FinalProject_Ana

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```
library(tidyverse)
```

```
## -- Attaching packages --------------------------------------- tidyverse 1.3.2 --
## v ggplot2 3.4.0      v purrr   0.3.5
## v tibble  3.1.8      v dplyr   1.0.10
## v tidyr   1.2.1      v stringr 1.5.0
## v readr   2.1.3      v forcats 0.5.2
## -- Conflicts ------------------------------------------ tidyverse_conflicts() --
## x dplyr::filter() masks stats::filter()
## x dplyr::lag()    masks stats::lag()
```

```
library(lubridate)
```

```
##
## Attaching package: 'lubridate'
##
## The following objects are masked from 'package:base':
##
##     date, intersect, setdiff, union
```

```
library(trend)
library(zoo)
```

```
##
## Attaching package: 'zoo'
##
## The following objects are masked from 'package:base':
##
##     as.Date, as.Date.numeric
```

```
library(tseries)
```

```
## Registered S3 method overwritten by 'quantmod':
##   method            from
##   as.zoo.data.frame zoo
```

```
library(dplyr)
library(cowplot)
```

```
##
## Attaching package: 'cowplot'
##
## The following object is masked from 'package:lubridate':
##
##     stamp
```

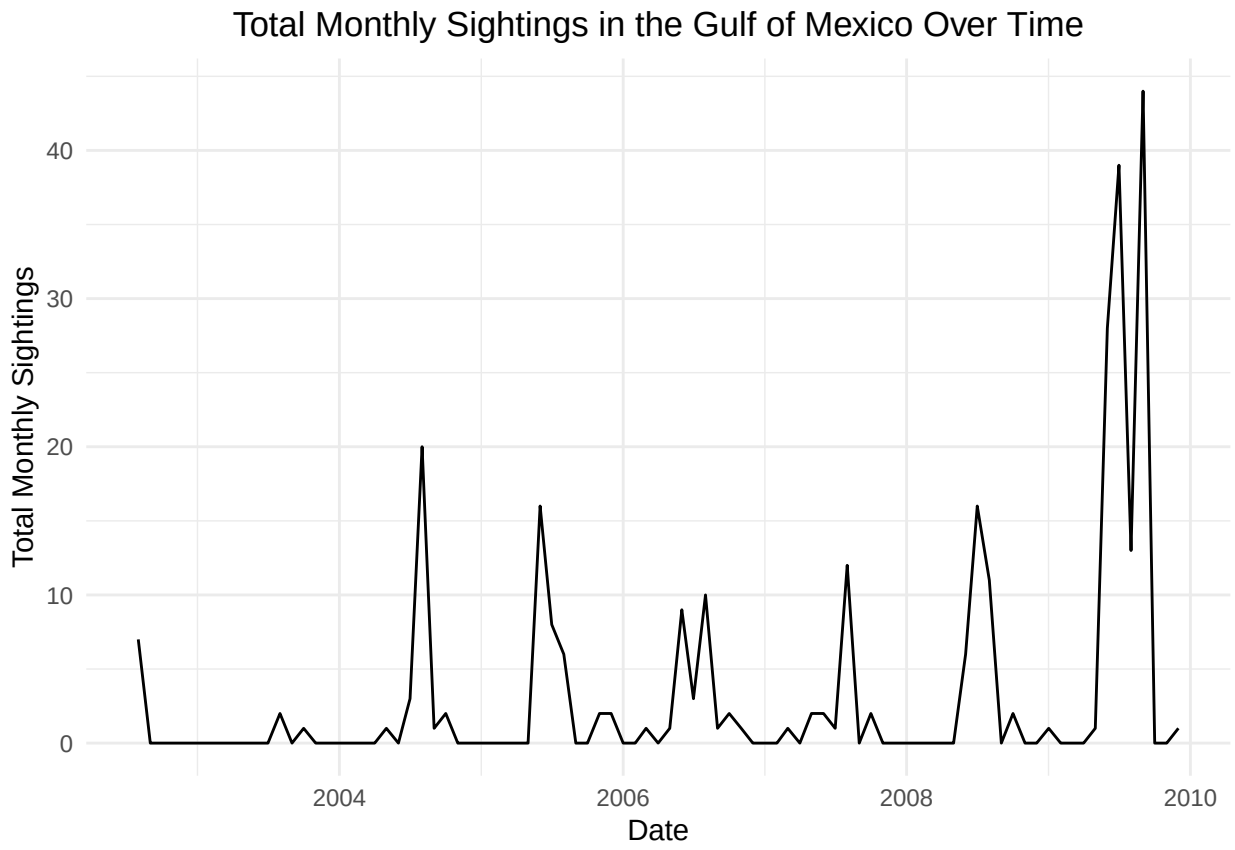
```
library(trend)
library(Kendall)
```

```
#read in data
gom_sightings <- read_csv("./Data/whaleshark_data/cleaned_gom_data.csv")
```

```
## Rows: 281 Columns: 21
## -- Column specification --------------------------------------------------------
## Delimiter: ","
## chr  (8): row_id, species_name, scientific_name, common_name, ds_type, platf...
## dbl  (6): dataset_id, latitude, longitude, itis_tsn, lprecision, tprecision
## lgl  (4): group_size, series_id, timezone, notes
## dttm (1): last_mod
## date (1): date
## time (1): time
##
## i Use `spec()` to retrieve the full column specification for this data.
## i Specify the column types or set `show_col_types = FALSE` to quiet this message.
```

```
## calculate number of sightings per month/year
#isolate month and year
gom_sightings <- mutate(gom_sightings, month = month(date)) %>%
  mutate(gom_sightings, year = year(date)) %>%
  mutate(month_yr = my(paste(month,"-",year)))

#sum number of sightings per month-year
gom_sightings <- gom_sightings %>% group_by(month_yr) %>% mutate(total_sightings = n())

#need to fill in all missing months/years
#generate sequence of all months and years between August 2002 and December 2009
dates <- as.data.frame(seq(as.Date("2002-08-01"), as.Date("2009-12-01"), "months"))
colnames(dates)[1] ="month_yr"

#Select month/yr and total sightings from gom_sightings
sightings <- gom_sightings %>% select(month_yr, total_sightings)
sightings <- distinct(sightings)

#left join that to the new sequence of months and years
sightings_all_months <- left_join(dates, sightings, by ="month_yr")

#Fill in all NAs as a total sighting of 0
sightings_all_months[is.na(sightings_all_months)] <- 0

#initial timeseries
ggplot(sightings_all_months, aes(x = month_yr, y = total_sightings)) +
  geom_line() +
```

```
  labs(x = "Date", y = "Total Monthly Sightings", title = "Total Monthly Sightings in the Gulf of Mexico
  theme_minimal() +
  theme(plot.title = element_text(hjust = 0.5))
```



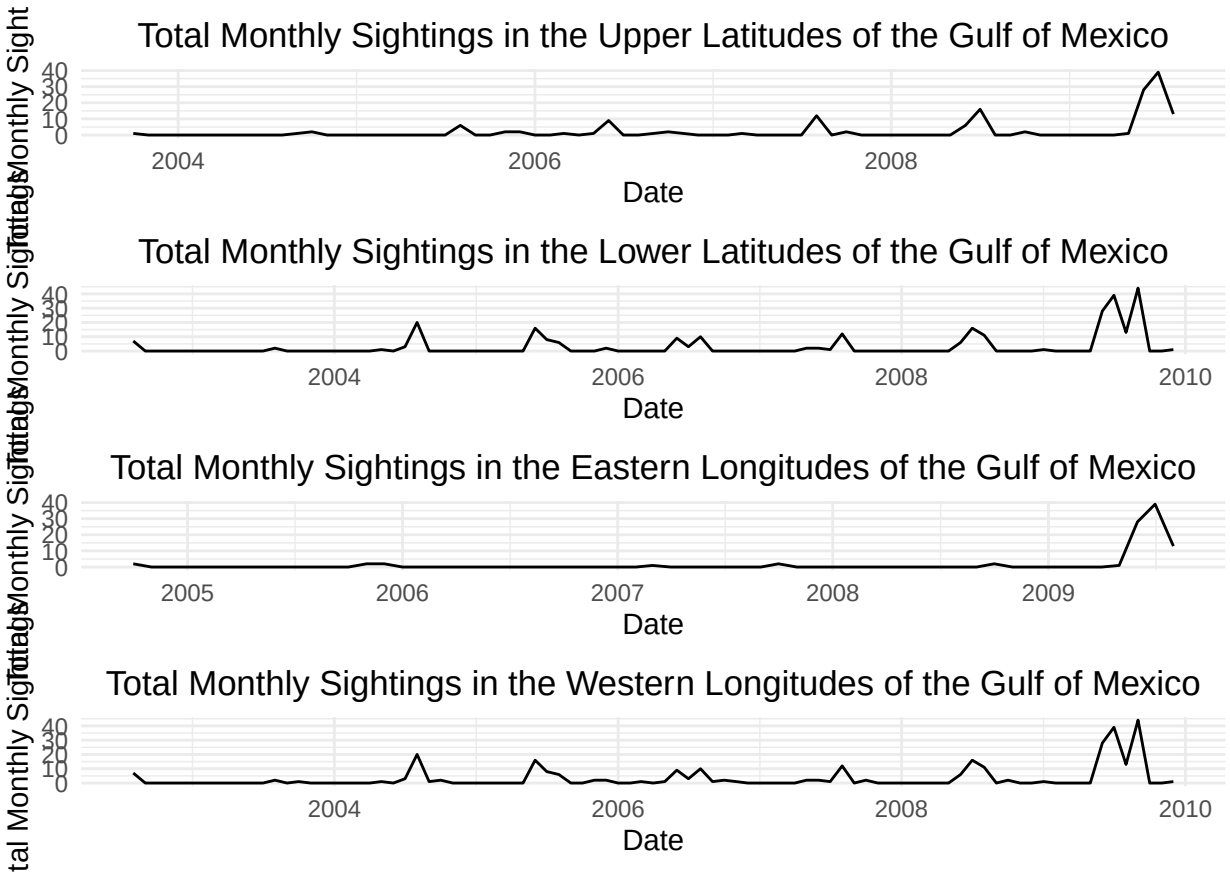

```
# latitudes: range from 20-29; break in half at 25 and compare two categories since there are a
# ton of obvs at lat = 21 and 27+
lower_lats <- gom_sightings %>% filter(latitude >= 20 & latitude < 25) #n = 241
upper_lats <- gom_sightings %>% filter(latitude >= 25 & latitude <= 30) #n = 40

## lower latitude ts
lower_lat_dates <- as.data.frame(seq(as.Date("2002-08-01"), as.Date("2009-12-01"), "months"))
colnames(lower_lat_dates)[1] ="month_yr"

#Select month/yr and total sightings from gom_sightings
lower_lat_sightings <- lower_lats %>% select(month_yr, total_sightings)
lower_lat_sightings <- distinct(lower_lat_sightings)

#left join that to the new sequence of months and years
lower_lat_sightings_all_months <- left_join(lower_lat_dates, lower_lat_sightings, by ="month_yr")

#Fill in all NAs as a total sighting of 0
lower_lat_sightings_all_months[is.na(lower_lat_sightings_all_months)] <- 0

lower_lat_plot <- ggplot(lower_lat_sightings_all_months, aes(x = month_yr, y = total_sightings)) +
  geom_line() +
```

```
  labs(x = "Date", y = "Total Monthly Sightings", title = "Total Monthly Sightings in the Lower Latitud
  theme_minimal() +
  theme(plot.title = element_text(hjust = 0.5))

## upper latitude ts
upper_lat_dates <- as.data.frame(seq(as.Date("2003-10-01"), as.Date("2009-08-01"), "months"))
colnames(upper_lat_dates)[1] ="month_yr"

#Select month/yr and total sightings from gom_sightings
upper_lat_sightings <- upper_lats %>% select(month_yr, total_sightings)
upper_lat_sightings <- distinct(upper_lat_sightings)

#left join that to the new sequence of months and years
upper_lat_sightings_all_months <- left_join(upper_lat_dates, upper_lat_sightings, by ="month_yr")

#Fill in all NAs as a total sighting of 0
upper_lat_sightings_all_months[is.na(upper_lat_sightings_all_months)] <- 0

upper_lat_plot <- ggplot(upper_lat_sightings_all_months, aes(x = month_yr, y = total_sightings)) +
  geom_line() +
  labs(x = "Date", y = "Total Monthly Sightings", title = "Total Monthly Sightings in the Upper Latitud
  theme_minimal() +
  theme(plot.title = element_text(hjust = 0.5))
```

```
# longitudes: range from -80--96; break in half at 89 and compare two categories

eastern_longs <- gom_sightings %>% filter(longitude > -86 & longitude <= -80) #n = 12
western_longs <- gom_sightings %>% filter(longitude >= -97 & longitude <= -86) #n = 269

## eastern longitude ts
eastern_long_dates <- as.data.frame(seq(as.Date("2004-10-01"), as.Date("2009-08-01"), "months"))
colnames(eastern_long_dates)[1] ="month_yr"

#Select month/yr and total sightings from gom_sightings
eastern_long_sightings <- eastern_longs %>% select(month_yr, total_sightings)
eastern_long_sightings <- distinct(eastern_long_sightings)

#left join that to the new sequence of months and years
eastern_long_sightings_all_months <- left_join(eastern_long_dates, eastern_long_sightings, by ="month_y

#Fill in all NAs as a total sighting of 0
eastern_long_sightings_all_months[is.na(eastern_long_sightings_all_months)] <- 0

eastern_long_plot <- ggplot(eastern_long_sightings_all_months, aes(x = month_yr, y = total_sightings)) +
  geom_line() +
  labs(x = "Date", y = "Total Monthly Sightings", title = "Total Monthly Sightings in the Eastern Longi
  theme_minimal() +
  theme(plot.title = element_text(hjust = 0.5))

## western longitude ts
western_long_dates <- as.data.frame(seq(as.Date("2002-08-01"), as.Date("2009-12-01"), "months"))
colnames(western_long_dates)[1] ="month_yr"
```

```r
#Select month/yr and total sightings from gom_sightings
western_long_sightings <- western_longs %>% select(month_yr, total_sightings)
western_long_sightings <- distinct(western_long_sightings)

#left join that to the new sequence of months and years
western_long_sightings_all_months <- left_join(western_long_dates, western_long_sightings, by ="month_yr

#Fill in all NAs as a total sighting of 0
western_long_sightings_all_months[is.na(western_long_sightings_all_months)] <- 0

western_long_plot <- ggplot(western_long_sightings_all_months, aes(x = month_yr, y = total_sightings)) +
  geom_line() +
  labs(x = "Date", y = "Total Monthly Sightings", title = "Total Monthly Sightings in the Western Longi
  theme_minimal() +
  theme(plot.title = element_text(hjust = 0.5))
```

```r
# compare all plots together
plot_grid(upper_lat_plot, lower_lat_plot, eastern_long_plot, western_long_plot, nrow = 4, align = 'v', a
```




```r
lat_20 <- gom_sightings %>% filter(latitude >= 20 & latitude < 21) # n = 2
lat_21 <- gom_sightings %>% filter(latitude >= 21 & latitude < 22) # n = 236
lat_22 <- gom_sightings %>% filter(latitude >= 22 & latitude < 23) # n = 1
lat_23 <- gom_sightings %>% filter(latitude >= 23 & latitude < 24) # n = 0
lat_24 <- gom_sightings %>% filter(latitude >= 24 & latitude < 25) # n = 2
lat_25 <- gom_sightings %>% filter(latitude >= 25 & latitude < 26) # n = 3
```

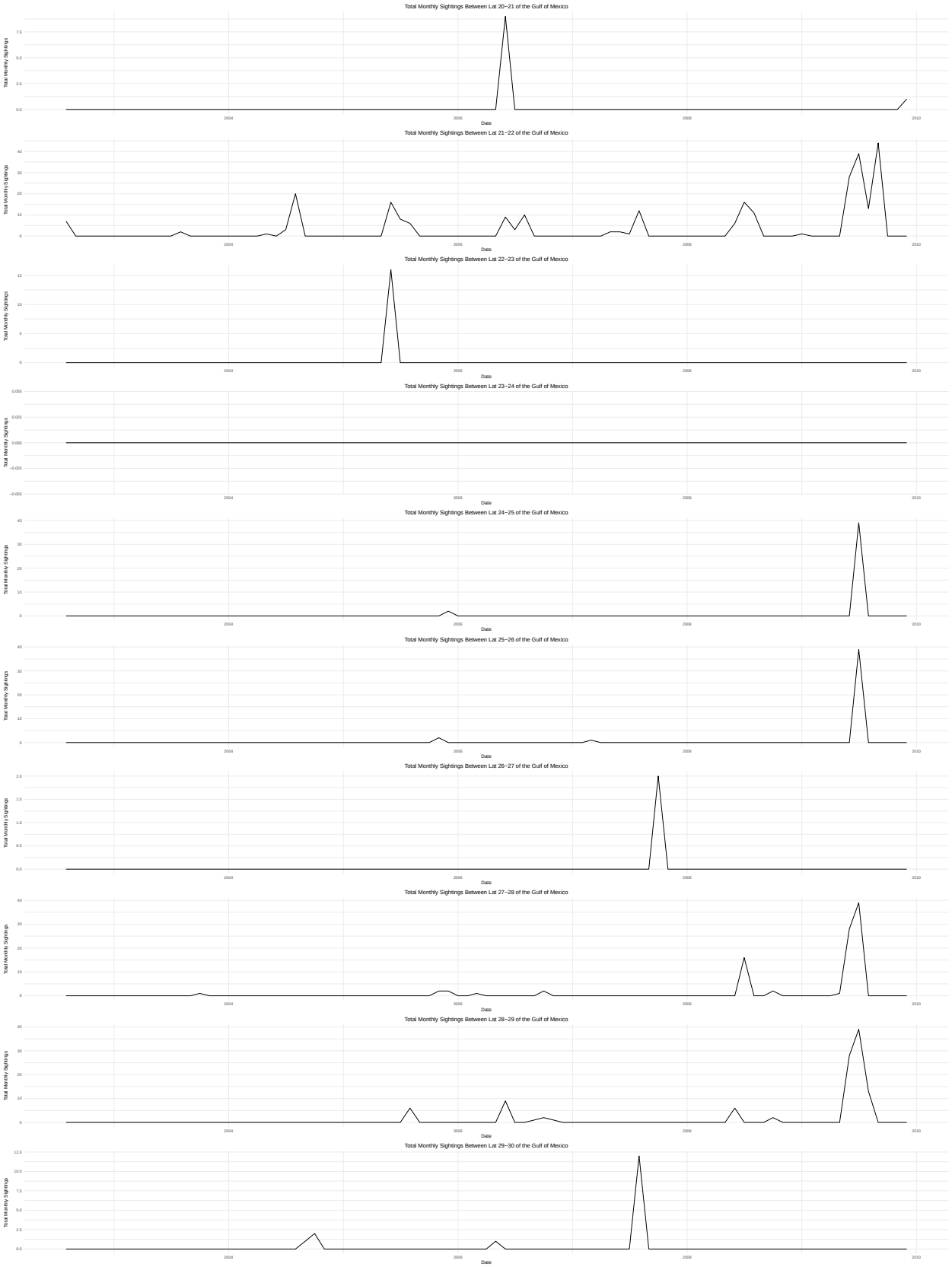
```r
lat_26 <- gom_sightings %>% filter(latitude >= 26 & latitude < 27) # n = 2
lat_27 <- gom_sightings %>% filter(latitude >= 27 & latitude < 28) # n = 12
lat_28 <- gom_sightings %>% filter(latitude >= 28 & latitude < 29) # n = 18
lat_29 <- gom_sightings %>% filter(latitude >= 29 & latitude < 30) # n = 5

## set same date range for all using min/max of all lats. come back to make sure this is okay
all_lat_dates <- as.data.frame(seq(as.Date("2002-08-01"), as.Date("2009-12-01"), "months"))
colnames(all_lat_dates)[1] ="month_yr"

## lat 20

#Select month/yr and total sightings from gom_sightings
lat_20_sightings <- lat_20 %>% select(month_yr, total_sightings)
lat_20_sightings <- distinct(lat_20_sightings)

#left join that to the new sequence of months and years
lat_20_sightings_all_months <- left_join(all_lat_dates, lat_20_sightings, by ="month_yr")

#Fill in all NAs as a total sighting of 0
lat_20_sightings_all_months[is.na(lat_20_sightings_all_months)] <- 0

lat_20_plot <- ggplot(lat_20_sightings_all_months, aes(x = month_yr, y = total_sightings)) +
  geom_line() +
  labs(x = "Date", y = "Total Monthly Sightings", title = "Total Monthly Sightings Between Lat 20-21 of
  theme_minimal() +
  theme(plot.title = element_text(hjust = 0.5))

## lat 21

#Select month/yr and total sightings from gom_sightings
lat_21_sightings <- lat_21 %>% select(month_yr, total_sightings)
lat_21_sightings <- distinct(lat_21_sightings)

#left join that to the new sequence of months and years
lat_21_sightings_all_months <- left_join(all_lat_dates, lat_21_sightings, by ="month_yr")

#Fill in all NAs as a total sighting of 0
lat_21_sightings_all_months[is.na(lat_21_sightings_all_months)] <- 0

lat_21_plot <- ggplot(lat_21_sightings_all_months, aes(x = month_yr, y = total_sightings)) +
  geom_line() +
  labs(x = "Date", y = "Total Monthly Sightings", title = "Total Monthly Sightings Between Lat 21-22 of
  theme_minimal() +
  theme(plot.title = element_text(hjust = 0.5))

## lat 22

#Select month/yr and total sightings from gom_sightings
lat_22_sightings <- lat_22 %>% select(month_yr, total_sightings)
lat_22_sightings <- distinct(lat_22_sightings)

#left join that to the new sequence of months and years
lat_22_sightings_all_months <- left_join(all_lat_dates, lat_22_sightings, by ="month_yr")
```

```r
#Fill in all NAs as a total sighting of 0
lat_22_sightings_all_months[is.na(lat_22_sightings_all_months)] <- 0

lat_22_plot <- ggplot(lat_22_sightings_all_months, aes(x = month_yr, y = total_sightings)) +
  geom_line() +
  labs(x = "Date", y = "Total Monthly Sightings", title = "Total Monthly Sightings Between Lat 22-23 of
  theme_minimal() +
  theme(plot.title = element_text(hjust = 0.5))

## lat 23

#Select month/yr and total sightings from gom_sightings
lat_23_sightings <- lat_23 %>% select(month_yr, total_sightings)
lat_23_sightings <- distinct(lat_23_sightings)

#left join that to the new sequence of months and years
lat_23_sightings_all_months <- left_join(all_lat_dates, lat_23_sightings, by ="month_yr")

#Fill in all NAs as a total sighting of 0
lat_23_sightings_all_months[is.na(lat_23_sightings_all_months)] <- 0

lat_23_plot <- ggplot(lat_23_sightings_all_months, aes(x = month_yr, y = total_sightings)) +
  geom_line() +
  labs(x = "Date", y = "Total Monthly Sightings", title = "Total Monthly Sightings Between Lat 23-24 of
  theme_minimal() +
  theme(plot.title = element_text(hjust = 0.5))

## lat 24

#Select month/yr and total sightings from gom_sightings
lat_24_sightings <- lat_24 %>% select(month_yr, total_sightings)
lat_24_sightings <- distinct(lat_24_sightings)

#left join that to the new sequence of months and years
lat_24_sightings_all_months <- left_join(all_lat_dates, lat_24_sightings, by ="month_yr")

#Fill in all NAs as a total sighting of 0
lat_24_sightings_all_months[is.na(lat_24_sightings_all_months)] <- 0

lat_24_plot <- ggplot(lat_24_sightings_all_months, aes(x = month_yr, y = total_sightings)) +
  geom_line() +
  labs(x = "Date", y = "Total Monthly Sightings", title = "Total Monthly Sightings Between Lat 24-25 of
  theme_minimal() +
  theme(plot.title = element_text(hjust = 0.5))

## lat 25

#Select month/yr and total sightings from gom_sightings
lat_25_sightings <- lat_25 %>% select(month_yr, total_sightings)
lat_25_sightings <- distinct(lat_25_sightings)

#left join that to the new sequence of months and years
lat_25_sightings_all_months <- left_join(all_lat_dates, lat_25_sightings, by ="month_yr")
```

```r
#Fill in all NAs as a total sighting of 0
lat_25_sightings_all_months[is.na(lat_25_sightings_all_months)] <- 0

lat_25_plot <- ggplot(lat_25_sightings_all_months, aes(x = month_yr, y = total_sightings)) +
  geom_line() +
  labs(x = "Date", y = "Total Monthly Sightings", title = "Total Monthly Sightings Between Lat 25-26 of
  theme_minimal() +
  theme(plot.title = element_text(hjust = 0.5))

## lat 26

#Select month/yr and total sightings from gom_sightings
lat_26_sightings <- lat_26 %>% select(month_yr, total_sightings)
lat_26_sightings <- distinct(lat_26_sightings)

#left join that to the new sequence of months and years
lat_26_sightings_all_months <- left_join(all_lat_dates, lat_26_sightings, by ="month_yr")

#Fill in all NAs as a total sighting of 0
lat_26_sightings_all_months[is.na(lat_26_sightings_all_months)] <- 0

lat_26_plot <- ggplot(lat_26_sightings_all_months, aes(x = month_yr, y = total_sightings)) +
  geom_line() +
  labs(x = "Date", y = "Total Monthly Sightings", title = "Total Monthly Sightings Between Lat 26-27 of
  theme_minimal() +
  theme(plot.title = element_text(hjust = 0.5))

## lat 27

#Select month/yr and total sightings from gom_sightings
lat_27_sightings <- lat_27 %>% select(month_yr, total_sightings)
lat_27_sightings <- distinct(lat_27_sightings)

#left join that to the new sequence of months and years
lat_27_sightings_all_months <- left_join(all_lat_dates, lat_27_sightings, by ="month_yr")

#Fill in all NAs as a total sighting of 0
lat_27_sightings_all_months[is.na(lat_27_sightings_all_months)] <- 0

lat_27_plot <- ggplot(lat_27_sightings_all_months, aes(x = month_yr, y = total_sightings)) +
  geom_line() +
  labs(x = "Date", y = "Total Monthly Sightings", title = "Total Monthly Sightings Between Lat 27-28 of
  theme_minimal() +
  theme(plot.title = element_text(hjust = 0.5))

## lat 28

#Select month/yr and total sightings from gom_sightings
lat_28_sightings <- lat_28 %>% select(month_yr, total_sightings)
lat_28_sightings <- distinct(lat_28_sightings)

#left join that to the new sequence of months and years
lat_28_sightings_all_months <- left_join(all_lat_dates, lat_28_sightings, by ="month_yr")
```

```r
#Fill in all NAs as a total sighting of 0
lat_28_sightings_all_months[is.na(lat_28_sightings_all_months)] <- 0

lat_28_plot <- ggplot(lat_28_sightings_all_months, aes(x = month_yr, y = total_sightings)) +
  geom_line() +
  labs(x = "Date", y = "Total Monthly Sightings", title = "Total Monthly Sightings Between Lat 28-29 of
  theme_minimal() +
  theme(plot.title = element_text(hjust = 0.5))

## lat 29

#Select month/yr and total sightings from gom_sightings
lat_29_sightings <- lat_29 %>% select(month_yr, total_sightings)
lat_29_sightings <- distinct(lat_29_sightings)

#left join that to the new sequence of months and years
lat_29_sightings_all_months <- left_join(all_lat_dates, lat_29_sightings, by ="month_yr")

#Fill in all NAs as a total sighting of 0
lat_29_sightings_all_months[is.na(lat_29_sightings_all_months)] <- 0

lat_29_plot <- ggplot(lat_29_sightings_all_months, aes(x = month_yr, y = total_sightings)) +
  geom_line() +
  labs(x = "Date", y = "Total Monthly Sightings", title = "Total Monthly Sightings Between Lat 29-30 of
  theme_minimal() +
  theme(plot.title = element_text(hjust = 0.5))
```

```r
# compare all plots together
lat_comparison_plot <- plot_grid(lat_20_plot, lat_21_plot, lat_22_plot, lat_23_plot, lat_24_plot, lat_25
save_plot("./Figures/lat_comparison_plot.pdf", lat_comparison_plot, base_height = 40, base_width = 20)
print(lat_comparison_plot)
```


Total Monthly Sightings Between Lat 20–21 of the Gulf of Mexico
Total Monthly Sightings
Date
Total Monthly Sightings Between Lat 21–22 of the Gulf of Mexico
Total Monthly Sightings
Date
Total Monthly Sightings Between Lat 22–23 of the Gulf of Mexico
Total Monthly Sightings
Date
Total Monthly Sightings Between Lat 23–24 of the Gulf of Mexico
Total Monthly Sightings
Date
Total Monthly Sightings Between Lat 24–25 of the Gulf of Mexico
Total Monthly Sightings
Date
Total Monthly Sightings Between Lat 25–26 of the Gulf of Mexico
Total Monthly Sightings
Date
Total Monthly Sightings Between Lat 26–27 of the Gulf of Mexico
Total Monthly Sightings
Date
Total Monthly Sightings Between Lat 27–28 of the Gulf of Mexico
Total Monthly Sightings
Date
Total Monthly Sightings Between Lat 28–29 of the Gulf of Mexico
Total Monthly Sightings
Date
Total Monthly Sightings Between Lat 29–30 of the Gulf of Mexico
Total Monthly Sightings
Date

```r
# doing longs - counting 2 by 2
long_80 <- gom_sightings %>% filter(longitude < -80 & longitude >= -82) # n = 3
long_82 <- gom_sightings %>% filter(longitude < -82 & longitude >= -84) # n = 8
long_84 <- gom_sightings %>% filter(longitude < -84 & longitude >= -86) # n = 1
long_86 <- gom_sightings %>% filter(longitude < -86 & longitude >= -88) # n = 240
long_88 <- gom_sightings %>% filter(longitude < -88 & longitude >= -90) # n = 8
long_90 <- gom_sightings %>% filter(longitude < -90 & longitude >= -92) # n = 15
long_92 <- gom_sightings %>% filter(longitude < -92 & longitude >= -94) # n = 3
long_94 <- gom_sightings %>% filter(longitude < -94 & longitude >= -96) # n = 1
long_96 <- gom_sightings %>% filter(longitude < -96 & longitude >= -98) # n = 2

## set same date range for all using min/max of all lats. come back to make sure this is okay
all_long_dates <- as.data.frame(seq(as.Date("2002-08-01"), as.Date("2009-12-01"), "months"))
colnames(all_long_dates)[1] ="month_yr"

## long 80

#Select month/yr and total sightings from gom_sightings
long_80_sightings <- long_80 %>% select(month_yr, total_sightings)
long_80_sightings <- distinct(long_80_sightings)

#left join that to the new sequence of months and years
long_80_sightings_all_months <- left_join(all_lat_dates, long_80_sightings, by ="month_yr")

#Fill in all NAs as a total sighting of 0
long_80_sightings_all_months[is.na(long_80_sightings_all_months)] <- 0

long_80_plot <- ggplot(long_80_sightings_all_months, aes(x = month_yr, y = total_sightings)) +
  geom_line() +
  labs(x = "Date", y = "Total Monthly Sightings", title = "Total Monthly Sightings Between Long -80--82
  theme_minimal() +
  theme(plot.title = element_text(hjust = 0.5))

## lat 21

#Select month/yr and total sightings from gom_sightings
long_82_sightings <- long_82 %>% select(month_yr, total_sightings)
long_82_sightings <- distinct(long_82_sightings)

#left join that to the new sequence of months and years
long_82_sightings_all_months <- left_join(all_lat_dates, long_82_sightings, by ="month_yr")

#Fill in all NAs as a total sighting of 0
long_82_sightings_all_months[is.na(long_82_sightings_all_months)] <- 0

long_82_plot <- ggplot(long_82_sightings_all_months, aes(x = month_yr, y = total_sightings)) +
  geom_line() +
  labs(x = "Date", y = "Total Monthly Sightings", title = "Total Monthly Sightings Between Long -82--84
  theme_minimal() +
  theme(plot.title = element_text(hjust = 0.5))

## long 84
```

```r
#Select month/yr and total sightings from gom_sightings
long_84_sightings <- long_84 %>% select(month_yr, total_sightings)
long_84_sightings <- distinct(long_84_sightings)

#left join that to the new sequence of months and years
long_84_sightings_all_months <- left_join(all_lat_dates, long_84_sightings, by ="month_yr")

#Fill in all NAs as a total sighting of 0
long_84_sightings_all_months[is.na(long_84_sightings_all_months)] <- 0

long_84_plot <- ggplot(long_84_sightings_all_months, aes(x = month_yr, y = total_sightings)) +
  geom_line() +
  labs(x = "Date", y = "Total Monthly Sightings", title = "Total Monthly Sightings Between Long -84--86
  theme_minimal() +
  theme(plot.title = element_text(hjust = 0.5))

## long 86

#Select month/yr and total sightings from gom_sightings
long_86_sightings <- long_86 %>% select(month_yr, total_sightings)
long_86_sightings <- distinct(long_86_sightings)

#left join that to the new sequence of months and years
long_86_sightings_all_months <- left_join(all_lat_dates, long_86_sightings, by ="month_yr")

#Fill in all NAs as a total sighting of 0
long_86_sightings_all_months[is.na(long_86_sightings_all_months)] <- 0

long_86_plot <- ggplot(long_86_sightings_all_months, aes(x = month_yr, y = total_sightings)) +
  geom_line() +
  labs(x = "Date", y = "Total Monthly Sightings", title = "Total Monthly Sightings Between Long -86--88
  theme_minimal() +
  theme(plot.title = element_text(hjust = 0.5))

## long 88

#Select month/yr and total sightings from gom_sightings
long_88_sightings <- long_88 %>% select(month_yr, total_sightings)
long_88_sightings <- distinct(long_88_sightings)

#left join that to the new sequence of months and years
long_88_sightings_all_months <- left_join(all_lat_dates, long_88_sightings, by ="month_yr")

#Fill in all NAs as a total sighting of 0
long_88_sightings_all_months[is.na(long_88_sightings_all_months)] <- 0

long_88_plot <- ggplot(long_88_sightings_all_months, aes(x = month_yr, y = total_sightings)) +
  geom_line() +
  labs(x = "Date", y = "Total Monthly Sightings", title = "Total Monthly Sightings Between Long -88--90
  theme_minimal() +
  theme(plot.title = element_text(hjust = 0.5))

## long 90
```

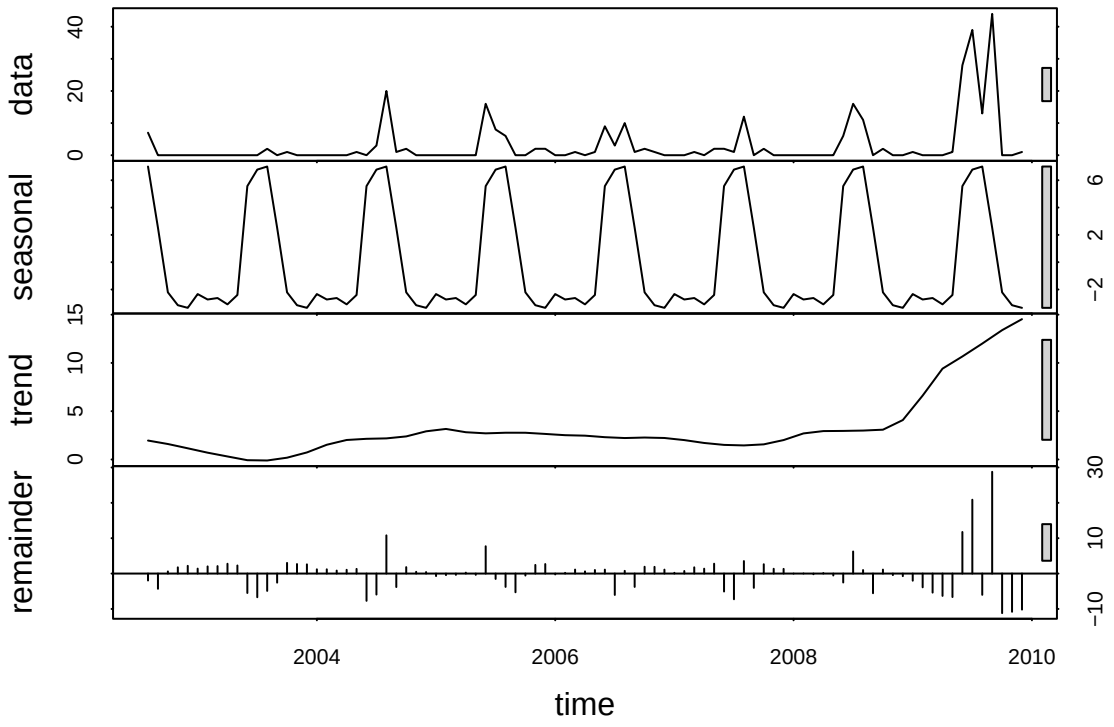
```r
#Select month/yr and total sightings from gom_sightings
long_90_sightings <- long_90 %>% select(month_yr, total_sightings)
long_90_sightings <- distinct(long_90_sightings)

#left join that to the new sequence of months and years
long_90_sightings_all_months <- left_join(all_lat_dates, long_90_sightings, by ="month_yr")

#Fill in all NAs as a total sighting of 0
long_90_sightings_all_months[is.na(long_90_sightings_all_months)] <- 0

long_90_plot <- ggplot(long_90_sightings_all_months, aes(x = month_yr, y = total_sightings)) +
  geom_line() +
  labs(x = "Date", y = "Total Monthly Sightings", title = "Total Monthly Sightings Between Long -90--92
  theme_minimal() +
  theme(plot.title = element_text(hjust = 0.5))

## long 92

#Select month/yr and total sightings from gom_sightings
long_92_sightings <- long_92 %>% select(month_yr, total_sightings)
long_92_sightings <- distinct(long_92_sightings)

#left join that to the new sequence of months and years
long_92_sightings_all_months <- left_join(all_lat_dates, long_92_sightings, by ="month_yr")

#Fill in all NAs as a total sighting of 0
long_92_sightings_all_months[is.na(long_92_sightings_all_months)] <- 0

long_92_plot <- ggplot(long_92_sightings_all_months, aes(x = month_yr, y = total_sightings)) +
  geom_line() +
  labs(x = "Date", y = "Total Monthly Sightings", title = "Total Monthly Sightings Between Long -92--94
  theme_minimal() +
  theme(plot.title = element_text(hjust = 0.5))

## long 94

#Select month/yr and total sightings from gom_sightings
long_94_sightings <- long_94 %>% select(month_yr, total_sightings)
long_94_sightings <- distinct(long_94_sightings)

#left join that to the new sequence of months and years
long_94_sightings_all_months <- left_join(all_lat_dates, long_94_sightings, by ="month_yr")

#Fill in all NAs as a total sighting of 0
long_94_sightings_all_months[is.na(long_94_sightings_all_months)] <- 0

long_94_plot <- ggplot(long_94_sightings_all_months, aes(x = month_yr, y = total_sightings)) +
  geom_line() +
  labs(x = "Date", y = "Total Monthly Sightings", title = "Total Monthly Sightings Between Long -94--96
  theme_minimal() +
  theme(plot.title = element_text(hjust = 0.5))

## long 96
```

```r
#Select month/yr and total sightings from gom_sightings
long_96_sightings <- long_96 %>% select(month_yr, total_sightings)
long_96_sightings <- distinct(long_96_sightings)

#left join that to the new sequence of months and years
long_96_sightings_all_months <- left_join(all_lat_dates, long_96_sightings, by ="month_yr")

#Fill in all NAs as a total sighting of 0
long_96_sightings_all_months[is.na(long_96_sightings_all_months)] <- 0

long_96_plot <- ggplot(long_96_sightings_all_months, aes(x = month_yr, y = total_sightings)) +
  geom_line() +
  labs(x = "Date", y = "Total Monthly Sightings", title = "Total Monthly Sightings Between Long -96--98
  theme_minimal() +
  theme(plot.title = element_text(hjust = 0.5))
```

```r
# compare all plots together
long_comparison_plot <- plot_grid(long_80_plot, long_82_plot, long_84_plot, long_86_plot, long_88_plot,
save_plot("./Figures/long_comparison_plot.pdf", long_comparison_plot, base_height = 40, base_width = 20
print(long_comparison_plot)
```


```r
##### Next Analysis - test for increasing trend over all time. Need to take out seasonality ####
# set time series object
gom_ts <- ts(sightings_all_months$total_sightings, start = c(2002,8), frequency = 12)
```

```
# decompose time series
gom_ts_decomposed <- stl(gom_ts, s.window = "periodic")

plot(gom_ts_decomposed)
```




```
# run monotonic trend analysis - seasonal Mann Kendall ##### NOTE! This had too few observations to be
gom_sighting_analysis <- Kendall::SeasonalMannKendall(gom_ts)
```

```
## WARNING: Error exit, tauk2. IFAULT =  12
## WARNING: Error exit, tauk2. IFAULT =  12
```

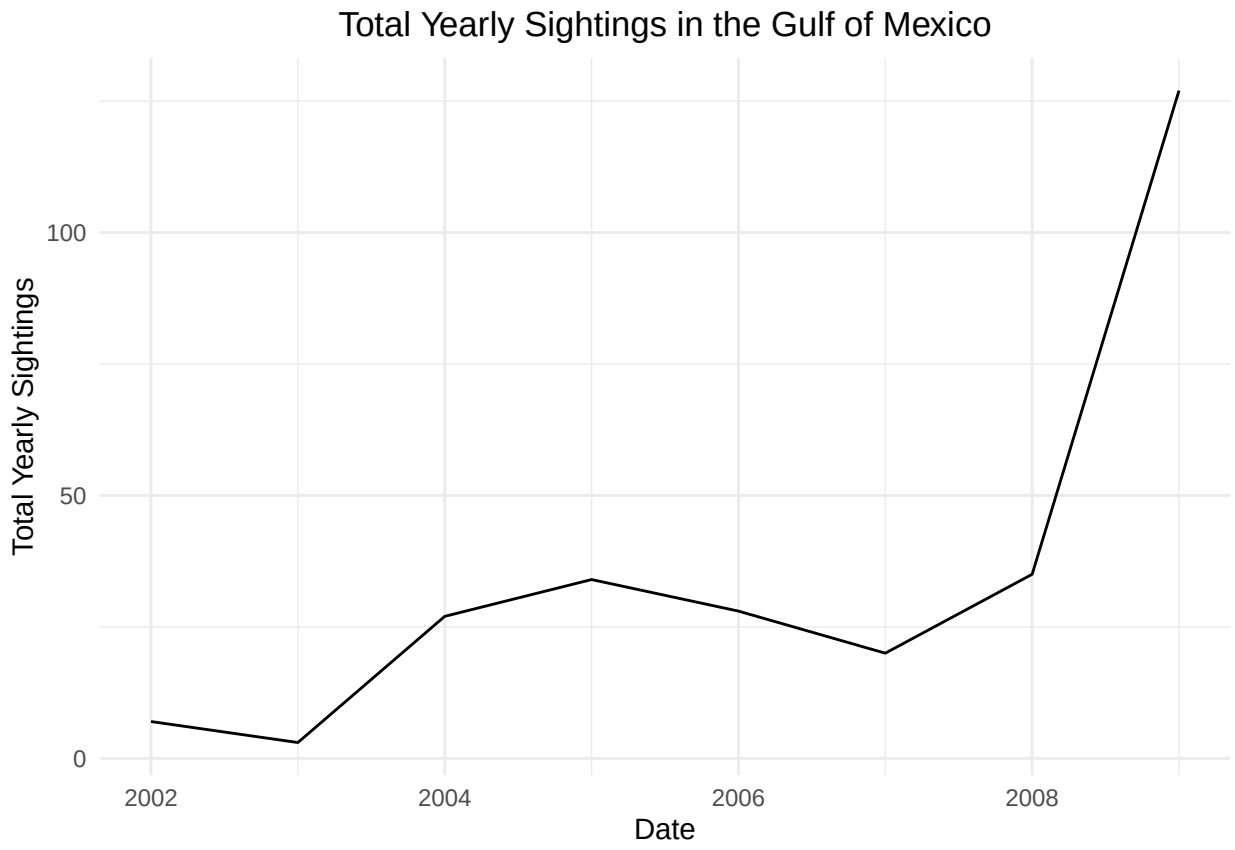
```
#show results
gom_sighting_analysis
```

```
## tau = 0.322, 2-sided pvalue =0.0017759
```

```
summary(gom_sighting_analysis)
```

```
## Score =  63 , Var(Score) = 406.3333
## denominator =  195.4925
## tau = 0.322, 2-sided pvalue =0.0017759
```

```r
### new attempt, grouping by year
gom_yearly_sightings <- gom_sightings %>% group_by(year) %>% mutate(total_sightings = n())

# all years are already filled in

#Select month/yr and total sightings from gom_sightings
yearly_sightings <- gom_yearly_sightings %>% select(year, total_sightings)
yearly_sightings <- distinct(yearly_sightings)

#initial timeseries
ggplot(yearly_sightings, aes(x = year, y = total_sightings)) +
  geom_line() +
  labs(x = "Date", y = "Total Yearly Sightings", title = "Total Yearly Sightings in the Gulf of Mexico")
  theme_minimal() +
  theme(plot.title = element_text(hjust = 0.5))
```




```r
# set time series object
gom_yearly_ts <- ts(yearly_sightings$total_sightings, start = c(2002), frequency = 1)

# decompose time series
# gom_yearly_ts_decomposed <- stl(gom_yearly_ts) - won't work

# plot(gom_yearly_ts_decomposed) #won't work bc of previous error

# run monotonic trend analysis -  Mann Kendall and lm ##### NOTE! This had too few observations to be v
```

```r
gom_yearly_sighting_analysis_mk <- Kendall::MannKendall(gom_yearly_ts)
gom_yearly_sighting_analysis_lm <- lm(year ~ total_sightings, data = yearly_sightings)

#show results
gom_yearly_sighting_analysis_mk
```

```
## tau = 0.429, 2-sided pvalue =0.17355
```

```r
summary(gom_yearly_sighting_analysis_mk)
```

```
## Score =  12 , Var(Score) = 65.33334
## denominator =  28
## tau = 0.429, 2-sided pvalue =0.17355
```

```r
gom_yearly_sighting_analysis_lm
```

```
##
## Call:
## lm(formula = year ~ total_sightings, data = yearly_sightings)
##
## Coefficients:
##     (Intercept)  total_sightings
##       2.004e+03        4.585e-02
```

```r
summary(gom_yearly_sighting_analysis_lm)
```

```
##
## Call:
## lm(formula = year ~ total_sightings, data = yearly_sightings)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -2.2105 -1.0522 -0.5804  1.1684  2.5057
##
## Coefficients:
##                   Estimate Std. Error  t value Pr(>|t|)
## (Intercept)     2.004e+03  8.899e-01 2251.767   <2e-16 ***
## total_sightings 4.585e-02  1.759e-02    2.607   0.0403 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 1.812 on 6 degrees of freedom
## Multiple R-squared:  0.5311, Adjusted R-squared:  0.4529
## F-statistic: 6.796 on 1 and 6 DF,  p-value: 0.04029
```

```r
## aggregate by high sighting months only then do a mann-kendall - NOT SEASONAL - on that!

# analysis on only June-Sept
summer_fall <- gom_sightings %>% filter(month %in% 6:9)
summer_fall_sightings <- summer_fall %>% select(month_yr, total_sightings)
```

```r
summer_fall_sightings <- distinct(summer_fall_sightings)

# generate missing values
summer_fall_dates <- as.data.frame(seq(as.Date("2002-08-01"), as.Date("2009-12-01"), "months"))
colnames(summer_fall_dates)[1] ="month_yr"
summer_fall_dates <- summer_fall_dates %>% filter(month(month_yr) %in% 6:9)

#left join that to the new sequence of months and years
summer_fall_sightings <- left_join(summer_fall_dates, summer_fall_sightings, by ="month_yr")

#Fill in all NAs as a total sighting of 0
summer_fall_sightings[is.na(summer_fall_sightings)] <- 0

summer_fall_plot <- ggplot(summer_fall_sightings, aes(x = month_yr, y = total_sightings)) +
  geom_line() +
  labs(x = "Date", y = "Total Monthly Sightings", title = "Total Monthly Sightings from June through Sep
  theme_minimal() +
  theme(plot.title = element_text(hjust = 0.5))

# set time series object
summer_fall_ts <- ts(summer_fall_sightings$total_sightings, start = c(2002), frequency = 1)

# decompose time series
# summer_fall_ts_decomposed <- stl(summer_fall_ts) # not working

# plot(gom_yearly_ts_decomposed) #won't work bc of previous error

# run monotonic trend analysis -  Mann Kendall
summer_fall_analysis_mk <- Kendall::MannKendall(summer_fall_ts)

#show results
summer_fall_analysis_mk # significant!
```

```
## tau = 0.384, 2-sided pvalue =0.0041013
```