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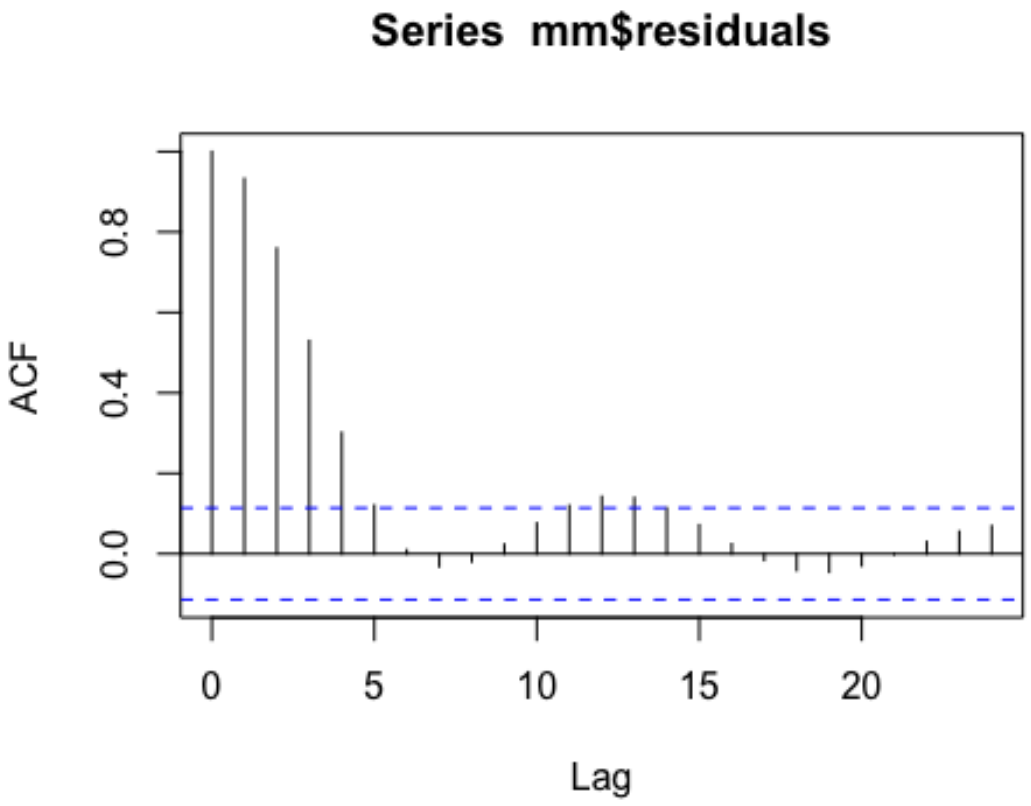
```
library(readxl)

## Warning: package 'readxl' was built under R version 3.3.2

library(forecast)

## Warning: package 'forecast' was built under R version 3.3.2

## Warning in as.POSIXlt.POSIXct(Sys.time()): unknown timezone 'default/
## America/Chicago'

library(tseries)

## Warning: package 'tseries' was built under R version 3.3.2

library(timeSeries)

## Loading required package: timeDate

library(base)
library(stats)
m <- read.csv('Gas Furnace Dataset.csv', header = TRUE)
x <- m[,1]
y <- m[,2]
mm <- lm(y~x)
acf(mm$residuals)
```

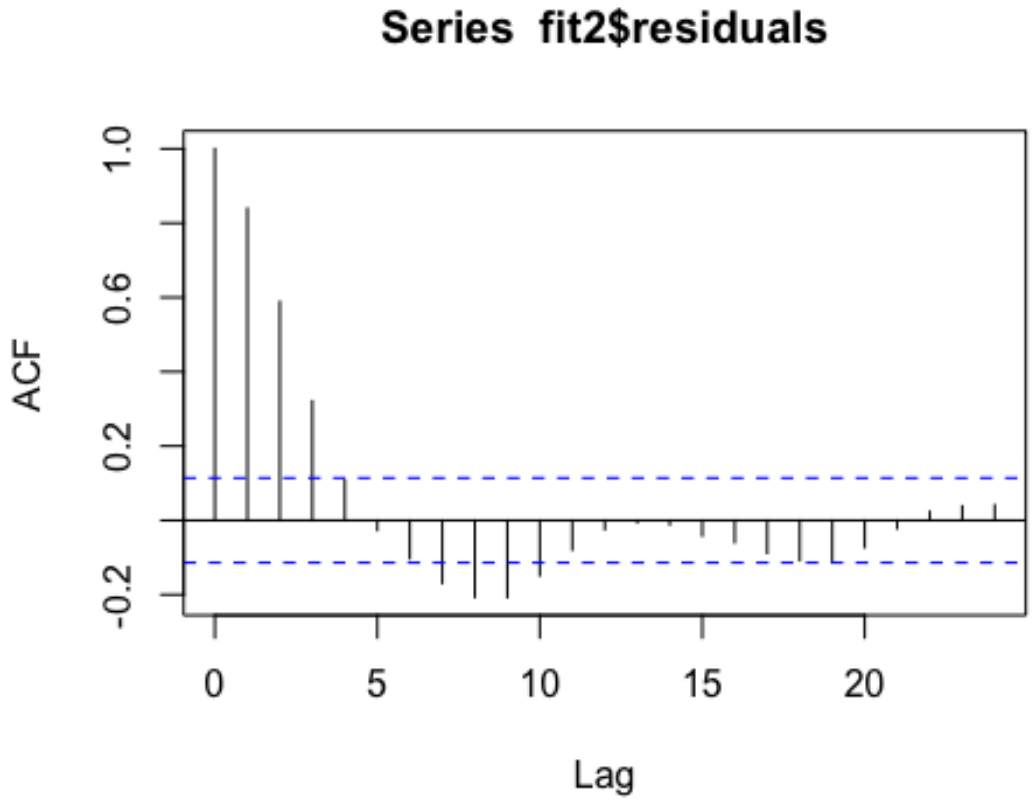


From the plot we did for the residuals for linear regression model, we can see that the some of the points are out of the 95%.

2.ARIMA(0,0,1)

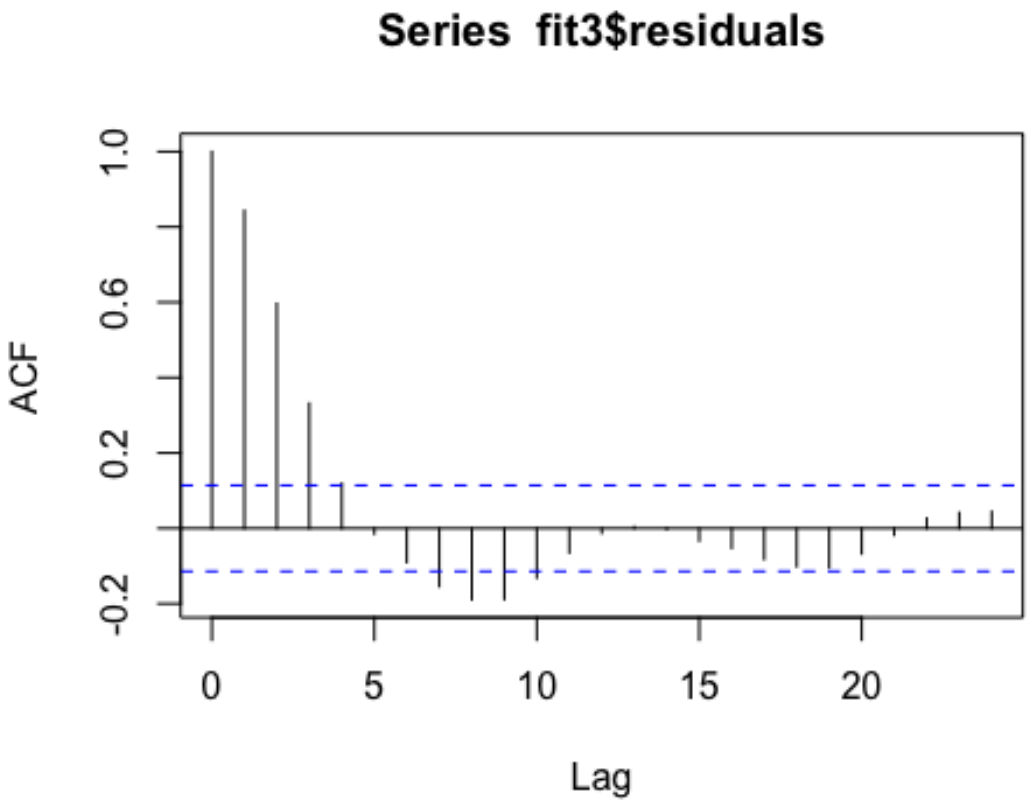
```
arma.innovation <- function(x, arma.model) {
  p <- arma.model$arma[1]
  q <- arma.model$arma[2]
  num.coef <- p + q
  ar.coef <- arma.model$coef[seq_len(p)]
  ma.coef <- arma.model$coef[p + seq_len(q)]
  if (q == 0) {
    infinite.ar.coef <- ar.coef
  } else {
    infinite.ar.coef <- -ARMAtoMA(-ma.coef, -ar.coef, num.coef)
  }
  return(as.vector(filter(x, c(1, -infinite.ar.coef), side=1)))
}

model2 <- arima(mm$residuals,order = c(0,0,1))
x2.adj <- arma.innovation(x, model2)
y2.adj <- arma.innovation(y, model2)
```

```
fit2 <- lm(y2.adj~x2.adj)
acf(fit2$residuals)
```



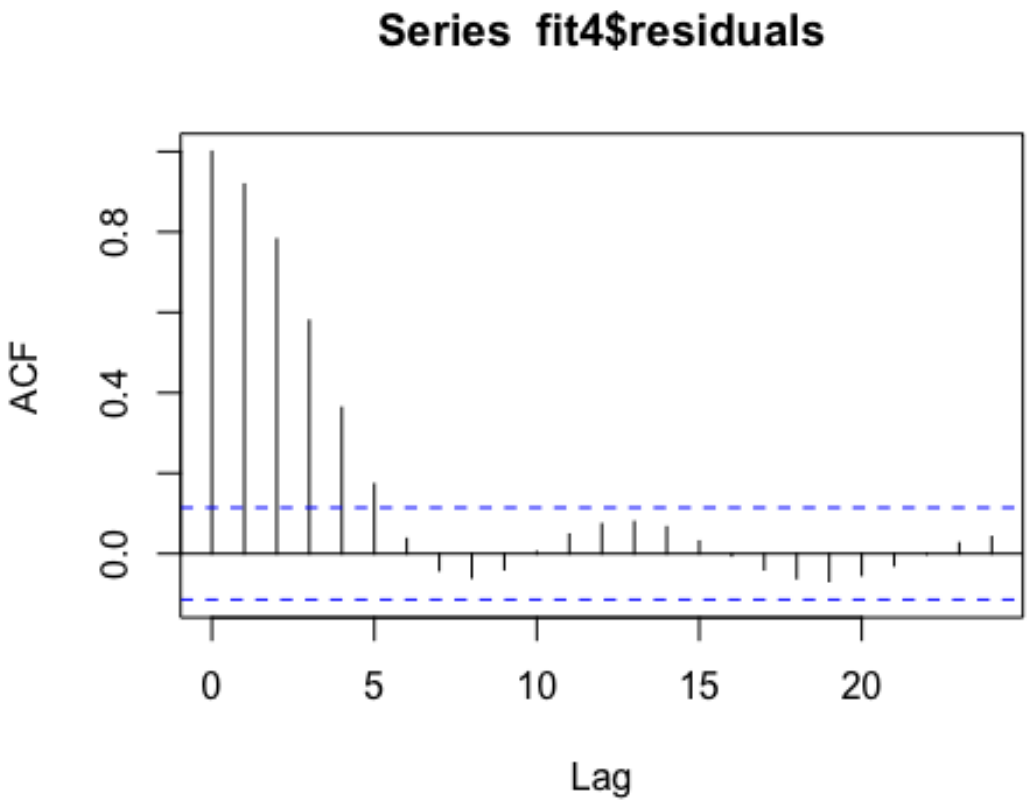
3.ARIMA(1,0,0)

```
model3 <- arima(ts(mm$residuals), order = c(1,0,0))
x3.adj <- arma.innovation(x, model3)
y3.adj <- arma.innovation(y, model3)
fit3 <- lm(y3.adj~x3.adj)
acf(fit3$residuals)
```



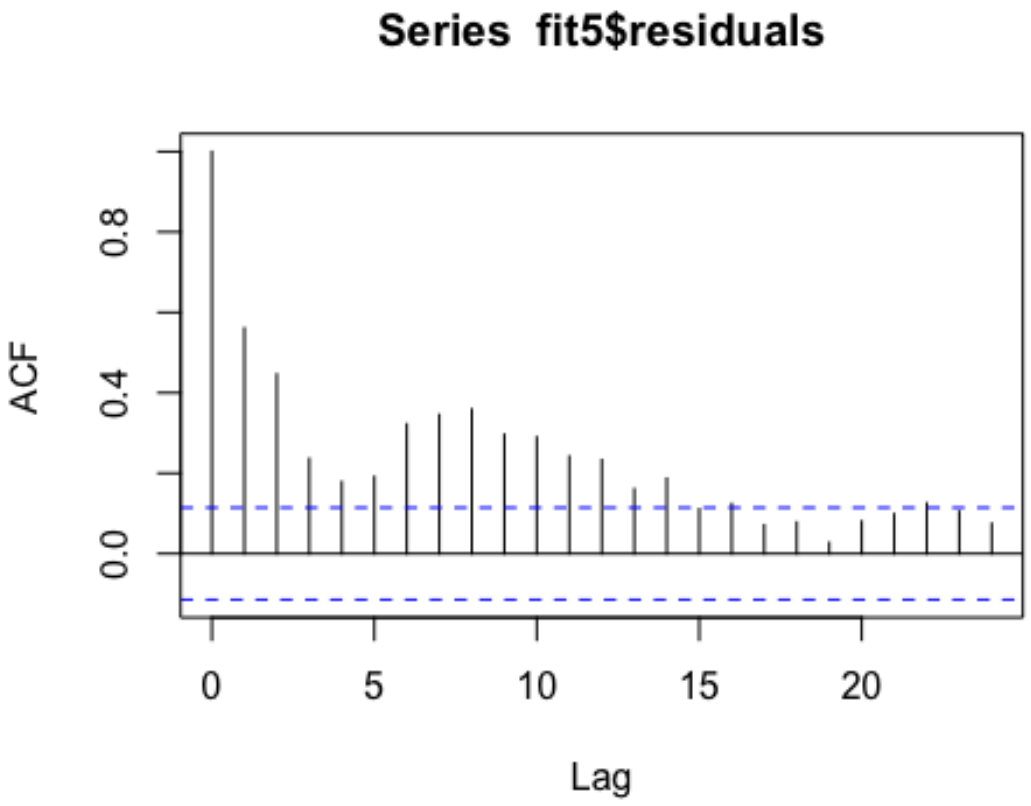
4.ARIMA(0,0,2)

```
model4 <- arima(ts(mm$residuals), order = c(0,0,2))
x4.adj <- arma.innovation(x, model4)
y4.adj <- arma.innovation(y, model4)
fit4 <- lm(y4.adj~x4.adj)
acf(fit4$residuals)
```



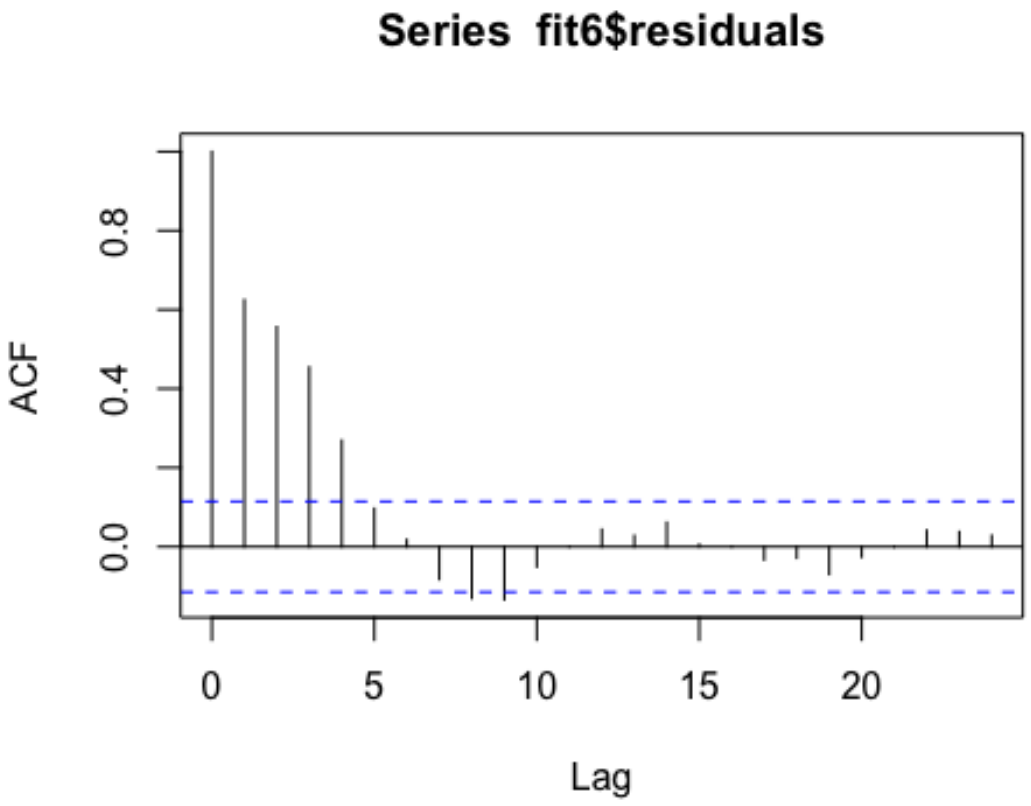
5.ARIMA(2,0,0)

```
model5 <- arima(ts(mm$residuals), order = c(2,0,0))
x5.adj <- arma.innovation(x, model5)
y5.adj <- arma.innovation(y, model5)
fit5 <- lm(y5.adj~x5.adj)
acf(fit5$residuals)
```



6.ARIMA(2,0,2)

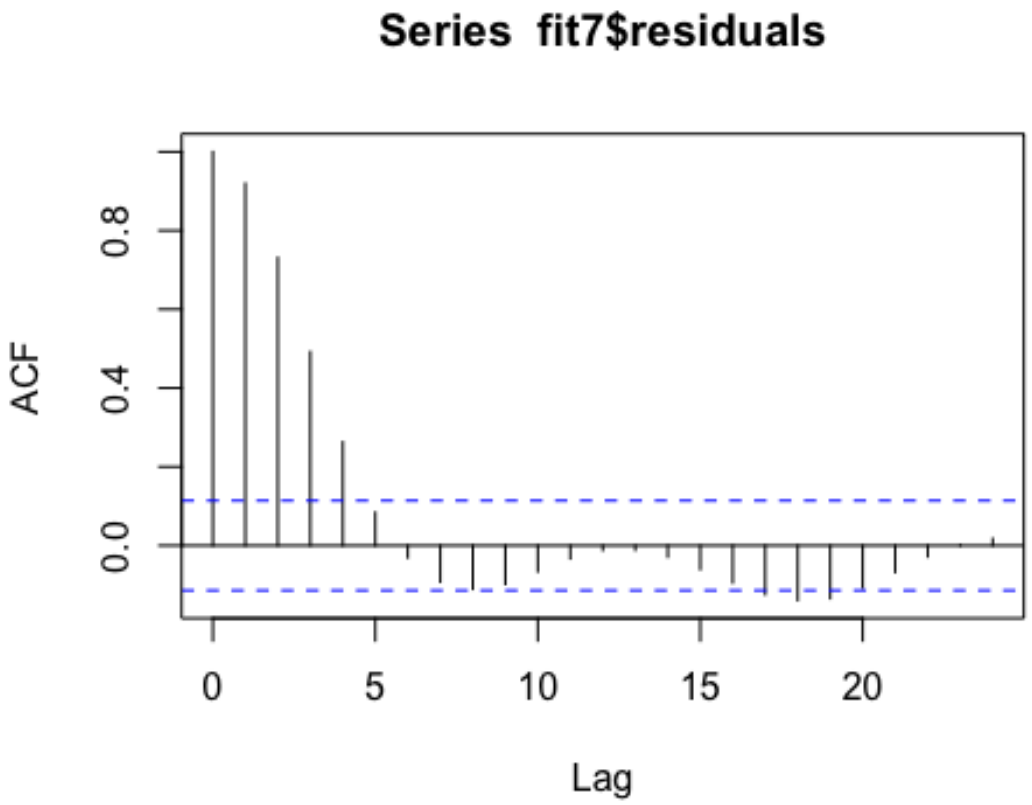
```
model6 <- arima(ts(mm$residuals), order = c(2,0,2))
x6.adj <- arma.innovation(x, model6)
y6.adj <- arma.innovation(y, model6)
fit6 <- lm(y6.adj~x6.adj)
acf(fit6$residuals)
```



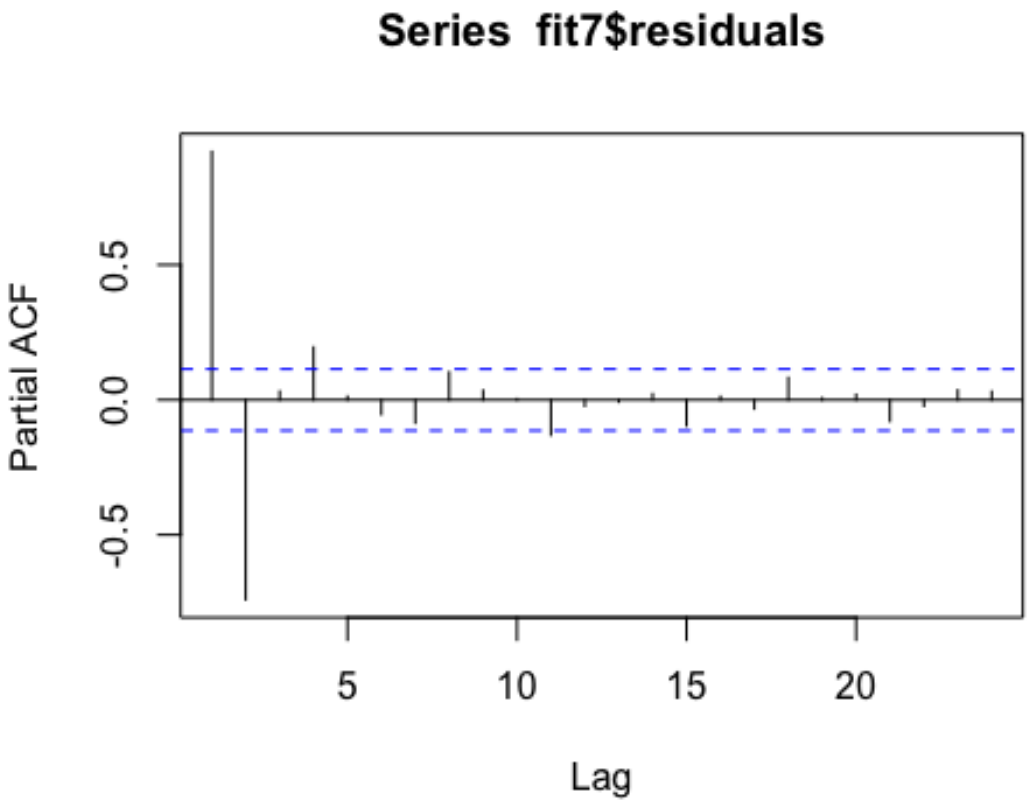
7.ARFIMA

```
library(fracdiff)
library(arfima)

## Loading required package: ltsa

## Note that the arfima package has new defaults starting with
## 1.4-0: type arfimachanges() for a list, as well as some other notes.
## NOTE: some of these are quite important!

##
## Attaching package: 'arfima'

## The following object is masked from 'package:forecast':
##
##     arfima

## The following object is masked from 'package:stats':
##
##     BIC

fy <- fracdiff(y)
fx <- fracdiff(x)
dfx <- diffseries(x, fx$d)
```

```r
dfy <- diffseries(y, fx$d)
fit7 <- lm(dfy~dfx)
acf(fit7$residuals)
```




```r
pacf(fit7$residuals)
```



8. Based on the models we saw above and the acf, pacf plots we made, the model in Q7 is the best.As we can see, the correlation between residuals are smaller than the other models.