719 8.340628
## 2021.135       8.172775 8.069546 8.276003 8.014820 8.330729
## 2021.154       8.155168 8.051939 8.258397 7.997214 8.313122
## 2021.173       8.135248 8.032019 8.238477 7.977293 8.293202
## 2021.192       8.149929 8.046700 8.253157 7.991974 8.307883
## 2021.212       8.109634 8.006405 8.212863 7.951680 8.267588
## 2021.231       8.123715 8.020486 8.226944 7.965760 8.281669
## 2021.250       8.106115 8.002886 8.209343 7.948160 8.264069
## 2021.269       8.114009 8.010780 8.217238 7.956054 8.271963
## 2021.288       8.133369 8.030140 8.236598 7.975415 8.291323
## 2021.308       8.097270 7.994041 8.200499 7.939316 8.255225
## 2021.327       8.123039 8.019810 8.226268 7.965085 8.280993
## 2021.346       8.116442 8.013213 8.219671 7.958487 8.274396
## 2021.365       8.117170 8.013941 8.220399 7.959215 8.275124
## 2021.385       8.124312 8.021083 8.227540 7.966357 8.282266
## 2021.404       8.170178 8.066949 8.273407 8.012224 8.328132
## 2021.423       8.148498 8.045269 8.251727 7.990543 8.306452
```

```
## 2021.442       8.150425 8.047196 8.253654 7.992470 8.308379
## 2021.462       8.139793 8.036564 8.243022 7.981839 8.297748
## 2021.481       8.150871 8.047642 8.254100 7.992917 8.308826
## 2021.500       8.171865 8.068636 8.275094 8.013911 8.329820
## 2021.519       8.188150 8.084922 8.291379 8.030196 8.346105
## 2021.538       8.198767 8.095538 8.301996 8.040812 8.356721
## 2021.558       8.183336 8.080107 8.286565 8.025382 8.341291
## 2021.577       8.172346 8.069117 8.275575 8.014391 8.330300
## 2021.596       8.218018 8.114790 8.321247 8.060064 8.375973
## 2021.615       8.201687 8.098458 8.304916 8.043733 8.359641
## 2021.635       8.171396 8.068167 8.274625 8.013442 8.329350
## 2021.654       8.177234 8.074005 8.280463 8.019279 8.335188
## 2021.673       8.184254 8.081026 8.287483 8.026300 8.342209
## 2021.692       8.174487 8.071258 8.277716 8.016533 8.332442
## 2021.712       8.195637 8.092408 8.298866 8.037682 8.353591
## 2021.731       8.182507 8.079279 8.285736 8.024553 8.340462
## 2021.750       8.162141 8.058912 8.265370 8.004186 8.320095
## 2021.769       8.172296 8.069067 8.275525 8.014342 8.330250
## 2021.788       8.166782 8.063554 8.270011 8.008828 8.324737
## 2021.808       8.190414 8.087185 8.293643 8.032460 8.348369
## 2021.827       8.188814 8.085585 8.292043 8.030860 8.346769
## 2021.846       8.196688 8.093459 8.299917 8.038733 8.354642
## 2021.865       8.163214 8.059985 8.266442 8.005259 8.321168
## 2021.885       8.175820 8.072591 8.279049 8.017865 8.333774
## 2021.904       8.155926 8.052697 8.259155 7.997972 8.313881
## 2021.923       8.190881 8.087652 8.294110 8.032927 8.348835
## 2021.942       8.178346 8.075117 8.281575 8.020392 8.336301
## 2021.962       8.177292 8.074063 8.280521 8.019337 8.335246
## 2021.981       8.159601 8.056372 8.262830 8.001647 8.317555
## 2022.000       8.181765 8.078536 8.284994 8.023811 8.339720
## 2022.019       8.171584 8.068355 8.274813 8.013630 8.329538
## 2022.038       8.167292 8.064148 8.270436 8.009467 8.325116
## 2022.058       8.169050 8.065906 8.272194 8.011225 8.326875
## 2022.077       8.178840 8.075696 8.281984 8.021016 8.336665
##                         ME       RMSE        MAE          MPE      MAPE
## Training set  5.344694e-17 0.07678678 0.05975517 -0.008998726 0.7384776
## Test set     -1.067714e-01 0.15220261 0.12592061 -1.342966486 1.5740041
##                  MASE      ACF1
## Training set 1.002478 0.4212881
## Test set     2.112497        NA
```

```
autoplot(m4v4_lin_out[[1]], series = 'Training') +
  autolayer(m4v4_lin_out[[2]], series = 'Test') +
  autolayer(m4v4_lin_out[[3]], series = 'Test Forecast', alpha = .3) +
  autolayer(m4v4_lin_out[[3]]$fitted, series = 'Fitted') +
  theme_classic() +
  coord_cartesian(#ylim = c(-50, 400),
                  xlim = c(2011, 2023))
```




```
summary(m4v4_lin_out[[3]])
```

```
##
## Forecast method: Linear regression model
##
## Model Information:
##
## Call:
## tslm(formula = as.formula(formula), data = train_ts01)
##
## Coefficients:
## (Intercept)        trend      season2      season3      season4      season5
##   8.0374475    0.0001208   -0.0103021   -0.0147150   -0.0130777   -0.0034082
##     season6      season7      season8      season9     season10     season11
##  -0.0063599    0.0064637   -0.0035562   -0.0212836   -0.0413245   -0.0267645
##    season12     season13     season14     season15     season16     season17
##  -0.0671798   -0.0532200   -0.0709409   -0.0631672   -0.0439279   -0.0801473
##    season18     season19     season20     season21     season22     season23
##  -0.0544994   -0.0612175   -0.0606101   -0.0535892   -0.0078435   -0.0296446
##    season24     season25     season26     season27     season28     season29
##  -0.0278384   -0.0385905   -0.0276332   -0.0067601    0.0094043    0.0198998
##    season30     season31     season32     season33     season34     season35
##   0.0043485   -0.0067627    0.0387892    0.0223371   -0.0080748   -0.0023578
##    season36     season37     season38     season39     season40     season41
##   0.0045422   -0.0053459    0.0156831    0.0024328   -0.0180544   -0.0080202
##    season42     season43     season44     season45     season46     season47
##  -0.0136544    0.0098567    0.0081359    0.0158884   -0.0177065   -0.0052211
##    season48     season49     season50     season51     season52
##  -0.0252353    0.0095988   -0.0030570   -0.0042321   -0.0220436
##
##
## Error measures:
##                        ME       RMSE        MAE          MPE      MAPE
## Training set 5.344694e-17 0.07678678 0.05975517 -0.008998726 0.7384776
```

```
##                    MASE      ACF1
## Training set 0.7410219 0.4212881
##
## Forecasts:
##          Point Forecast    Lo 80    Hi 80    Lo 95    Hi 95
## 2021.096       8.169729 8.066500 8.272958 8.011775 8.327684
## 2021.115       8.182674 8.079445 8.285903 8.024719 8.340628
## 2021.135       8.172775 8.069546 8.276003 8.014820 8.330729
## 2021.154       8.155168 8.051939 8.258397 7.997214 8.313122
## 2021.173       8.135248 8.032019 8.238477 7.977293 8.293202
## 2021.192       8.149929 8.046700 8.253157 7.991974 8.307883
## 2021.212       8.109634 8.006405 8.212863 7.951680 8.267588
## 2021.231       8.123715 8.020486 8.226944 7.965760 8.281669
## 2021.250       8.106115 8.002886 8.209343 7.948160 8.264069
## 2021.269       8.114009 8.010780 8.217238 7.956054 8.271963
## 2021.288       8.133369 8.030140 8.236598 7.975415 8.291323
## 2021.308       8.097270 7.994041 8.200499 7.939316 8.255225
## 2021.327       8.123039 8.019810 8.226268 7.965085 8.280993
## 2021.346       8.116442 8.013213 8.219671 7.958487 8.274396
## 2021.365       8.117170 8.013941 8.220399 7.959215 8.275124
## 2021.385       8.124312 8.021083 8.227540 7.966357 8.282266
## 2021.404       8.170178 8.066949 8.273407 8.012224 8.328132
## 2021.423       8.148498 8.045269 8.251727 7.990543 8.306452
## 2021.442       8.150425 8.047196 8.253654 7.992470 8.308379
## 2021.462       8.139793 8.036564 8.243022 7.981839 8.297748
## 2021.481       8.150871 8.047642 8.254100 7.992917 8.308826
## 2021.500       8.171865 8.068636 8.275094 8.013911 8.329820
## 2021.519       8.188150 8.084922 8.291379 8.030196 8.346105
## 2021.538       8.198767 8.095538 8.301996 8.040812 8.356721
## 2021.558       8.183336 8.080107 8.286565 8.025382 8.341291
## 2021.577       8.172346 8.069117 8.275575 8.014391 8.330300
## 2021.596       8.218018 8.114790 8.321247 8.060064 8.375973
## 2021.615       8.201687 8.098458 8.304916 8.043733 8.359641
## 2021.635       8.171396 8.068167 8.274625 8.013442 8.329350
## 2021.654       8.177234 8.074005 8.280463 8.019279 8.335188
## 2021.673       8.184254 8.081026 8.287483 8.026300 8.342209
## 2021.692       8.174487 8.071258 8.277716 8.016533 8.332442
## 2021.712       8.195637 8.092408 8.298866 8.037682 8.353591
## 2021.731       8.182507 8.079279 8.285736 8.024553 8.340462
## 2021.750       8.162141 8.058912 8.265370 8.004186 8.320095
## 2021.769       8.172296 8.069067 8.275525 8.014342 8.330250
## 2021.788       8.166782 8.063554 8.270011 8.008828 8.324737
## 2021.808       8.190414 8.087185 8.293643 8.032460 8.348369
## 2021.827       8.188814 8.085585 8.292043 8.030860 8.346769
## 2021.846       8.196688 8.093459 8.299917 8.038733 8.354642
## 2021.865       8.163214 8.059985 8.266442 8.005259 8.321168
## 2021.885       8.175820 8.072591 8.279049 8.017865 8.333774
## 2021.904       8.155926 8.052697 8.259155 7.997972 8.313881
## 2021.923       8.190881 8.087652 8.294110 8.032927 8.348835
## 2021.942       8.178346 8.075117 8.281575 8.020392 8.336301
## 2021.962       8.177292 8.074063 8.280521 8.019337 8.335246
## 2021.981       8.159601 8.056372 8.262830 8.001647 8.317555
## 2022.000       8.181765 8.078536 8.284994 8.023811 8.339720
## 2022.019       8.171584 8.068355 8.274813 8.013630 8.329538
```

```
## 2022.038       8.167292 8.064148 8.270436 8.009467 8.325116
## 2022.058       8.169050 8.065906 8.272194 8.011225 8.326875
## 2022.077       8.178840 8.075696 8.281984 8.021016 8.336665
```

PLOO All: Imputed - Excluding External Variables (Forecasting SALINITY)

```
# PLOO All: Imputed - Training partition (01/18/1999-01/04/2021)
#owt_df02_gb09_ploo_wkly03_train_tb03
# PLOO All: Imputed - Test partition (01/11/2021-01/03/2022)
#owt_df02_gb09_ploo_wkly03_test_tb03

owt_df02_gb09_ploo_wkly03_train_tb03 %>%
  plot_time_series(date_sample,
                   SALINITY)
```

```
owt_df02_gb09_ploo_wkly03_train_tb03 %>%
  plot_stl_diagnostics(date_sample,
                       SALINITY,
                       .frequency = "auto",
                       .trend = "auto")
```

```
## frequency = 13 observations per 1 quarter
```

```
## trend = 53 observations per 1 year
```

```
m1v5_lin_out <- lr_ts_mod(tb_train = owt_df02_gb09_ploo_wkly03_train_tb03,
                          tb_test = owt_df02_gb09_ploo_wkly03_test_tb03,
                          date = "date_sample",
                          param = "SALINITY",
                          ext_pred = c(),
                          train_start = c(1999, lubridate::isoweek(ymd(train_start))),
                          test_start = c(2021, 6),
                          freq = 52,
                          h = 52,
                          formula = "SALINITY ~ trend + season")
```

```
##          Point Forecast    Lo 80    Hi 80    Lo 95    Hi 95
## 2021.096       33.42302 33.22214 33.62390 33.11565 33.73039
## 2021.115       33.42077 33.21989 33.62164 33.11339 33.72814
## 2021.135       33.42944 33.22856 33.63032 33.12207 33.73681
## 2021.154       33.44559 33.24471 33.64647 33.13822 33.75296
## 2021.173       33.42688 33.22600 33.62776 33.11951 33.73425
## 2021.192       33.43081 33.22993 33.63169 33.12344 33.73818
## 2021.212       33.45630 33.25542 33.65718 33.14893 33.76367
## 2021.231       33.45863 33.25775 33.65951 33.15126 33.76600
## 2021.250       33.50178 33.30090 33.70266 33.19441 33.80915
## 2021.269       33.51466 33.31378 33.71554 33.20729 33.82203
## 2021.288       33.51867 33.31779 33.71955 33.21130 33.82604
## 2021.308       33.58090 33.38002 33.78178 33.27353 33.88827
## 2021.327       33.61351 33.41264 33.81439 33.30614 33.92089
## 2021.346       33.57152 33.37064 33.77240 33.26415 33.87889
## 2021.365       33.56633 33.36545 33.76721 33.25896 33.87370
## 2021.385       33.62365 33.42277 33.82453 33.31627 33.93102
```

```
## 2021.404       33.61126 33.41038 33.81214 33.30389 33.91863
## 2021.423       33.61125 33.41037 33.81213 33.30388 33.91862
## 2021.442       33.59852 33.39764 33.79940 33.29115 33.90589
## 2021.462       33.59807 33.39719 33.79894 33.29069 33.90544
## 2021.481       33.59845 33.39757 33.79933 33.29108 33.90582
## 2021.500       33.59068 33.38980 33.79156 33.28331 33.89805
## 2021.519       33.56942 33.36854 33.77030 33.26204 33.87679
## 2021.538       33.57752 33.37665 33.77840 33.27015 33.88490
## 2021.558       33.55736 33.35648 33.75823 33.24998 33.86473
## 2021.577       33.53334 33.33246 33.73422 33.22597 33.84071
## 2021.596       33.53376 33.33288 33.73464 33.22639 33.84113
## 2021.615       33.53062 33.32974 33.73150 33.22325 33.83799
## 2021.635       33.50884 33.30796 33.70972 33.20147 33.81621
## 2021.654       33.45389 33.25302 33.65477 33.14652 33.76127
## 2021.673       33.46346 33.26258 33.66434 33.15609 33.77083
## 2021.692       33.45866 33.25779 33.65954 33.15129 33.76604
## 2021.712       33.47316 33.27229 33.67404 33.16579 33.78054
## 2021.731       33.45844 33.25756 33.65932 33.15107 33.76581
## 2021.750       33.45248 33.25160 33.65336 33.14511 33.75985
## 2021.769       33.44129 33.24041 33.64217 33.13392 33.74866
## 2021.788       33.42192 33.22104 33.62280 33.11455 33.72929
## 2021.808       33.41129 33.21041 33.61217 33.10392 33.71866
## 2021.827       33.42182 33.22094 33.62270 33.11445 33.72919
## 2021.846       33.39264 33.19176 33.59352 33.08527 33.70001
## 2021.865       33.40353 33.20265 33.60441 33.09616 33.71090
## 2021.885       33.41761 33.21673 33.61849 33.11024 33.72498
## 2021.904       33.43236 33.23149 33.63324 33.12499 33.73974
## 2021.923       33.42424 33.22336 33.62512 33.11687 33.73161
## 2021.942       33.43060 33.22972 33.63148 33.12323 33.73797
## 2021.962       33.42735 33.22647 33.62823 33.11998 33.73472
## 2021.981       33.43381 33.23293 33.63468 33.12643 33.74118
## 2022.000       33.41633 33.21545 33.61721 33.10895 33.72370
## 2022.019       33.39624 33.19537 33.59712 33.08887 33.70362
## 2022.038       33.40993 33.20922 33.61065 33.10281 33.71705
## 2022.058       33.40277 33.20206 33.60348 33.09565 33.70989
## 2022.077       33.42351 33.22280 33.62423 33.11639 33.73063
##                        ME      RMSE        MAE          MPE      MAPE     MASE
## Training set -1.858927e-17 0.1494234 0.11208469 -0.002000979 0.3348794 2.384824
## Test set      9.563622e-02 0.1072698 0.09563622  0.284563198 0.2845632 2.034850
##                  ACF1
## Training set 0.852831
## Test set           NA
```

```
autoplot(m1v5_lin_out[[1]], series = 'Training') +
  autolayer(m1v5_lin_out[[2]], series = 'Test') +
  autolayer(m1v5_lin_out[[3]], series = 'Test Forecast', alpha = .3) +
  autolayer(m1v5_lin_out[[3]]$fitted, series = 'Fitted') +
  theme_classic() +
  coord_cartesian(#ylim = c(-50, 400),
                  xlim = c(2011, 2023))
```

```
summary(m1v5_lin_out[[3]])
```

```
##
## Forecast method: Linear regression model
##
## Model Information:
##
## Call:
## tslm(formula = as.formula(formula), data = train_ts01)
##
## Coefficients:
## (Intercept)        trend      season2      season3      season4      season5
##   3.350e+01   -6.594e-05   -2.002e-02   -6.261e-03   -1.336e-02    7.450e-03
##     season6      season7      season8      season9     season10     season11
##   3.597e-03    1.405e-03    1.015e-02    2.636e-02    7.719e-03    1.171e-02
##    season12     season13     season14     season15     season16     season17
##   3.727e-02    3.966e-02    8.288e-02    9.583e-02    9.990e-02    1.622e-01
##    season18     season19     season20     season21     season22     season23
##   1.949e-01    1.530e-01    1.478e-01    2.052e-01    1.929e-01    1.929e-01
##    season24     season25     season26     season27     season28     season29
##   1.803e-01    1.799e-01    1.803e-01    1.726e-01    1.514e-01    1.596e-01
##    season30     season31     season32     season33     season34     season35
##   1.395e-01    1.156e-01    1.160e-01    1.130e-01    9.126e-02    3.638e-02
##    season36     season37     season38     season39     season40     season41
##   4.601e-02    4.128e-02    5.585e-02    4.119e-02    3.530e-02    2.417e-02
##    season42     season43     season44     season45     season46     season47
##   4.865e-03   -5.698e-03    4.897e-03   -2.422e-02   -1.326e-02    8.850e-04
##    season48     season49     season50     season51     season52
##   1.571e-02    7.648e-03    1.407e-02    1.089e-02    1.741e-02
##
##
## Error measures:
##                         ME      RMSE       MAE          MPE      MAPE      MASE
## Training set -1.858927e-17 0.1494234 0.1120847 -0.002000979 0.3348794 0.9109584
```

```
##                  ACF1
## Training set 0.852831
##
## Forecasts:
##          Point Forecast    Lo 80    Hi 80    Lo 95    Hi 95
## 2021.096       33.42302 33.22214 33.62390 33.11565 33.73039
## 2021.115       33.42077 33.21989 33.62164 33.11339 33.72814
## 2021.135       33.42944 33.22856 33.63032 33.12207 33.73681
## 2021.154       33.44559 33.24471 33.64647 33.13822 33.75296
## 2021.173       33.42688 33.22600 33.62776 33.11951 33.73425
## 2021.192       33.43081 33.22993 33.63169 33.12344 33.73818
## 2021.212       33.45630 33.25542 33.65718 33.14893 33.76367
## 2021.231       33.45863 33.25775 33.65951 33.15126 33.76600
## 2021.250       33.50178 33.30090 33.70266 33.19441 33.80915
## 2021.269       33.51466 33.31378 33.71554 33.20729 33.82203
## 2021.288       33.51867 33.31779 33.71955 33.21130 33.82604
## 2021.308       33.58090 33.38002 33.78178 33.27353 33.88827
## 2021.327       33.61351 33.41264 33.81439 33.30614 33.92089
## 2021.346       33.57152 33.37064 33.77240 33.26415 33.87889
## 2021.365       33.56633 33.36545 33.76721 33.25896 33.87370
## 2021.385       33.62365 33.42277 33.82453 33.31627 33.93102
## 2021.404       33.61126 33.41038 33.81214 33.30389 33.91863
## 2021.423       33.61125 33.41037 33.81213 33.30388 33.91862
## 2021.442       33.59852 33.39764 33.79940 33.29115 33.90589
## 2021.462       33.59807 33.39719 33.79894 33.29069 33.90544
## 2021.481       33.59845 33.39757 33.79933 33.29108 33.90582
## 2021.500       33.59068 33.38980 33.79156 33.28331 33.89805
## 2021.519       33.56942 33.36854 33.77030 33.26204 33.87679
## 2021.538       33.57752 33.37665 33.77840 33.27015 33.88490
## 2021.558       33.55736 33.35648 33.75823 33.24998 33.86473
## 2021.577       33.53334 33.33246 33.73422 33.22597 33.84071
## 2021.596       33.53376 33.33288 33.73464 33.22639 33.84113
## 2021.615       33.53062 33.32974 33.73150 33.22325 33.83799
## 2021.635       33.50884 33.30796 33.70972 33.20147 33.81621
## 2021.654       33.45389 33.25302 33.65477 33.14652 33.76127
## 2021.673       33.46346 33.26258 33.66434 33.15609 33.77083
## 2021.692       33.45866 33.25779 33.65954 33.15129 33.76604
## 2021.712       33.47316 33.27229 33.67404 33.16579 33.78054
## 2021.731       33.45844 33.25756 33.65932 33.15107 33.76581
## 2021.750       33.45248 33.25160 33.65336 33.14511 33.75985
## 2021.769       33.44129 33.24041 33.64217 33.13392 33.74866
## 2021.788       33.42192 33.22104 33.62280 33.11455 33.72929
## 2021.808       33.41129 33.21041 33.61217 33.10392 33.71866
## 2021.827       33.42182 33.22094 33.62270 33.11445 33.72919
## 2021.846       33.39264 33.19176 33.59352 33.08527 33.70001
## 2021.865       33.40353 33.20265 33.60441 33.09616 33.71090
## 2021.885       33.41761 33.21673 33.61849 33.11024 33.72498
## 2021.904       33.43236 33.23149 33.63324 33.12499 33.73974
## 2021.923       33.42424 33.22336 33.62512 33.11687 33.73161
## 2021.942       33.43060 33.22972 33.63148 33.12323 33.73797
## 2021.962       33.42735 33.22647 33.62823 33.11998 33.73472
## 2021.981       33.43381 33.23293 33.63468 33.12643 33.74118
## 2022.000       33.41633 33.21545 33.61721 33.10895 33.72370
## 2022.019       33.39624 33.19537 33.59712 33.08887 33.70362
```

```
## 2022.038       33.40993 33.20922 33.61065 33.10281 33.71705
## 2022.058       33.40277 33.20206 33.60348 33.09565 33.70989
## 2022.077       33.42351 33.22280 33.62423 33.11639 33.73063
```

PLOO Excluding Outliers: Imputed - Excluding External Variables (Forecasting SALINITY)

```
# PLOO Excluding Outliers: Imputed - Training partition (01/18/1999-01/04/2021)
#owt_df02_gb09_ploo_wkly02_train_tb03
# PLOO Excluding Outliers: Imputed - Test partition (01/11/2021-01/03/2022)
#owt_df02_gb09_ploo_wkly02_test_tb03

owt_df02_gb09_ploo_wkly02_train_tb03 %>%
  plot_time_series(date_sample,
                   SALINITY)
```

```
owt_df02_gb09_ploo_wkly02_train_tb03 %>%
  plot_stl_diagnostics(date_sample,
                       SALINITY,
                       .frequency = "auto",
                       .trend = "auto")
```

```
## frequency = 13 observations per 1 quarter
```

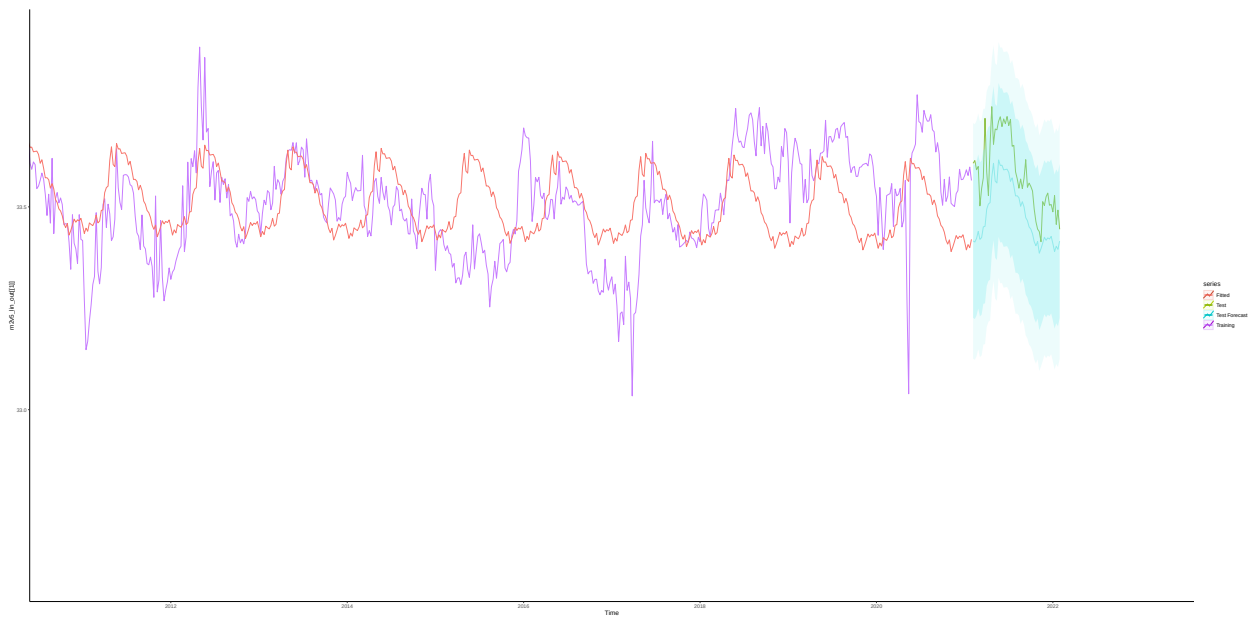
```
## trend = 53 observations per 1 year
```

```
m2v5_lin_out <- lr_ts_mod(tb_train = owt_df02_gb09_ploo_wkly02_train_tb03,
                          tb_test = owt_df02_gb09_ploo_wkly02_test_tb03,
                          date = "date_sample",
                          param = "SALINITY",
                          ext_pred = c(),
                          train_start = c(1999, lubridate::isoweek(ymd(train_start))),
                          test_start = c(2021, 6),
                          freq = 52,
                          h = 52,
                          formula = "SALINITY ~ trend + season")
```

```
##          Point Forecast    Lo 80    Hi 80    Lo 95    Hi 95
## 2021.096       33.41613 33.22635 33.60591 33.12574 33.70652
## 2021.115       33.41323 33.22345 33.60301 33.12284 33.70362
## 2021.135       33.42215 33.23237 33.61193 33.13176 33.71254
## 2021.154       33.43933 33.24954 33.62911 33.14893 33.72972
## 2021.173       33.41993 33.23015 33.60971 33.12954 33.71032
## 2021.192       33.42422 33.23444 33.61400 33.13383 33.71461
## 2021.212       33.45068 33.26090 33.64046 33.16028 33.74107
## 2021.231       33.45199 33.26221 33.64178 33.16160 33.74239
## 2021.250       33.49437 33.30459 33.68415 33.20398 33.78476
## 2021.269       33.50700 33.31721 33.69678 33.21660 33.79739
## 2021.288       33.51055 33.32077 33.70033 33.22016 33.80094
## 2021.308       33.57382 33.38403 33.76360 33.28342 33.86421
## 2021.327       33.60745 33.41767 33.79723 33.31706 33.89784
## 2021.346       33.56377 33.37399 33.75355 33.27338 33.85416
## 2021.365       33.55882 33.36904 33.74860 33.26843 33.84921
## 2021.385       33.61577 33.42598 33.80555 33.32537 33.90616
## 2021.404       33.60206 33.41227 33.79184 33.31166 33.89245
## 2021.423       33.60268 33.41290 33.79246 33.31229 33.89307
```

```
## 2021.442       33.59103 33.40125 33.78081 33.30064 33.88142
## 2021.462       33.59210 33.40232 33.78188 33.30171 33.88249
## 2021.481       33.59292 33.40314 33.78270 33.30253 33.88331
## 2021.500       33.58473 33.39495 33.77451 33.29434 33.87512
## 2021.519       33.56291 33.37313 33.75270 33.27252 33.85331
## 2021.538       33.57159 33.38181 33.76138 33.28120 33.86199
## 2021.558       33.55072 33.36094 33.74050 33.26033 33.84111
## 2021.577       33.52700 33.33722 33.71678 33.23661 33.81739
## 2021.596       33.52729 33.33751 33.71707 33.23690 33.81768
## 2021.615       33.52239 33.33260 33.71217 33.23199 33.81278
## 2021.635       33.50146 33.31167 33.69124 33.21106 33.79185
## 2021.654       33.51262 33.32284 33.70240 33.22223 33.80301
## 2021.673       33.49987 33.31008 33.68965 33.20947 33.79026
## 2021.692       33.47358 33.28380 33.66336 33.18319 33.76397
## 2021.712       33.46603 33.27625 33.65582 33.17564 33.75643
## 2021.731       33.45051 33.26073 33.64029 33.16012 33.74091
## 2021.750       33.44522 33.25543 33.63500 33.15482 33.73561
## 2021.769       33.43365 33.24387 33.62343 33.14326 33.72404
## 2021.788       33.41409 33.22430 33.60387 33.12369 33.70448
## 2021.808       33.40416 33.21437 33.59394 33.11376 33.69455
## 2021.827       33.41459 33.22481 33.60437 33.12419 33.70498
## 2021.846       33.38573 33.19595 33.57551 33.09534 33.67612
## 2021.865       33.39698 33.20719 33.58676 33.10658 33.68737
## 2021.885       33.41042 33.22064 33.60021 33.12003 33.70082
## 2021.904       33.42508 33.23529 33.61486 33.13468 33.71547
## 2021.923       33.41756 33.22778 33.60734 33.12717 33.70796
## 2021.942       33.42363 33.23385 33.61342 33.13324 33.71403
## 2021.962       33.42063 33.23085 33.61041 33.13024 33.71102
## 2021.981       33.42718 33.23740 33.61696 33.13679 33.71757
## 2022.000       33.40967 33.21988 33.59945 33.11927 33.70006
## 2022.019       33.38980 33.20002 33.57958 33.09941 33.68019
## 2022.038       33.40283 33.21320 33.59245 33.11267 33.69298
## 2022.058       33.39525 33.20563 33.58488 33.10510 33.68541
## 2022.077       33.41586 33.22624 33.60549 33.12571 33.70602
##                         ME      RMSE       MAE          MPE      MAPE     MASE
## Training set -6.123497e-18 0.1411693 0.1097105 -0.001780718 0.3276193 2.457331
## Test set      1.001722e-01 0.1115920 0.1001722  0.298067126 0.2980671 2.243689
##                  ACF1
## Training set 0.895257
## Test set           NA
```

```
autoplot(m2v5_lin_out[[1]], series = 'Training') +
  autolayer(m2v5_lin_out[[2]], series = 'Test') +
  autolayer(m2v5_lin_out[[3]], series = 'Test Forecast', alpha = .3) +
  autolayer(m2v5_lin_out[[3]]$fitted, series = 'Fitted') +
  theme_classic() +
  coord_cartesian(#ylim = c(-50, 400),
                  xlim = c(2011, 2023))
```




```
summary(m2v5_lin_out[[3]])
```

```
##
## Forecast method: Linear regression model
##
## Model Information:
##
## Call:
## tslm(formula = as.formula(formula), data = train_ts01)
##
## Coefficients:
## (Intercept)        trend      season2      season3      season4      season5
##   3.350e+01   -7.796e-05   -1.979e-02   -6.683e-03   -1.418e-02    6.508e-03
##     season6      season7      season8      season9     season10     season11
##   2.798e-03   -2.054e-05    8.974e-03    2.623e-02    6.913e-03    1.128e-02
##    season12     season13     season14     season15     season16     season17
##   3.781e-02    3.921e-02    8.166e-02    9.437e-02    9.800e-02    1.613e-01
##    season18     season19     season20     season21     season22     season23
##   1.951e-01    1.515e-01    1.466e-01    2.036e-01    1.900e-01    1.907e-01
##    season24     season25     season26     season27     season28     season29
##   1.791e-01    1.803e-01    1.811e-01    1.730e-01    1.513e-01    1.601e-01
##    season30     season31     season32     season33     season34     season35
##   1.393e-01    1.156e-01    1.160e-01    1.112e-01    9.031e-02    1.015e-01
##    season36     season37     season38     season39     season40     season41
##   8.887e-02    6.267e-02    5.520e-02    3.976e-02    3.454e-02    2.305e-02
##    season42     season43     season44     season45     season46     season47
##   3.562e-03   -6.290e-03    4.220e-03   -2.456e-02   -1.323e-02    2.904e-04
##    season48     season49     season50     season51     season52
##   1.502e-02    7.585e-03    1.373e-02    1.081e-02    1.744e-02
##
##
## Error measures:
##                         ME      RMSE       MAE          MPE      MAPE      MASE
## Training set -6.123497e-18 0.1411693 0.1097105 -0.001780718 0.3276193 0.9324258
```

```
##                   ACF1
## Training set 0.895257
##
## Forecasts:
##          Point Forecast    Lo 80    Hi 80    Lo 95    Hi 95
## 2021.096       33.41613 33.22635 33.60591 33.12574 33.70652
## 2021.115       33.41323 33.22345 33.60301 33.12284 33.70362
## 2021.135       33.42215 33.23237 33.61193 33.13176 33.71254
## 2021.154       33.43933 33.24954 33.62911 33.14893 33.72972
## 2021.173       33.41993 33.23015 33.60971 33.12954 33.71032
## 2021.192       33.42422 33.23444 33.61400 33.13383 33.71461
## 2021.212       33.45068 33.26090 33.64046 33.16028 33.74107
## 2021.231       33.45199 33.26221 33.64178 33.16160 33.74239
## 2021.250       33.49437 33.30459 33.68415 33.20398 33.78476
## 2021.269       33.50700 33.31721 33.69678 33.21660 33.79739
## 2021.288       33.51055 33.32077 33.70033 33.22016 33.80094
## 2021.308       33.57382 33.38403 33.76360 33.28342 33.86421
## 2021.327       33.60745 33.41767 33.79723 33.31706 33.89784
## 2021.346       33.56377 33.37399 33.75355 33.27338 33.85416
## 2021.365       33.55882 33.36904 33.74860 33.26843 33.84921
## 2021.385       33.61577 33.42598 33.80555 33.32537 33.90616
## 2021.404       33.60206 33.41227 33.79184 33.31166 33.89245
## 2021.423       33.60268 33.41290 33.79246 33.31229 33.89307
## 2021.442       33.59103 33.40125 33.78081 33.30064 33.88142
## 2021.462       33.59210 33.40232 33.78188 33.30171 33.88249
## 2021.481       33.59292 33.40314 33.78270 33.30253 33.88331
## 2021.500       33.58473 33.39495 33.77451 33.29434 33.87512
## 2021.519       33.56291 33.37313 33.75270 33.27252 33.85331
## 2021.538       33.57159 33.38181 33.76138 33.28120 33.86199
## 2021.558       33.55072 33.36094 33.74050 33.26033 33.84111
## 2021.577       33.52700 33.33722 33.71678 33.23661 33.81739
## 2021.596       33.52729 33.33751 33.71707 33.23690 33.81768
## 2021.615       33.52239 33.33260 33.71217 33.23199 33.81278
## 2021.635       33.50146 33.31167 33.69124 33.21106 33.79185
## 2021.654       33.51262 33.32284 33.70240 33.22223 33.80301
## 2021.673       33.49987 33.31008 33.68965 33.20947 33.79026
## 2021.692       33.47358 33.28380 33.66336 33.18319 33.76397
## 2021.712       33.46603 33.27625 33.65582 33.17564 33.75643
## 2021.731       33.45051 33.26073 33.64029 33.16012 33.74091
## 2021.750       33.44522 33.25543 33.63500 33.15482 33.73561
## 2021.769       33.43365 33.24387 33.62343 33.14326 33.72404
## 2021.788       33.41409 33.22430 33.60387 33.12369 33.70448
## 2021.808       33.40416 33.21437 33.59394 33.11376 33.69455
## 2021.827       33.41459 33.22481 33.60437 33.12419 33.70498
## 2021.846       33.38573 33.19595 33.57551 33.09534 33.67612
## 2021.865       33.39698 33.20719 33.58676 33.10658 33.68737
## 2021.885       33.41042 33.22064 33.60021 33.12003 33.70082
## 2021.904       33.42508 33.23529 33.61486 33.13468 33.71547
## 2021.923       33.41756 33.22778 33.60734 33.12717 33.70796
## 2021.942       33.42363 33.23385 33.61342 33.13324 33.71403
## 2021.962       33.42063 33.23085 33.61041 33.13024 33.71102
## 2021.981       33.42718 33.23740 33.61696 33.13679 33.71757
## 2022.000       33.40967 33.21988 33.59945 33.11927 33.70006
## 2022.019       33.38980 33.20002 33.57958 33.09941 33.68019
```

```
## 2022.038       33.40283 33.21320 33.59245 33.11267 33.69298
## 2022.058       33.39525 33.20563 33.58488 33.10510 33.68541
## 2022.077       33.41586 33.22624 33.60549 33.12571 33.70602
```

SBOO All: Imputed - Excluding External Variables (Forecasting SALINITY)

```
# SBOO All: Imputed - Training partition (01/18/1999-01/04/2021)
#owt_df02_gb09_sboo_wkly03_train_tb03
# SBOO All: Imputed - Test partition (01/11/2021-01/03/2022)
#owt_df02_gb09_sboo_wkly03_test_tb03

owt_df02_gb09_sboo_wkly03_train_tb03 %>%
  plot_time_series(date_sample,
                   SALINITY)
```

```
owt_df02_gb09_sboo_wkly03_train_tb03 %>%
  plot_stl_diagnostics(date_sample,
                       SALINITY,
                       .frequency = "auto",
                       .trend = "auto")
```

```
## frequency = 13 observations per 1 quarter
```

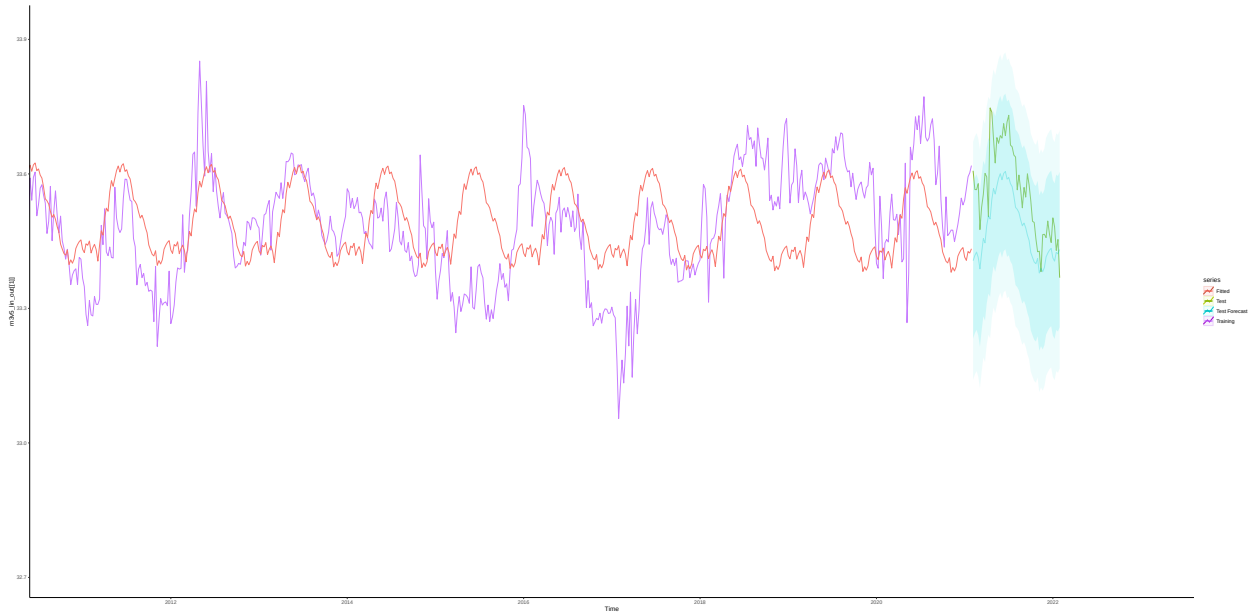
```
## trend = 53 observations per 1 year
```

```
m3v5_lin_out <- lr_ts_mod(tb_train = owt_df02_gb09_sboo_wkly03_train_tb03,
                          tb_test = owt_df02_gb09_sboo_wkly03_test_tb03,
                          date = "date_sample",
                          param = "SALINITY",
                          ext_pred = c(),
                          train_start = c(1999, lubridate::isoweek(ymd(train_start))),
                          test_start = c(2021, 6),
                          freq = 52,
                          h = 52,
                          formula = "SALINITY ~ trend + season")
```

```
##          Point Forecast    Lo 80    Hi 80    Lo 95    Hi 95
## 2021.096       33.40632 33.23291 33.57974 33.14098 33.67167
## 2021.115       33.41793 33.24452 33.59134 33.15258 33.68327
## 2021.135       33.42565 33.25223 33.59906 33.16030 33.69099
## 2021.154       33.41375 33.24034 33.58717 33.14841 33.67910
## 2021.173       33.38818 33.21477 33.56159 33.12283 33.65353
## 2021.192       33.42370 33.25028 33.59711 33.15835 33.68904
## 2021.212       33.45586 33.28244 33.62927 33.19051 33.72120
## 2021.231       33.44611 33.27270 33.61952 33.18076 33.71145
## 2021.250       33.48456 33.31115 33.65798 33.21922 33.74991
## 2021.269       33.50638 33.33296 33.67979 33.24103 33.77172
## 2021.288       33.49935 33.32594 33.67276 33.23400 33.76469
## 2021.308       33.54267 33.36925 33.71608 33.27732 33.80801
## 2021.327       33.56751 33.39410 33.74092 33.30216 33.83286
## 2021.346       33.55503 33.38162 33.72844 33.28968 33.82037
## 2021.365       33.57301 33.39960 33.74643 33.30767 33.83836
## 2021.385       33.59018 33.41676 33.76359 33.32483 33.85552
## 2021.404       33.60043 33.42702 33.77384 33.33508 33.86577
## 2021.423       33.58688 33.41347 33.76029 33.32153 33.85223
```

```
## 2021.442       33.60118 33.42776 33.77459 33.33583 33.86652
## 2021.462       33.60542 33.43201 33.77884 33.34008 33.87077
## 2021.481       33.58835 33.41493 33.76176 33.32300 33.85369
## 2021.500       33.59204 33.41862 33.76545 33.32669 33.85738
## 2021.519       33.57832 33.40490 33.75173 33.31297 33.84366
## 2021.538       33.57157 33.39816 33.74498 33.30623 33.83692
## 2021.558       33.55098 33.37757 33.72439 33.28564 33.81633
## 2021.577       33.52537 33.35196 33.69879 33.26003 33.79072
## 2021.596       33.52099 33.34757 33.69440 33.25564 33.78633
## 2021.615       33.51361 33.34020 33.68702 33.24827 33.77896
## 2021.635       33.49743 33.32401 33.67084 33.23208 33.76277
## 2021.654       33.48427 33.31086 33.65769 33.21893 33.74962
## 2021.673       33.49036 33.31695 33.66378 33.22502 33.75571
## 2021.692       33.47965 33.30623 33.65306 33.21430 33.74499
## 2021.712       33.46333 33.28992 33.63674 33.19798 33.72868
## 2021.731       33.45140 33.27798 33.62481 33.18605 33.71674
## 2021.750       33.42429 33.25088 33.59771 33.15895 33.68964
## 2021.769       33.41355 33.24014 33.58697 33.14821 33.67890
## 2021.788       33.40343 33.23002 33.57684 33.13808 33.66878
## 2021.808       33.39972 33.22631 33.57313 33.13437 33.66506
## 2021.827       33.41126 33.23785 33.58467 33.14591 33.67660
## 2021.846       33.37886 33.20545 33.55227 33.11352 33.64421
## 2021.865       33.38924 33.21582 33.56265 33.12389 33.65458
## 2021.885       33.38178 33.20837 33.55519 33.11643 33.64712
## 2021.904       33.39132 33.21791 33.56474 33.12598 33.65667
## 2021.923       33.41471 33.24130 33.58813 33.14937 33.68006
## 2021.942       33.42333 33.24991 33.59674 33.15798 33.68867
## 2021.962       33.42993 33.25651 33.60334 33.16458 33.69527
## 2021.981       33.43387 33.26045 33.60728 33.16852 33.69921
## 2022.000       33.41274 33.23932 33.58615 33.14739 33.67808
## 2022.019       33.40545 33.23204 33.57886 33.14010 33.67079
## 2022.038       33.42512 33.25185 33.59839 33.15999 33.69025
## 2022.058       33.42180 33.24852 33.59507 33.15667 33.68692
## 2022.077       33.43128 33.25801 33.60455 33.16615 33.69641
##                         ME      RMSE        MAE          MPE      MAPE     MASE
## Training set -6.205923e-18 0.1289931 0.10160558 -0.001487309 0.3036048 2.764791
## Test set      8.702422e-02 0.1024643 0.08977283  0.258952595 0.2671888 2.442810
##                   ACF1
## Training set 0.9099218
## Test set            NA
```

```
autoplot(m3v5_lin_out[[1]], series = 'Training') +
  autolayer(m3v5_lin_out[[2]], series = 'Test') +
  autolayer(m3v5_lin_out[[3]], series = 'Test Forecast', alpha = .3) +
  autolayer(m3v5_lin_out[[3]]$fitted, series = 'Fitted') +
  theme_classic() +
  coord_cartesian(#ylim = c(-50, 400),
                  xlim = c(2011, 2023))
```




```
summary(m3v5_lin_out[[3]])
```

```
##
## Forecast method: Linear regression model
##
## Model Information:
##
## Call:
## tslm(formula = as.formula(formula), data = train_ts01)
##
## Coefficients:
## (Intercept)        trend      season2      season3      season4      season5
##   3.345e+01   -3.326e-05   -7.255e-03    1.245e-02    9.157e-03    1.868e-02
##     season6      season7      season8      season9     season10     season11
##  -7.978e-03    3.660e-03    1.141e-02   -4.467e-04   -2.599e-02    9.562e-03
##    season12     season13     season14     season15     season16     season17
##   4.175e-02    3.204e-02    7.053e-02    9.237e-02    8.538e-02    1.287e-01
##    season18     season19     season20     season21     season22     season23
##   1.536e-01    1.412e-01    1.592e-01    1.764e-01    1.867e-01    1.731e-01
##    season24     season25     season26     season27     season28     season29
##   1.875e-01    1.918e-01    1.747e-01    1.784e-01    1.647e-01    1.580e-01
##    season30     season31     season32     season33     season34     season35
##   1.375e-01    1.119e-01    1.076e-01    1.002e-01    8.406e-02    7.094e-02
##    season36     season37     season38     season39     season40     season41
##   7.706e-02    6.638e-02    5.009e-02    3.819e-02    1.112e-02    4.170e-04
##    season42     season43     season44     season45     season46     season47
##  -9.674e-03   -1.335e-02   -1.778e-03   -3.414e-02   -2.373e-02   -3.116e-02
##    season48     season49     season50     season51     season52
##  -2.158e-02    1.842e-03    1.049e-02    1.712e-02    2.109e-02
##
##
## Error measures:
##                         ME      RMSE       MAE          MPE      MAPE      MASE
## Training set -6.205923e-18 0.1289931 0.1016056 -0.001487309 0.3036048 0.8655685
```

```
##                   ACF1
## Training set 0.9099218
##
## Forecasts:
##          Point Forecast    Lo 80    Hi 80    Lo 95    Hi 95
## 2021.096       33.40632 33.23291 33.57974 33.14098 33.67167
## 2021.115       33.41793 33.24452 33.59134 33.15258 33.68327
## 2021.135       33.42565 33.25223 33.59906 33.16030 33.69099
## 2021.154       33.41375 33.24034 33.58717 33.14841 33.67910
## 2021.173       33.38818 33.21477 33.56159 33.12283 33.65353
## 2021.192       33.42370 33.25028 33.59711 33.15835 33.68904
## 2021.212       33.45586 33.28244 33.62927 33.19051 33.72120
## 2021.231       33.44611 33.27270 33.61952 33.18076 33.71145
## 2021.250       33.48456 33.31115 33.65798 33.21922 33.74991
## 2021.269       33.50638 33.33296 33.67979 33.24103 33.77172
## 2021.288       33.49935 33.32594 33.67276 33.23400 33.76469
## 2021.308       33.54267 33.36925 33.71608 33.27732 33.80801
## 2021.327       33.56751 33.39410 33.74092 33.30216 33.83286
## 2021.346       33.55503 33.38162 33.72844 33.28968 33.82037
## 2021.365       33.57301 33.39960 33.74643 33.30767 33.83836
## 2021.385       33.59018 33.41676 33.76359 33.32483 33.85552
## 2021.404       33.60043 33.42702 33.77384 33.33508 33.86577
## 2021.423       33.58688 33.41347 33.76029 33.32153 33.85223
## 2021.442       33.60118 33.42776 33.77459 33.33583 33.86652
## 2021.462       33.60542 33.43201 33.77884 33.34008 33.87077
## 2021.481       33.58835 33.41493 33.76176 33.32300 33.85369
## 2021.500       33.59204 33.41862 33.76545 33.32669 33.85738
## 2021.519       33.57832 33.40490 33.75173 33.31297 33.84366
## 2021.538       33.57157 33.39816 33.74498 33.30623 33.83692
## 2021.558       33.55098 33.37757 33.72439 33.28564 33.81633
## 2021.577       33.52537 33.35196 33.69879 33.26003 33.79072
## 2021.596       33.52099 33.34757 33.69440 33.25564 33.78633
## 2021.615       33.51361 33.34020 33.68702 33.24827 33.77896
## 2021.635       33.49743 33.32401 33.67084 33.23208 33.76277
## 2021.654       33.48427 33.31086 33.65769 33.21893 33.74962
## 2021.673       33.49036 33.31695 33.66378 33.22502 33.75571
## 2021.692       33.47965 33.30623 33.65306 33.21430 33.74499
## 2021.712       33.46333 33.28992 33.63674 33.19798 33.72868
## 2021.731       33.45140 33.27798 33.62481 33.18605 33.71674
## 2021.750       33.42429 33.25088 33.59771 33.15895 33.68964
## 2021.769       33.41355 33.24014 33.58697 33.14821 33.67890
## 2021.788       33.40343 33.23002 33.57684 33.13808 33.66878
## 2021.808       33.39972 33.22631 33.57313 33.13437 33.66506
## 2021.827       33.41126 33.23785 33.58467 33.14591 33.67660
## 2021.846       33.37886 33.20545 33.55227 33.11352 33.64421
## 2021.865       33.38924 33.21582 33.56265 33.12389 33.65458
## 2021.885       33.38178 33.20837 33.55519 33.11643 33.64712
## 2021.904       33.39132 33.21791 33.56474 33.12598 33.65667
## 2021.923       33.41471 33.24130 33.58813 33.14937 33.68006
## 2021.942       33.42333 33.24991 33.59674 33.15798 33.68867
## 2021.962       33.42993 33.25651 33.60334 33.16458 33.69527
## 2021.981       33.43387 33.26045 33.60728 33.16852 33.69921
## 2022.000       33.41274 33.23932 33.58615 33.14739 33.67808
## 2022.019       33.40545 33.23204 33.57886 33.14010 33.67079
```

```
## 2022.038       33.42512 33.25185 33.59839 33.15999 33.69025
## 2022.058       33.42180 33.24852 33.59507 33.15667 33.68692
## 2022.077       33.43128 33.25801 33.60455 33.16615 33.69641
```

SBOO Excluding Outliers: Imputed - Excluding External Variables (Forecasting SALINITY)

```
# SBOO Excluding Outliers: Imputed - Training partition (01/18/1999-01/04/2021)
#owt_df02_gb09_sboo_wkly02_train_tb03
# SBOO Excluding Outliers: Imputed - Test partition (01/11/2021-01/03/2022)
#owt_df02_gb09_sboo_wkly02_test_tb03

owt_df02_gb09_sboo_wkly02_train_tb03 %>%
  plot_time_series(date_sample,
                   SALINITY)
```

```
owt_df02_gb09_sboo_wkly02_train_tb03 %>%
  plot_stl_diagnostics(date_sample,
                       SALINITY,
                       .frequency = "auto",
                       .trend = "auto")
```

```
## frequency = 13 observations per 1 quarter
```

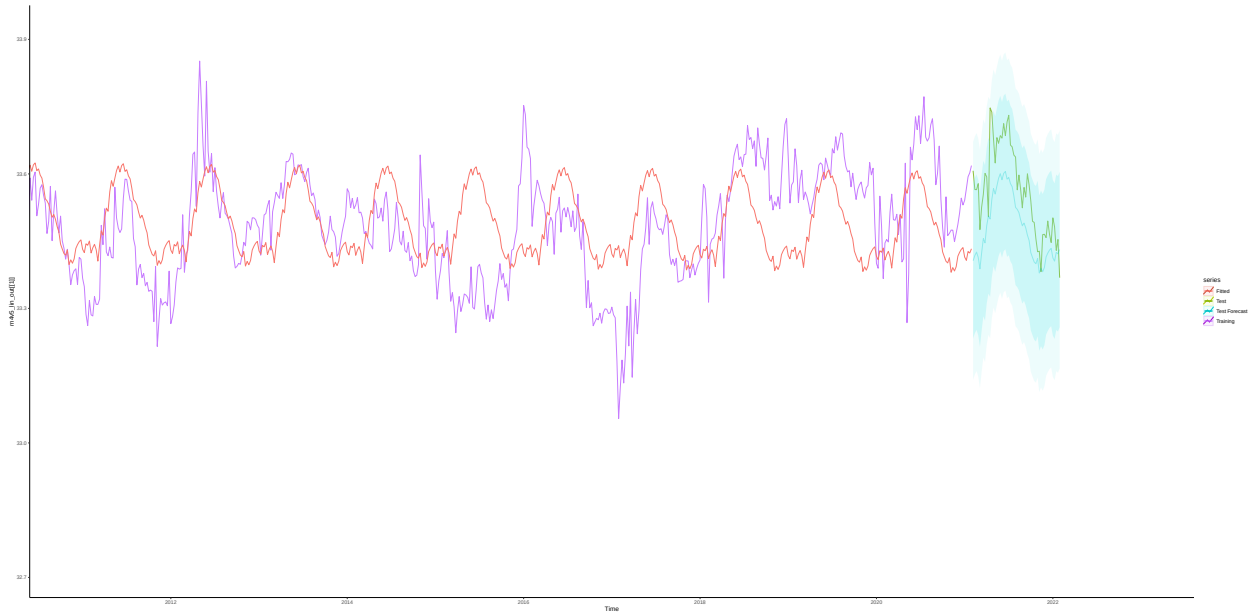
```
## trend = 53 observations per 1 year
```

```
m4v5_lin_out <- lr_ts_mod(tb_train = owt_df02_gb09_sboo_wkly02_train_tb03,
                          tb_test = owt_df02_gb09_sboo_wkly02_test_tb03,
                          date = "date_sample",
                          param = "SALINITY",
                          ext_pred = c(),
                          train_start = c(1999, lubridate::isoweek(ymd(train_start))),
                          test_start = c(2021, 6),
                          freq = 52,
                          h = 52,
                          formula = "SALINITY ~ trend + season")
```

```
##          Point Forecast    Lo 80    Hi 80    Lo 95    Hi 95
## 2021.096       33.40632 33.23291 33.57974 33.14098 33.67167
## 2021.115       33.41793 33.24452 33.59134 33.15258 33.68327
## 2021.135       33.42565 33.25223 33.59906 33.16030 33.69099
## 2021.154       33.41375 33.24034 33.58717 33.14841 33.67910
## 2021.173       33.38818 33.21477 33.56159 33.12283 33.65353
## 2021.192       33.42370 33.25028 33.59711 33.15835 33.68904
## 2021.212       33.45586 33.28244 33.62927 33.19051 33.72120
## 2021.231       33.44611 33.27270 33.61952 33.18076 33.71145
## 2021.250       33.48456 33.31115 33.65798 33.21922 33.74991
## 2021.269       33.50638 33.33296 33.67979 33.24103 33.77172
## 2021.288       33.49935 33.32594 33.67276 33.23400 33.76469
## 2021.308       33.54267 33.36925 33.71608 33.27732 33.80801
## 2021.327       33.56751 33.39410 33.74092 33.30216 33.83286
## 2021.346       33.55503 33.38162 33.72844 33.28968 33.82037
## 2021.365       33.57301 33.39960 33.74643 33.30767 33.83836
## 2021.385       33.59018 33.41676 33.76359 33.32483 33.85552
## 2021.404       33.60043 33.42702 33.77384 33.33508 33.86577
## 2021.423       33.58688 33.41347 33.76029 33.32153 33.85223
```

```
## 2021.442       33.60118 33.42776 33.77459 33.33583 33.86652
## 2021.462       33.60542 33.43201 33.77884 33.34008 33.87077
## 2021.481       33.58835 33.41493 33.76176 33.32300 33.85369
## 2021.500       33.59204 33.41862 33.76545 33.32669 33.85738
## 2021.519       33.57832 33.40490 33.75173 33.31297 33.84366
## 2021.538       33.57157 33.39816 33.74498 33.30623 33.83692
## 2021.558       33.55098 33.37757 33.72439 33.28564 33.81633
## 2021.577       33.52537 33.35196 33.69879 33.26003 33.79072
## 2021.596       33.52099 33.34757 33.69440 33.25564 33.78633
## 2021.615       33.51361 33.34020 33.68702 33.24827 33.77896
## 2021.635       33.49743 33.32401 33.67084 33.23208 33.76277
## 2021.654       33.48427 33.31086 33.65769 33.21893 33.74962
## 2021.673       33.49036 33.31695 33.66378 33.22502 33.75571
## 2021.692       33.47965 33.30623 33.65306 33.21430 33.74499
## 2021.712       33.46333 33.28992 33.63674 33.19798 33.72868
## 2021.731       33.45140 33.27798 33.62481 33.18605 33.71674
## 2021.750       33.42429 33.25088 33.59771 33.15895 33.68964
## 2021.769       33.41355 33.24014 33.58697 33.14821 33.67890
## 2021.788       33.40343 33.23002 33.57684 33.13808 33.66878
## 2021.808       33.39972 33.22631 33.57313 33.13437 33.66506
## 2021.827       33.41126 33.23785 33.58467 33.14591 33.67660
## 2021.846       33.37886 33.20545 33.55227 33.11352 33.64421
## 2021.865       33.38924 33.21582 33.56265 33.12389 33.65458
## 2021.885       33.38178 33.20837 33.55519 33.11643 33.64712
## 2021.904       33.39132 33.21791 33.56474 33.12598 33.65667
## 2021.923       33.41471 33.24130 33.58813 33.14937 33.68006
## 2021.942       33.42333 33.24991 33.59674 33.15798 33.68867
## 2021.962       33.42993 33.25651 33.60334 33.16458 33.69527
## 2021.981       33.43387 33.26045 33.60728 33.16852 33.69921
## 2022.000       33.41274 33.23932 33.58615 33.14739 33.67808
## 2022.019       33.40545 33.23204 33.57886 33.14010 33.67079
## 2022.038       33.42512 33.25185 33.59839 33.15999 33.69025
## 2022.058       33.42180 33.24852 33.59507 33.15667 33.68692
## 2022.077       33.43128 33.25801 33.60455 33.16615 33.69641
##                         ME      RMSE        MAE          MPE      MAPE     MASE
## Training set -6.205923e-18 0.1289931 0.10160558 -0.001487309 0.3036048 2.764791
## Test set      8.702422e-02 0.1024643 0.08977283  0.258952595 0.2671888 2.442810
##                   ACF1
## Training set 0.9099218
## Test set            NA
```

```
autoplot(m4v5_lin_out[[1]], series = 'Training') +
  autolayer(m4v5_lin_out[[2]], series = 'Test') +
  autolayer(m4v5_lin_out[[3]], series = 'Test Forecast', alpha = .3) +
  autolayer(m4v5_lin_out[[3]]$fitted, series = 'Fitted') +
  theme_classic() +
  coord_cartesian(#ylim = c(-50, 400),
                  xlim = c(2011, 2023))
```




```
summary(m4v5_lin_out[[3]])
```

```
##
## Forecast method: Linear regression model
##
## Model Information:
##
## Call:
## tslm(formula = as.formula(formula), data = train_ts01)
##
## Coefficients:
## (Intercept)        trend      season2      season3      season4      season5
##   3.345e+01   -3.326e-05   -7.255e-03    1.245e-02    9.157e-03    1.868e-02
##     season6      season7      season8      season9     season10     season11
##  -7.978e-03    3.660e-03    1.141e-02   -4.467e-04   -2.599e-02    9.562e-03
##    season12     season13     season14     season15     season16     season17
##   4.175e-02    3.204e-02    7.053e-02    9.237e-02    8.538e-02    1.287e-01
##    season18     season19     season20     season21     season22     season23
##   1.536e-01    1.412e-01    1.592e-01    1.764e-01    1.867e-01    1.731e-01
##    season24     season25     season26     season27     season28     season29
##   1.875e-01    1.918e-01    1.747e-01    1.784e-01    1.647e-01    1.580e-01
##    season30     season31     season32     season33     season34     season35
##   1.375e-01    1.119e-01    1.076e-01    1.002e-01    8.406e-02    7.094e-02
##    season36     season37     season38     season39     season40     season41
##   7.706e-02    6.638e-02    5.009e-02    3.819e-02    1.112e-02    4.170e-04
##    season42     season43     season44     season45     season46     season47
##  -9.674e-03   -1.335e-02   -1.778e-03   -3.414e-02   -2.373e-02   -3.116e-02
##    season48     season49     season50     season51     season52
##  -2.158e-02    1.842e-03    1.049e-02    1.712e-02    2.109e-02
##
##
## Error measures:
##                         ME      RMSE       MAE          MPE      MAPE      MASE
## Training set -6.205923e-18 0.1289931 0.1016056 -0.001487309 0.3036048 0.8655685
```

```
##                   ACF1
## Training set 0.9099218
##
## Forecasts:
##          Point Forecast    Lo 80    Hi 80    Lo 95    Hi 95
## 2021.096       33.40632 33.23291 33.57974 33.14098 33.67167
## 2021.115       33.41793 33.24452 33.59134 33.15258 33.68327
## 2021.135       33.42565 33.25223 33.59906 33.16030 33.69099
## 2021.154       33.41375 33.24034 33.58717 33.14841 33.67910
## 2021.173       33.38818 33.21477 33.56159 33.12283 33.65353
## 2021.192       33.42370 33.25028 33.59711 33.15835 33.68904
## 2021.212       33.45586 33.28244 33.62927 33.19051 33.72120
## 2021.231       33.44611 33.27270 33.61952 33.18076 33.71145
## 2021.250       33.48456 33.31115 33.65798 33.21922 33.74991
## 2021.269       33.50638 33.33296 33.67979 33.24103 33.77172
## 2021.288       33.49935 33.32594 33.67276 33.23400 33.76469
## 2021.308       33.54267 33.36925 33.71608 33.27732 33.80801
## 2021.327       33.56751 33.39410 33.74092 33.30216 33.83286
## 2021.346       33.55503 33.38162 33.72844 33.28968 33.82037
## 2021.365       33.57301 33.39960 33.74643 33.30767 33.83836
## 2021.385       33.59018 33.41676 33.76359 33.32483 33.85552
## 2021.404       33.60043 33.42702 33.77384 33.33508 33.86577
## 2021.423       33.58688 33.41347 33.76029 33.32153 33.85223
## 2021.442       33.60118 33.42776 33.77459 33.33583 33.86652
## 2021.462       33.60542 33.43201 33.77884 33.34008 33.87077
## 2021.481       33.58835 33.41493 33.76176 33.32300 33.85369
## 2021.500       33.59204 33.41862 33.76545 33.32669 33.85738
## 2021.519       33.57832 33.40490 33.75173 33.31297 33.84366
## 2021.538       33.57157 33.39816 33.74498 33.30623 33.83692
## 2021.558       33.55098 33.37757 33.72439 33.28564 33.81633
## 2021.577       33.52537 33.35196 33.69879 33.26003 33.79072
## 2021.596       33.52099 33.34757 33.69440 33.25564 33.78633
## 2021.615       33.51361 33.34020 33.68702 33.24827 33.77896
## 2021.635       33.49743 33.32401 33.67084 33.23208 33.76277
## 2021.654       33.48427 33.31086 33.65769 33.21893 33.74962
## 2021.673       33.49036 33.31695 33.66378 33.22502 33.75571
## 2021.692       33.47965 33.30623 33.65306 33.21430 33.74499
## 2021.712       33.46333 33.28992 33.63674 33.19798 33.72868
## 2021.731       33.45140 33.27798 33.62481 33.18605 33.71674
## 2021.750       33.42429 33.25088 33.59771 33.15895 33.68964
## 2021.769       33.41355 33.24014 33.58697 33.14821 33.67890
## 2021.788       33.40343 33.23002 33.57684 33.13808 33.66878
## 2021.808       33.39972 33.22631 33.57313 33.13437 33.66506
## 2021.827       33.41126 33.23785 33.58467 33.14591 33.67660
## 2021.846       33.37886 33.20545 33.55227 33.11352 33.64421
## 2021.865       33.38924 33.21582 33.56265 33.12389 33.65458
## 2021.885       33.38178 33.20837 33.55519 33.11643 33.64712
## 2021.904       33.39132 33.21791 33.56474 33.12598 33.65667
## 2021.923       33.41471 33.24130 33.58813 33.14937 33.68006
## 2021.942       33.42333 33.24991 33.59674 33.15798 33.68867
## 2021.962       33.42993 33.25651 33.60334 33.16458 33.69527
## 2021.981       33.43387 33.26045 33.60728 33.16852 33.69921
## 2022.000       33.41274 33.23932 33.58615 33.14739 33.67808
## 2022.019       33.40545 33.23204 33.57886 33.14010 33.67079
```

```
## 2022.038       33.42512 33.25185 33.59839 33.15999 33.69025
## 2022.058       33.42180 33.24852 33.59507 33.15667 33.68692
## 2022.077       33.43128 33.25801 33.60455 33.16615 33.69641
```