STAT 443 Lab 7

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Question 1

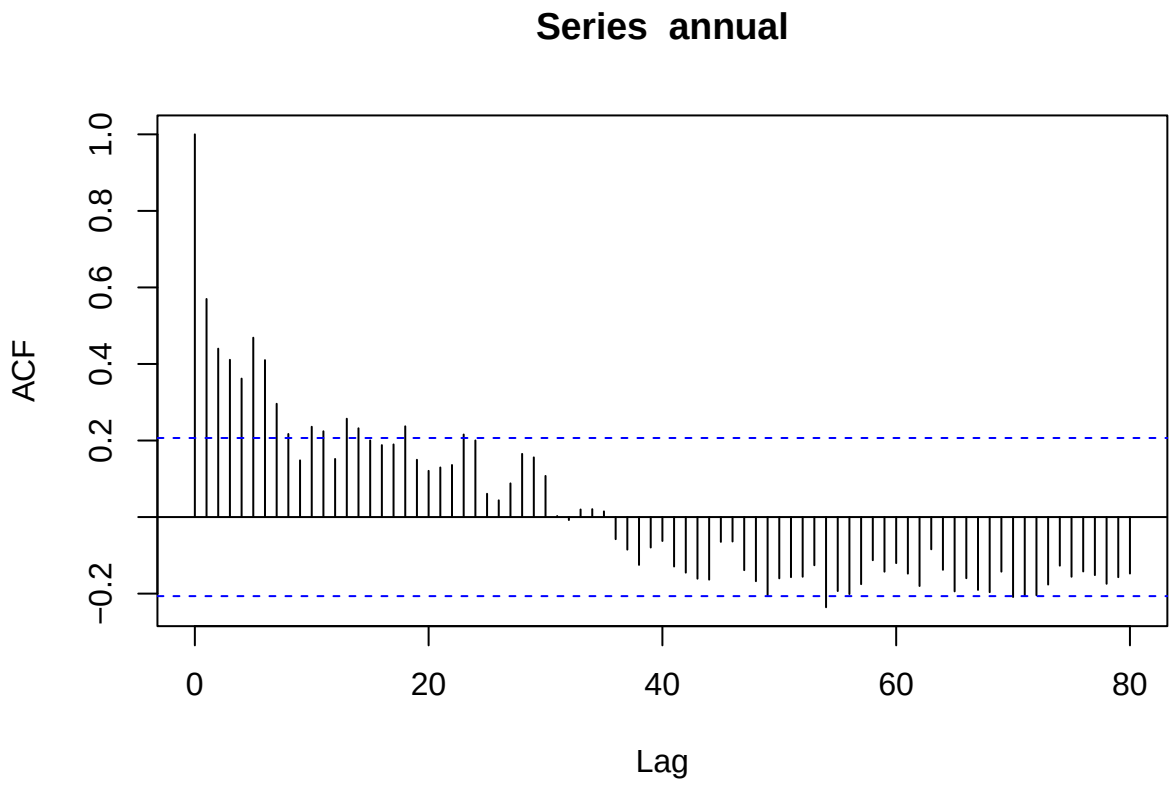
```
temp <- read.csv("TempPG.csv", header = TRUE)
annual <- ts(temp$Annual, start = 1919, end = 2008)
ar_fit <- arima(annual, order = c(1, 0, 0))
c(ar_fit$coef, sigma2 = ar_fit$sigma2)
```

```
##        ar1  intercept     sigma2
##  0.5842789 -1.9591486  1.2650296
```

The fitted model is $X_t + 1.96 = 0.58(X_{t-1} + 1.96) + Z_t$ with $\sigma^2 = 1.27$.

Question 2

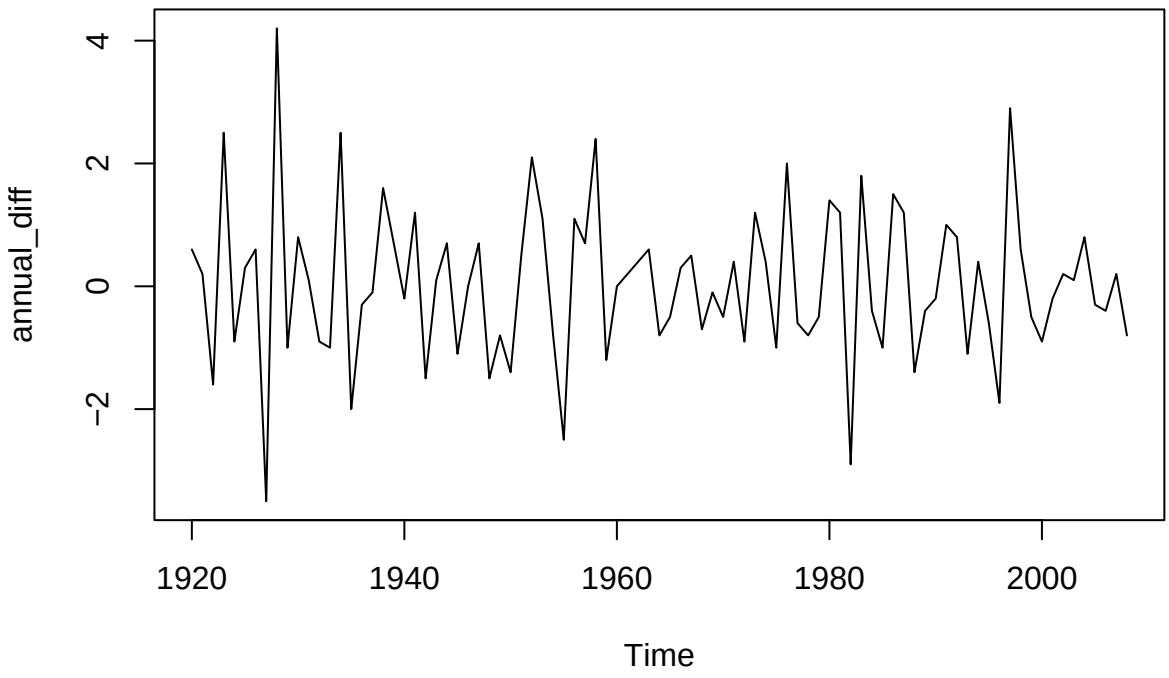
```
acf(annual, lag.max = 80)
```



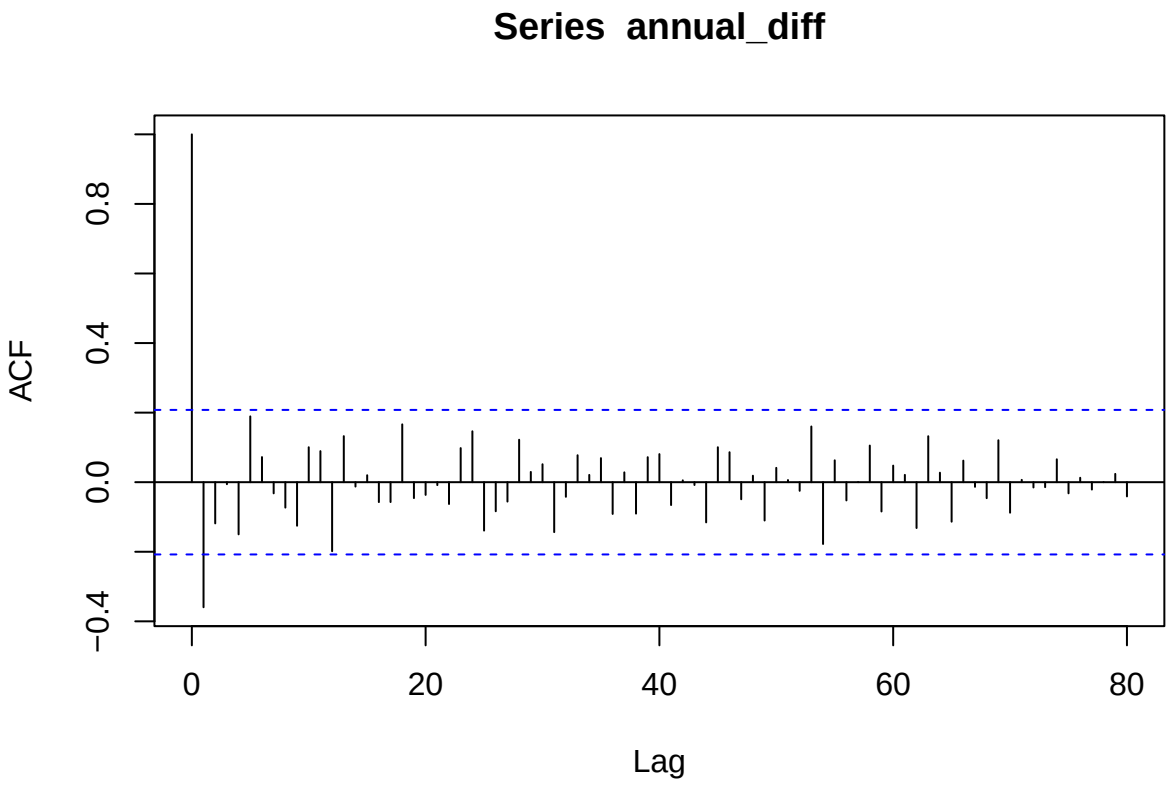
The acf spikes up and down, having a lot more local maximums and minimums compared to acfs of other AR(1) processes. It also oscillates around 0 less frequently than other AR(1) processes.

Question 3

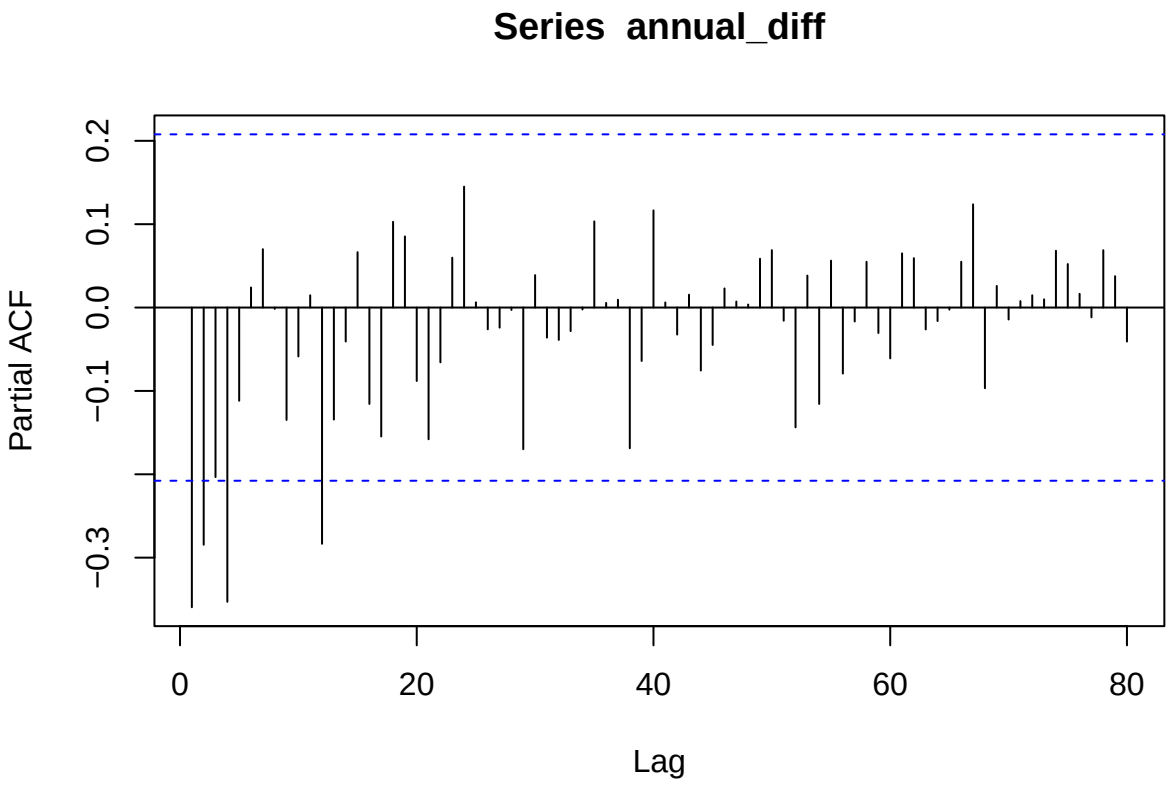
```
annual_diff <- diff(annual)
plot(annual_diff)
```




```
acf(annual_diff, lag.max = 80)
```




```
pacf(annual_diff, lag.max = 80)
```



The acf and pacf tail off with no pattern, so I would first see how well an ARMA(1,1) fits for the differenced series. Thus for the annual minimum temperature series I would suggest an ARIMA(1,1,1) model.

Question 4

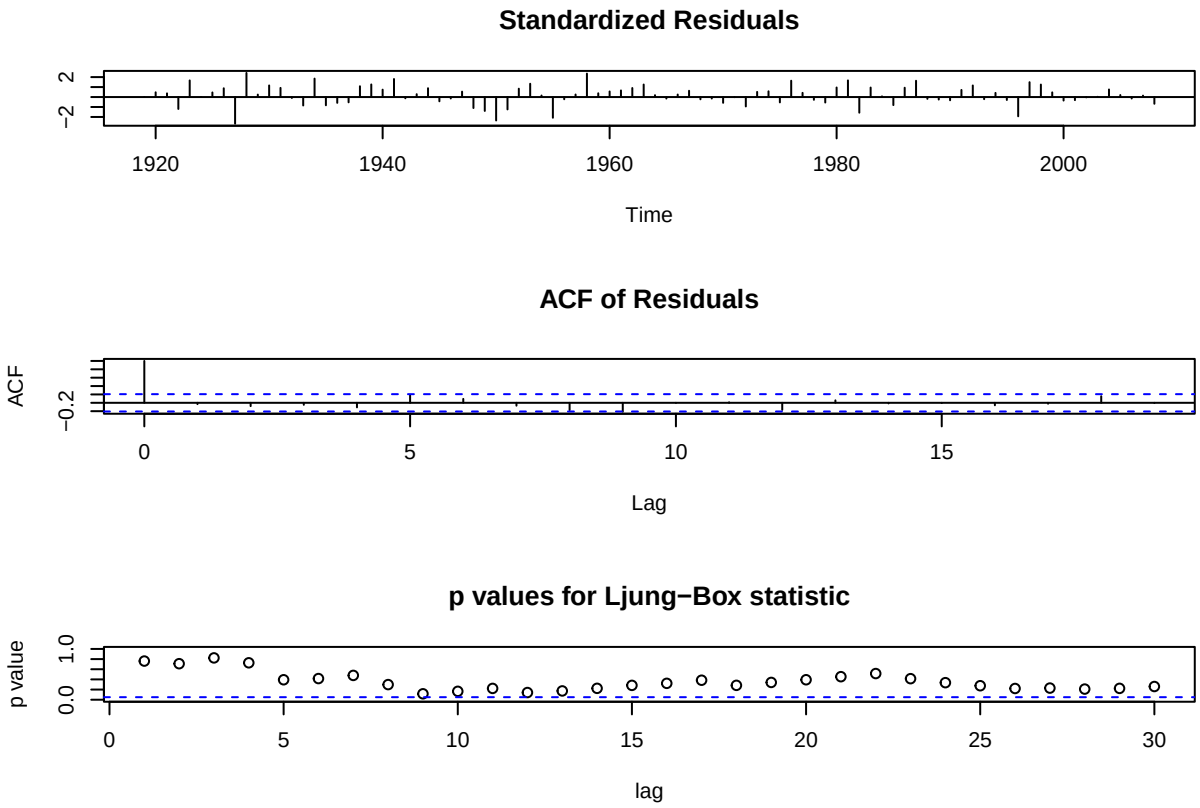
```
arima_fit <- arima(annual, order = c(1, 1, 1))
c(arima_fit$coef, sigma2 = arima_fit$sigma2)
```

```
##        ar1        ma1     sigma2
##  0.2112046 -0.8487811  1.1122216
```

The model is $Y_t = 0.21Y_{t-1} + Z_t - 0.85Z_{t-1}$ where $Y_t = X_t - X_{t-1}$ and $\sigma^2 = 1.11$.

Question 5

```
tsdiag(arima_fit, gof.lag = 30)
```



From the first two plots we see that the residuals seem small and random, which is a good sign in terms of how well the model fits. The p-values for the Ljung-Box test don't seem to fall within 0.05 which is also a good sign

Question 6

```
c(AIC_AR1 = AIC(ar_fit),
  AIC_ARIMA111 = AIC(arima_fit))
```

```
##       AIC_AR1 AIC_ARIMA111
##      282.9851     268.9621
```

Since the ARIMA(1,1,1) model has a smaller AIC, I would select that.