MasterForecasters_D3

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```
# Load necessary packages
library(tidyverse)
library(patchwork)
library(GGally)
library(lubridate)
library(hms)

library(fpp3)
library(forecast)

library(knitr)
library(kableExtra)
library(tinytex)
library(latex2exp)
```

```
# Load the data from "data/Data_S1.CSV" and "data/Data_S2.CSV"
data <- read.csv("data/Data_S1.CSV")
data <- rbind(data, read.csv("data/Data_S2.CSV"))
data <- rbind(data, read.csv("data/Data_S3.CSV"))

# Convert DATE_TIME
data$DATE_TIME <- as_datetime(data$DATE_TIME)

# delete duplicates based on DATE_TIME
data <- data[!duplicated(data$DATE_TIME),]

data <- as_tsibble(data, index=DATE_TIME)

kable(data[5001:5005, ])
```

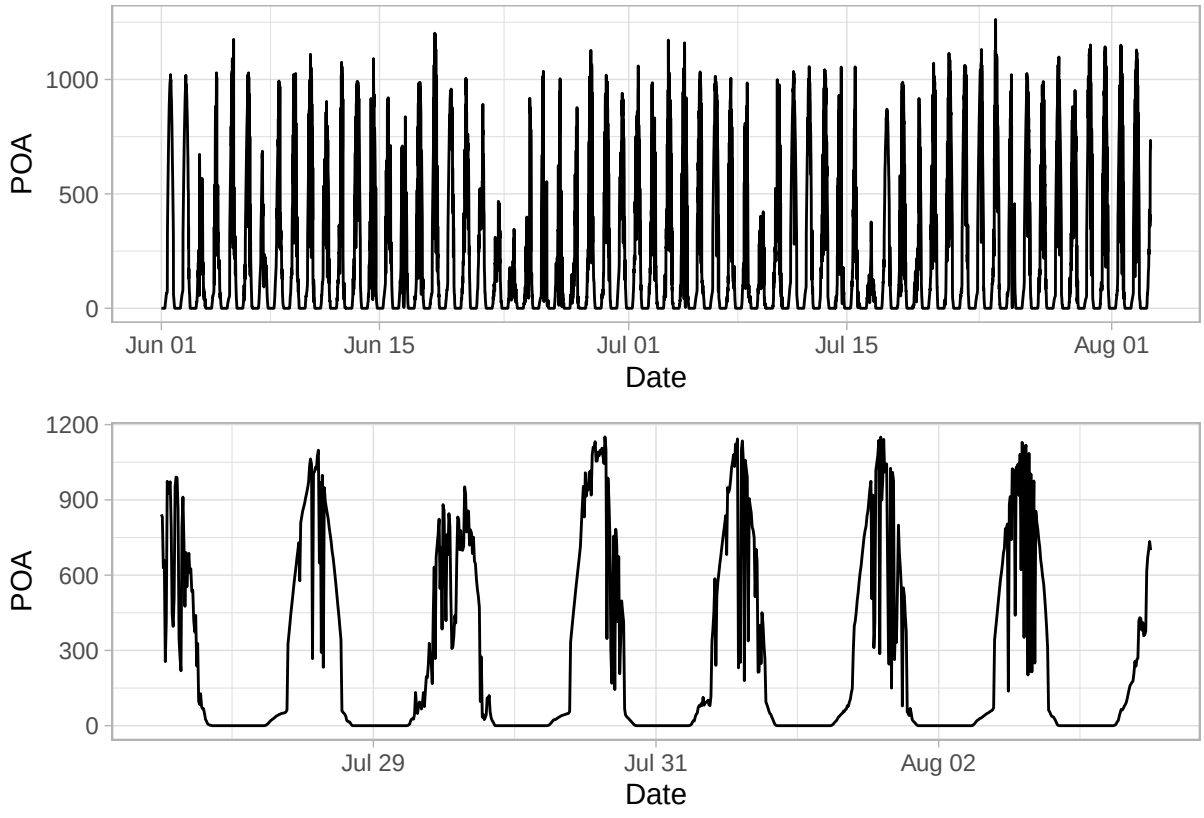
DATE_TIME	AIRTEMP	RH_AVG	DEWPT	WS	GHI	DNI	DIFF	POA
2023-07-05 17:20:00	32.65	50.36	21.01	1.988	104.8	0	104.8	111.40
2023-07-05 17:30:00	31.48	61.72	23.28	2.144	96.0	0	96.0	103.90
2023-07-05 17:40:00	31.00	63.82	23.36	1.870	69.9	0	69.9	81.80
2023-07-05 17:50:00	30.70	64.63	23.29	1.978	63.5	0	63.5	71.17
2023-07-05 18:00:00	30.55	64.88	23.20	1.728	69.9	0	69.9	68.33

```
weather <- read.csv("data/piscataway, nj 2023-06-01 to 2023-08-31.csv")
weather <- weather %>%
  select(datetime, temp, dew, humidity, precip,
         precipprob, winddir, cloudcover, visibility)
```

```r
weather$datetime <- as_datetime(weather$datetime)
weather <- as_tsibble(weather, index=datetime)
```

```r
data <- data %>%
  mutate(datetime_rounded = floor_date(DATE_TIME, "hour"))

data <- left_join(
  data, rename(weather, DATE_TIME = datetime),
  by = c("datetime_rounded" = "DATE_TIME"))

data <- select(data, -datetime_rounded)
```

```r
POQ_vs_TIME <- data %>% autoplot(POA) +
  xlab("Date")

POA_vs_LAST_7D <- data %>%
  filter(DATE_TIME >= max(DATE_TIME) - as.difftime(7, units = "days")) %>%
  autoplot(POA) +
  xlab("Date")

(POQ_vs_TIME + theme_light()) / (POA_vs_LAST_7D + theme_light())
```



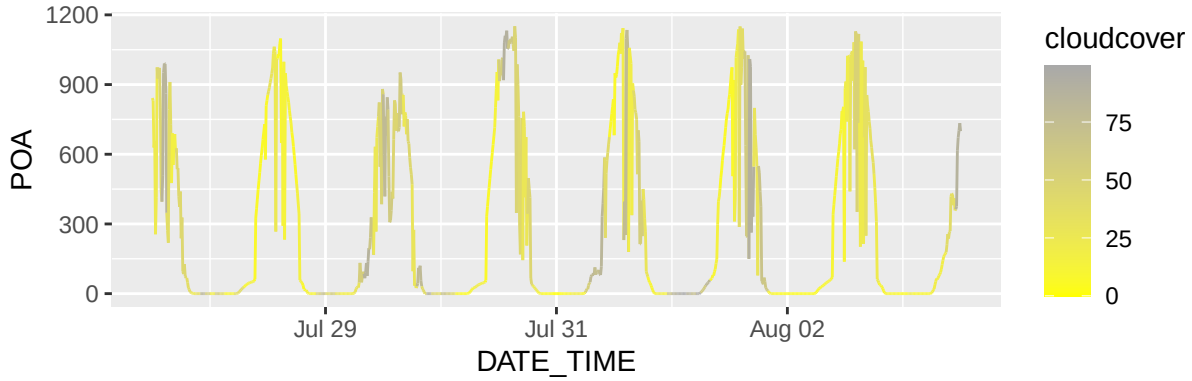

```r
POA_vs_LAST_7D_CC <- data %>%
  filter(DATE_TIME >= max(DATE_TIME) - as.difftime(7, units = "days")) %>%
  ggplot(aes(x=DATE_TIME, y=POA, color=cloudcover)) +
  geom_line() +
  scale_colour_gradient(low = "yellow", high = "darkgrey")
```

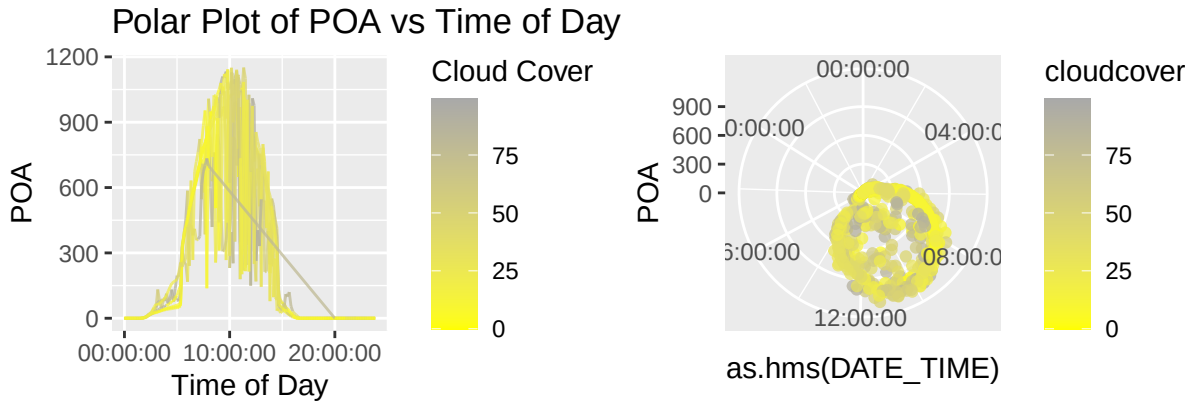
```
polar_cc <- data %>%
  filter(DATE_TIME >= max(DATE_TIME) - as.difftime(7, units = "days")) %>%
  ggplot(
  aes(x=as.hms(DATE_TIME), y=POA,
            group=yday(DATE_TIME), color=cloudcover)) +
  geom_point(alpha = 0.75) +  # Scatter plot with 75% transparency
  scale_colour_gradient(low = "yellow", high = "darkgrey") +
  coord_polar()  # Converts the plot to polar coordinates
  labs(title = "Polar Plot of POA vs Time of Day",
       x = "Time of Day",
       y = "POA",
       colour = "Cloud Cover")
```

```
## $x
## [1] "Time of Day"
##
## $y
## [1] "POA"
##
## $colour
## [1] "Cloud Cover"
##
## $title
## [1] "Polar Plot of POA vs Time of Day"
##
## attr(,"class")
## [1] "labels"
```

```
line_cc <- data %>%
  filter(DATE_TIME >= max(DATE_TIME) - as.difftime(7, units = "days")) %>%
  ggplot(
  aes(x=as.hms(DATE_TIME), y=POA,
            group=yday(DATE_TIME), color=cloudcover)) +
  geom_line(alpha = 0.75) +  # Scatter plot with 75% transparency
  scale_colour_gradient(low = "yellow", high = "darkgrey") +
  labs(title = "Polar Plot of POA vs Time of Day",
       x = "Time of Day",
       y = "POA",
       colour = "Cloud Cover")

POA_vs_LAST_7D_CC / (line_cc + polar_cc)
```

```
## Warning: `as.hms()` was deprecated in hms 0.5.0.
## i Please use `as_hms()` instead.
## This warning is displayed once every 8 hours.
## Call `lifecycle::last_lifecycle_warnings()` to see where this warning was
## generated.
```

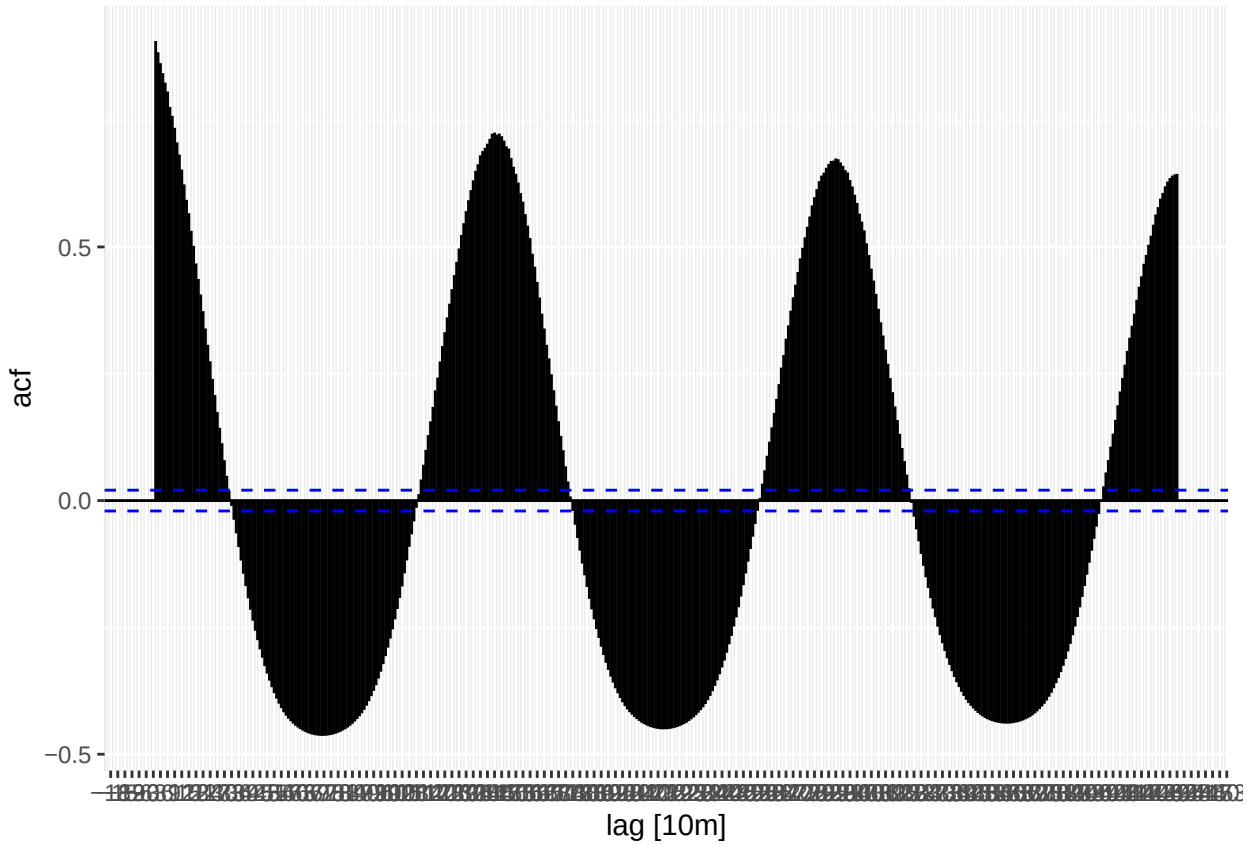




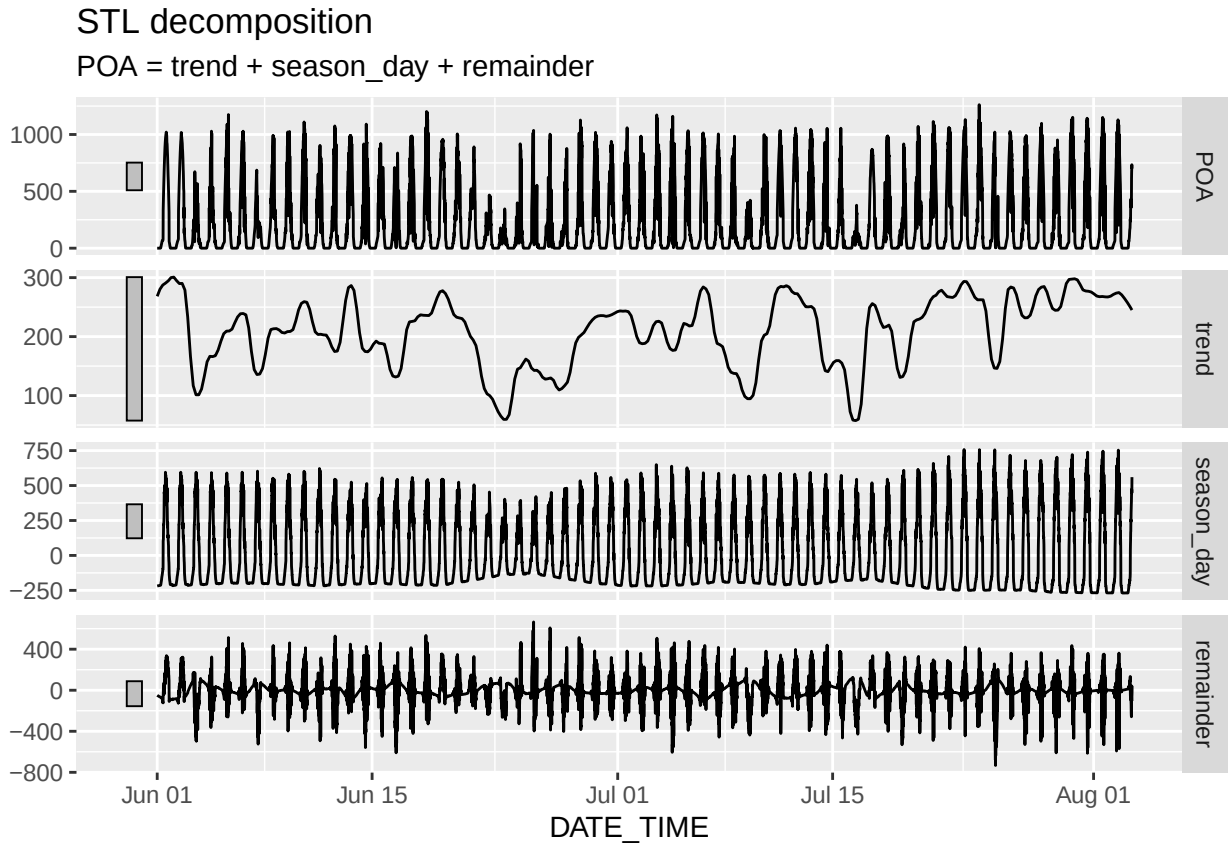

```
data %>% ACF(POA, lag_max=3*24*6, season="day") |> autoplot()
```

```
## Warning: The `...` argument of `PACF()` is deprecated as of feasts 0.2.2.
## i ACF variables should be passed to the `y` argument. If multiple variables are
##   to be used, specify them using `vars(...)`.
## This warning is displayed once every 8 hours.
## Call `lifecycle::last_lifecycle_warnings()` to see where this warning was
## generated.
```

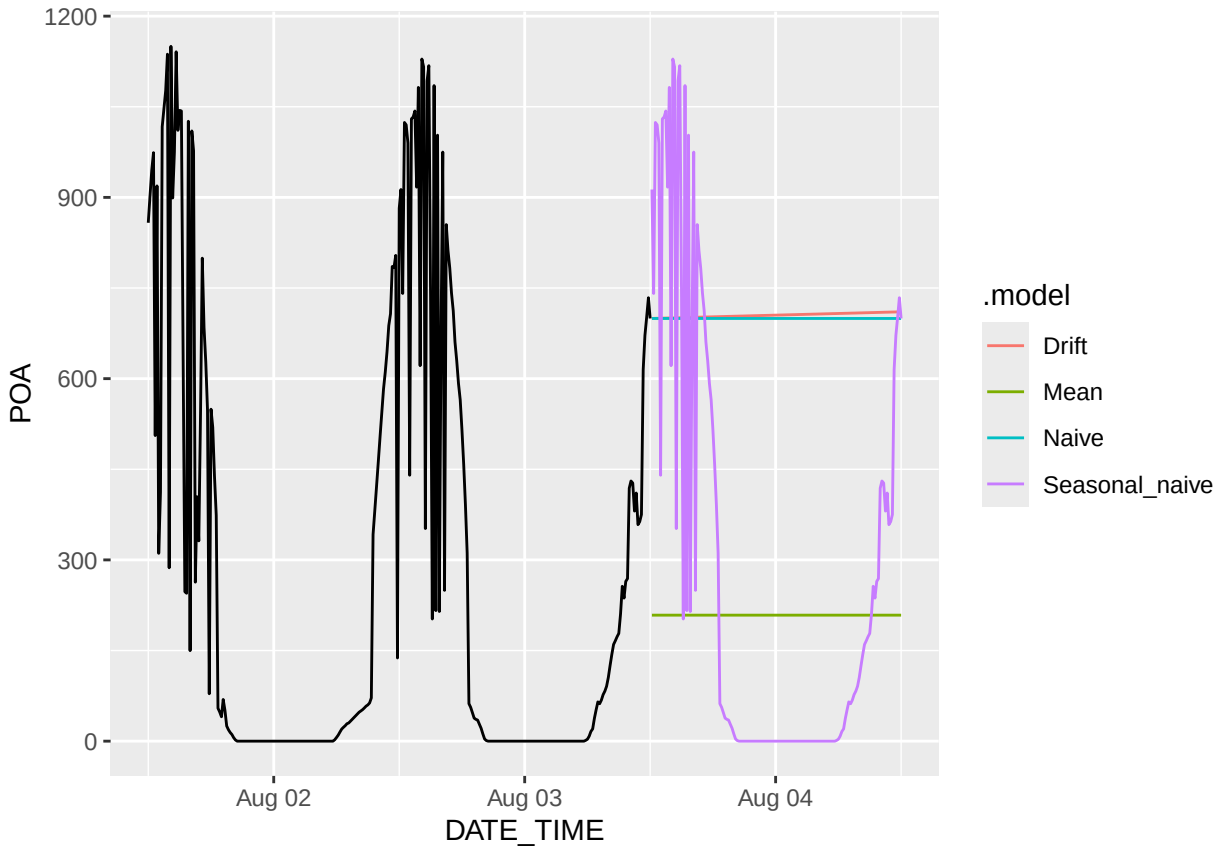
```
## Warning: ACF currently only supports one column, `POA` will be used.
```



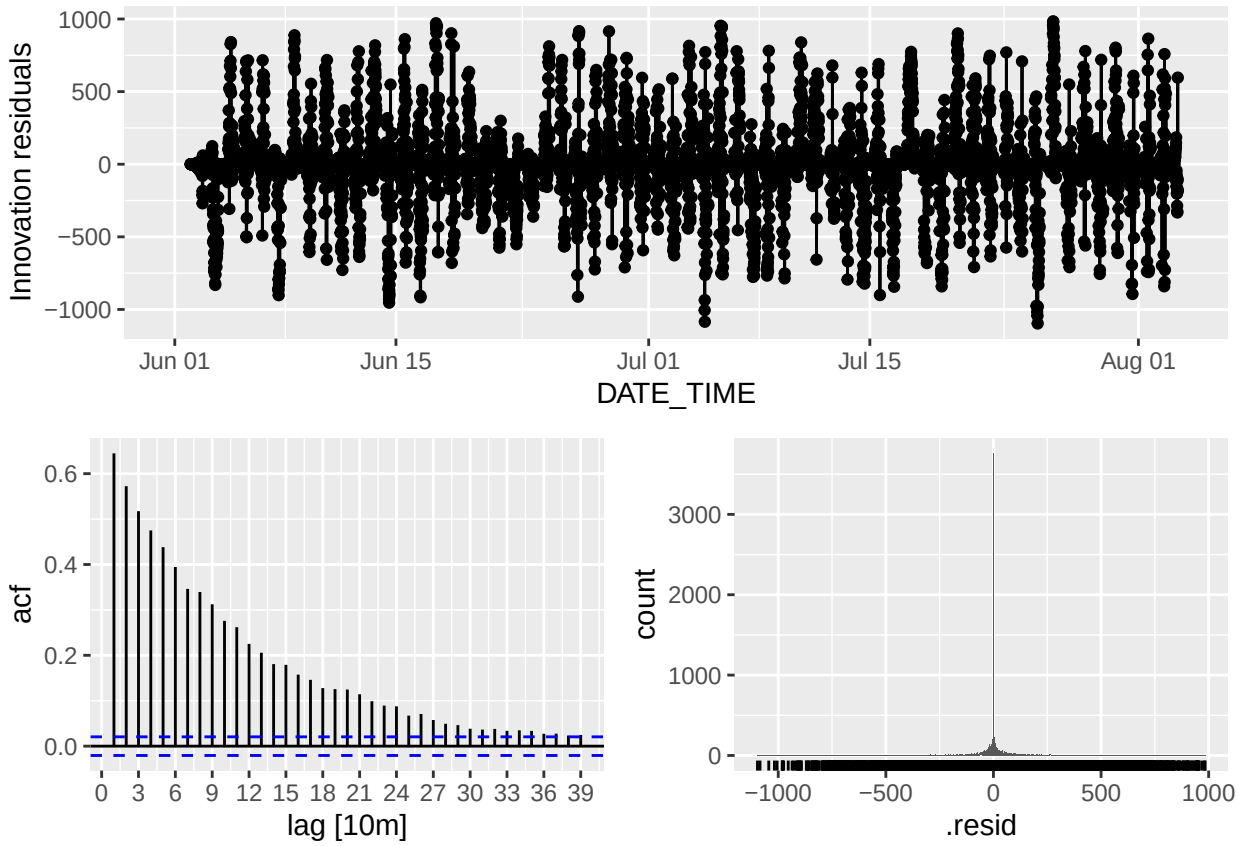

```
dcmp <- data %>%
  model(stl = STL(POA ~ season(period="day")))

components(dcmp) %>% autoplot()
```



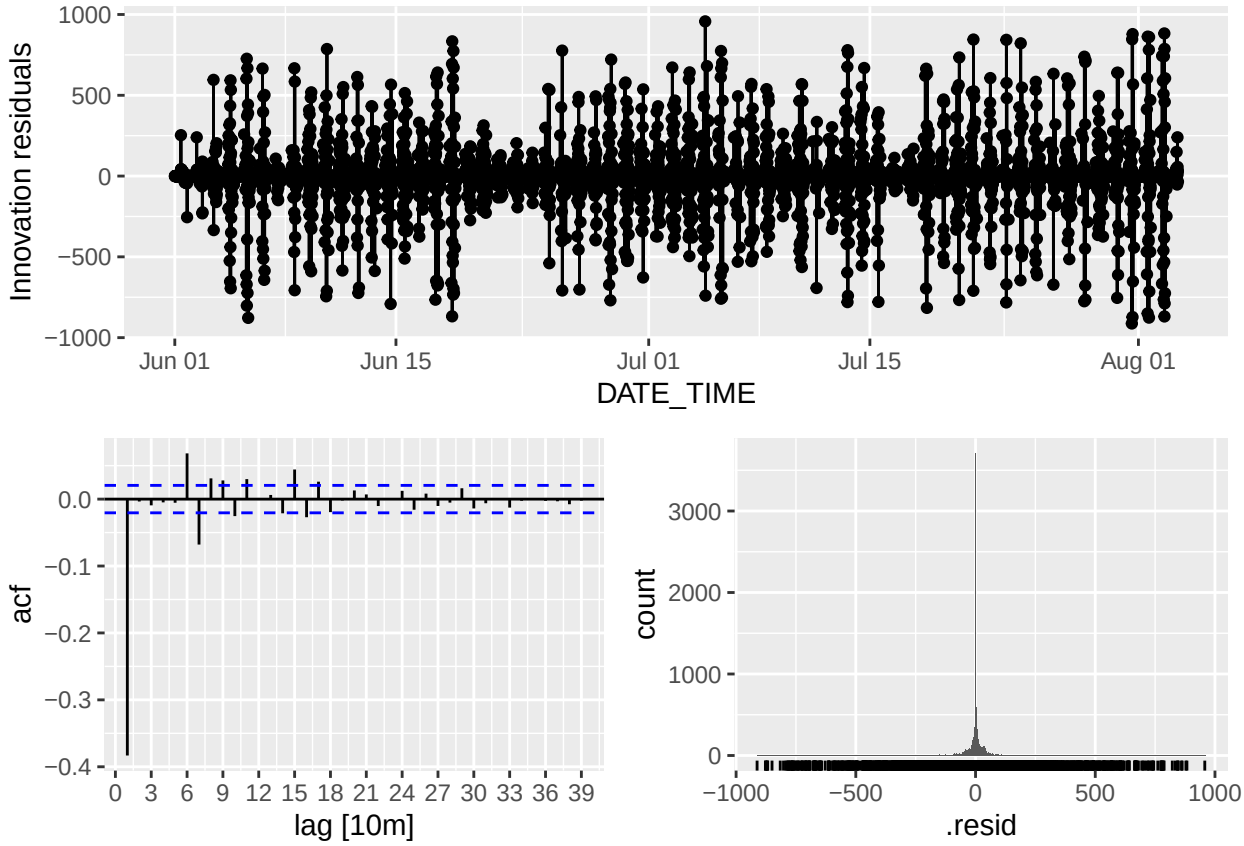

```
benchmarks <- data %>% model(
  Seasonal_naive = SNAIVE(POA ~ lag("1 day")),
  Naive = NAIVE(POA),
  Drift = RW(POA ~ drift()),
  Mean = MEAN(POA))

benchmark_forecasts <- benchmarks %>% forecast(h="1 days")

benchmark_forecasts %>%
  autoplot(level = NULL) +
  autolayer(data %>% filter(DATE_TIME >= max(DATE_TIME) - as.difftime(2, units = "days")), POA)
```




```
gg_tsresiduals(benchmarks["Seasonal_naive"])
```




```
gg_tsresiduals(benchmarks["Naive"])
```



Assume the residuals are white noise - Use ljung-box to determine whether the residuals are indistringuishable from white noise - If lb_pvalue > 0.05, then

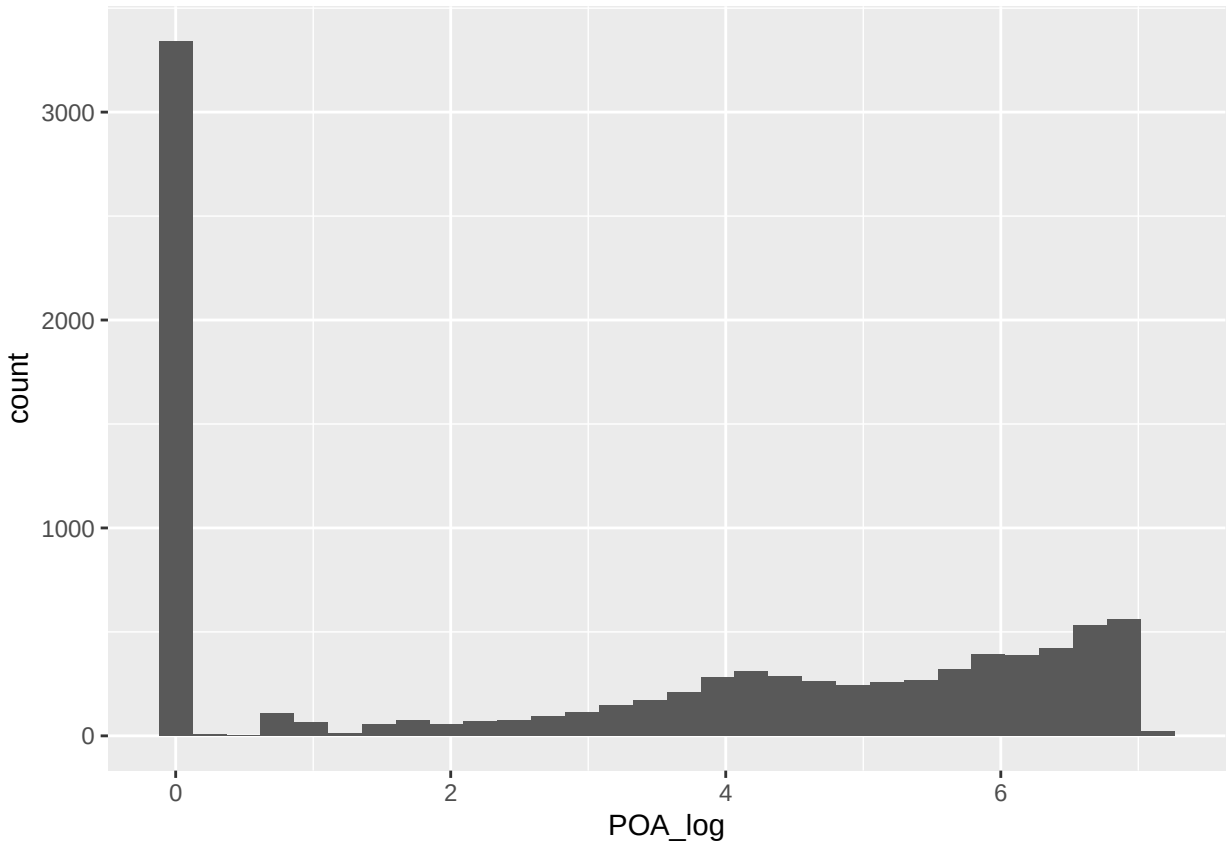
```
augment(benchmarks) %>% features(.resid, ljung_box, lag=2*6*24)
```

```
## # A tibble: 4 x 3
##   .model         lb_stat lb_pvalue
##   <chr>            <dbl>     <dbl>
## 1 Drift            1929.         0
## 2 Mean           493151.         0
## 3 Naive            1929.         0
## 4 Seasonal_naive  30037.         0
```

Data Transforms

```
data <- data %>%
  mutate(POA_log = log(POA + 1), # Add 1 to POA to avoid log(0)
         POA_log = ifelse(is.infinite(POA_log) | is.nan(POA_log), NA, POA_log))
data <- data %>%
  mutate(POA_diffed_log = c(NA, diff(POA_log)))

data %>% ggplot(aes(x=POA_log)) +
  geom_histogram()
```

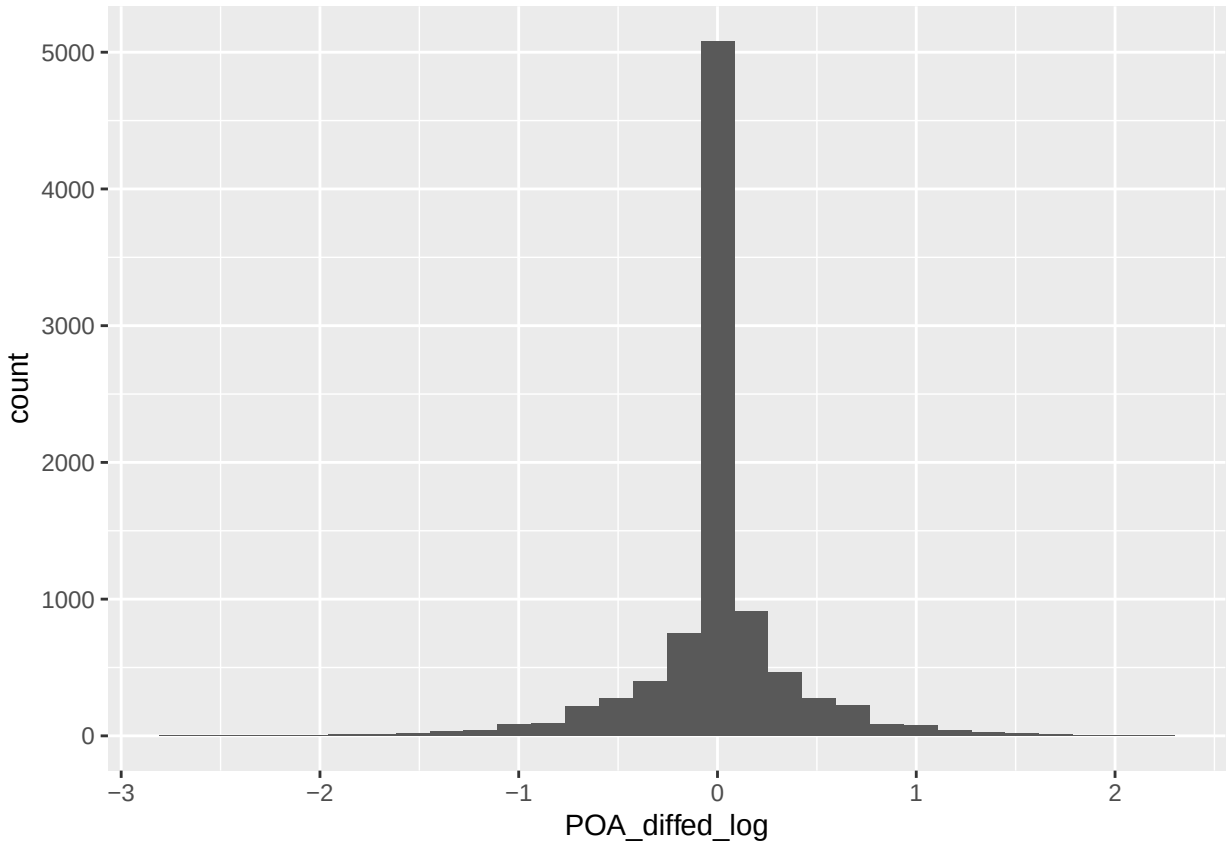
```
## `stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
```




```
data %>% ggplot(aes(x=POA_diffed_log)) +
  geom_histogram()
```

```
## `stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
```

```
## Warning: Removed 1 row containing non-finite outside the scale range
## (`stat_bin()`).
```

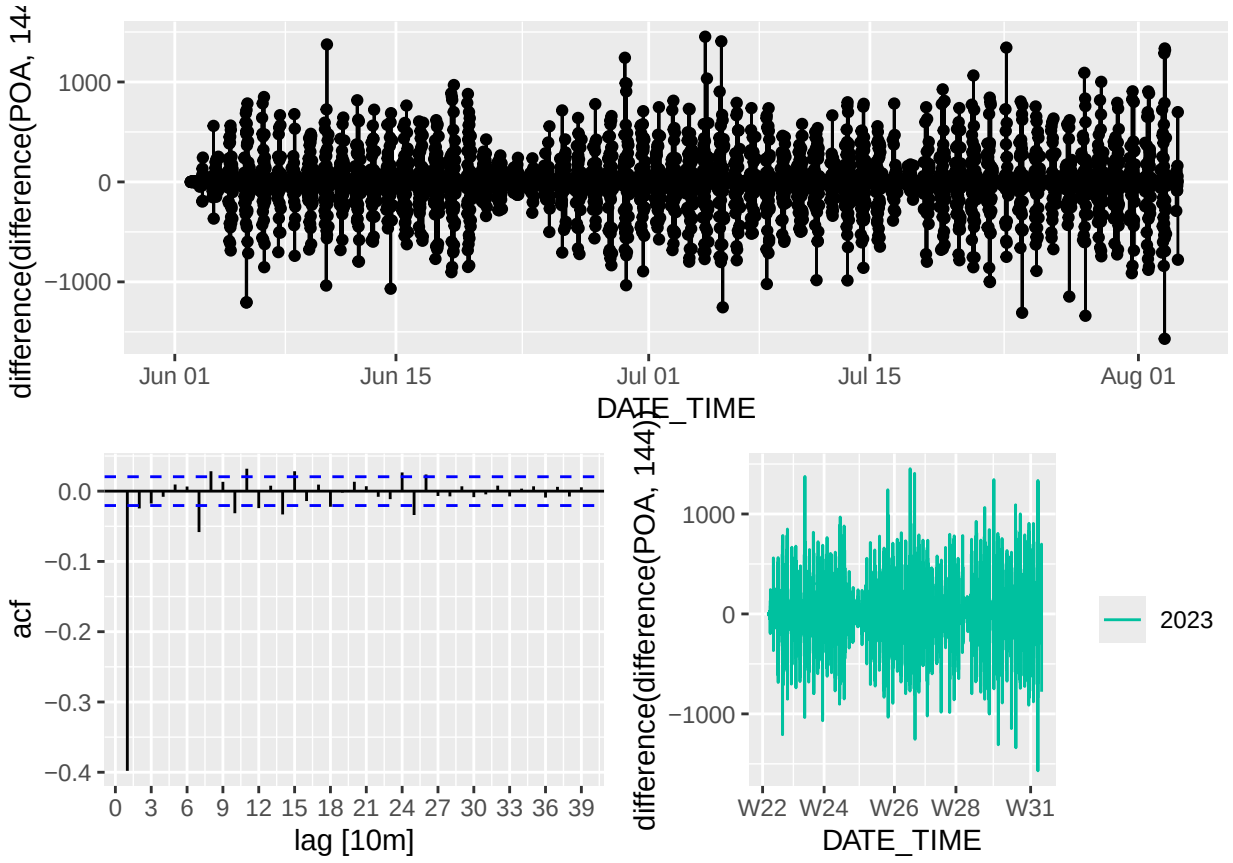



```
data %>% gg_tsdisplay(
  difference(POA, 144) |> difference()
)
```

```
## Warning: Removed 145 rows containing missing values or values outside the scale range
## (`geom_line()`).
```

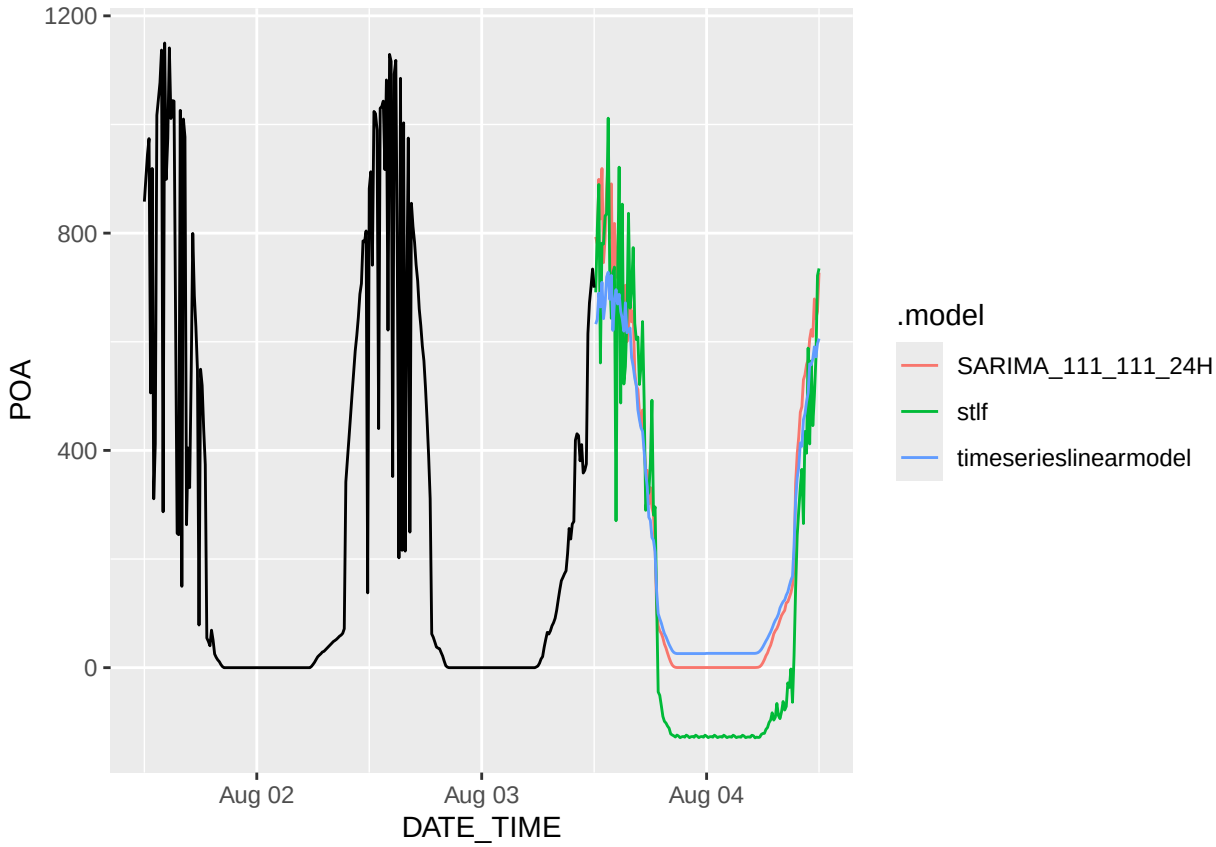
```
## Warning: Removed 145 rows containing missing values or values outside the scale range
## (`geom_point()`).
```

```
## Warning: Removed 145 rows containing missing values or values outside the scale range
## (`geom_line()`).
```




```
fit <- data %>% model(
  stlf = decomposition_model(
    STL(POA ~ trend(), robust=TRUE),
    NAIVE(season_adjust)),

  timeserieslinearmodel = TSLM(POA ~ trend() + season("1 day")),

  SARIMA_111_111_24H = ARIMA(log(POA+1) ~ pdq(1, 1, 1) + PDQ(1, 1, 1, "1 day")),
)
```

```
fit_forecasts <- fit %>% forecast(h="1 days")

fit_forecasts <- fit_forecasts %>%
  mutate(.mean = pmax(.mean, 0))

fit_forecasts %>%
  autoplot(level = NULL) +
  autolayer(data %>% filter(DATE_TIME >= max(DATE_TIME) - as.difftime(2, units = "days")), POA)
```


1200
800
400
0
POA
Aug 02
Aug 03
Aug 04
DATE_TIME
.model
SARIMA_111_111_24H
stlf
timeserieslinearmodel