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title: "06_Forecasting"
author: "Callum Weinberg"
date: "December 2, 2021"
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
```


###### SEASON ONLY MODEL #####

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

# Used in the Report #
```{r forecast}
# 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))
model43
AICc(model43)

# Perform Prediction
mypred = predict(model43, n.ahead=12)
#mypred = forecast(model40,h=12, level=c(95))

# Code from Lecture Notes, doing with GGPLOT instead
#ts.plot(landings, xlim=c(0,144), ylim=c(-300000,900000))
#points(133:144,mypred$pred)
#lines(133:144,mypred$pred+1.96*mypred$se,lty=2)
#lines(133:144,mypred$pred-1.96*mypred$se,lty=2)


# Update the Full Dataset with the data for the 12 predicted rows
#landings_forecast = landings
landings_pred_2019 = data.frame(Year = rep(2019,12),
                                Month = seq(1,12,by=1),
                                pounds = mypred$pred,
                                upper = mypred$pred+1.96*mypred$se,
                                lower = mypred$pred-1.96*mypred$se,
                                pounds.bc = rep(NA,12))

landings_pred_2019$date =  as.Date(with(landings_pred_2019,
                                paste0(as.character(landings_pred_2019$Year),"-",
                                as.character(landings_pred_2019$Month),"-01"), "%Y-%m-%d"))


## Plot the Original Data with the Forecast
forecast_plot = ggplot() +
  geom_line(data = landings_full, mapping = aes(x = date, y = pounds/1000)) +
  geom_line(data = landings_pred_2019, mapping = aes(x = date, y = pounds/1000), color = "red", linetype = "dashed") +
  geom_line(data = landings_pred_2019, mapping = aes(x = date, y = upper/1000), color = "blue", linetype = "twodash",
size = .8) +
  geom_line(data = landings_pred_2019, mapping = aes(x = date, y = lower/1000), color = "blue", linetype = "twodash",
size = .8) +
  labs(x = "Date", y = "Thousands of Pounds") +
  scale_x_date(breaks = scales::breaks_pretty(15)) +
  scale_y_continuous(limits = c(-500,900)) +
  theme(text = element_text(size = 20),
    legend.title = element_text(size = 10),
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    legend.text = element_text(size = 10),
    legend.key.width=unit(1,"cm"),
    axis.text.y = element_text(angle=90, hjust=1, size = 10),
    axis.text.x = element_text(size = 10),
    plot.title = element_text(hjust = 0.5, size = 12),
    axis.title=element_text(size=10,face="bold"))
forecast_plot

# Plot Forecast
png(filename = "Images/forecast.png", width = 960, height = 480)
forecast_plot
dev.off()
```




# Not Used in the Report #
```{r forecast}
# Model 40 - Not Used in Final Report
model40 = Arima(landing_ts_so, order=c(2,0,2), seasonal = list(order = c(1,1,1), period = 12),
                method = "ML",fixed = c(NA,NA,0,NA,NA,NA))
model40
AICc(model40)

# Perform Prediction
mypred = predict(model40, n.ahead=12)
#mypred = forecast(model40,h=12, level=c(95))

# Code from Lecture Notes, doing with GGPLOT instead
#ts.plot(landings, xlim=c(0,144), ylim=c(-300000,900000))
#points(133:144,mypred$pred)
#lines(133:144,mypred$pred+1.96*mypred$se,lty=2)
#lines(133:144,mypred$pred-1.96*mypred$se,lty=2)


# Update the Full Dataset with the data for the 12 predicted rows
#landings_forecast = landings
landings_pred_2019 = data.frame(Year = rep(2019,12),
                                Month = seq(1,12,by=1),
                                pounds = mypred$pred,
                                pounds.bc = rep(NA,12))

landings_pred_2019$date =  as.Date(with(landings_pred_2019,
                                paste0(as.character(landings_pred_2019$Year),"-",
                                as.character(landings_pred_2019$Month),"-01"), "%Y-%m-%d"))

landings_forecast = rbind(landings,landings_pred_2019)




## Plot the Original Data with the Forecast
forecast_plot = ggplot(data = landings_forecast, mapping = aes(x = date, y = pounds/1000)) +
  geom_line() +
  labs(x = "Date", y = "Thousands of Pounds", title = "Forecast") +
  scale_x_date(breaks = scales::breaks_pretty(10)) +
  scale_y_continuous(limits = c(-200,900)) +
  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 = 10),
    axis.text.x = element_text(size = 10),
    plot.title = element_text(hjust = 0.5, size = 12),
    axis.title=element_text(size=10,face="bold"))
forecast_plot


## Plot the Actual Data
load(file="Data/landings_full.Rdata")
full_plot = ggplot(data = landings_full, mapping = aes(x = date, y = pounds/1000)) +
  geom_line() +
  labs(x = "Date", y = "Thousands of Pounds", title = "Actual Data") +
  scale_x_date(breaks = scales::breaks_pretty(10)) +
  scale_y_continuous(limits = c(-200,900)) +
  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 = 10),
    axis.text.x = element_text(size = 10),
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    plot.title = element_text(hjust = 0.5, size = 12),
    axis.title=element_text(size=10,face="bold"))
full_plot



```

# Not Used in the Report #
```{r forecast}
# Model 44
model44 = arima(landing_ts_so, order=c(2,0,3), seasonal = list(order = c(1,1,1), period = 12),
                method = "ML",fixed = c(0,NA,0,0,NA,NA,NA))
model44
AICc(model44)

# Perform Prediction
mypred = predict(model44, n.ahead=12)
#mypred = forecast(model40,h=12, level=c(95))

# Code from Lecture Notes, doing with GGPLOT instead
#ts.plot(landings, xlim=c(0,144), ylim=c(-300000,900000))
#points(133:144,mypred$pred)
#lines(133:144,mypred$pred+1.96*mypred$se,lty=2)
#lines(133:144,mypred$pred-1.96*mypred$se,lty=2)


# Update the Full Dataset with the data for the 12 predicted rows
#landings_forecast = landings
landings_pred_2019 = data.frame(Year = rep(2019,12),
                                Month = seq(1,12,by=1),
                                pounds = mypred$pred,
                                pounds.bc = rep(NA,12))

landings_pred_2019$date =  as.Date(with(landings_pred_2019,
                                paste0(as.character(landings_pred_2019$Year),"-",
                                as.character(landings_pred_2019$Month),"-01"), "%Y-%m-%d"))

landings_forecast = rbind(landings,landings_pred_2019)



## Plot the Original Data with the Forecast
forecast_plot = ggplot(data = landings_forecast, mapping = aes(x = date, y = pounds/1000)) +
  geom_line() +
  labs(x = "Date", y = "Thousands of Pounds", title = "Forecast") +
  scale_x_date(breaks = scales::breaks_pretty(10)) +
  scale_y_continuous(limits = c(-200,900)) +
  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 = 10),
    axis.text.x = element_text(size = 10),
    plot.title = element_text(hjust = 0.5, size = 12),
    axis.title=element_text(size=10,face="bold"))
forecast_plot


## Plot the Actual Data
load(file="Data/landings_full.Rdata")
full_plot = ggplot(data = landings_full, mapping = aes(x = date, y = pounds/1000)) +
  geom_line() +
  labs(x = "Date", y = "Thousands of Pounds", title = "Actual Data") +
  scale_x_date(breaks = scales::breaks_pretty(10)) +
  scale_y_continuous(limits = c(-200,900)) +
  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 = 10),
    axis.text.x = element_text(size = 10),
    plot.title = element_text(hjust = 0.5, size = 12),
    axis.title=element_text(size=10,face="bold"))
full_plot
```
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##### TREND ONLY MODEL - Not used in the Report #####

## Load the Trend-Only Differenced Data

```{r}
load(file="Data/landings_transformed_no_season.Rdata")
landing_ts_ns = landings_transformed_no_season$pounds_transformed
```


## Forecast Model 22

```{r}
# Rerun the Model (defined in 04)
model22 = arima(landing_ts_ns, order=c(15,1,0), method = "ML")
model22
AICc(model22)

# Perform Prediction
mypred = predict(model22, n.ahead=12)

# Code from Lecture Notes, doing with GGPLOT instead
#ts.plot(landings, xlim=c(0,144), ylim=c(-300000,900000))
#points(133:144,mypred$pred)
#lines(133:144,mypred$pred+1.96*mypred$se,lty=2)
#lines(133:144,mypred$pred-1.96*mypred$se,lty=2)


# Update the Full Dataset with the data for the 12 predicted rows
#landings_forecast = landings
landings_pred_2019 = data.frame(Year = rep(2019,12),
                                Month = seq(1,12,by=1),
                                pounds = mypred$pred,
                                pounds.bc = rep(NA,12))

landings_pred_2019$date =  as.Date(with(landings_pred_2019,
                                paste0(as.character(landings_pred_2019$Year),"-",
                                as.character(landings_pred_2019$Month),"-01"), "%Y-%m-%d"))

landings_forecast = rbind(landings,landings_pred_2019)



## Plot the Original Data with the Forecast
forecast_plot = ggplot(data = landings_forecast, mapping = aes(x = date, y = pounds/1000)) +
  geom_line() +
  labs(x = "Date", y = "Thousands of Pounds", title = "Forecast") +
  scale_x_date(breaks = scales::breaks_pretty(10)) +
  scale_y_continuous(limits = c(-100,900)) +
  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 = 10),
    axis.text.x = element_text(size = 10),
    plot.title = element_text(hjust = 0.5, size = 12),
    axis.title=element_text(size=10,face="bold"))
forecast_plot
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## Plot the Actual Data
load(file="Data/landings_full.Rdata")
full_plot = ggplot(data = landings_full, mapping = aes(x = date, y = pounds/1000)) +
  geom_line() +
  labs(x = "Date", y = "Thousands of Pounds", title = "Actual Data") +
  scale_x_date(breaks = scales::breaks_pretty(10)) +
  scale_y_continuous(limits = c(-100,900)) +
  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 = 10),
    axis.text.x = element_text(size = 10),
    plot.title = element_text(hjust = 0.5, size = 12),
    axis.title=element_text(size=10,face="bold"))
full_plot

```

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