STAT 443: Lab 7

Saksham Sudershan (Student #31339427)

09/03/2022

Question 1

```
data <- read.csv("TempPG.csv")
ts <- ts(data$Annual)
model1 <- arima(ts, order = c(1,0,0), include.mean = T)
model1
```

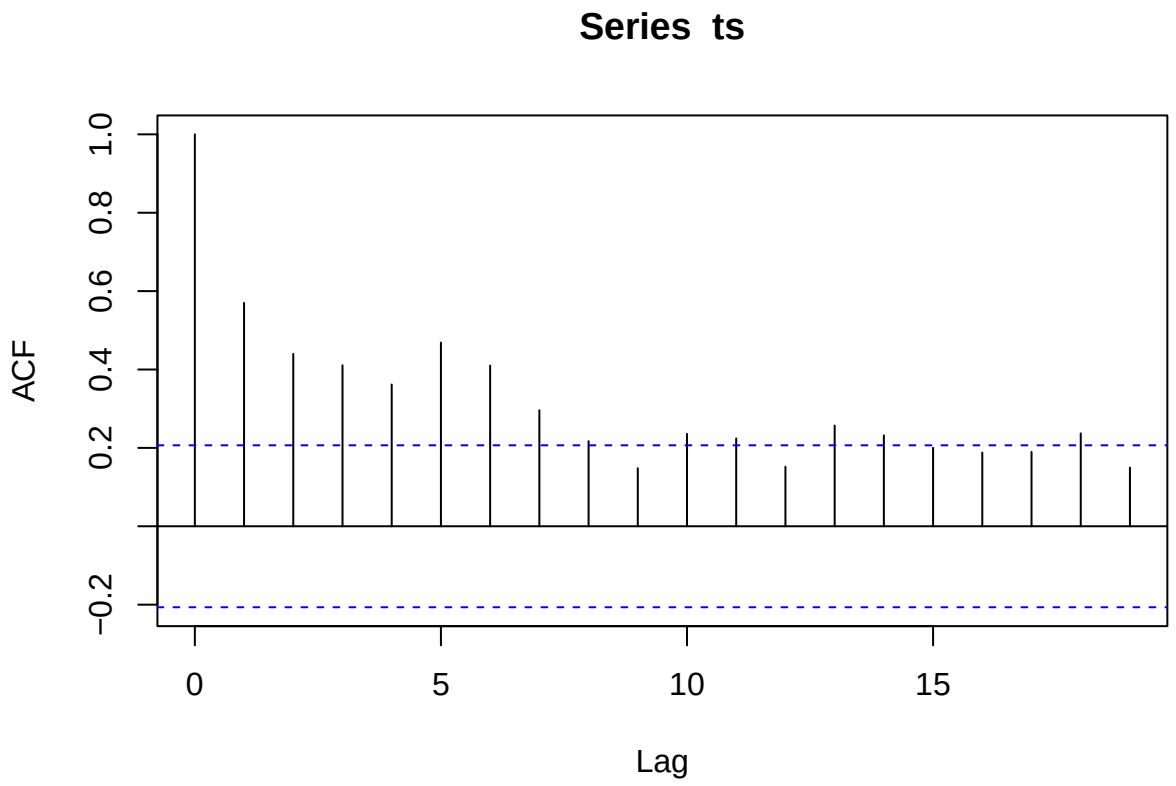
```
##
## Call:
## arima(x = ts, order = c(1, 0, 0), include.mean = T)
##
## Coefficients:
##          ar1  intercept
##       0.5843    -1.9591
## s.e.  0.0864     0.2810
##
## sigma^2 estimated as 1.265:  log likelihood = -138.49,  aic = 282.99
```

The fitted model would be:

$$X_t - (-1.9591) = 0.5843(X_{t-1} + 1.9591) + Z_t \qquad where\ Z_t \sim \mathbb{N}(0, 1.265)$$

Question 2

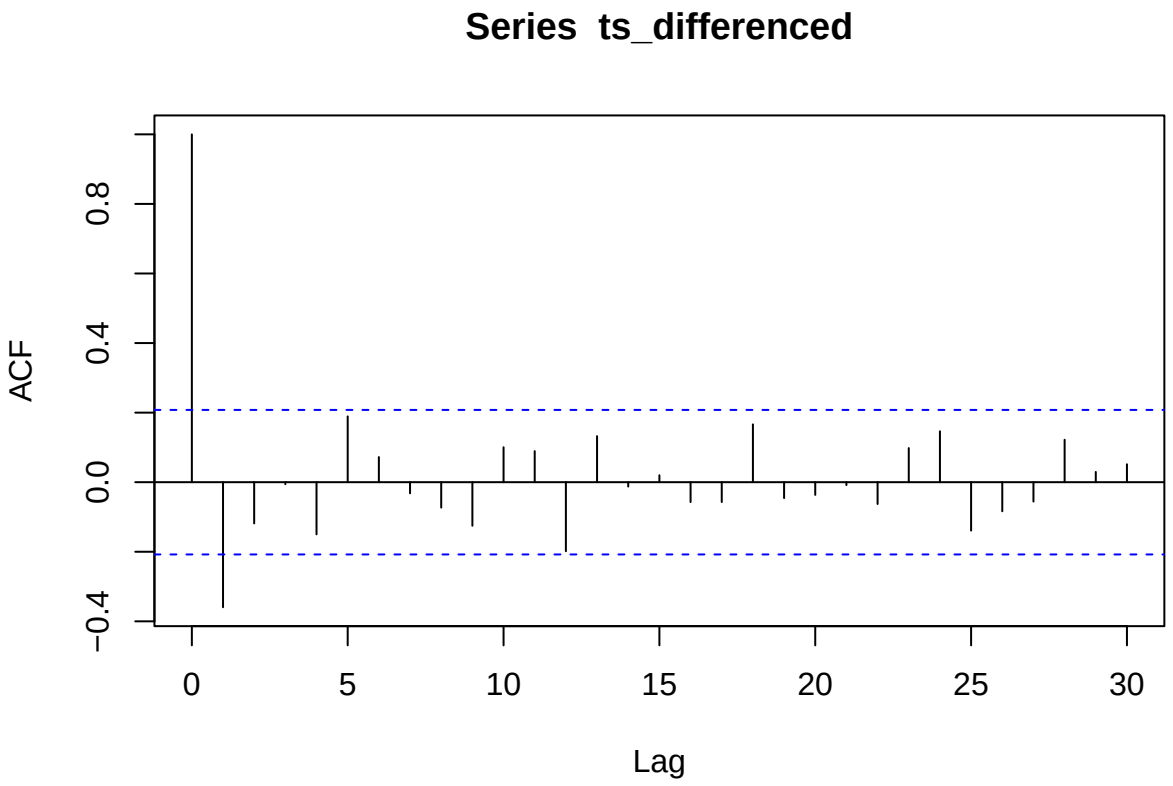
```
acf(ts)
```



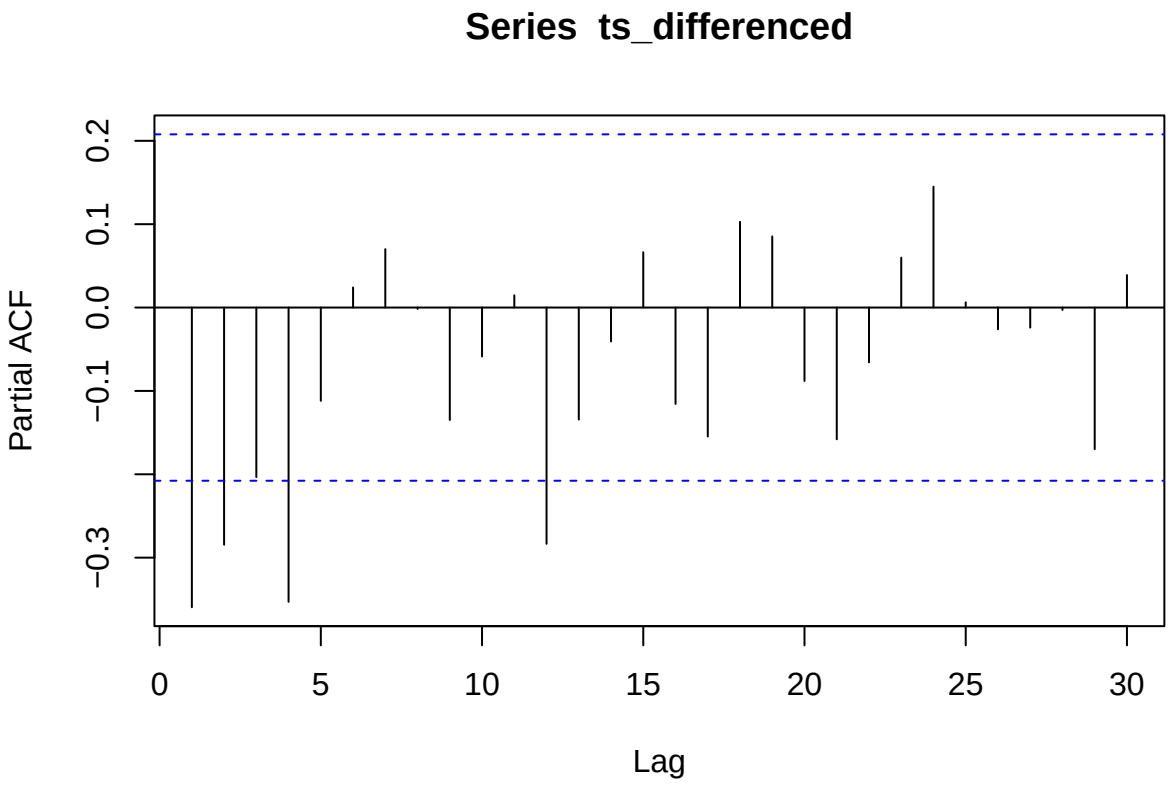
For an AR(1), we would expect the ACF to tail off exponentially or damped sinusoidally. However, here we see spikes at lags $h = 5, 10 \ldots$ so this ACF graph differs from one of an AR(1) process.

Question 3

```
ts_differenced <- diff(ts, lag = 1, differences = 1)
acf(ts_differenced, lag.max = 30)
```




```
pacf(ts_differenced, lag.max = 30)
```



The ACF of the differenced series cuts of at lag $h = 1$ and the PACF tails off in no particular pattern, which means that we could fit an MA(1) model to this differenced series.

Question 4

```
model2 <- arima(ts, order = c(0,1,1))
model2
```

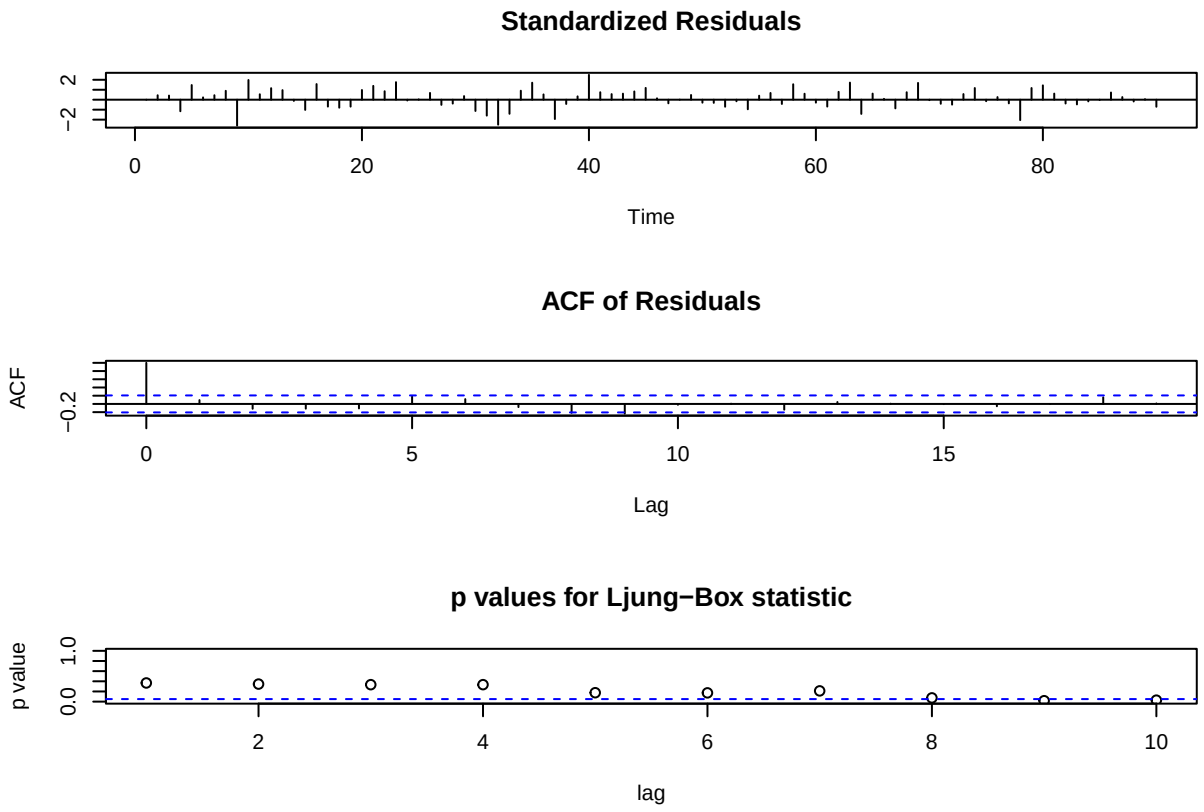
```
##
## Call:
## arima(x = ts, order = c(0, 1, 1))
##
## Coefficients:
##           ma1
##       -0.7504
## s.e.   0.0892
##
## sigma^2 estimated as 1.143:  log likelihood = -132.65,  aic = 269.29
```

The fitted ARIMA model is given by:

$$X_t - X_{t-1} = Z_t - 0.7504 Z_{t-1} \qquad where\ Z_t \sim \mathbb{N}(0, 1.143)$$

Question 5

```
tsdiag(model2)
```



The model appears to fit well. There seems to be very little correlation between the residuals, which is what we would want from our model. The p-values for the Ljung-Box statistic also are high for lags before $h = 7$, which suggests that the fits reasonably well.

Question 6

```
model1$aic
```

```
## [1] 282.9851
```

```
model2$aic
```

```
## [1] 269.2902
```

As we can see here, the AIC value for the ARIMA(0,1,1) model is lower than that for the AR(1) model. Thus, we would select the ARIMA(0,1,1) model.