STAT 443: Lab 7

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Question 1

```r
temp <- read.csv("TempPG.csv")

summer <- temp[, c("Year", "Summer")]

summer_ts <- ts(summer$Summer,
                start = min(summer$Year),
                frequency = 1)

summer_ar <- arima(summer_ts,
                   order = c(2, 0, 0)
                  )
summer_ar
```

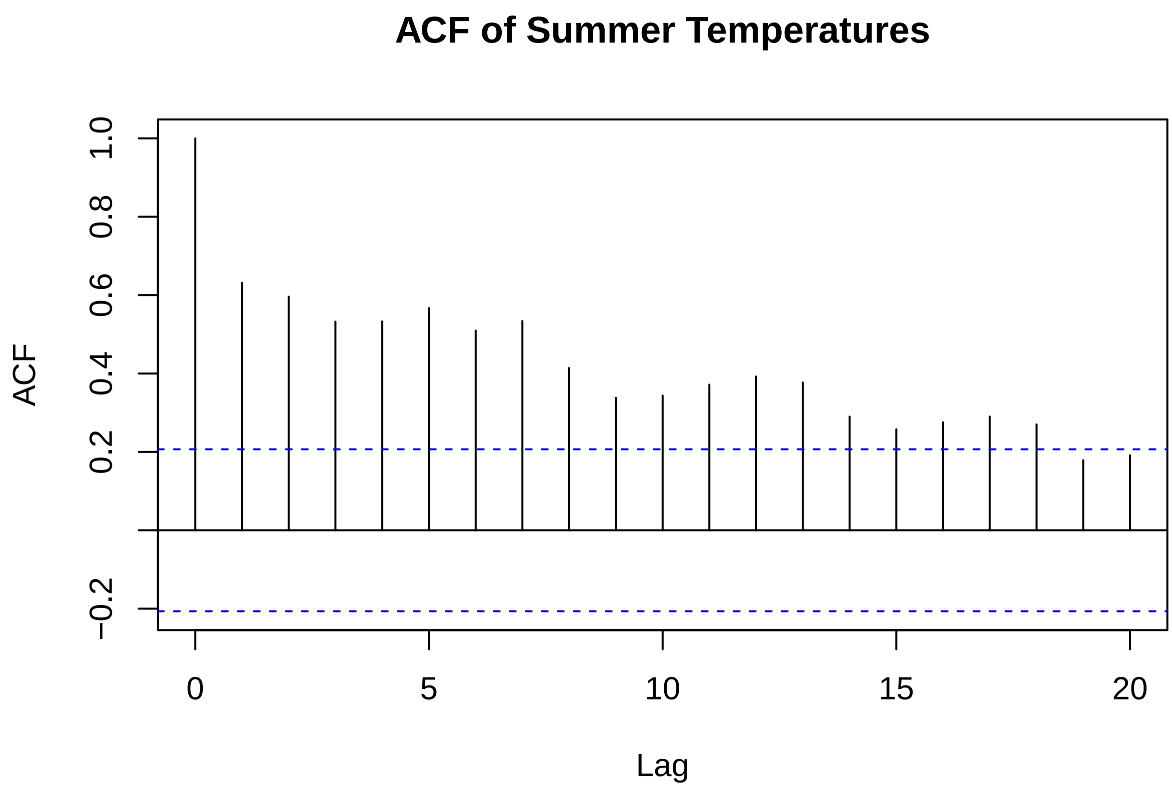
```
##
## Call:
## arima(x = summer_ts, order = c(2, 0, 0))
##
## Coefficients:
##          ar1     ar2  intercept
##       0.4297  0.3466     7.1615
## s.e.  0.0986  0.0994     0.3482
##
## sigma^2 estimated as 0.607:  log likelihood = -105.65,  aic = 219.3
```

X_t = ar1 X_t-1 + ar2 X_t-2 + Z_t X_t - 7.1615 = 0.4297 (X_t-1 - 7.1615) + 0.3466 (X_t-2 - 7.1615) + Z_t

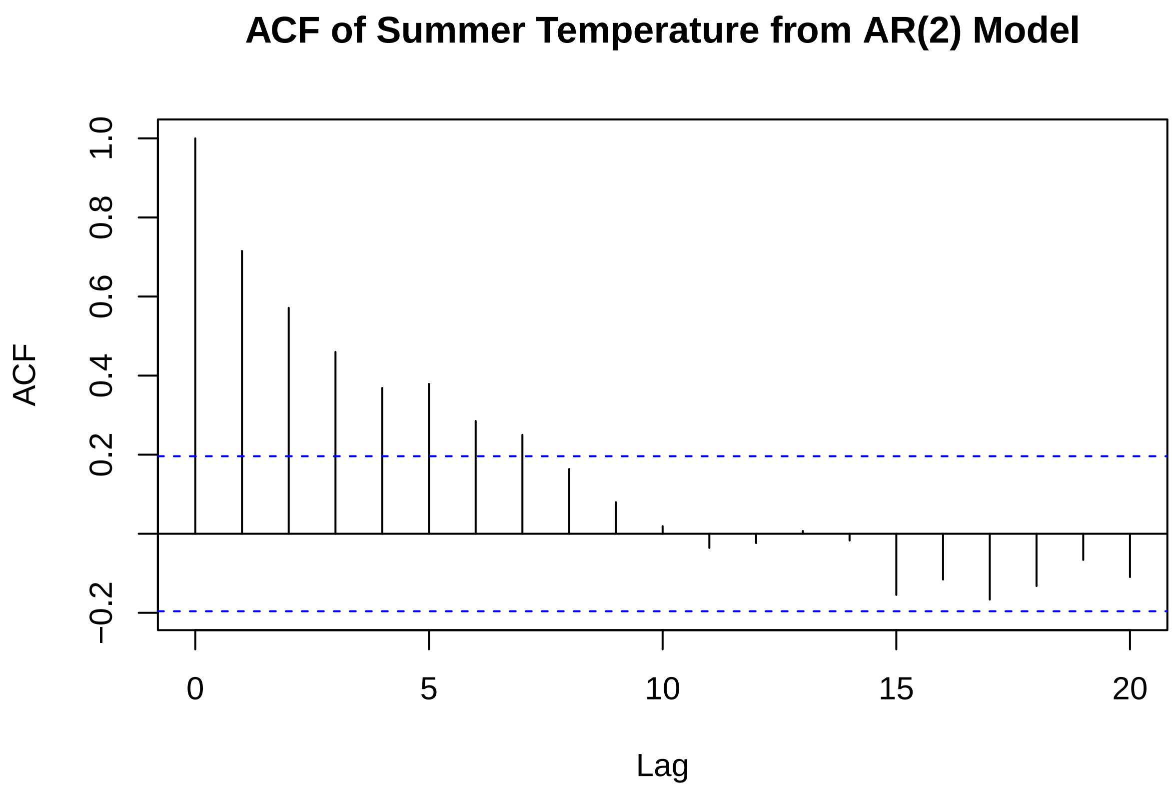
$$X_t = 7.1615 + 0.4297 * Y_{t-1} + 0.3466 * Y_{t-2} + Z_t$$

Question 2

```r
# Lab 6 Sample ACF
acf(summer_ts,
    main = "ACF of Summer Temperatures",
    lag.max = 20)
```



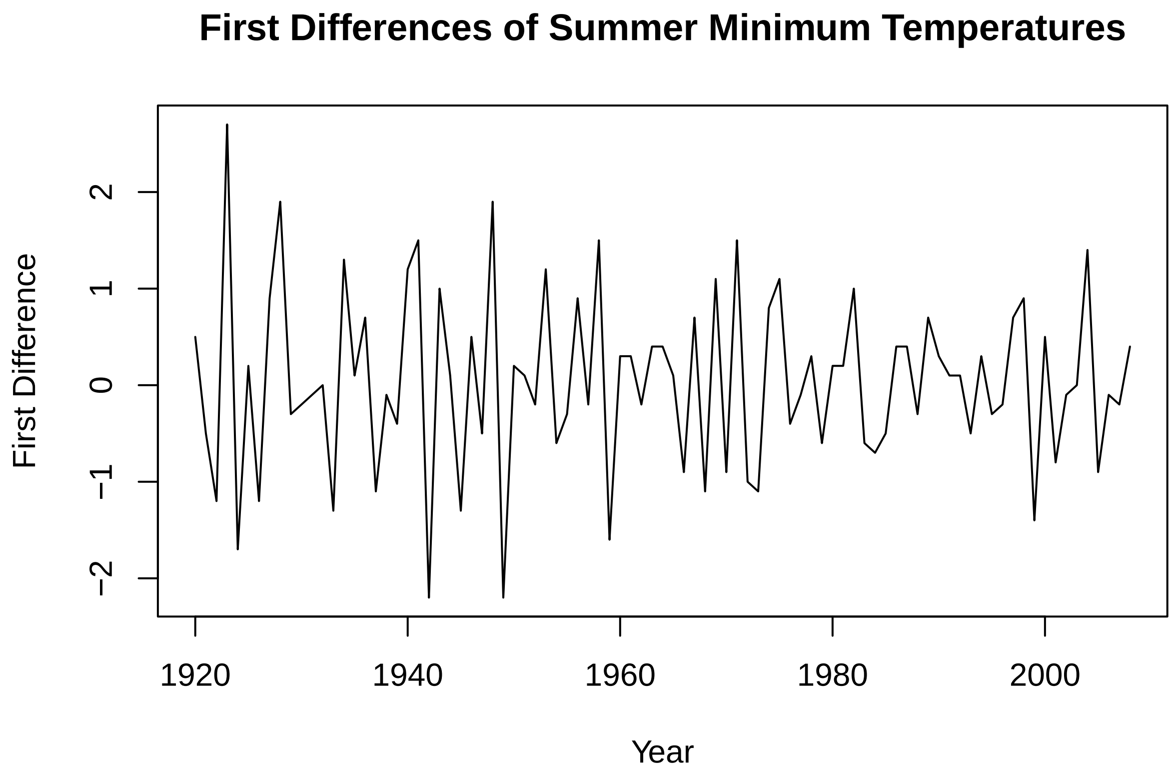

```r
# Lab 7 ARIMA ACF
arima_model <-  arima.sim(n = 100,
                          model = list(ar = c(0.4297, 0.3466))
                        )

acf(arima_model,
    main="ACF of Summer Temperature from AR(2) Model")
```



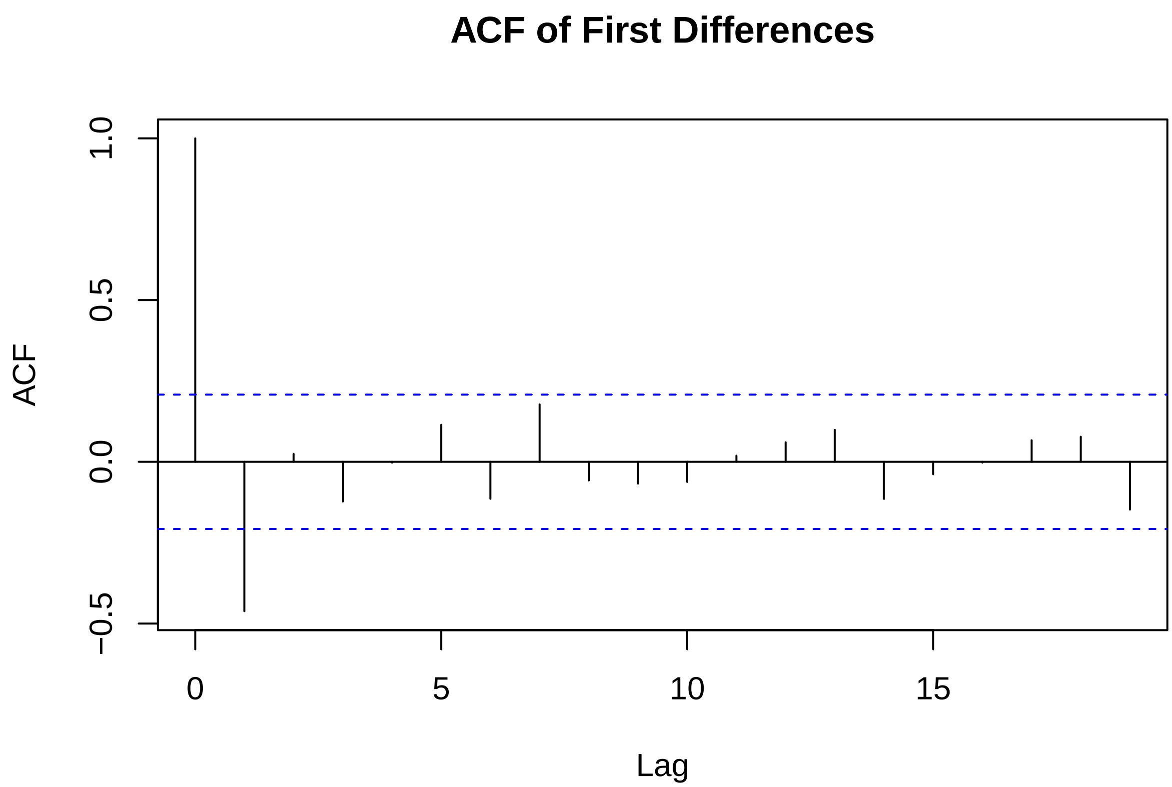
For a theoretical AR(2) Model, I would expect a quick decay but we end up seeing a relatively slower decay in our sample ACF.

Question 3 (Check Ch2)

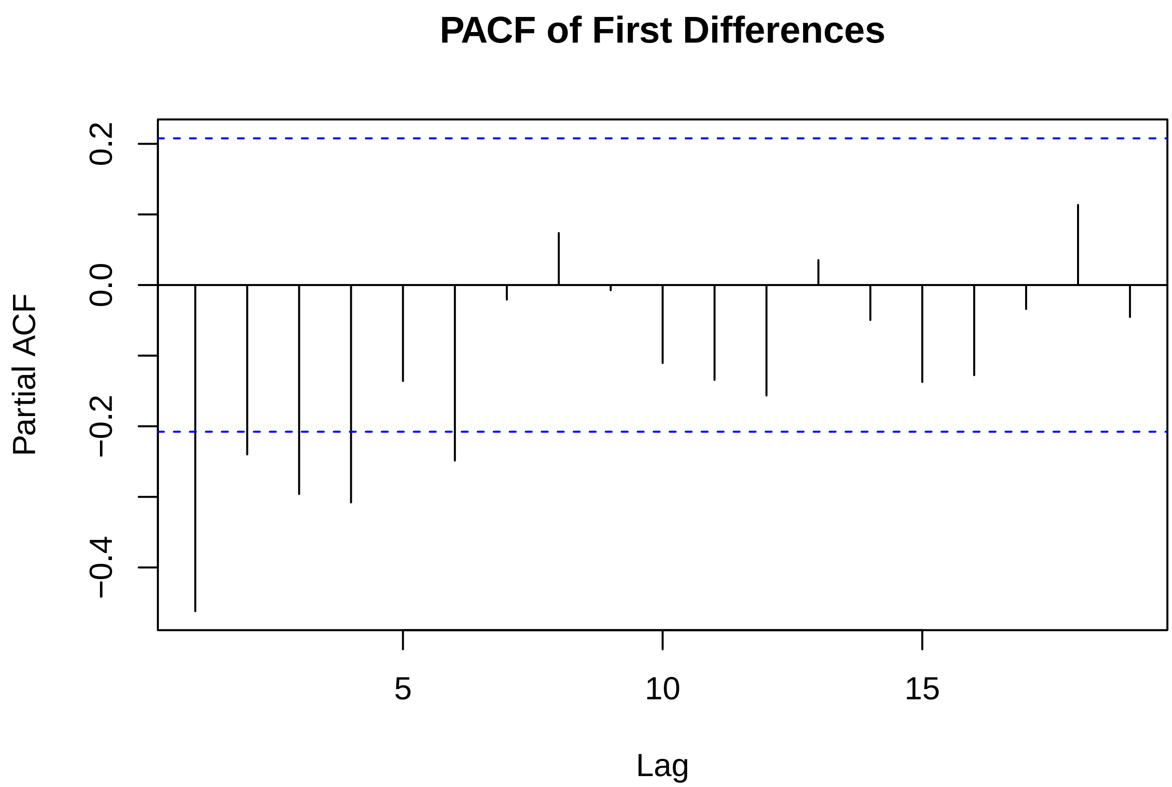
```
diff_summer <- diff(summer_ts)

plot(diff_summer,
     main = "First Differences of Summer Minimum Temperatures",
     ylab = "First Difference",
     xlab = "Year")
```




```
acf(diff_summer,
    main = "ACF of First Differences")
```




```r
pacf(diff_summer,
     main = "PACF of First Differences")
```



Since the ACF cuts off after lag 1 and the PACF shows a slow decay, I would suggest the MA(1) model

Question 4

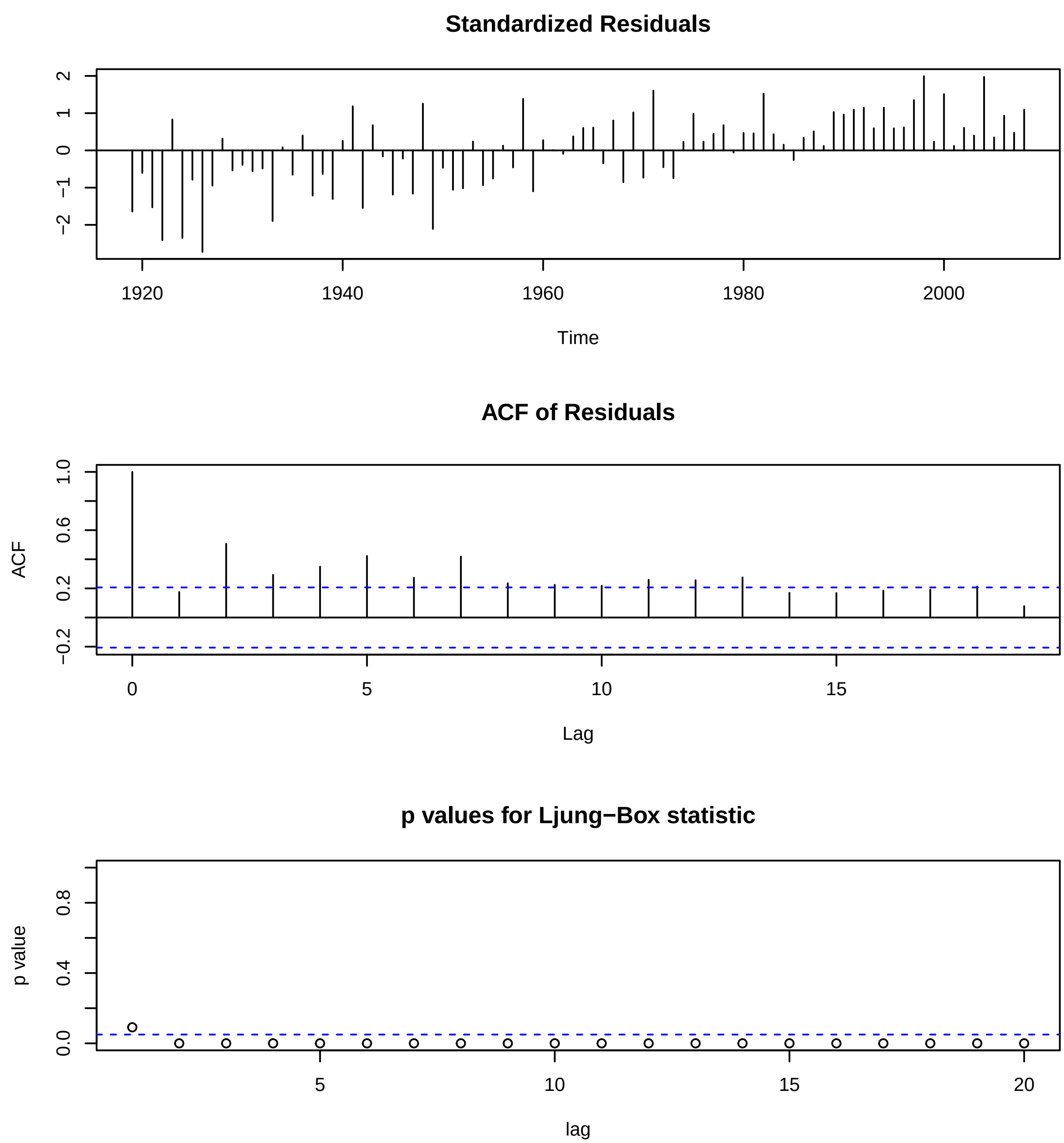
```
summer_ma <- arima(summer_ts,
                   order = c(0, 0, 1)
                  )
summer_ma
```

```
##
## Call:
## arima(x = summer_ts, order = c(0, 0, 1))
##
## Coefficients:
##          ma1  intercept
##       0.4251     7.1823
## s.e.  0.0765     0.1410
##
## sigma^2 estimated as 0.8873:  log likelihood = -122.42,  aic = 250.84
```

$$X_t = 7.1823 + 0.4251 * Z_{t-1} + Z_t$$

Question 5

```r
tsdiag(summer_ma,
       gof.lag = 20)
```



Our residuals appear arbitrary without any trend or pattern, however, the acf of residuals show no significant autocorrelation and the Ljung-Box test p-values were all below our boundary line. Thus, suggesting insignificance and it tells us that the model appear to fit poorly.

Question 6

```
summer_ar
```

```
##
## Call:
## arima(x = summer_ts, order = c(2, 0, 0))
##
## Coefficients:
##          ar1     ar2  intercept
##       0.4297  0.3466     7.1615
## s.e.  0.0986  0.0994     0.3482
##
## sigma^2 estimated as 0.607:  log likelihood = -105.65,  aic = 219.3
```

```
summer_ma
```

```
##
## Call:
## arima(x = summer_ts, order = c(0, 0, 1))
##
## Coefficients:
##          ma1  intercept
##       0.4251     7.1823
## s.e.  0.0765     0.1410
##
## sigma^2 estimated as 0.8873:  log likelihood = -122.42,  aic = 250.84
```

Since our AR Model has a smaller AIC compared to the MA Model. Therefore, I would select the AR Model over the MA Model