DS 633- RESEARCH PAPER

Predicting S&P 500 Index

BY: CHAYAN GUJRAL

Contents

Introduction

This paper constructs a statistical model to determine what economic factors effects the price of S&P 500. This paper tries to construct linear parametric and nonlinear non Parametric regression models and analyze different statistical parameters on how and why this paper holds accurate hypothesis.

Previous Research

No previous research is conducted and my paper conduct no citations from any other research paper.

Methodology

This research paper is based on Time-Series data having 171 monthly observations. Statistical software R is used to perform the analysis.

Functional Specification: -

The S&P 500 index is hypothesized to be a negative function of unemployment rate, positive function of Consumer price percentage change, positive function of United States Imports, negative function of Global energy price Index and negative function of federal fund rate.

$$SnP\_Index = f(unr, cpi, importts, Epi, Int\_rate) \quad \text{(1)}$$
(- + + - -)

Population Regression Line: -

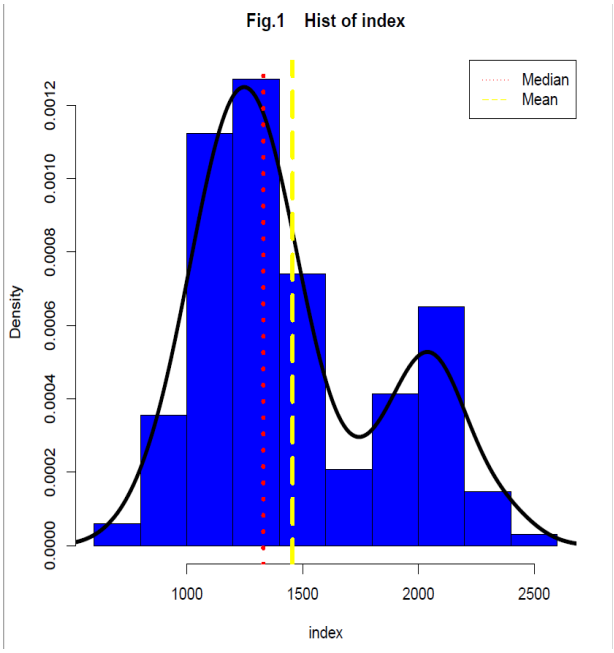
$$SnP\_Index = \alpha - \beta_1 unr + \beta_2 cpi + \beta_3 importts - \beta_4 Epi - \beta_5 Int\_rate \quad \text{(2)}$$

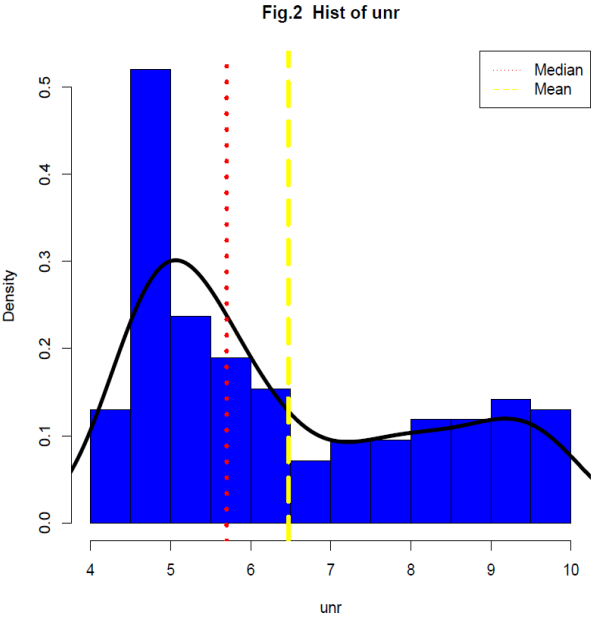
Sample Regression Line: -

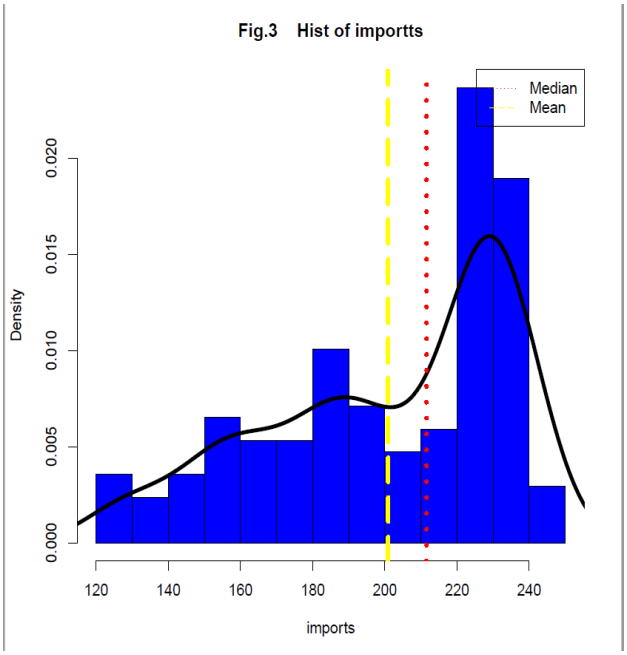
$$SnP\_Index = a - b_1 unr + b_2 cpi + b_3 importts - b_4 Epi - b_5 Int\_rate \quad \text{(3)}$$

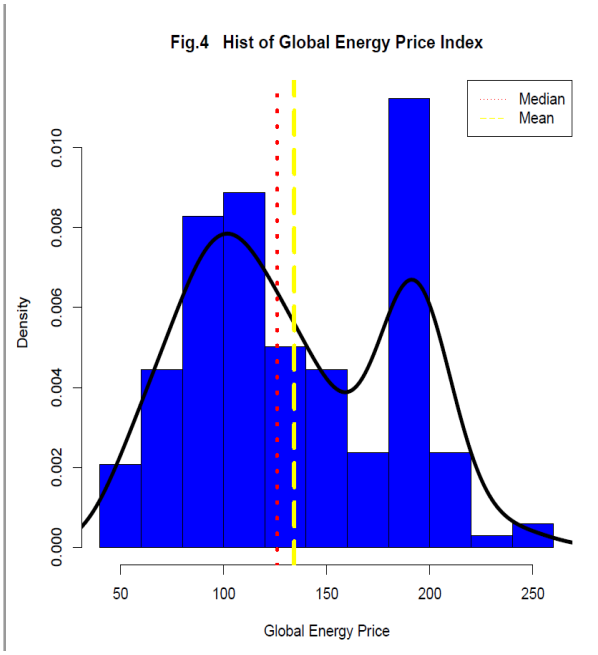
Results

Histograms









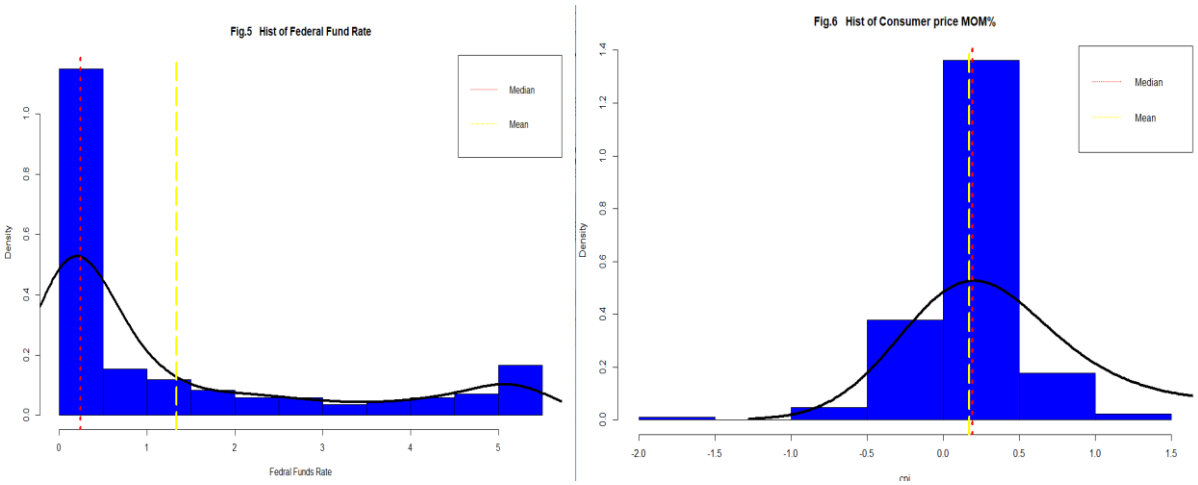


Fig.1 to Fig. 6 shows histograms for our data, the only data which is very skewed is Federal Funds rate and the least skewed is the consumer price percent change every month. The vertical lines show the Median and mean and we can see in Fig 6 they are almost coinciding with one another showing a perfect bell curve

The dependent variable is skewed to the right but the mean and median are pretty much close which shows low level of skewness altogether which will come handy while forming the regression model

Time Series Plots.

Fig.7 through Fig. 12 shows time series plot for all the data.

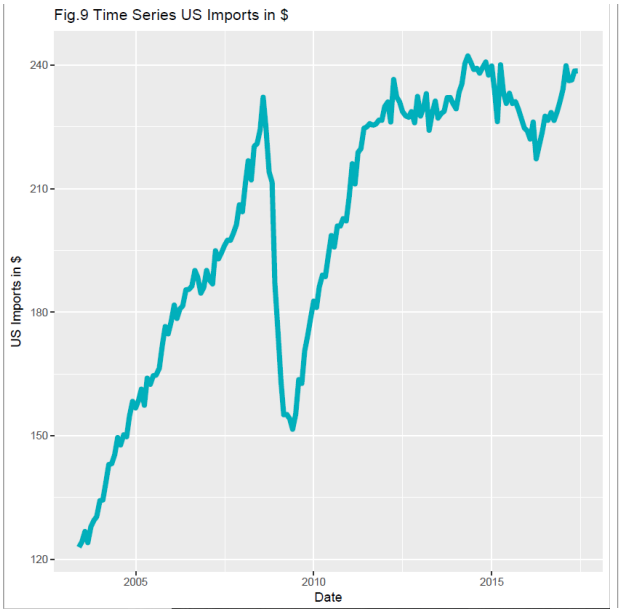


Fig.9 Time Series US Imports in $
US Imports in $
240
210
180
150
120
2005
2010
2015
Date

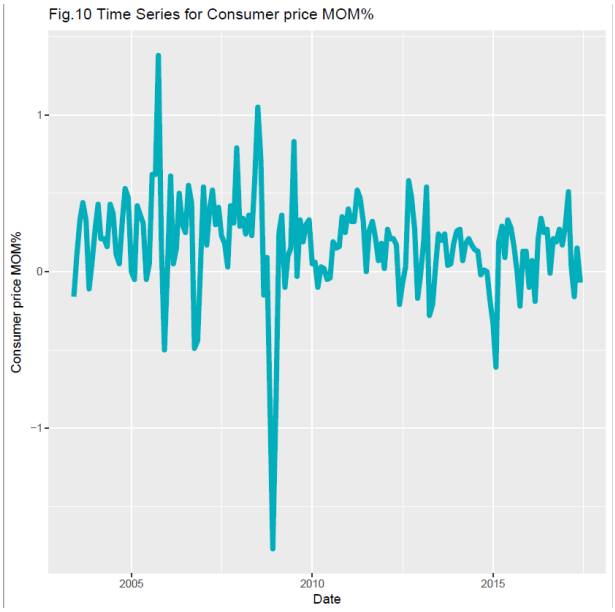


Fig.10 Time Series for Consumer price MOM%
Consumer price MOM%
1
0
−1
2005
2010
2015
Date

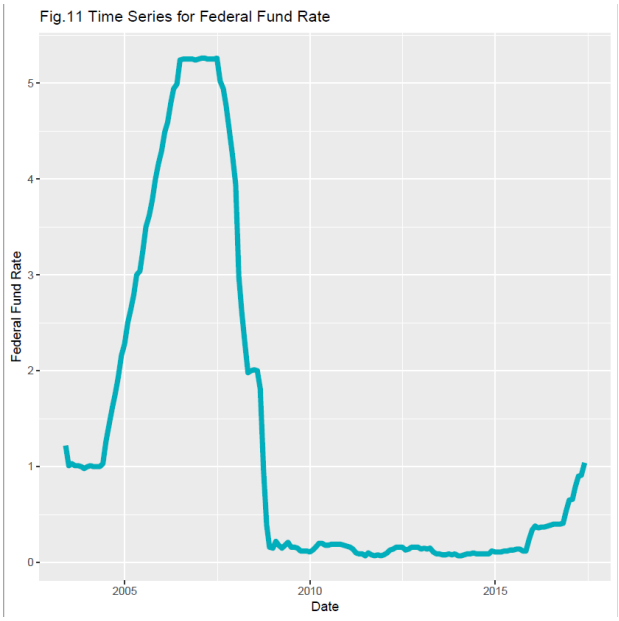


Fig.11 Time Series for Federal Fund Rate
Federal Fund Rate
5
4
3
2
1
0
2005
2010
2015
Date

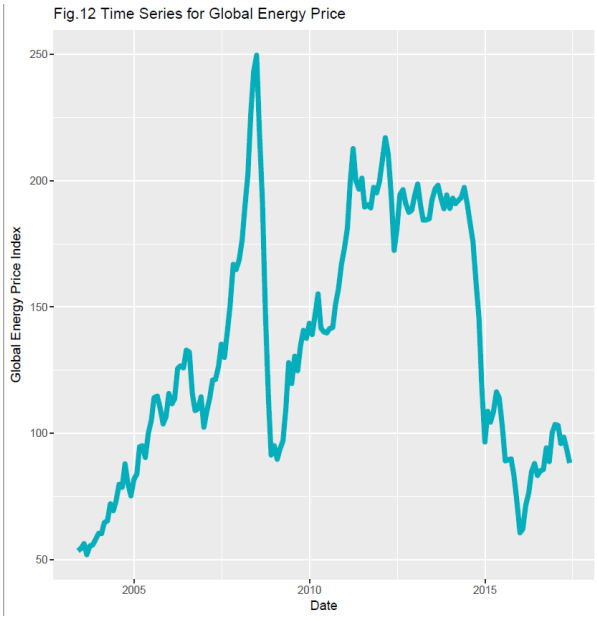


Fig.12 Time Series for Global Energy Price
Global Energy Price Index
250
200
150
100
50
2005
2010
2015
Date

Scatter Plots

Fig .13 to Fig.17 shows Scatter Plots of S&P Index with all the independent variables and we should see how it lined up with our hypothesis.

Fig.13 Index vs Unemployment Rate

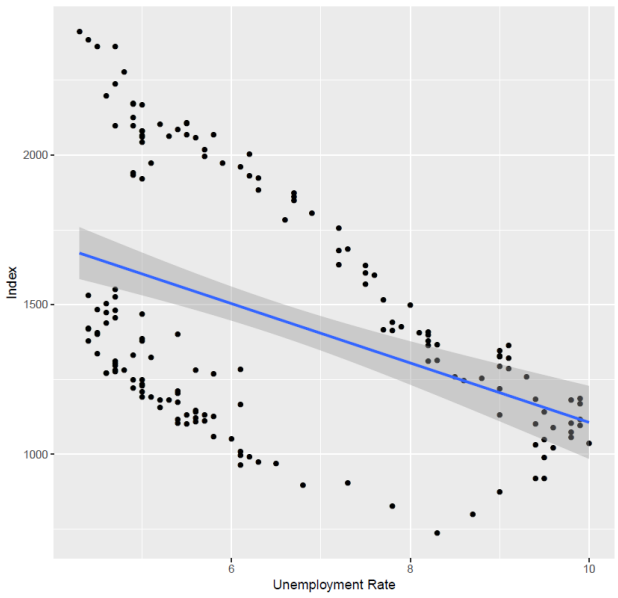


Fig.14 Index vs US. Imports

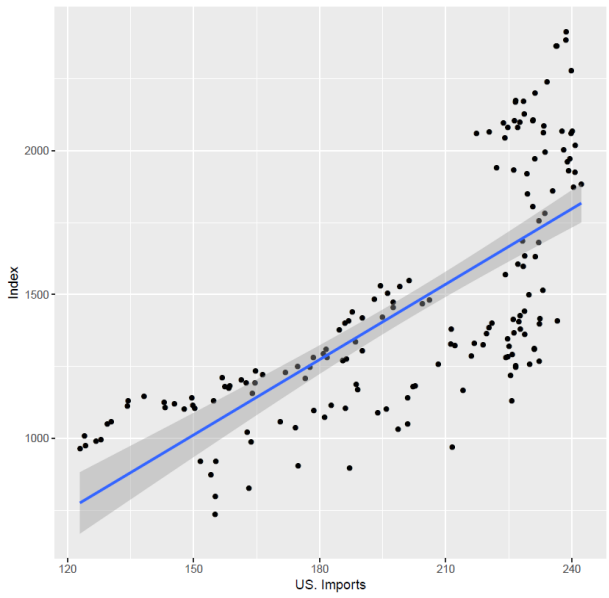


Fig.15 Index vs Consumer Price MoM%

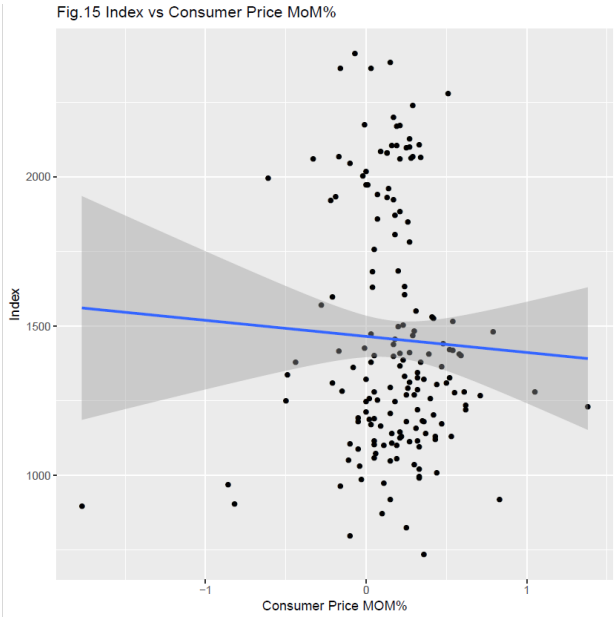
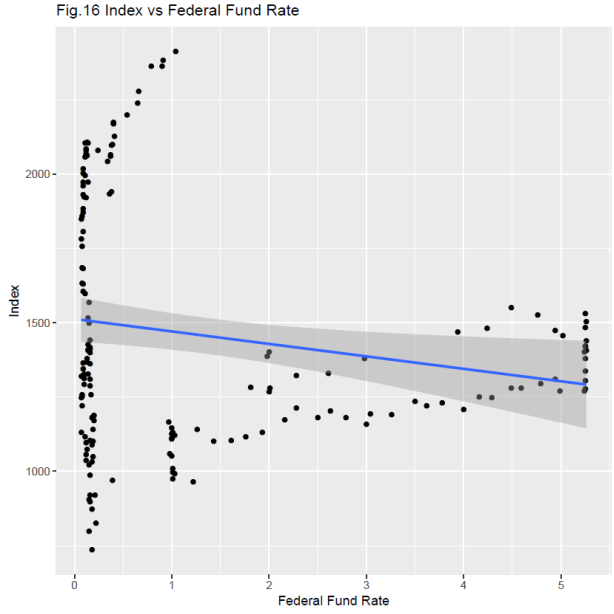
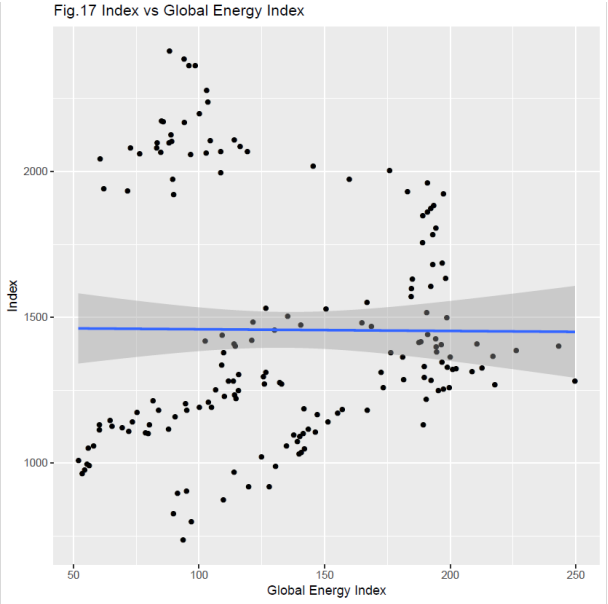


Fig.16 Index vs Federal Fund Rate





From Fig.13, Fig.15 and Fig. 17 we can see that it is a negative trending and which clearly state that our hypothesis in relation with unemployment rate, Global energy index and Federal Funds rates are true.

Fig 14. Clearly shows an increasing trend.

Fig. 16 is unclear due to very less correlation among variables, it will become more clear using the correlation matrix and more solid by linear regression model.

Descriptive statistics

Below table shows descriptive statistics for our data.

Table 1

	n	mean	sd	median	min	max	range	skew	kurtosis	se
index	169	1456.839	401.551	319.545	735.09	2411.8	1676.71	0.659	-0.677	30.889
unr	169	6.471	1.786	1.483	4.3	10	5.7	0.625	-1.09	0.137
importts	169	200.919	33.474	32.069	122.95	242.24	119.29	-0.662	-0.786	2.575
cpi	169	0.17	0.322	0.208	-1.77	1.38	3.15	-1.289	8.571	0.025
Int_rate	169	1.334	1.765	0.237	0.07	5.26	5.19	1.26	0.038	0.136
Epi	169	134.258	48.877	60.603	51.976	249.607	197.631	0.205	-1.153	3.76

Global energy index is statistically normally distributed and Federal Funds rate does not have any peakedness.

Correlation Matrix

Table 2

	index	unr	importts	Epi	Int_rate	cpi
index	1	-0.442	0.728	-0.007	-0.184	-0.043
unr	-0.442	1	0.035	0.463	-0.607	-0.061
importts	0.728	0.035	1	0.59	-0.336	-0.088
Epi	-0.007	0.463	0.59	1	-0.183	0.152
Int_rate	-0.184	-0.607	-0.336	-0.183	1	0.21
cpi	-0.043	-0.061	-0.088	0.152	0.21	1

Looking at the table 2 and our hypothesis, most of the variables turn out to be accurate accept cpi mom%, which here shows very marginal negative function of S&P 500 index if this is significant or not further in our regression model.

There is none autocorrelation since the collinearity merely crossing the value of .6 which is very less.

Linear Regression Model.

According to our linear model hypothesized we run the linear fit model and form the following equation.

$$SnP\_Index = \alpha - \beta_1 unr + \beta_2 cpi + \beta_3 importts - \beta_4 Epi - \beta_5 Int\_rate$$

Table 3

```
Coefficients:
             Estimate Std. Error t value Pr(>|t|)
(Intercept) 294.7357   134.4493   2.192   0.0298 *
unr         -89.2391    10.8346  -8.236 5.48e-14 ***
cpi         157.9059    33.8752   4.661 6.50e-06 ***
importts     11.2409     0.5375  20.915  < 2e-16 ***
Epi          -3.5755     0.3912  -9.140 2.39e-16 ***
Int_rate    -49.2708     9.6187  -5.122 8.44e-07 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 132.1 on 163 degrees of freedom
Multiple R-squared:  0.895,     Adjusted R-squared:  0.8918
F-statistic: 277.9 on 5 and 163 DF,  p-value: < 2.2e-16
```

According to linear model all of our coefficients are statistically highly significant and the whole equation supports the alternate hypothesis to be true since F-Statistics is 277.9.

We form the linear equation as:

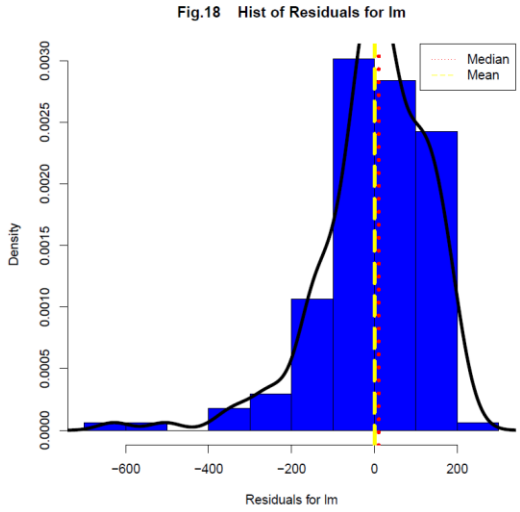
$$SnP_{Index} = 294.73 - 89.23unr + 157.93cpi + 11.24importts - 3.57Epi - 49.27Int\_rate$$

With coefficient of determination as 89%.

Residuals Analysis

Below is the residual analysis of our linear model

Histograms for residuals.



Thing worth noting is that The median and mode are almost coinciding and even though it is negatively skewed it is close to normally distributed. Which shows that the model is capable of predicting accurately.

Scatter plots for residuals

Fig.19 Actuals vs Predicted

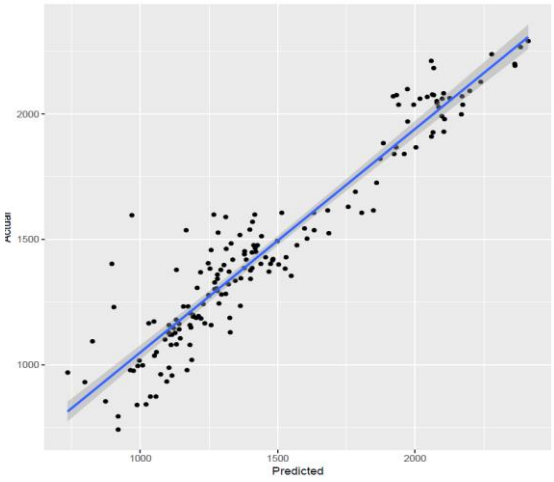


Fig.20 Residuals vs Unemployment Rate

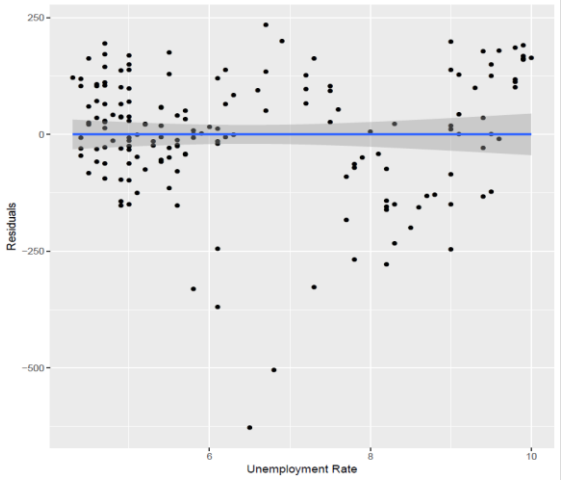


Fig.21 Residuals vs Consumer Price MoM%

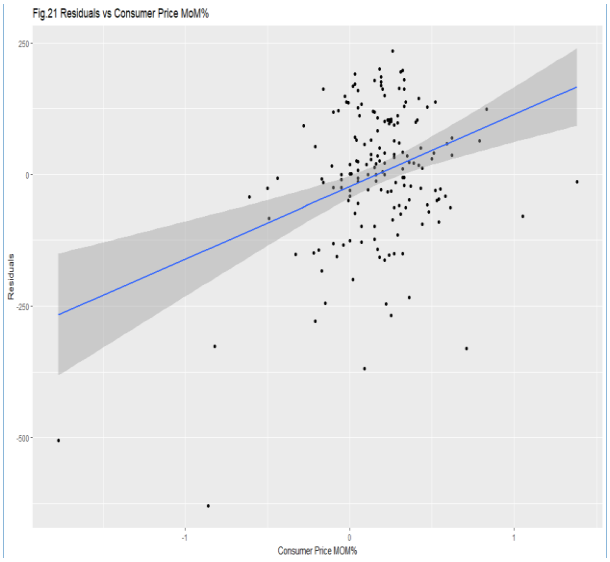
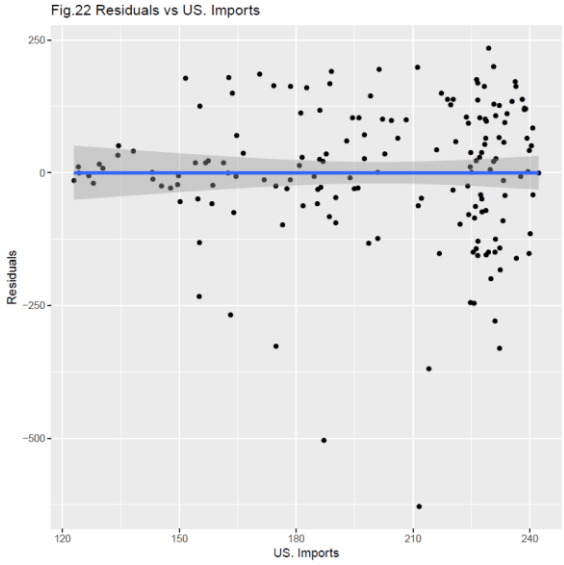


Fig.22 Residuals vs US. Imports



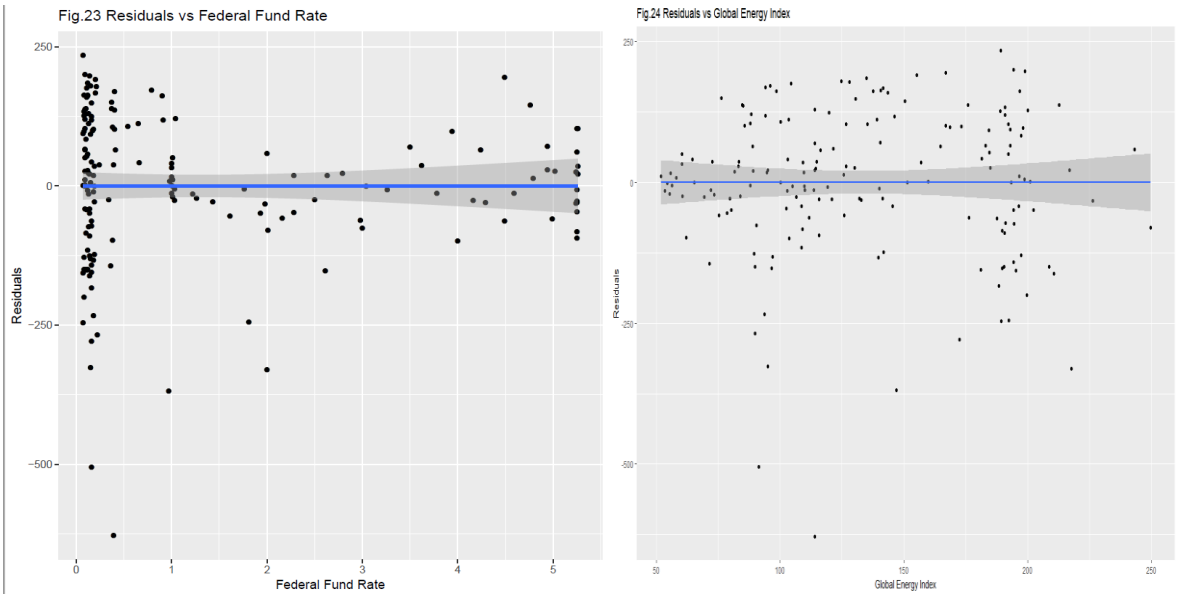


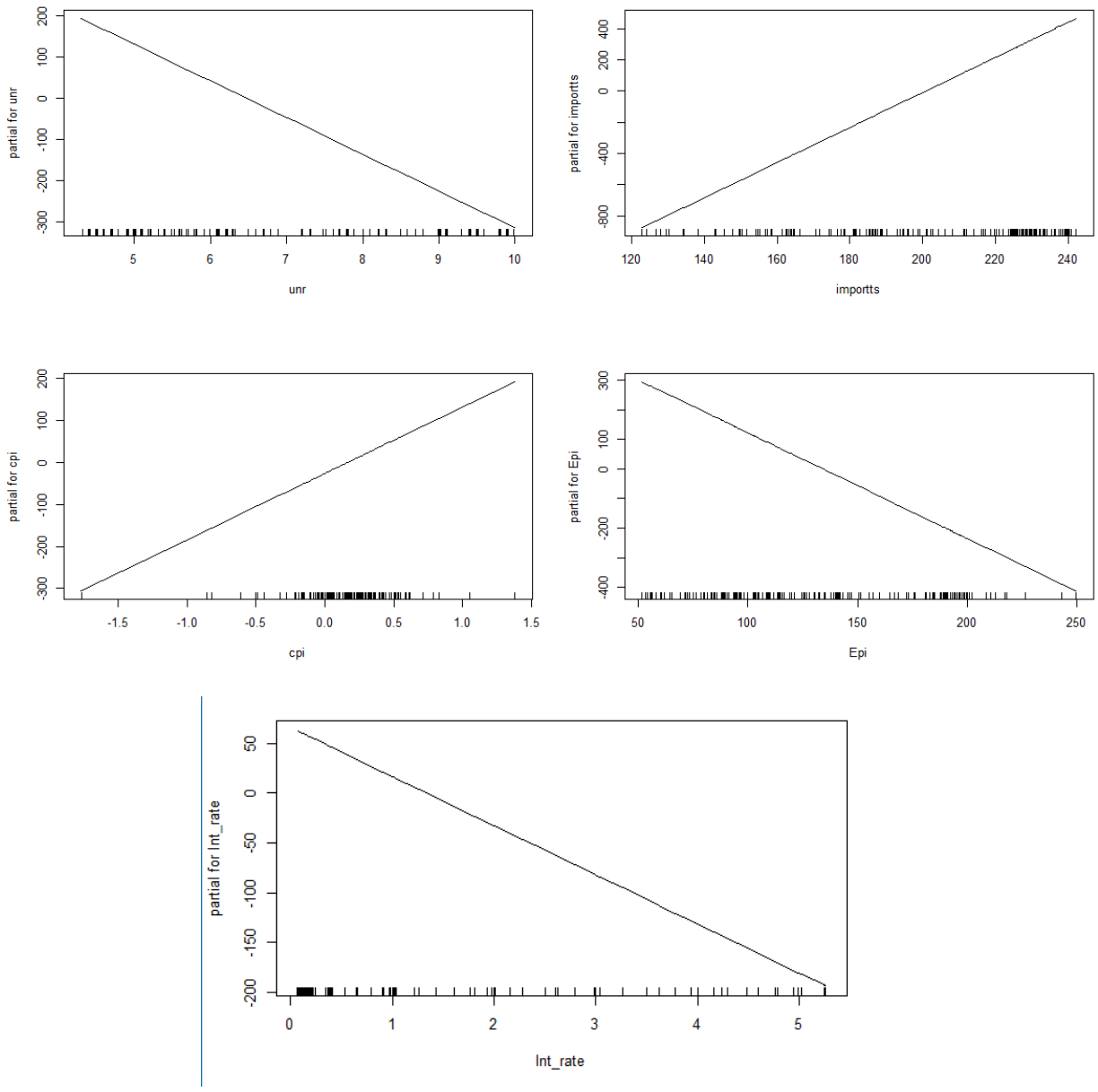
Fig. 19 shows the linear and strong relation between actual and predicited which shows the accuracy of the predicited model.

Fig 20- Fig 24 shows scatter plot of residuals and all independent variables and according to the non existent trend line exept cpi it shows no correlation whatsoever which also shows high accuracy of the model.

GAM regression model

Gam is the nonlinear non parametric models. There is no equation but shows the trend using graphs.

Fig 25. Show a combined output of GAM analysis for our data with degree of freedom of 1.

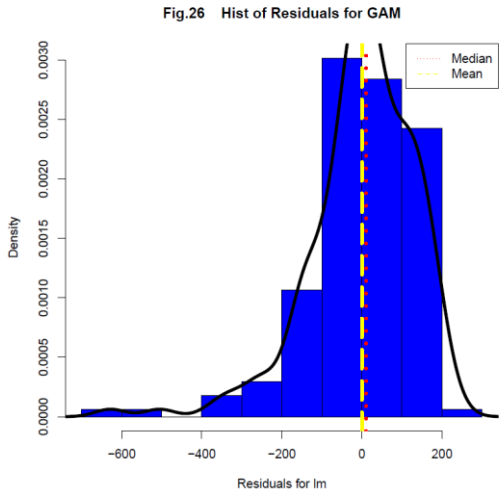


Looking at the plots our hypothesis stands true as we can see the unemployment Energy index consumer price and Federal Funds has negative impact on SnP index and rest have positive impact.

R-Square: - comes out to be .89 which is similar to linear model which suggest linear association of dependent and independent variables.

Regression Analysis for Gam.

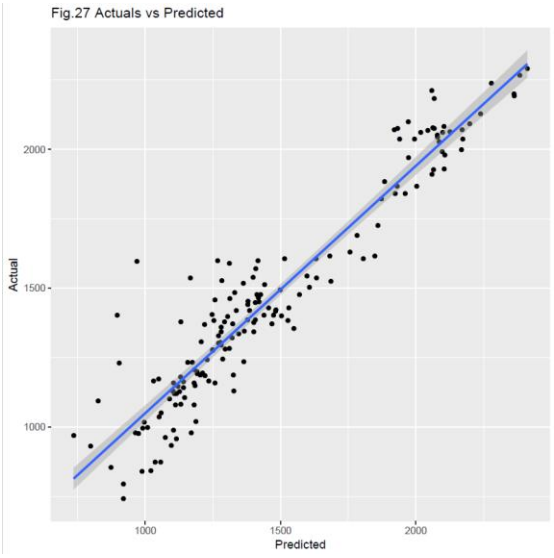
Histogram for residuals.

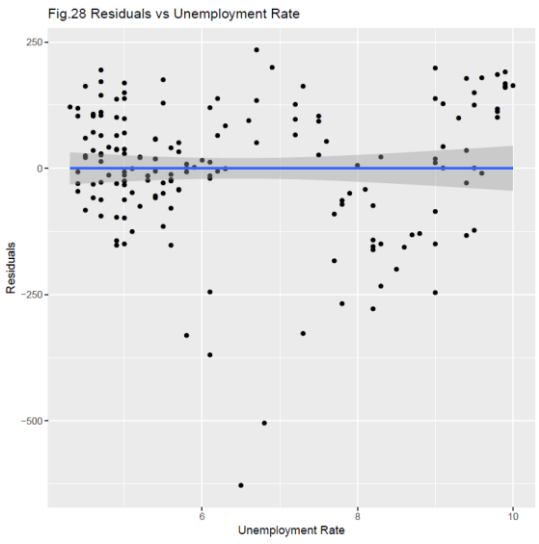


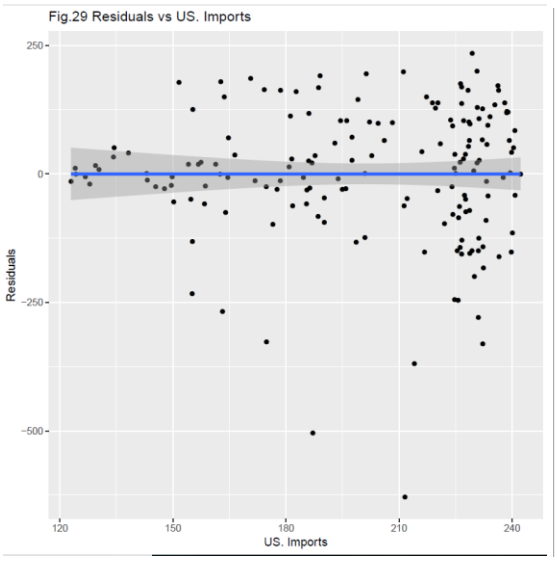
IT is very much similar to linear model, almost normally distributed showing accuracy of the model.

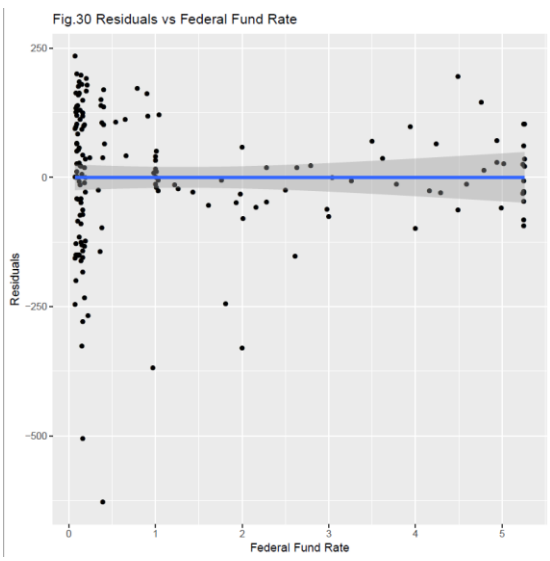
Skewness is -1.12 but since median and mean are closely located, which is good thing for any model on any given day.

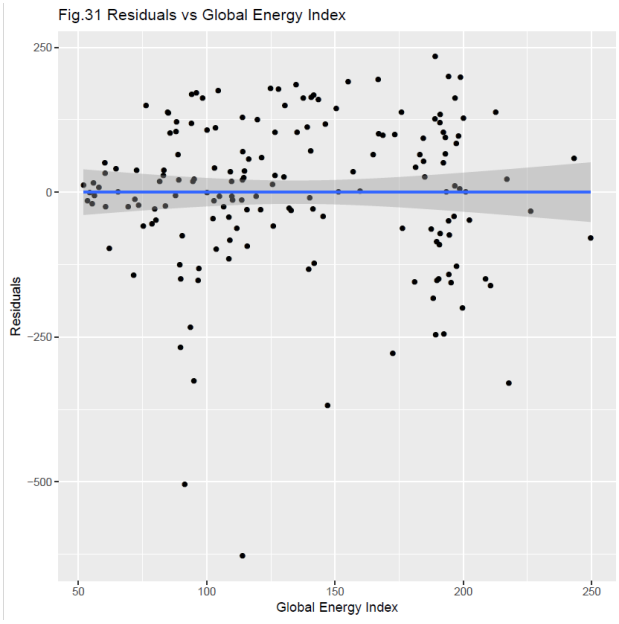
Scatter Plots with residuals.











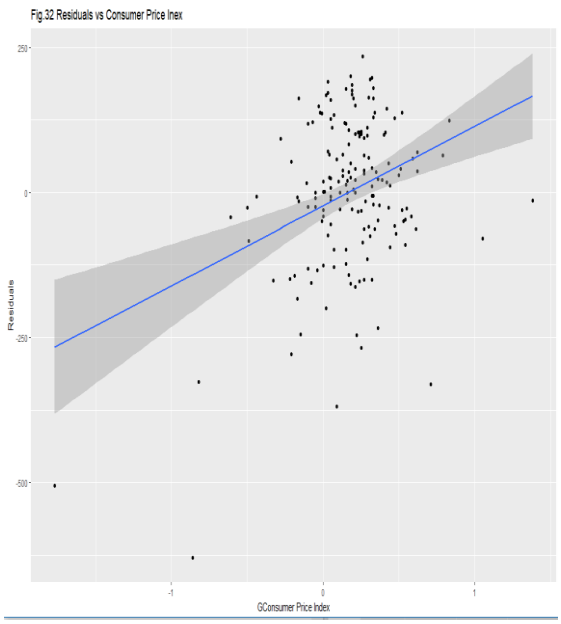


Fig 27 shows the scatter plot of actual vs predicited and by looking at it we can see a strong positive trend line which shows the accuracy of the prediction.

Fig 28-Fig32 shows the scatter plot of residuals vs all the independent variables and the trend line is non existant other than cpi which shows the quality of independent variable chosed to predict the values.

Conclusion:

This model has accurately predicted the value of S&P 500 index up to 89% of coefficient of determination. Both linear and GAM model has the same explanatory power showing the linear association of independent and dependent variables.

All assumptions were coming out to be true and our hypothesis was accurately proved in the results.

Appendix I

R- Script Used is pasted below.

```
library(readxl)

library(ggplot2)

library(psych)

library(lmtest)

library(gam)

snp_500_index <- read_excel("~/Spring 2018/DS 633/Final/snp 500 index.xlsx",

                            sheet = "Sheet1")

View(snp_500_index)

spDF<- snp_500_index

spDF<- as.data.frame(spDF)

spDF<- na.omit(spDF)

dim(spDF)


#histograms


par(mfcol=c(1,1))

pdf(file= "hist3.pdf")

par(mfcol=c(1,1))

hist(spDF$index,main ="Fig.1    Hist of index", prob =1, xlab = "index", col = "blue");
lines(density(spDF$index),lwd = 4)

abline(v = median(spDF$index),col = "Red",lty = 3,lwd = 4)
```

```
abline(v = mean(spDF$index),col = "yellow",lty = 5,lwd = 4)

legend("topright", lty = c(3, 5), col = c("red","yellow"), legend = c("Median","Mean"))


hist(spDF$unr,main ="Fig.2  Hist of unr", prob =1, xlab = "unr", col = "blue"); lines(density(spDF$unr),lwd
= 4)

abline(v = median(spDF$unr),col = "Red",lty = 3,lwd = 4)

abline(v = mean(spDF$unr),col = "yellow",lty = 5,lwd = 4)

legend("topright", lty = c(3, 5), col = c("red","yellow"), legend = c("Median","Mean"))


hist(spDF$importts,main ="Fig.3    Hist of importts", prob =1, xlab = "imports", col = "blue");
lines(density(spDF$importts),lwd = 4)

abline(v = median(spDF$importts),col = "Red",lty = 3,lwd = 4)

abline(v = mean(spDF$importts),col = "yellow",lty = 5,lwd = 4)

legend("topright", lty = c(3, 5), col = c("red","yellow"), legend = c("Median","Mean"))


hist(spDF$Epi,main ="Fig.4   Hist of Global Energy Price Index", prob =1, xlab = "Global Energy Price", col
= "blue"); lines(density(spDF$Epi),lwd = 4)

abline(v = median(spDF$Epi),col = "Red",lty = 3,lwd = 4)

abline(v = mean(spDF$Epi),col = "yellow",lty = 5,lwd = 4)

legend("topright", lty = c(3, 5), col = c("red","yellow"), legend = c("Median","Mean"))


hist(spDF$Int_rate,main ="Fig.5   Hist of Federal Fund Rate", prob =1, xlab = "Fedral Funds Rate", col =
"blue"); lines(density(spDF$Int_rate),lwd = 4)

abline(v = median(spDF$Int_rate),col = "Red",lty = 3,lwd = 4)

abline(v = mean(spDF$Int_rate),col = "yellow",lty = 5,lwd = 4)

legend("topright", lty = c(3, 5), col = c("red","yellow"), legend = c("Median","Mean"))


hist(spDF$cpi,main ="Fig.6   Hist of Consumer price MOM%", prob =1, xlab = "cpi", col = "blue");
lines(density(spDF$Int_rate),lwd = 4)

abline(v = median(spDF$cpi),col = "Red",lty = 3,lwd = 4)
```

```
abline(v = mean(spDF$cpi),col = "yellow",lty = 5,lwd = 4)
legend("topright", lty = c(3, 5), col = c("red","yellow"), legend = c("Median","Mean"))



dev.off()
graphics.off()

#Time-Series Plot
pdf(file = "tsplot5.pdf")
par(mfcol = c(2,2))

ggplot(data = spDF, aes(x = Date, y = index)) + labs(y = "SnP Index")+ggtitle("Fig.7 Time Series for Index")
+
  geom_line(color = "#00AFBB", size = 2)
ggplot(data = spDF, aes(x = Date, y = unr))+ labs(y = "UnemPloyment Rate")+ggtitle("Fig.8 Time Series for
Unemployment Rate") +
  geom_line(color = "#00AFBB", size = 2)

ggplot(data = spDF, aes(x = Date, y = importts)) + labs(y = "US Imports in $")+ggtitle("Fig.9 Time Series
US Imports in $") +
  geom_line(color = "#00AFBB", size = 2)

ggplot(data = spDF, aes(x = Date, y = cpi))+ labs(y = "Consumer price MOM%")+ggtitle("Fig.10 Time
Series for Consumer price MOM%") +
  geom_line(color = "#00AFBB", size = 2)

ggplot(data = spDF, aes(x = Date, y = Int_rate))+ labs(y = "Federal Fund Rate")+ggtitle("Fig.11 Time Series
for Federal Fund Rate") +
  geom_line(color = "#00AFBB", size = 2)
```

```
ggplot(data = spDF, aes(x = Date, y = Epi))+ labs(y = "Global Energy Price Index")+ggtitle("Fig.12 Time Series for Global Energy Price") +
  geom_line(color = "#00AFBB", size = 2)

dev.off()
graphics.off()

#scatterplots
pdf(file = "scatterplots3.pdf")
par(mfcol = c(1,1))

ggplot(data=spDF, aes(unr,index)) +   labs(x="Unemployment Rate", y="Index") +
  geom_point() +stat_smooth(method = "lm") +ggtitle("Fig.13 Index vs Unemployment Rate")

ggplot(data=spDF, aes(importts,index)) +   labs(x="US. Imports", y="Index") +
  geom_point() +stat_smooth(method = "lm") +ggtitle("Fig.14 Index vs US. Imports")

ggplot(data=spDF, aes(cpi,index)) +   labs(x="Consumer Price MOM%", y="Index") +
  geom_point() +stat_smooth(method = "lm") +ggtitle("Fig.15 Index vs Consumer Price MoM%")

ggplot(data=spDF, aes(Int_rate,index)) +   labs(x="Federal Fund Rate", y="Index") +
  geom_point() +stat_smooth(method = "lm") +ggtitle("Fig.16 Index vs Federal Fund Rate")

ggplot(data=spDF, aes(Epi,index)) +   labs(x="Global Energy Index", y="Index") +
  geom_point() +stat_smooth(method = "lm") +ggtitle("Fig.17 Index vs Global Energy Index")

dev.off()
graphics.off()
```

```
#descriptive statistics

names(spDF)
desc<- round(describe(spDF[,c("index","unr","importts","cpi","Int_rate","Epi")]),3)

 #correlation matrix
 cor<- round(cor(spDF[,c("index","unr","importts","Epi","Int_rate","cpi")],use="na.or.complete"),3)




 # linear regression
 names(spDF)
 fit<-lm(index~unr+cpi+importts+Epi+Int_rate,data=spDF,na.action=na.omit)
 summary(fit)
 dwtest(fit)

 #Linear residual dataframe
 rdf<-data.frame(spDF,r=fit$residuals,p=fit$fitted.values)
 pdf(file = "linearresid2.pdf")
 par(mfcol=c(1,1))

 hist(rdf$r,main ="Fig.18    Hist of Residuals for lm", prob =1,
     xlab = "Residuals for lm", col = "blue");
 lines(density(rdf$r),lwd = 4)
 abline(v = median(rdf$r),col = "Red",lty = 3,lwd = 4)
 abline(v = mean(rdf$r),col = "yellow",lty = 5,lwd = 4)
 legend("topright", lty = c(3, 5), col = c("red","yellow"), legend = c("Median","Mean"))
```

```
dev.off()
graphics.off()

skew(rdf$r)
pdf(file = "Scatter_Res_LM2.pdf")

ggplot(data=rdf, aes(index,p)) +   labs(x="Predicted", y="Actual") +
  geom_point() +stat_smooth(method = "lm") +ggtitle("Fig.19 Actuals vs Predicted")

ggplot(data=rdf, aes(unr,r)) +   labs(x="Unemployment Rate", y="Residuals") +
  geom_point() +stat_smooth(method = "lm") +ggtitle("Fig.20 Residuals vs Unemployment Rate")

ggplot(data=rdf, aes(cpi,r)) +   labs(x="Consumer Price MOM%", y="Residuals") +
  geom_point() +stat_smooth(method = "lm") +ggtitle("Fig.21 Residuals vs Consumer Price MoM%");

ggplot(data=rdf, aes(importts,r)) +   labs(x="US. Imports", y="Residuals") +
  geom_point() +stat_smooth(method = "lm") +ggtitle("Fig.22 Residuals vs US. Imports")

ggplot(data=rdf, aes(Int_rate,r)) +   labs(x="Federal Fund Rate", y="Residuals") +
  geom_point() +stat_smooth(method = "lm") +ggtitle("Fig.23 Residuals vs Federal Fund Rate")

ggplot(data=rdf, aes(Epi,r)) +   labs(x="Global Energy Index", y="Residuals") +
  geom_point() +stat_smooth(method = "lm") +ggtitle("Fig.24 Residuals vs Global Energy Index")

dev.off()
graphics.off()
```

```
# gam regression
library(gam)
fit<-gam(index~s(unr,1)+s(importts)+s(Epi,1)+s(Int_rate,1),na.action=na.omit,data=spDF)
par(mfcol=c(2,2)); plot.gam(fit)
dwtest(fit)
#residual dataframe
rdf<-data.frame(spDF,r=fit$residuals,p=fit$fitted.values)

pdf(file = "Gamresid1.pdf")
par(mfcol=c(1,1))

hist(rdf$r,main ="Fig.26    Hist of Residuals for GAM", prob =1,
    xlab = "Residuals for lm", col = "blue");
lines(density(rdf$r),lwd = 4)
abline(v = median(rdf$r),col = "Red",lty = 3,lwd = 4)
abline(v = mean(rdf$r),col = "yellow",lty = 5,lwd = 4)
legend("topright", lty = c(3, 5), col = c("red","yellow"), legend = c("Median","Mean"))
skew(rdf$r)
dev.off()
graphics.off()


pdf(file = "Scatter_Res_GAM1.pdf")

ggplot(data=rdf, aes(index,p)) +   labs(x="Predicted", y="Actual") +
  geom_point() +stat_smooth(method = "lm") +ggtitle("Fig.27 Actuals vs Predicted")

ggplot(data=rdf, aes(unr,r)) +   labs(x="Unemployment Rate", y="Residuals") +
  geom_point() +stat_smooth(method = "lm") +ggtitle("Fig.28 Residuals vs Unemployment Rate")
```

```
ggplot(data=rdf, aes(importts,r)) +   labs(x="US. Imports", y="Residuals") +
  geom_point() +stat_smooth(method = "lm") +ggtitle("Fig.29 Residuals vs US. Imports")

ggplot(data=rdf, aes(Int_rate,r)) +   labs(x="Federal Fund Rate", y="Residuals") +
  geom_point() +stat_smooth(method = "lm") +ggtitle("Fig.30 Residuals vs Federal Fund Rate")

ggplot(data=rdf, aes(Epi,r)) +   labs(x="Global Energy Index", y="Residuals") +
  geom_point() +stat_smooth(method = "lm") +ggtitle("Fig.31 Residuals vs Global Energy Index")

ggplot(data=rdf, aes(cpi,r)) +   labs(x="GConsumer Price Index", y="Residuals") +
  geom_point() +stat_smooth(method = "lm") +ggtitle("Fig.32 Residuals vs Consumer Price Inex")


dev.off()
graphics.off()

R_Square_GAM<- cor(rdf$index,rdf$p)^2
```

Appendix- II

Data set is pasted below.

Date	index	unr	importts	cpi	Int_rate	Epi
5/30/2003	963.59	6.1	122.95	-0.16	1.22	53.5160045392877
6/30/2003	974.5	6.3	124.25	0.11	1.01	54.4496980493557
7/31/2003	990.31	6.2	126.74	0.33	1.03	56.2795226259468
8/29/2003	1,008.01	6.1	124.05	0.44	1.01	51.9759621560102
9/30/2003	995.97	6.1	127.93	0.33	1.01	55.4145747828168
10/31/2003	1,050.71	6	129.47	-0.11	1.00	55.8511720577312

11/28/2003	1,058.20	5.8	130.36	0.05	0.98	57.9759663303543
12/31/2003	1,111.92	5.7	134.23	0.27	1.00	60.3632704688512
1/30/2004	1,131.13	5.7	134.41	0.43	1.01	60.3536832163409
2/27/2004	1,144.94	5.6	138.2	0.21	1.00	64.6196793676070
3/31/2004	1,126.21	5.8	143	0.21	1.00	65.3970341546718
4/30/2004	1,107.30	5.6	143.23	0.16	1.00	72.0266612208297
5/31/2004	1,120.68	5.6	145.43	0.43	1.03	69.4128768008489
6/30/2004	1,140.84	5.6	149.56	0.37	1.26	73.4224155352312
7/30/2004	1,101.72	5.5	147.77	0.11	1.43	79.7559473729571
8/31/2004	1,104.24	5.4	150.23	0.05	1.61	78.6488491371294
9/30/2004	1,114.58	5.4	149.77	0.32	1.76	87.8599807163819
10/29/2004	1,130.20	5.5	154.73	0.53	1.93	80.2123443022663
11/30/2004	1,173.82	5.4	158.35	0.47	2.16	75.2784924792806
12/31/2004	1,211.92	5.4	156.76	0	2.28	81.6983403037208
1/31/2005	1,181.27	5.3	158.62	-0.05	2.50	83.8966198842217
2/28/2005	1,203.60	5.4	161.32	0.42	2.63	94.6023465719798
3/31/2005	1,180.59	5.2	157.42	0.36	2.79	95.0774188133122
4/29/2005	1,156.85	5.2	163.98	0.31	3.00	90.4714284751115
5/31/2005	1,191.50	5.1	162.5	-0.05	3.04	100.1332089348930
6/30/2005	1,191.33	5	164.57	0.05	3.26	104.9792612026520
7/29/2005	1,234.18	5	164.74	0.62	3.50	114.0727614743140
8/31/2005	1,220.33	4.9	166.39	0.62	3.62	114.7182860535600
9/30/2005	1,228.81	5	171.81	1.38	3.78	110.0648916816440
10/31/2005	1,207.01	5	176.53	0.15	4.00	103.7223523711020
11/30/2005	1,249.48	5	174.75	-0.5	4.16	106.5630842334890
12/30/2005	1,248.29	4.9	177.64	0	4.29	115.6918150595120
1/31/2006	1,280.08	4.7	181.74	0.61	4.49	111.7260108875300
2/28/2006	1,280.66	4.8	178.5	0.05	4.59	113.6571155786470
3/31/2006	1,294.83	4.7	180.85	0.15	4.79	125.6262831059150
4/28/2006	1,310.61	4.7	181.52	0.5	4.94	126.6024258257330
5/31/2006	1,270.09	4.6	185.44	0.3	4.99	125.9529720131990
6/30/2006	1,270.20	4.6	185.53	0.25	5.24	132.8852097061250
7/31/2006	1,276.66	4.7	186.33	0.55	5.25	132.1038792216490
8/31/2006	1,303.82	4.7	190.14	0.44	5.25	115.7770908381160
9/29/2006	1,335.85	4.5	188.5	-0.49	5.25	109.0181383009440
10/31/2006	1,377.94	4.4	184.64	-0.44	5.25	109.7413023162270
11/30/2006	1,400.63	4.5	186.02	0.05	5.24	114.3799057476970
12/29/2006	1,418.30	4.4	190.15	0.54	5.25	102.4380345932540
1/31/2007	1,438.24	4.6	187.73	0.17	5.26	109.1802445944580
2/28/2007	1,406.82	4.5	186.88	0.39	5.26	113.9503676458560
3/30/2007	1,420.86	4.4	194.93	0.52	5.25	121.0001842704140

4/30/2007	1,482.37	4.5	192.97	0.3	5.25	121.4138958616890
5/31/2007	1,530.62	4.4	194.47	0.41	5.25	126.5693685500610
6/29/2007	1,503.35	4.6	196.11	0.23	5.26	135.2418119343170
7/31/2007	1,455.28	4.7	197.48	0.18	5.02	130.0600196396120
8/31/2007	1,473.99	4.6	197.49	0.03	4.94	140.4766650230900
9/28/2007	1,526.75	4.7	199.07	0.42	4.76	150.4860505047210
10/31/2007	1,549.38	4.7	201.27	0.31	4.49	166.8288780708030
11/30/2007	1,481.14	4.7	206.09	0.79	4.24	164.8368757230160
12/31/2007	1,468.36	5	204.42	0.29	3.94	168.6108497793390
1/31/2008	1,378.55	5	211.31	0.34	2.98	176.3136954545210
2/29/2008	1,330.63	4.9	216.78	0.24	2.61	189.6560353981990
3/31/2008	1,322.70	5.1	212.15	0.36	2.28	202.3254576311770
4/30/2008	1,385.59	5	220.28	0.23	1.98	226.2416486940100
5/30/2008	1,400.38	5.4	220.95	0.59	2.00	243.1130028742220
6/30/2008	1,280.00	5.6	224.28	1.05	2.01	249.6072413484830
7/31/2008	1,267.38	5.8	232.22	0.71	2.00	217.7497813170250
8/29/2008	1,282.83	6.1	224.77	-0.15	1.81	192.3890718446350
9/30/2008	1,166.36	6.1	214.09	0.09	0.97	147.0562188612560
10/31/2008	968.75	6.5	211.55	-0.86	0.39	113.9698565746290
11/28/2008	896.24	6.8	187.12	-1.77	0.16	91.4407533468280
12/31/2008	903.25	7.3	174.84	-0.82	0.15	95.0127950023346
1/30/2009	825.88	7.8	163.14	0.25	0.22	89.7827897470873
2/27/2009	735.09	8.3	155.11	0.36	0.18	93.6706388904760
3/31/2009	797.87	8.7	155.16	-0.1	0.15	96.9448832786502
4/30/2009	872.81	9	154.1	0.1	0.18	109.6615846458320
5/29/2009	919.14	9.4	151.59	0.15	0.21	127.9246121242680
6/30/2009	919.32	9.5	155.26	0.83	0.16	119.7492463565400
7/31/2009	987.48	9.5	163.64	-0.03	0.16	130.4771498170070
8/31/2009	1,020.62	9.6	162.71	0.33	0.15	124.8160051574080
9/30/2009	1,057.08	9.8	170.63	0.19	0.12	134.8037340969940
10/30/2009	1,036.19	10	174.23	0.3	0.12	140.6999813513270
11/30/2009	1,095.63	9.9	178.57	0.33	0.12	137.6457559441470
12/31/2009	1,115.10	9.9	182.7	0.05	0.11	143.5118316047230
1/29/2010	1,073.87	9.8	181.17	0.06	0.13	139.1409846849860
2/26/2010	1,104.49	9.8	186.09	-0.1	0.16	146.2551618810020
3/31/2010	1,169.43	9.9	189.03	0.03	0.20	155.1216114373380
4/30/2010	1,186.69	9.9	188.66	0.02	0.20	141.6982245924480
5/31/2010	1,089.41	9.6	193.83	-0.05	0.18	140.1231834463220

6/30/2010	1,030.71	9.4	198.63	-0.04	0.18	139.7800681288380
7/30/2010	1,101.60	9.4	195.85	0.19	0.19	141.4237458046950
8/31/2010	1,049.33	9.5	200.94	0.15	0.19	141.8889377639180
9/30/2010	1,141.20	9.5	200.94	0.16	0.19	151.3006224267820
10/29/2010	1,183.26	9.4	202.73	0.35	0.19	157.0154625606970
11/30/2010	1,180.55	9.8	202.18	0.25	0.18	166.9805860363650
12/31/2010	1,257.64	9.3	208.22	0.4	0.17	173.2875282612190
1/31/2011	1,286.12	9.1	216.06	0.32	0.16	181.3860697945880
2/28/2011	1,327.22	9	211.16	0.32	0.14	198.8520640563510
3/31/2011	1,325.83	9	218.85	0.52	0.10	212.6387114919030
4/29/2011	1,363.61	9.1	219.68	0.47	0.09	200.0139083817750
5/31/2011	1,345.20	9	224.67	0.32	0.09	196.6659466925660
6/30/2011	1,320.64	9.1	225.04	0	0.07	200.9392414756520
7/29/2011	1,292.28	9	225.81	0.26	0.10	189.6101023531370
8/31/2011	1,218.89	9	225.42	0.32	0.08	190.4055234825620
9/30/2011	1,131.42	9	225.7	0.22	0.07	189.2553226380070
10/31/2011	1,253.30	8.8	226.65	0.07	0.08	197.3016080235540
11/30/2011	1,246.96	8.6	226.63	0.18	0.07	195.2277782824870
12/30/2011	1,257.60	8.5	229.97	0.02	0.08	199.6190660897260
1/31/2012	1,312.41	8.3	231.06	0.27	0.10	208.6622786301820
2/29/2012	1,365.68	8.3	226.21	0.21	0.13	216.9519674640840
3/30/2012	1,408.47	8.2	236.53	0.21	0.14	210.6160888906380
4/30/2012	1,397.91	8.2	232.28	0.17	0.16	194.3473545838220
5/31/2012	1,310.33	8.2	231.04	-0.21	0.16	172.4508871981510
6/29/2012	1,362.16	8.2	228.75	-0.08	0.16	181.0117357009230
7/31/2012	1,379.32	8.2	227.71	0.03	0.13	194.5565262684300
8/31/2012	1,406.58	8.1	227.37	0.58	0.14	196.3770709237250
9/28/2012	1,440.67	7.8	228.71	0.48	0.16	190.9941746659090
10/31/2012	1,412.16	7.8	226.03	0.27	0.16	187.5229777752370
11/30/2012	1,416.18	7.7	232.41	-0.17	0.16	188.2774221332630
12/31/2012	1,426.19	7.9	227.66	-0.01	0.14	194.2096611742360
1/31/2013	1,498.11	8	229.79	0.2	0.15	198.6291059511610
2/28/2013	1,514.68	7.7	233.07	0.54	0.14	190.6463737981830
3/29/2013	1,569.19	7.5	224.2	-0.28	0.15	184.4144687472970
4/30/2013	1,597.57	7.6	228.41	-0.21	0.11	184.4915309682110
5/31/2013	1,630.74	7.5	231.28	0.04	0.09	184.9503705262390
6/28/2013	1,606.28	7.5	227.16	0.24	0.09	192.2515868508360
7/31/2013	1,685.73	7.3	228.28	0.2	0.08	196.7799009275180

8/30/2013	1,632.97	7.2	228.8	0.24	0.08	198.1404904044810
9/30/2013	1,681.55	7.2	232.11	0.04	0.09	193.0255177512710
10/31/2013	1,756.54	7.2	232.14	0.05	0.08	188.9509115030700
11/29/2013	1,805.81	6.9	230.68	0.18	0.09	194.2844368128350
12/31/2013	1,848.36	6.7	229.41	0.26	0.07	189.0425053035380
1/31/2014	1,782.59	6.6	233.54	0.27	0.07	193.0144926613900
2/28/2014	1,859.45	6.7	235.44	0.07	0.08	190.9420579362180
3/31/2014	1,872.34	6.7	240.4	0.18	0.09	192.2312405650640
4/30/2014	1,883.95	6.3	242.24	0.21	0.09	193.3848813821230
5/30/2014	1,923.57	6.3	240.72	0.17	0.10	197.2812772014240
6/30/2014	1,960.23	6.1	238.92	0.14	0.09	190.8476071977270
7/31/2014	1,930.67	6.2	239.24	0.13	0.09	182.9861345833440
8/29/2014	2,003.37	6.2	238.07	-0.02	0.09	175.8467996479830
9/30/2014	1,972.29	5.9	239.49	0.01	0.09	159.7739303765550
10/31/2014	2,018.05	5.7	240.77	0	0.09	145.3711724379850
11/28/2014	2,067.56	5.8	237.61	-0.17	0.12	119.2717997686810
12/31/2014	2,058.90	5.6	239.81	-0.33	0.11	96.6051946978652
1/30/2015	1,994.99	5.7	233.59	-0.61	0.11	108.6390143471280
2/27/2015	2,104.50	5.5	226.31	0.19	0.11	104.4447921866520
3/31/2015	2,067.89	5.5	240.09	0.29	0.12	108.6599026190740
4/30/2015	2,085.51	5.4	233.32	0.09	0.12	116.3616998867430
5/29/2015	2,107.39	5.5	230.73	0.33	0.13	113.9818427445880
6/30/2015	2,063.11	5.3	233.18	0.28	0.13	102.8575084315000
7/31/2015	2,103.84	5.2	230.71	0.16	0.14	89.1214805309233
8/31/2015	1,972.18	5.1	231.17	0	0.14	89.4902778586684
9/30/2015	1,920.03	5	229.33	-0.22	0.12	89.8564831181309
10/30/2015	2,079.36	5	227.1	0.13	0.12	83.1032708327139
11/30/2015	2,080.41	5	224.78	0.13	0.24	72.6554182443465
12/31/2015	2,043.94	5	224.04	-0.1	0.34	60.6438988664809
1/29/2016	1,940.24	4.9	222.07	0.07	0.38	62.0660772713202
2/29/2016	1,932.23	4.9	226.18	-0.19	0.36	71.4963350727842
3/31/2016	2,059.74	5	217.28	0.21	0.37	76.3547216400077
4/29/2016	2,065.30	5	220.32	0.34	0.37	84.7141337726937
5/31/2016	2,096.96	4.7	223.69	0.25	0.38	88.0085716209441
6/30/2016	2,098.86	4.9	227.61	0.27	0.39	83.3262506209829
7/29/2016	2,173.60	4.9	226.62	-0.01	0.40	85.0563544760001
8/31/2016	2,170.95	4.9	228.51	0.21	0.40	85.7209435220218
9/30/2016	2,168.27	5	226.59	0.19	0.40	94.1758411453731

10/31/2016	2,126.15	4.9	228.67	0.27	0.41	88.8286260937682
11/30/2016	2,198.81	4.6	231.22	0.17	0.54	100.1245306943480
12/30/2016	2,238.83	4.7	234.11	0.29	0.65	103.4575229900210
1/31/2017	2,278.87	4.8	239.87	0.51	0.66	103.0442089448710
2/28/2017	2,363.64	4.7	236.22	0.03	0.79	95.9832181797422
3/31/2017	2,362.72	4.5	236.43	-0.16	0.90	98.4248337508023
4/28/2017	2,384.20	4.4	238.59	0.15	0.91	94.0471938153037
5/31/2017	2,411.80	4.3	238.63	-0.07	1.04	88.2479073499946
6/30/2017	2,423.41	4.3	238.65	0.05	1.15	
7/31/2017	2,470.30	4.3	238.71	0.08	1.16	
8/31/2017	2,471.65	4.4	238.3	0.42	1.15	
9/29/2017	2,519.36	4.2	241.24	0.46	1.15	
10/31/2017	2,575.26	4.1	244.8	0.08	1.16	
11/30/2017	2,647.58	4.1	251.09	0.34	1.30	
12/29/2017	2,673.61	4.1	257.51	0.2	1.41	
1/31/2018	2,823.81	4.1	257.61	0.54	1.42	
2/28/2018	2,713.83	4.1	262.09	0.15	1.51	
3/30/2018	2,640.87	4.1	257.48	-0.06	1.69	