

# BF HW 6

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```
library(fpp)
```

```
## Loading required package: forecast
```

```
## Registered S3 method overwritten by 'quantmod':  
##   method             from  
##   as.zoo.data.frame zoo
```

```
## Loading required package: fma
```

```
## Loading required package: expsmooth
```

```
## Loading required package: lmttest
```

```
## Loading required package: zoo
```

```
##  
## Attaching package: 'zoo'
```

```
## The following objects are masked from 'package:base':  
##  
##   as.Date, as.Date.numeric
```

```
## Loading required package: tseries
```

```
library(fpp2)
```

```
## — Attaching packages ————— fpp2 2.4 —
```

```
## ✓ ggplot2 3.3.6
```

```
##
```

```
##  
## Attaching package: 'fpp2'
```

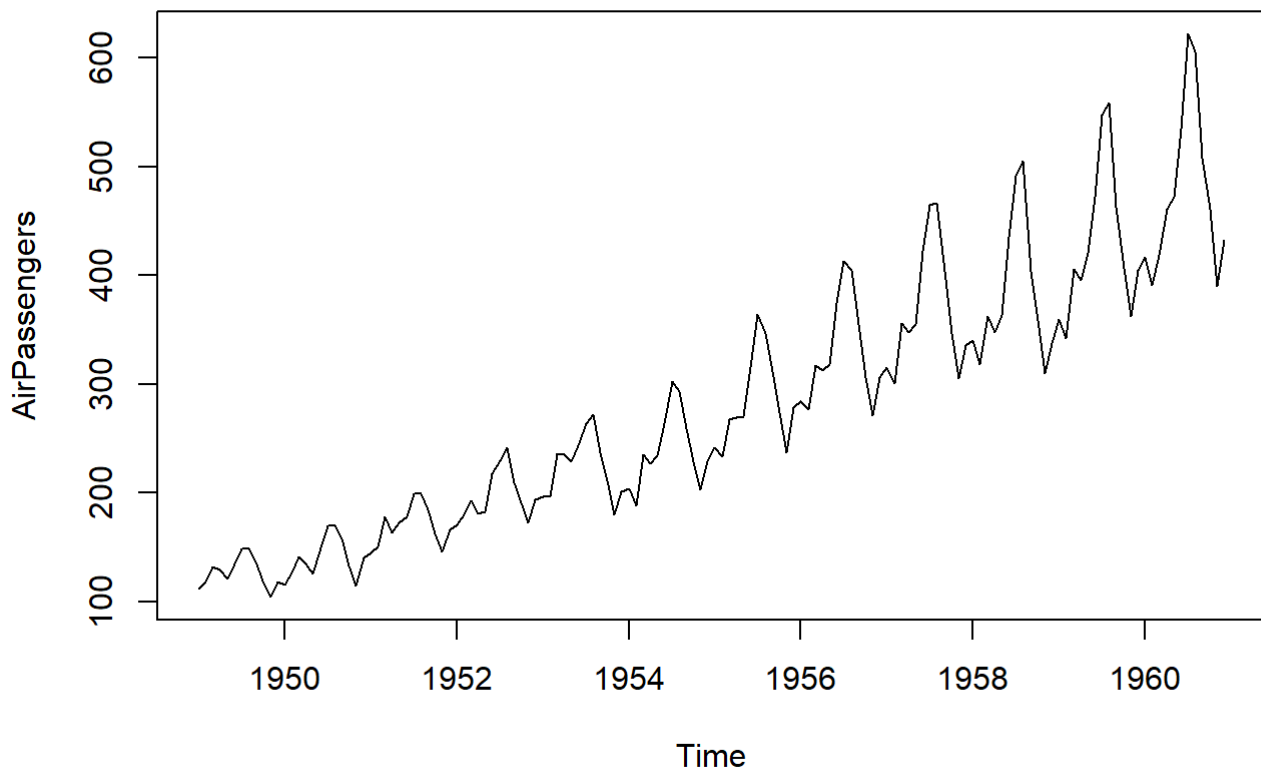
```
## The following objects are masked from 'package:fpp':
##
##   ausair, ausbeer, austa, austourists, debitcards, departures,
##   elecequip, euretail, guinearice, oil, sunspotarea, usmelec
```

```
library(forecast)
```

```
AirPassengers
```

```
##      Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
## 1949 112 118 132 129 121 135 148 148 136 119 104 118
## 1950 115 126 141 135 125 149 170 170 158 133 114 140
## 1951 145 150 178 163 172 178 199 199 184 162 146 166
## 1952 171 180 193 181 183 218 230 242 209 191 172 194
## 1953 196 196 236 235 229 243 264 272 237 211 180 201
## 1954 204 188 235 227 234 264 302 293 259 229 203 229
## 1955 242 233 267 269 270 315 364 347 312 274 237 278
## 1956 284 277 317 313 318 374 413 405 355 306 271 306
## 1957 315 301 356 348 355 422 465 467 404 347 305 336
## 1958 340 318 362 348 363 435 491 505 404 359 310 337
## 1959 360 342 406 396 420 472 548 559 463 407 362 405
## 1960 417 391 419 461 472 535 622 606 508 461 390 432
```

```
plot(AirPassengers)
```



```
nsdiffs(AirPassengers)
```

```
## [1] 1
```

```
# THE NSDIFFS FOR THE AIRPASSENGERS DATA IS 1
ndiffs(AirPassengers)
```

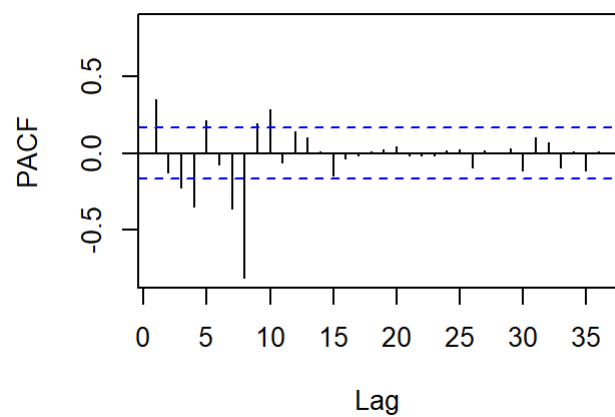
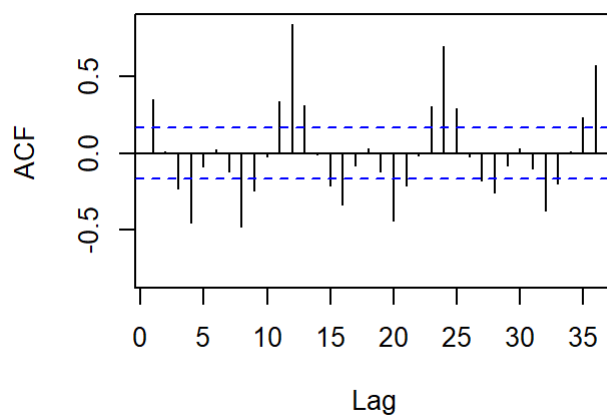
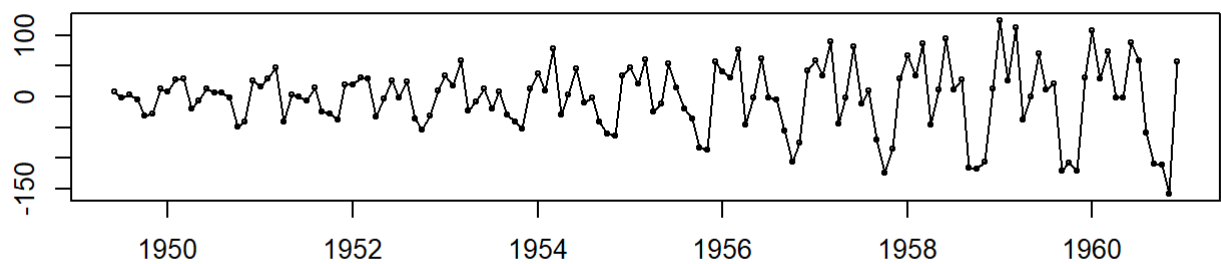
```
## [1] 1
```

```
# THE NSDIFFS FOR THE AIRPASSENGERS DATA IS 1
ndiffs((diff(AirPassengers,4)))
```

```
## [1] 0
```

```
# THE DIFFERENCE BETWEEN NSDIFFS AND NDIFFS FOR THE AIRPASSENGERS DATA IS 0 (1-1)
tsdisplay(diff(diff(AirPassengers,4)))
```

**diff(diff(AirPassengers, 4))**



```
fit3 <- auto.arima(AirPassengers,trace=TRUE, stepwise = FALSE )
```

```

##
## ARIMA(0,1,0)(0,1,0)[12] : 1031.539
## ARIMA(0,1,0)(0,1,1)[12] : 1030.846
## ARIMA(0,1,0)(0,1,2)[12] : 1032.465
## ARIMA(0,1,0)(1,1,0)[12] : 1030.501
## ARIMA(0,1,0)(1,1,1)[12] : 1032.317
## ARIMA(0,1,0)(1,1,2)[12] : 1034.414
## ARIMA(0,1,0)(2,1,0)[12] : 1032.309
## ARIMA(0,1,0)(2,1,1)[12] : 1034.423
## ARIMA(0,1,0)(2,1,2)[12] : Inf
## ARIMA(0,1,1)(0,1,0)[12] : 1020.733
## ARIMA(0,1,1)(0,1,1)[12] : 1021.192
## ARIMA(0,1,1)(0,1,2)[12] : 1019.812
## ARIMA(0,1,1)(1,1,0)[12] : 1020.614
## ARIMA(0,1,1)(1,1,1)[12] : Inf
## ARIMA(0,1,1)(1,1,2)[12] : Inf
## ARIMA(0,1,1)(2,1,0)[12] : 1019.496
## ARIMA(0,1,1)(2,1,1)[12] : Inf
## ARIMA(0,1,1)(2,1,2)[12] : Inf
## ARIMA(0,1,2)(0,1,0)[12] : 1022.816
## ARIMA(0,1,2)(0,1,1)[12] : 1023.319
## ARIMA(0,1,2)(0,1,2)[12] : 1021.934
## ARIMA(0,1,2)(1,1,0)[12] : 1022.742
## ARIMA(0,1,2)(1,1,1)[12] : Inf
## ARIMA(0,1,2)(1,1,2)[12] : Inf
## ARIMA(0,1,2)(2,1,0)[12] : 1021.628
## ARIMA(0,1,2)(2,1,1)[12] : Inf
## ARIMA(0,1,3)(0,1,0)[12] : 1020.522
## ARIMA(0,1,3)(0,1,1)[12] : 1021.286
## ARIMA(0,1,3)(0,1,2)[12] : 1020.837
## ARIMA(0,1,3)(1,1,0)[12] : 1020.842
## ARIMA(0,1,3)(1,1,1)[12] : 1021.296
## ARIMA(0,1,3)(2,1,0)[12] : 1020.423
## ARIMA(0,1,4)(0,1,0)[12] : 1021.176
## ARIMA(0,1,4)(0,1,1)[12] : 1020.854
## ARIMA(0,1,4)(1,1,0)[12] : 1020.285
## ARIMA(0,1,5)(0,1,0)[12] : 1022.076
## ARIMA(1,1,0)(0,1,0)[12] : 1020.488
## ARIMA(1,1,0)(0,1,1)[12] : 1021.103
## ARIMA(1,1,0)(0,1,2)[12] : 1019.811
## ARIMA(1,1,0)(1,1,0)[12] : 1020.582
## ARIMA(1,1,0)(1,1,1)[12] : Inf
## ARIMA(1,1,0)(1,1,2)[12] : Inf
## ARIMA(1,1,0)(2,1,0)[12] : 1019.557
## ARIMA(1,1,0)(2,1,1)[12] : Inf
## ARIMA(1,1,0)(2,1,2)[12] : Inf
## ARIMA(1,1,1)(0,1,0)[12] : 1022.583
## ARIMA(1,1,1)(0,1,1)[12] : 1023.214
## ARIMA(1,1,1)(0,1,2)[12] : 1021.793
## ARIMA(1,1,1)(1,1,0)[12] : 1022.674
## ARIMA(1,1,1)(1,1,1)[12] : Inf
## ARIMA(1,1,1)(1,1,2)[12] : Inf
## ARIMA(1,1,1)(2,1,0)[12] : 1021.513
## ARIMA(1,1,1)(2,1,1)[12] : Inf
## ARIMA(1,1,2)(0,1,0)[12] : 1024.478

```

```

## ARIMA(1,1,2)(0,1,1)[12] : 1025.198
## ARIMA(1,1,2)(0,1,2)[12] : 1023.802
## ARIMA(1,1,2)(1,1,0)[12] : Inf
## ARIMA(1,1,2)(1,1,1)[12] : Inf
## ARIMA(1,1,2)(2,1,0)[12] : 1023.483
## ARIMA(1,1,3)(0,1,0)[12] : 1019.733
## ARIMA(1,1,3)(0,1,1)[12] : 1020.211
## ARIMA(1,1,3)(1,1,0)[12] : 1019.812
## ARIMA(1,1,4)(0,1,0)[12] : Inf
## ARIMA(2,1,0)(0,1,0)[12] : 1022.583
## ARIMA(2,1,0)(0,1,1)[12] : 1023.222
## ARIMA(2,1,0)(0,1,2)[12] : 1021.861
## ARIMA(2,1,0)(1,1,0)[12] : 1022.691
## ARIMA(2,1,0)(1,1,1)[12] : Inf
## ARIMA(2,1,0)(1,1,2)[12] : Inf
## ARIMA(2,1,0)(2,1,0)[12] : 1021.6
## ARIMA(2,1,0)(2,1,1)[12] : Inf
## ARIMA(2,1,1)(0,1,0)[12] : 1018.165
## ARIMA(2,1,1)(0,1,1)[12] : 1018.84
## ARIMA(2,1,1)(0,1,2)[12] : 1018.628
## ARIMA(2,1,1)(1,1,0)[12] : 1018.395
## ARIMA(2,1,1)(1,1,1)[12] : Inf
## ARIMA(2,1,1)(2,1,0)[12] : 1018.336
## ARIMA(2,1,2)(0,1,0)[12] : 1019.771
## ARIMA(2,1,2)(0,1,1)[12] : 1020.613
## ARIMA(2,1,2)(1,1,0)[12] : 1020.224
## ARIMA(2,1,3)(0,1,0)[12] : 1020.474
## ARIMA(3,1,0)(0,1,0)[12] : 1023.984
## ARIMA(3,1,0)(0,1,1)[12] : 1024.921
## ARIMA(3,1,0)(0,1,2)[12] : 1023.827
## ARIMA(3,1,0)(1,1,0)[12] : 1024.484
## ARIMA(3,1,0)(1,1,1)[12] : Inf
## ARIMA(3,1,0)(2,1,0)[12] : 1023.496
## ARIMA(3,1,1)(0,1,0)[12] : 1019.565
## ARIMA(3,1,1)(0,1,1)[12] : 1020.374
## ARIMA(3,1,1)(1,1,0)[12] : 1020.005
## ARIMA(3,1,2)(0,1,0)[12] : Inf
## ARIMA(4,1,0)(0,1,0)[12] : 1022.456
## ARIMA(4,1,0)(0,1,1)[12] : 1022.836
## ARIMA(4,1,0)(1,1,0)[12] : 1022.208
## ARIMA(4,1,1)(0,1,0)[12] : 1024.624
## ARIMA(5,1,0)(0,1,0)[12] : 1024.622
##
##
##
## Best model: ARIMA(2,1,1)(0,1,0)[12]

```

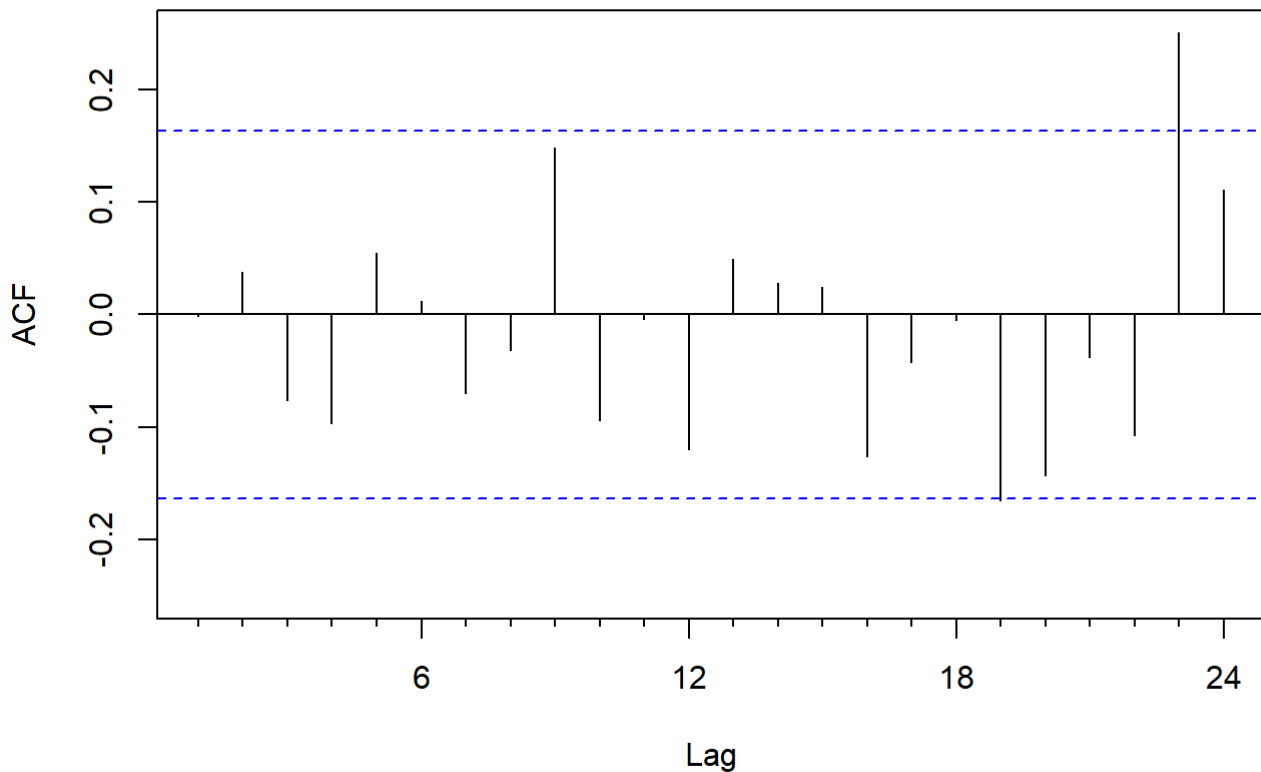
# FROM ABOVE ANALYZED THAT THE BEST MODEL IS (2,1,1)(0,1,0) WHICH THE VALUE IS THE LEAST ONE (1018.165). THE LEAST VALUE MEANS THE BEST MODEL. HERE IN (2,1,1) 2 MEANS THE NO OF VALUES IN ACF BELOW 0 NEAR AND CROSSING THE CONFIDENCE INTERVAL. 1 IN THE MIDDLE MEANS THE DIFF. THE LAST 1 REPRESENTS THE NO OF VALUES IN PACF BELOW 0 NEAR AND CROSSING THE CONFIDENCE INTERVAL. HERE IN (0,1,0) 0 MEANS THE NO OF VALUES IN ACF ABOVE 0 NEAR AND CROSSING THE CONFIDENCE INTERVAL. 1 MEANS THE DIFF. THE 0 IN THE LAST MEANS THE NO OF VALUES IN PACF ABOVE 0 NEAR AND CROSSING THE CONFIDENCE INTERVALS

fit3

```
## Series: AirPassengers
## ARIMA(2,1,1)(0,1,0)[12]
##
## Coefficients:
##          ar1      ar2      ma1
##      0.5960  0.2143 -0.9819
## s.e.  0.0888  0.0880  0.0292
##
## sigma^2 = 132.3: log likelihood = -504.92
## AIC=1017.85   AICc=1018.17   BIC=1029.35
```

```
# IT GIVES OUT THE VALUES OF THE SIGMA^2,AIC VALUE , COEFFICIENTS VALUES OF THE BEST MODEL
(2,1,1)(0,1,0)
#Residual Analysis
Acf(fit3$residuals)
```

### Series fit3\$residuals

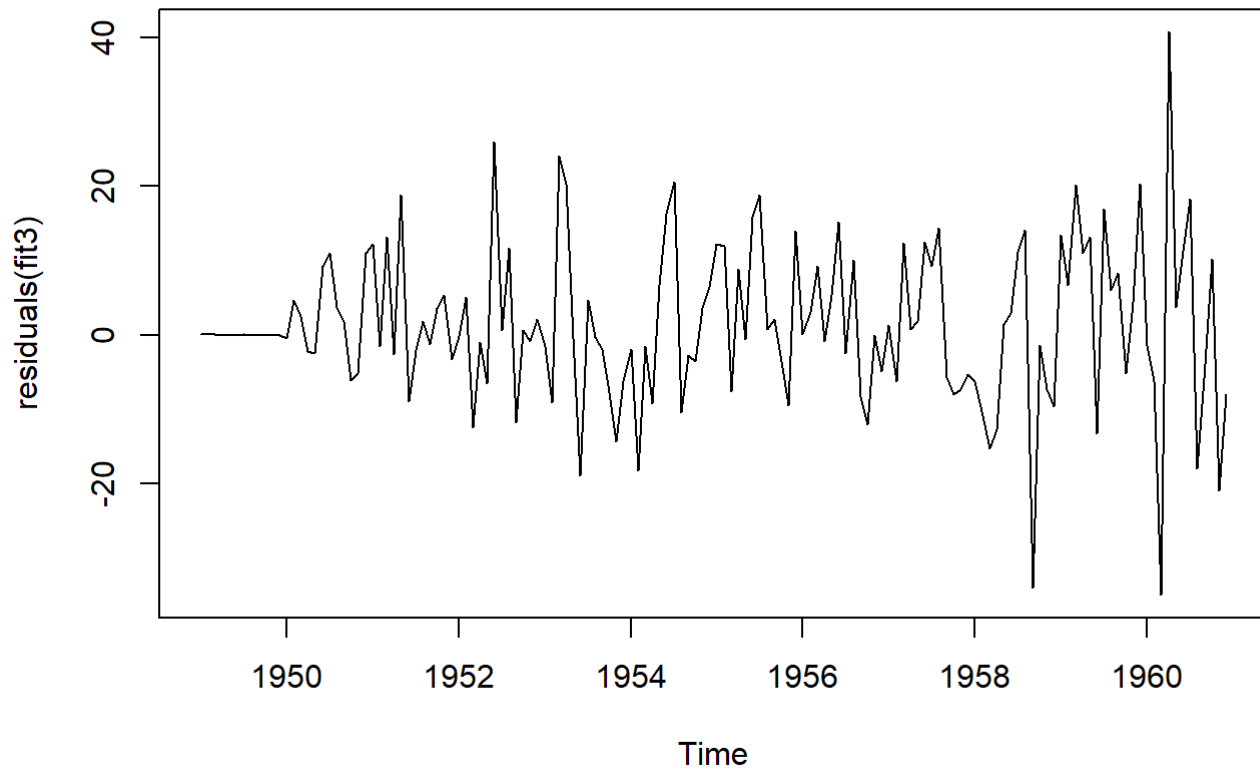


```
#HERE ONLY ONE VALUE IS CROSSING THE CONFIDENCE INTERVAL
Box.test(residuals(fit3), lag=20, type="Ljung")
```

```
##
## Box-Ljung test
##
## data: residuals(fit3)
## X-squared = 22.524, df = 20, p-value = 0.3128
```

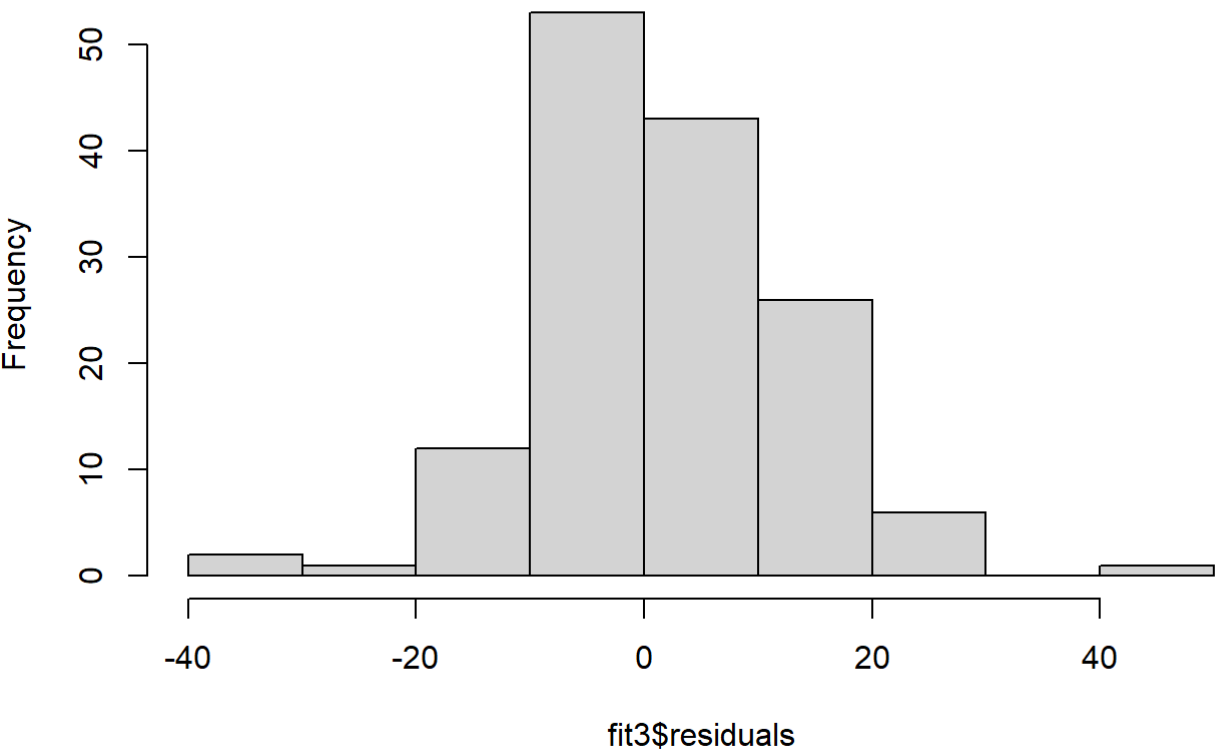
#GIVES OUT THE P VALUE WHICH IS 0.3128 WHICH IS MORE THAN 5 % WHICH MEANS IT HAS NO SIGNIFICANCE DIFFERENCE

```
plot.ts(residuals(fit3))
```



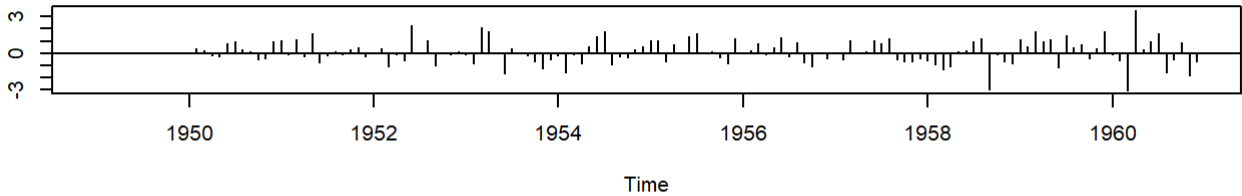
```
hist(fit3$residuals)
```

Histogram of fit3\$residuals

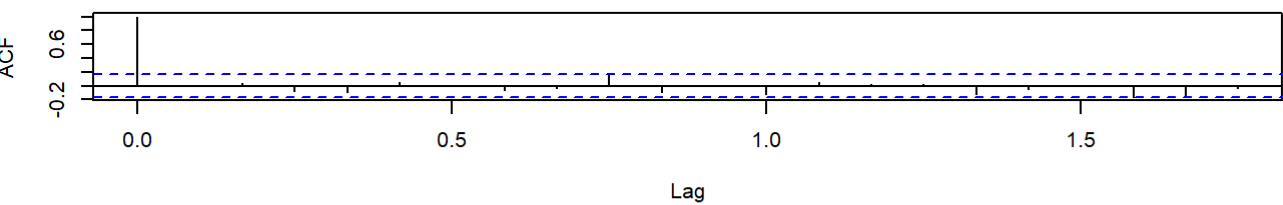


```
tsdiag(fit3)
```

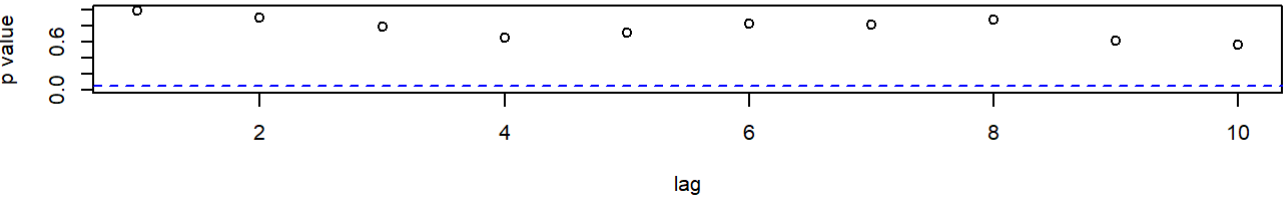
Standardized Residuals



ACF of Residuals



p values for Ljung-Box statistic





*#IT DISPLAYS 3 PLOTS OF STANDARDIZED RESIDUALS,ACF OF RESIDUALS AND P-VALUES OF THE LJUNG-BOX STATISTIC*