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title: "07_Spectral_Analysis"
author: "Callum Weinberg"
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output: pdf_document
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```{r setup, include=FALSE}
knitr::opts_chunk$set(echo = TRUE)
```

## Libraries

```{r}
library(dplyr, warn.conflicts = FALSE) #Using
library(tidyr) #Using
library(knitr) #Using
library(lubridate, warn.conflicts = FALSE) #Using
library(ggplot2) #Using
library(MASS) #Uncertain
library(qpcR) #Using
library(forecast) #Using
library(cowplot) #Using
library(TSA) #Using
```

##### Load Data #####

```{r}
load(file="Data/landings.Rdata")

load(file="Data/landings_transformed_season_only.Rdata")
landing_ts_so = landings_transformed_season_only$pounds_transformed
```

##### Periodogram of Original Data #####
```{r}
Periodogram
#periodogram = periodogram(landings$pounds, plot = TRUE)
periodogram = periodogram(landings$pounds, plot = FALSE)

Put into Dataframe
periodogram_df = data.frame(periodogram = periodogram$spec[1:60], frequency = periodogram$freq[1:60])

Plot
Periodogram_Graph = ggplot(data = periodogram_df, mapping = aes(x = frequency, y = periodogram)) +
 geom_segment(mapping = aes(xend = as.numeric(frequency), yend = 0)) +
 labs(x = "frequency", y = "periodogram") +
 theme(text = element_text(size = 20),
 legend.title = element_text(size = 10),
 legend.text = element_text(size = 10),
 legend.key.width=unit(1,"cm"),
 axis.text.y = element_text(angle=90, hjust=1, size = 12),
 axis.text.x = element_text(size = 12),
 plot.title = element_text(hjust = 0.5, size = 12),
 axis.title=element_text(size=10,face="bold"))

Periodogram_Graph

Get the Period at the spikes
print(1/periodogram_df[11,2])
print(1/periodogram_df[2,2])

Fisher Test for Periodicity
library(GeneCycle) #Using
fisher.g.test(landings$pounds)

Kolmogorov Smirnov Test
cpgram(landings$pounds,main="")

Plots for report
png(filename = "Images/periodogram.png", width = 960, height = 480)
Periodogram_Graph
dev.off()
```

##### Periodogram of Residuals of Model 3 #####
```{r}

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Model 43 - Model Chosen for Forecasting Final Report. Corresponds to Model 3 of the report.
model43 = arima(landing_ts_so, order=c(1,0,1), seasonal = list(order = c(1,1,1), period = 12),
 method = "ML",fixed = c(NA,NA,NA,NA))

Periodogram
#periodogram = periodogram(landings$pounds, plot = TRUE)
periodogram = periodogram(residuals(model43), plot = FALSE)

Put into Dataframe
periodogram_df = data.frame(periodogram = periodogram$spec[1:60], frequency = periodogram$freq[1:60])

Plot
Periodogram_Residuals = ggplot(data = periodogram_df, mapping = aes(x = frequency, y = periodogram)) +
 geom_segment(mapping = aes(xend = as.numeric(frequency), yend = 0)) +
 labs(x = "frequency", y = "periodogram") +
 theme(text = element_text(size = 20),
 legend.title = element_text(size = 10),
 legend.text = element_text(size = 10),
 legend.key.width=unit(1,"cm"),
 axis.text.y = element_text(angle=90, hjust=1, size = 12),
 axis.text.x = element_text(size = 12),
 plot.title = element_text(hjust = 0.5, size = 12),
 axis.title=element_text(size=10,face="bold"))

Periodogram_Residuals

Plots for report
png(filename = "Images/periodogram_residuals.png", width = 960, height = 480)
Periodogram_Residuals
dev.off()
```

##### Tests for Periodicity #####

```{r}
Fisher Test for Periodicity
library(GeneCycle) #Using
fisher.g.test(residuals(model43))

Kolmogorov Smirnov Test
png(filename = "Images/KS_test Residuals.png", width = 480, height = 480)
cpgram(residuals(model43),main="")
dev.off()
```

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