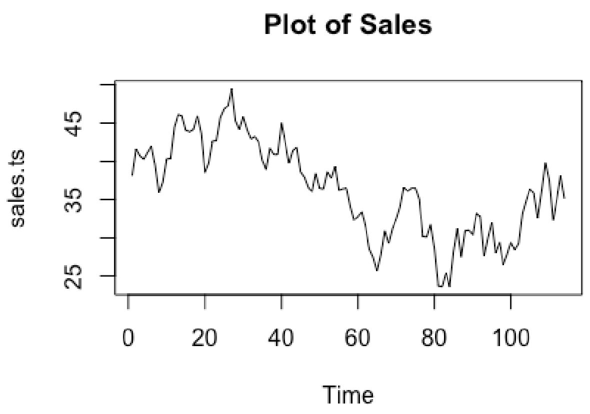
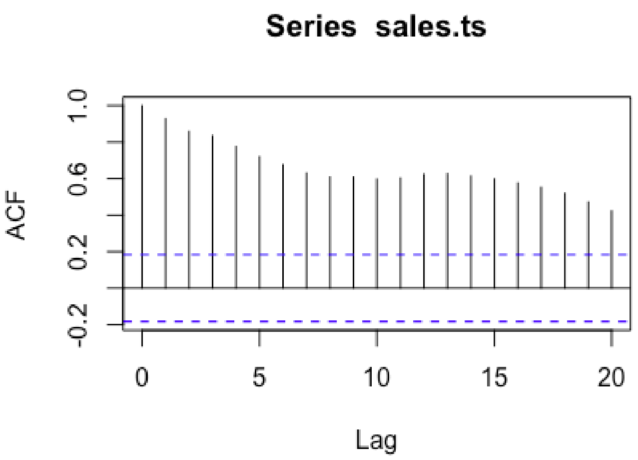
Assignment 5

Question 4

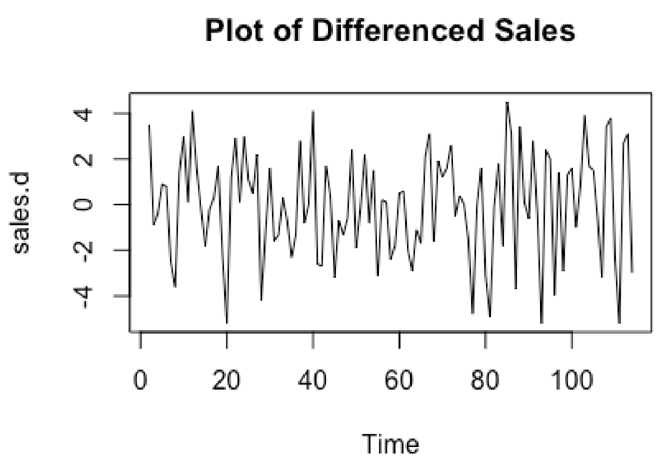
First, we plot the time series and its ACF:

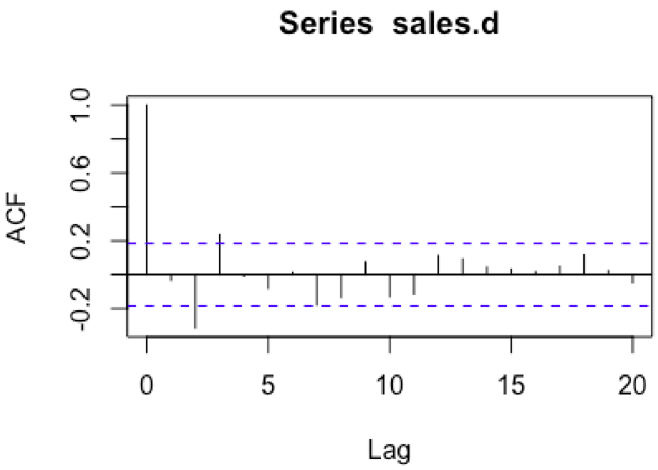


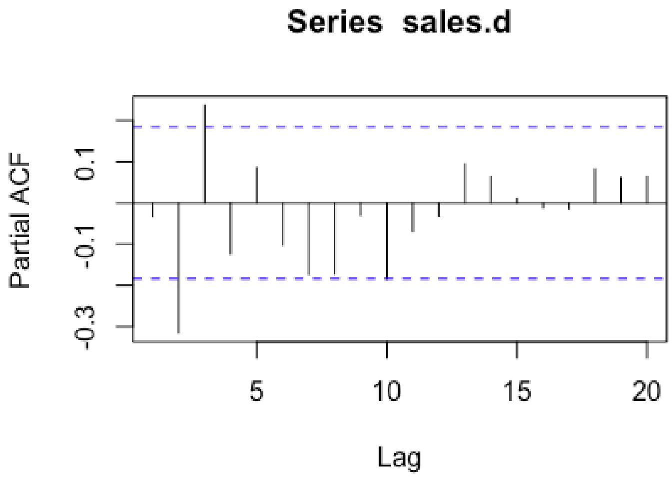


Both plots suggest that the series are not stationary.

There is no particular well-defined trend. The trend term appears to be linear. We use technique of differencing to obtain stationary time series.







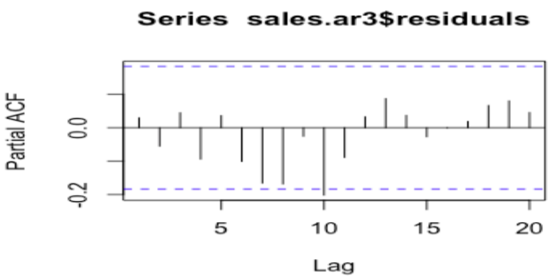
After differencing once we see from the plots of residuals that they look stationary and fairly uncorrelated except at lags 2 and 3. We should try to fit ARIMA (3,1,0), ARIMA (0,1,3), ARIMA (2,1,1) models.

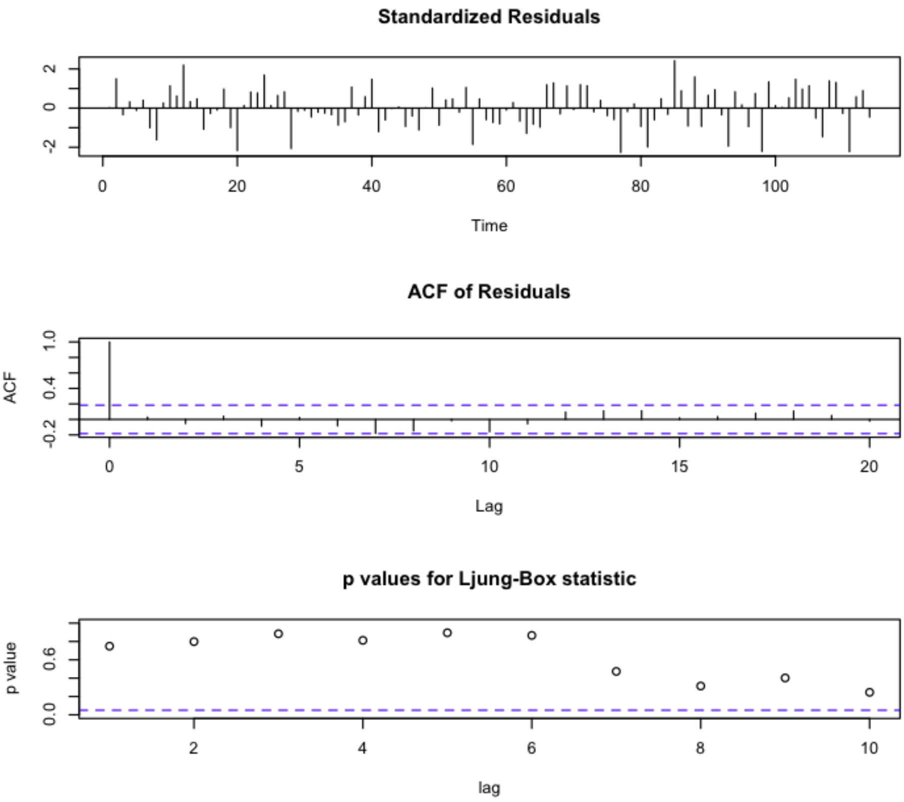
For ARIMA (3,1,0) we get:

```
Call:
arima(x = sales.ts, order = c(3, 1, 0), method = "ML")

Coefficients:
         ar1      ar2     ar3
      0.0413  -0.3167  0.2500
s.e.  0.0922   0.0875  0.0923

sigma^2 estimated as 4.576:  log likelihood = -246.48,  aic = 500.96
```



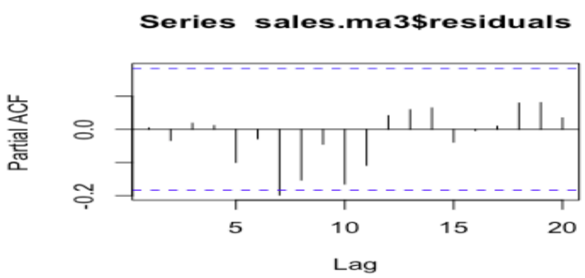


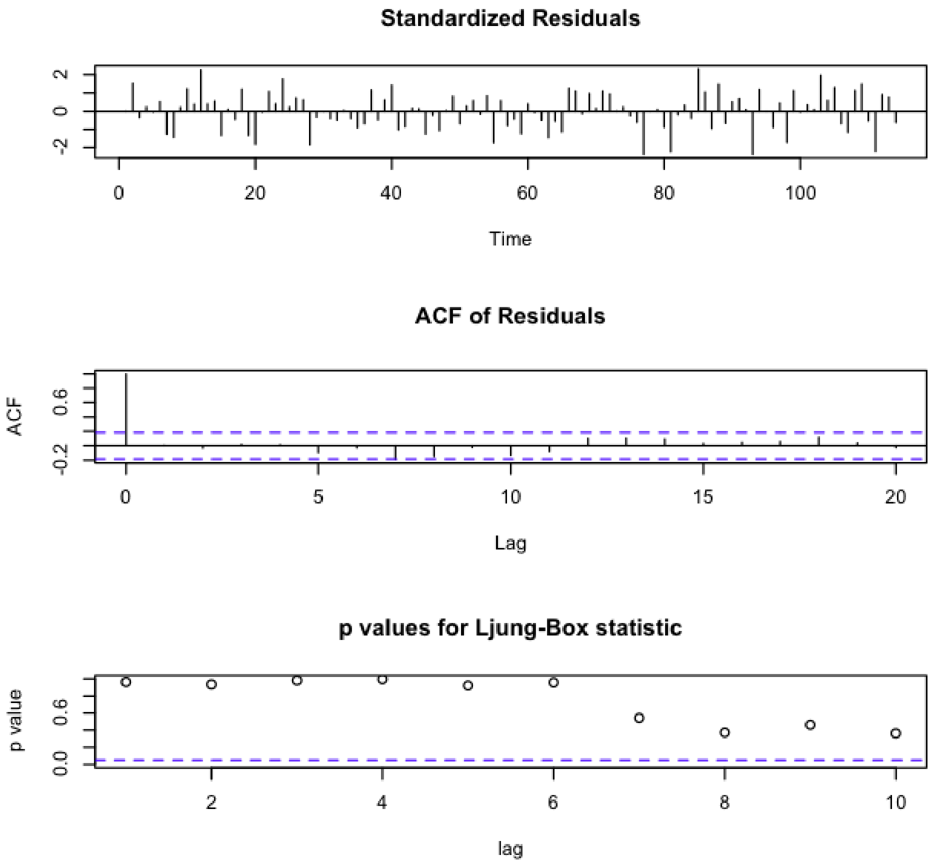
For ARIMA (0,1,3) we get:

```
Call:
arima(x = sales.ts, order = c(0, 1, 3), method = "ML")

Coefficients:
         ma1      ma2     ma3
      0.0847  -0.3427  0.2502
s.e.  0.0935   0.0888  0.1113

sigma^2 estimated as 4.468:  log likelihood = -245.22,  aic = 498.44
```



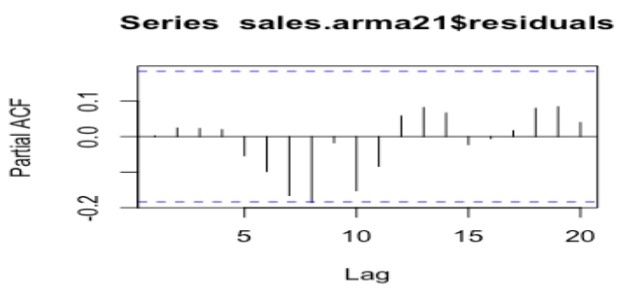


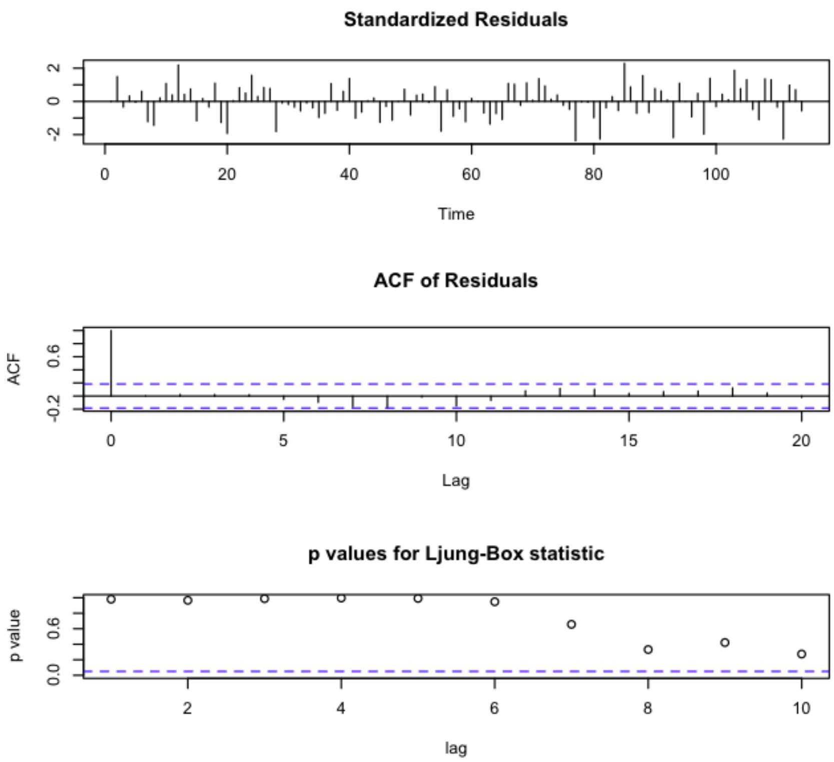
For ARIMA (2,1,1) model we get:

```
Call:
arima(x = sales.ts, order = c(2, 1, 1), method = "ML")

Coefficients:
          ar1      ar2     ma1
      -0.6131  -0.3489  0.7029
s.e.   0.1453   0.0979  0.1420

sigma^2 estimated as 4.447:  log likelihood = -244.94,  aic = 497.88
```

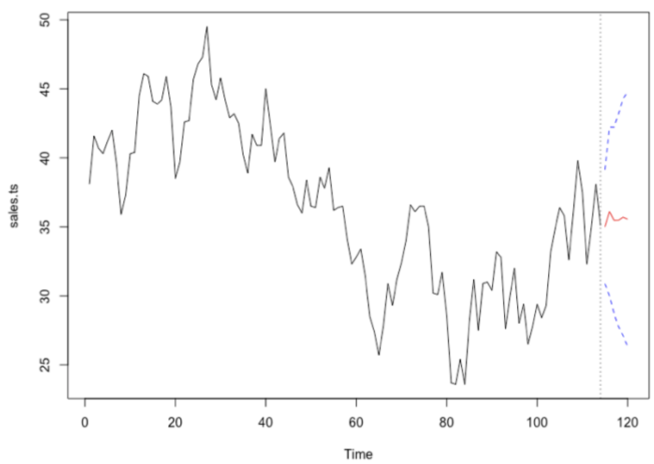




If we compare the plots for all 3 models we see that ARIMA (2,1,1) model passes the WN test. Whereas for AR (3) model in SPACF plot there is a spike at lag 10, and for MA (3) model there is a spike at lag 7 in SPACF plot. Also, if we compare AIC values of the 3 models, we see that ARIMA (2,1,1) model has the lowest AIC. Hence, we choose ARIMA (2,1,1) to make the forecasts and we get:

```
> sales.pred
$pred
Time Series:
Start = 115
End = 120
Frequency = 1
[1] 35.01178 36.11269 35.46852 35.47930 35.69747 35.55995

$se
Time Series:
Start = 115
End = 120
Frequency = 1
[1] 2.108821 3.119094 3.438072 3.929344 4.373361 4.710523
```



```
## Question 4
mypath = "/Users/safurasuleymanovs/Desktop/4B/Stat/A5/"
data.set ="sales2.txt"
sales.y = scan(paste(mypath,data.set,sep=""))
sales.ts = ts(scan(paste(mypath,data.set,sep="")))
plot(sales.ts, main="Plot of Sales")
acf(sales.ts)
sales.d = diff(sales.ts)
plot(sales.d, type="l", main = "Plot of Differenced Sales")
acf(sales.d)
pacf(sales.d)
sales.ar3 <- arima(sales.ts,order=c(3,1,0),method="ML")
pacf(sales.ar3$residuals)
tsdiag(sales.ar3)
sales.ma3 <- arima(sales.ts,order=c(0,1,3),method="ML")
pacf(sales.ma3$residuals)
tsdiag(sales.ma3)
sales.arma21 <- arima(sales.ts,order=c(2,1,1),method="ML")
pacf(sales.arma21$residuals)
tsdiag(sales.arma21)
sales.pred <- predict(sales.arma21,n.ahead=6,se.fit=TRUE)
u <- sales.pred$pred + 1.96*sales.pred$se
l <- sales.pred$pred - 1.96*sales.pred$se
plot(sales.ts,xlim=c(1,120),type="l",xlab="Time")
lines(sales.pred$pred,col="red")
lines(u,col='blue',lty='dashed')
lines(l,col='blue',lty='dashed')
abline(v=114,lty="dotted")
```