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PUT-CALL PARITY PROOF USING APPLE STOCK OPTION CHAINS

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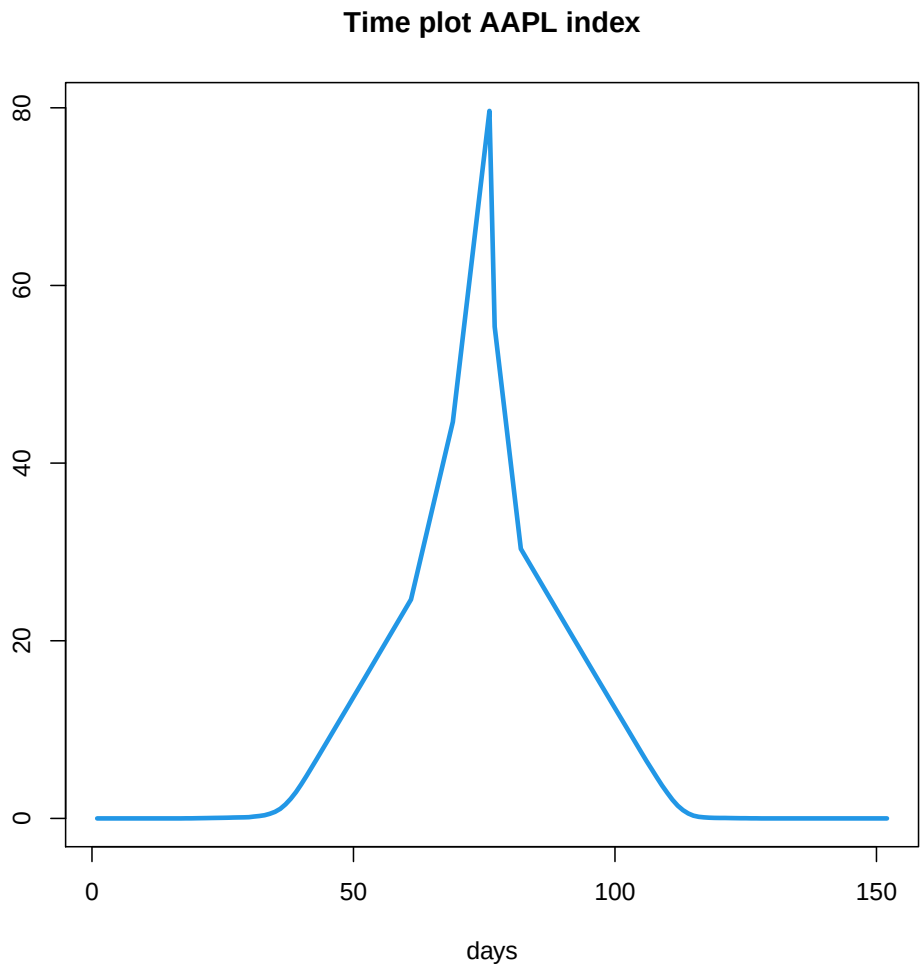
0.1 Introduction

For the project we used apple stock option chains data for options with a maturity date of 2/26/21.The objective of this report is to prove the put-call parity relationship is true.

0.2 Methodology & Results

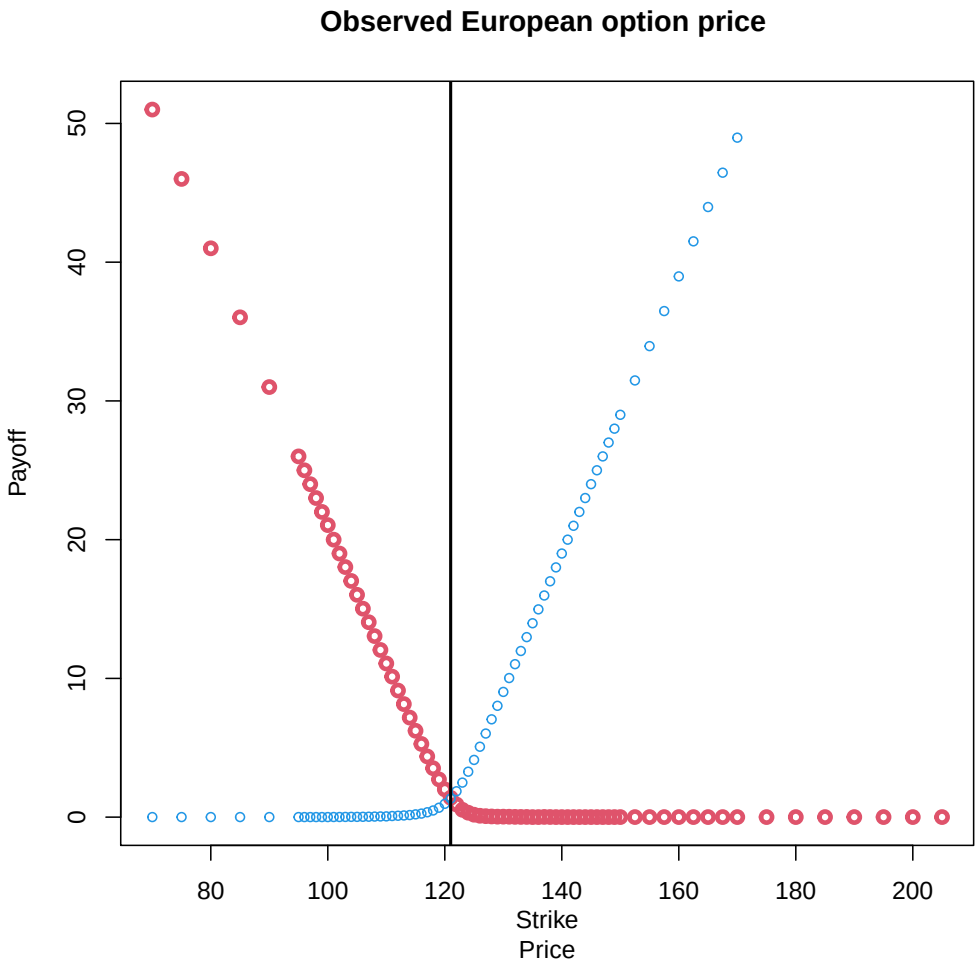
We got AAPL options chain data from NYSE.We created a time series plot of



the stock price.

We then fit a multiple linear regression model to the data using the strike,bid and ask prices for puts and calls and estimate the parameters.The observed strike price is $120

```
optdata<-read.csv("C:/Users/cheru/OneDrive/Documents/AAPL2.csv")
pmkt<-0.5*(optdata[,5]+optdata[,6])
cmkt<-0.5*(optdata[,22]+optdata[,23])
strike<-optdata[,3]
plot(strike,cmkt,lwd=3,col=c(2),ylab="Payoff",
     main="Observed European option price ", xlab="Strike
Price")
points(strike,pmkt,cex=0.8,col=c(4))
abline(v=121,lwd=2,col=c(1))
```




```
fit1<-lm(cmkt~pmkt+strike);fit1

##
```

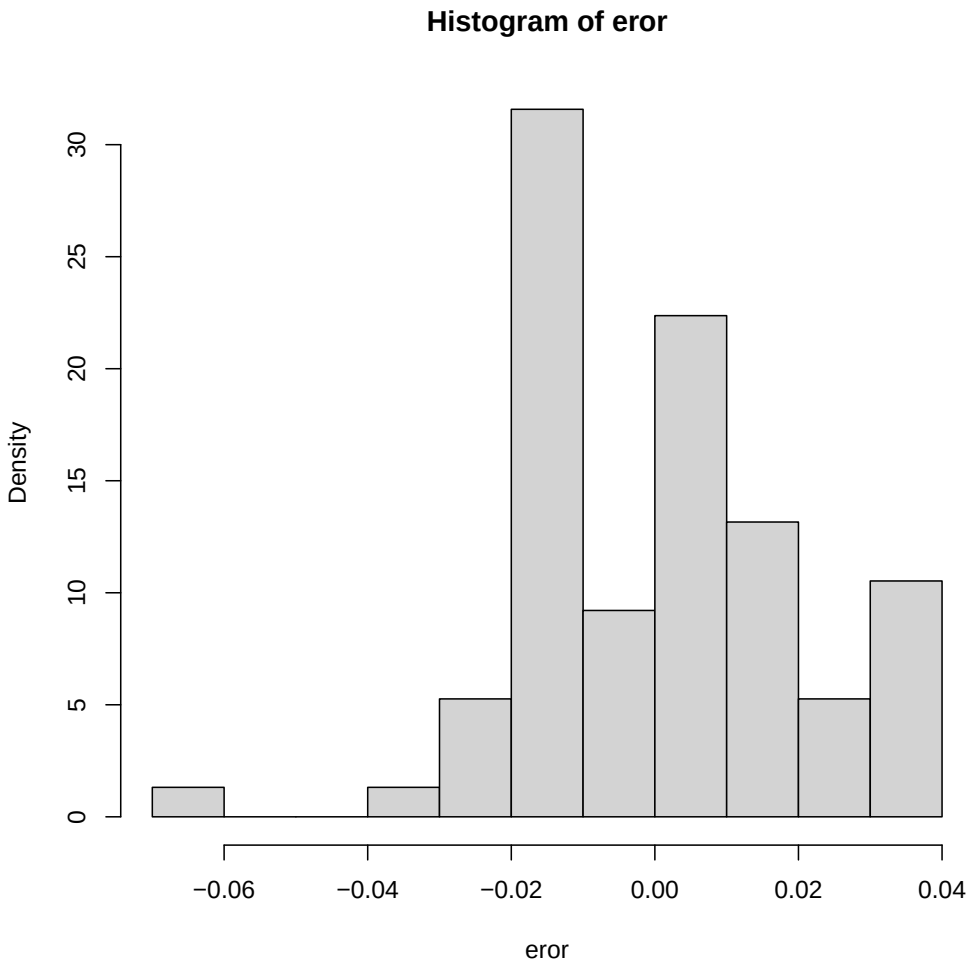
```
## Call:
## lm(formula = cmkt ~ pmkt + strike)
##
## Coefficients:
## (Intercept)         pmkt       strike
##    120.9295       0.9991      -0.9992
```

```
summary(fit1)
```

```
##
## Call:
## lm(formula = cmkt ~ pmkt + strike)
##
## Residuals:
##       Min        1Q    Median        3Q       Max
## -0.065045 -0.016815  0.002094  0.014834  0.035748
##
## Coefficients:
##               Estimate Std. Error t value Pr(>|t|)
## (Intercept)  1.209e+02  2.380e-02    5081   <2e-16 ***
## pmkt         9.991e-01  2.921e-04    3421   <2e-16 ***
## strike      -9.992e-01  2.162e-04   -4622   <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.01972 on 73 degrees of freedom
## Multiple R-squared:      1,Adjusted R-squared:      1
## F-statistic: 1.377e+07 on 2 and 73 DF,  p-value: < 2.2e-16
```

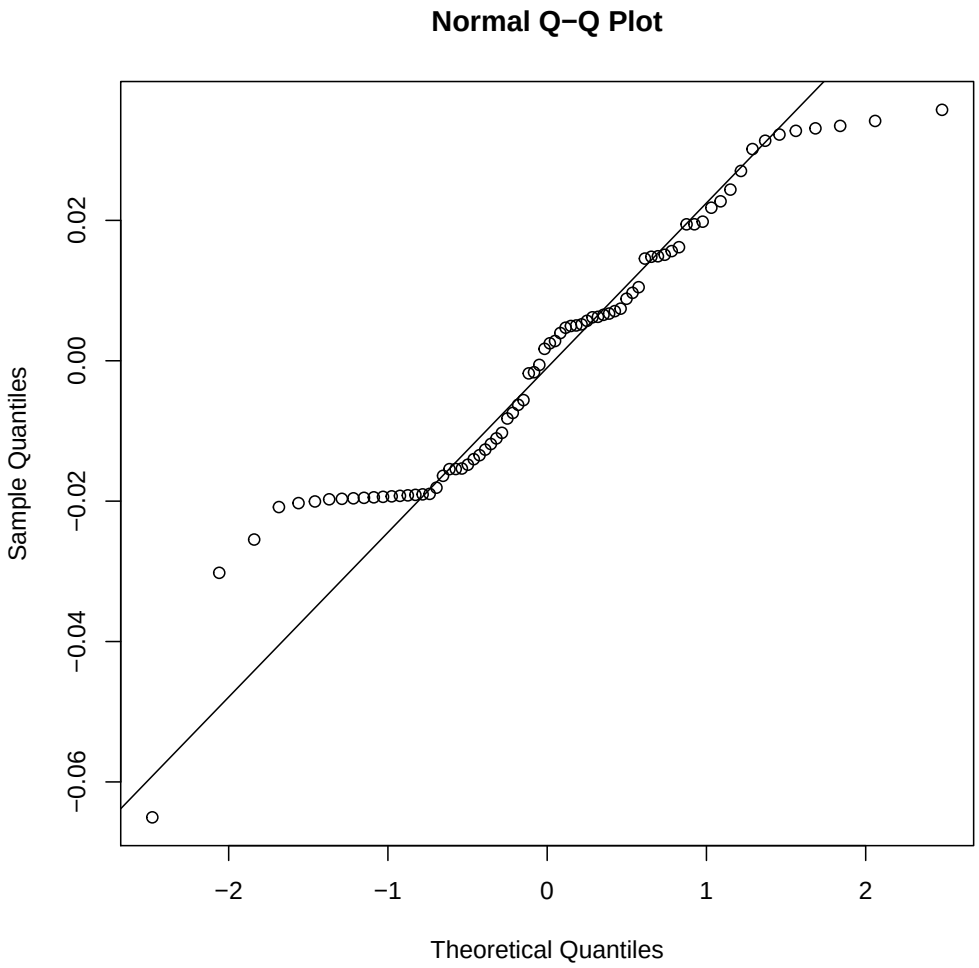
We then checked if the the assumption of normality over residuals is valid using the Shapiro-Wilk normality test and get the Normal QQ plot and histogram.

```
eror<-fit1$residuals
hist(eror,probability=T)
```




```
shapiro.test(eror)

##
##  Shapiro-Wilk normality test
##
## data:  eror
## W = 0.94538, p-value = 0.002593

shapiro.test(rnorm(1000))

##
##  Shapiro-Wilk normality test
##
```

```
## data:  rnorm(1000)
## W = 0.99877, p-value = 0.7342

qqnorm(eror)
qqline(eror)
```



0.3 Conclusion.

From the AAPL options chain data we have used we see proof of put-call parity after fitting a multiple linear regression model to the data.The shapiro-wilk normality test returned a p-value of 0.9839 which is greater than 0.5 thus we conclude there is indeed normality over the residuals.