PS1Q3

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library("quantmod")

##(a) Compile quarterly data for the U.S. real gross private domestic investment (DI) from 1947Q1 to 2023Q4.

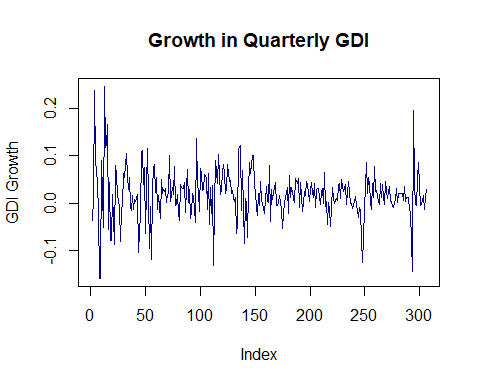
getSymbols(Symbols ="GPDI",src = "FRED", from = '1947/01/01')

## [1] "GPDI"

qua\_di <- as.matrix(GPDI[,1])  
qua\_di\_date = as.Date(row.names(qua\_di))  
n\_obs\_qua\_di = length(qua\_di\_date)

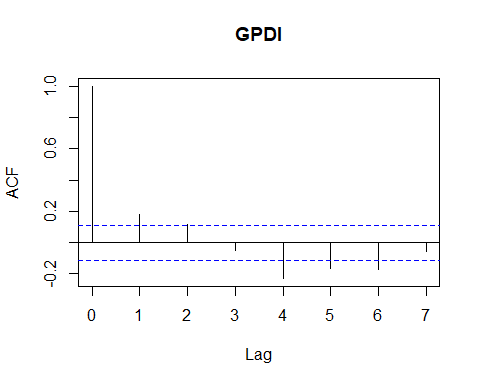
##(b) Compute growth in quarterly DI (GDI), provide its summary statistics and plot the data.

di\_return <- diff(qua\_di)/qua\_di[1:n\_obs\_qua\_di-1,1]  
di\_return\_date = qua\_di\_date[2:n\_obs\_qua\_di]  
n\_obs\_qua\_return = length(di\_return\_date)  
plot(di\_return, type = "l", col = "darkblue", main = "Growth in Quarterly GDI", ylab = "GDI Growth")



##(c) Compute and plot empirical autocorrelation function. Given the plot, do you expect any time-series correlation among the observations? Explain why?

acf(di\_return,lag=round(n\_obs\_qua\_return^(1/3)))



ACF=acf(di\_return,lag=round(n\_obs\_qua\_return^(1/3)), plot = FALSE)  
ACF$acf

## , , 1  
##   
## [,1]  
## [1,] 1.00000000  
## [2,] 0.18230712  
## [3,] 0.11675470  
## [4,] -0.04992628  
## [5,] -0.22861728  
## [6,] -0.16254377  
## [7,] -0.17190977  
## [8,] -0.05641716

Yes I do expect some time-series correlation among the observations. Because there are some lags where the bars extend beyond the dotted lines.

##(d) Set the maximum number of lags to the integer closest to the number of observations to the power one-third. Perform a test for joint autocorrelation in GDI and report your result. Does your finding consistent with that of Part 3c? Explain why?

t\_ratio <- ACF$acf[2]\*sqrt(n\_obs\_qua\_return)   
t\_ratio

## [1] 3.189072

Box.test(di\_return, lag = round(n\_obs\_qua\_return^(1/3)), type = "Ljung-Box")

##   
## Box-Ljung test  
##   
## data: di\_return  
## X-squared = 50.143, df = 7, p-value = 1.354e-08

Box.test(di\_return, lag = round(n\_obs\_qua\_return^(1/3)), type = "Box-Pierce")

##   
## Box-Pierce test  
##   
## data: di\_return  
## X-squared = 49.199, df = 7, p-value = 2.074e-08

##(e) Consider an AR(1) model and compute the theoretical autocorrelation function. Compare your findings with that of Part 3c.

lag\_di\_return = rbind(NA, as.matrix(di\_return[1:(n\_obs\_qua\_return-1),1]))  
intercept = matrix(1,n\_obs\_qua\_return)  
X = cbind(intercept,lag\_di\_return)  
y = di\_return  
reg\_result = ols(X[2:n\_obs\_qua\_return,],as.matrix(y[2:n\_obs\_qua\_return,1]))  
1 - sum(reg\_result$u\_hat^2)/sum(y^2)

## [1] 0.1381177

beta\_hat = reg\_result$beta\_hat  
beta\_hat

## [,1]  
## [1,] 0.01449087  
## [2,] 0.18233574

var\_beta\_hat = reg\_result$var\_beta\_hat  
test\_result = t\_test(beta\_hat,var\_beta\_hat)  
test\_result$t\_stat

## [,1]  
## [1,] 4.769901  
## [2,] 3.244819

test\_result$p\_value

## [,1]  
## [1,] 1.843163e-06  
## [2,] 1.175253e-03

ar\_coeff <- as.numeric(beta\_hat[2])  
ma\_coeff <- 0  
TACF <- ARMAacf(ar\_coeff, ma\_coeff, lag.max = round(n\_obs\_qua\_return^(1/3)))   
plot(c(0:round(n\_obs\_qua\_return^(1/3))),ACF$acf,type='l',xlab='Lag',ylab='ACF',ylim=c(-0.1,1))  
lines(0:round(n\_obs\_qua\_return^(1/3)),TACF,lty=2)  
grid(nx = 4, ny = 4)

