TSA Assignment 3

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Question 6

1.) Constructing Dataset

I first read in the data and construct the growth rate of the seasonally adjusted GDP.

```
df <- read_excel(data_path, skip=10)

# Generating time series object
gdp <- ts(df[2], frequency=4, start = c(1991, 1))

# Computing quarterly growth rate
r <- log(gdp) - log(lag(gdp))
```

2.) Model selection

For a beginning, I try all possible combinations of AR and MA models from 0 to 10. The results are stored in the matrix such that I can access the model parameters with the lowest AIC.

```
# Getting best model by hand aka brute force:

p_max <- 10   # 10 should be enough but could change to more
q_max <- 10
# Initializing space for p, q and respective AIC to be stored
info_mat <- matrix(NA, nrow = (p_max+1)*(q_max+1), ncol = 3)


counter <- 1
# Nested loop to try all different combinations
for (p in seq(from=0, to=p_max)){
  for (q in seq(from=0, to=q_max)){

    modl <- arima0(r, order = c(p, 0, q), optim.control = list(maxit = 1000))

    info <- c(p, q, modl$aic)
    info_mat[counter,] <- info
    counter <- counter + 1
  }
}

# Saving the parameters of the model with the lowest AIC
p_opt <- info_mat[which.min(info_mat[,3]),][1]
```

```r
q_opt <- info_mat[which.min(info_mat[,3]),][2]
aic_opt <- info_mat[which.min(info_mat[,3]),][3]
```

The optimal parameters with this approach are $p = 1$, $q = 0$ with $AIC =$ -726.9291525. Using this specification, the coefficients are then given by

```r
# Fitting the optimal model
fit_1 <- arima0(r, order=c(p_opt, 0, q_opt))
fit_1$coef
```

```
##          ar1    intercept
##  0.269721411 -0.007127391
```

To double check, I also use an R package which is supposed to find the best fitting ARMA model given an incformation criterion. The order is the same as with the approach above and the coefficients are identical as well.

```r
# Trying out R-Package auto.arima to see whether they get same results as my
# brute force approach
fit_2 <- auto.arima(r, ic='aic')
fit_2$coef
```

```
##          ar1    intercept
##  0.269877617 -0.007158814
```

3.) Serial correlation

To get a grip on whether the errors are serially correlated I look at the autocorrelations. None of the lags are statistically different from 0 which can be taken as evidence that the $ARMA(1,0)$ model accurately captures the dynamics of the time series.

Autocorrelations of the residuals from the ARMA(1,0) model