Assignment 9

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Data spans for 10 years. Data is daily basis.

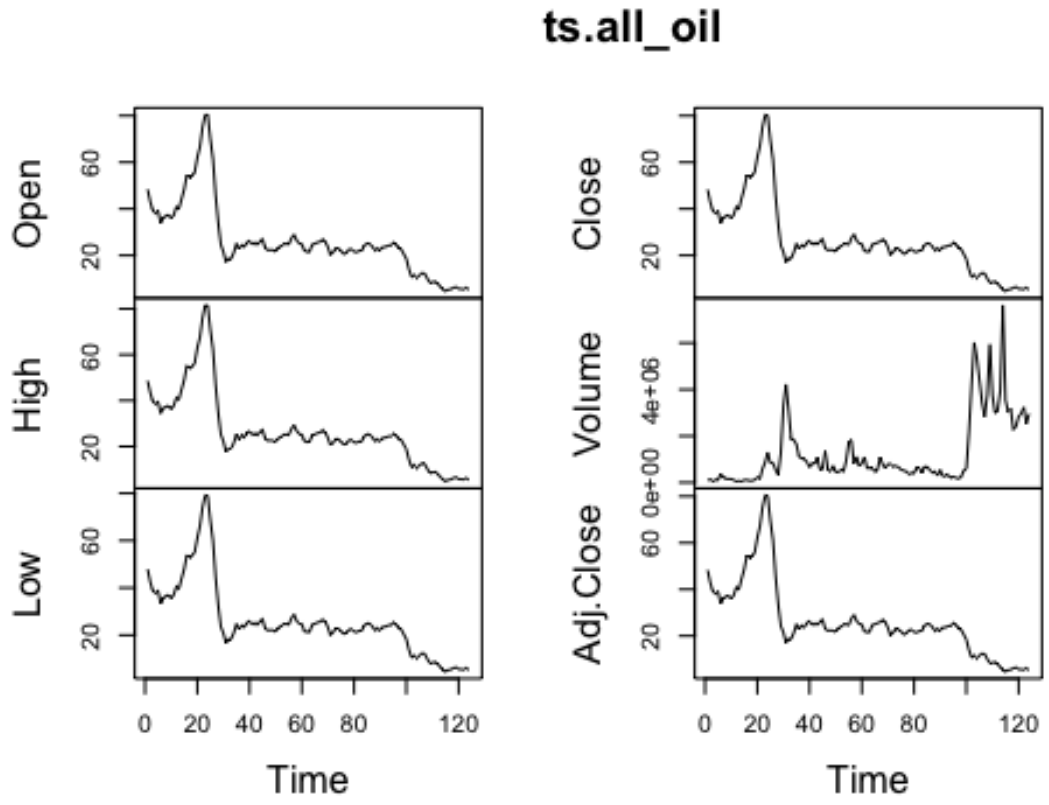
```
setwd("~/Desktop/DATA")
timeseries_oil<- read.csv("OIL.csv",
                          header=TRUE, stringsAsFactors=FALSE)
timeseries_gold<- read.csv("table.csv",
                           header=TRUE, stringsAsFactors=FALSE)
```

Changing from Daily to Monthly

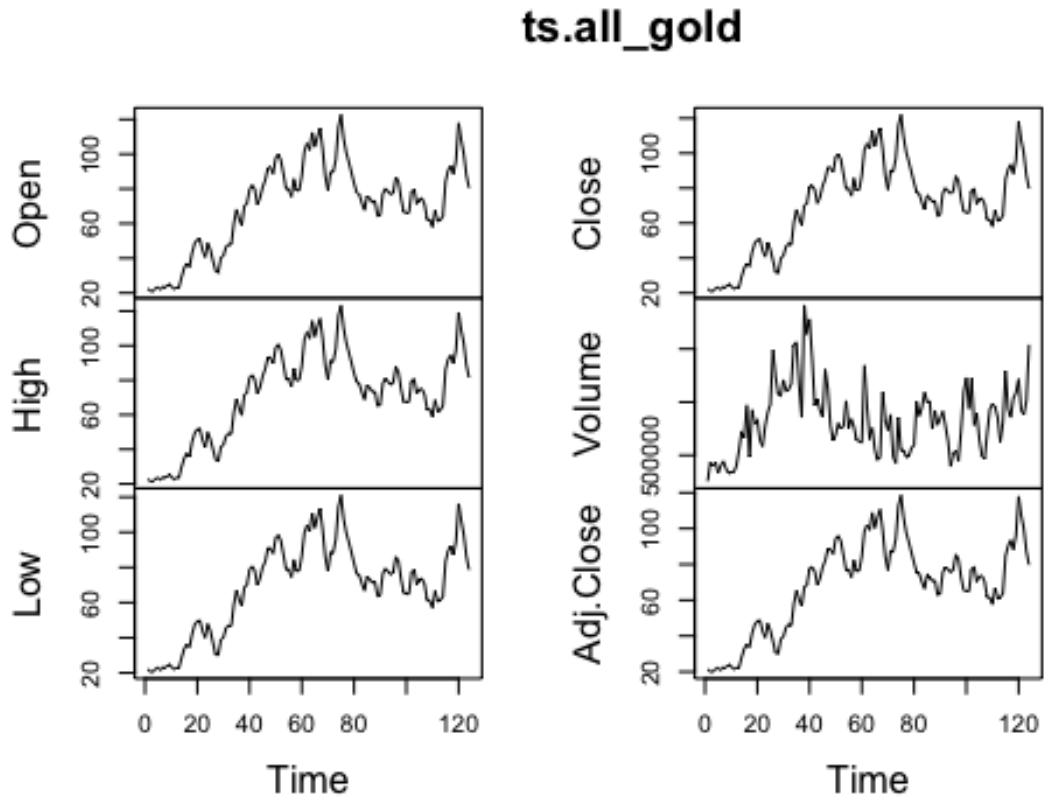
```
library(hydroTSM)

## Loading required package: zoo

##
## Attaching package: 'zoo'

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

## Loading required package: xts

m<- daily2monthly(timeseries_oil, FUN=mean, na.rm=TRUE)
timeseries_oil<- data.frame(m)
n<- daily2monthly(timeseries_gold, FUN=mean, na.rm=TRUE)
timeseries_gold<- data.frame(n)
```

Creating timeseries

```
ts.all_oil<-ts(timeseries_oil)
plot.ts(ts.all_oil)
```

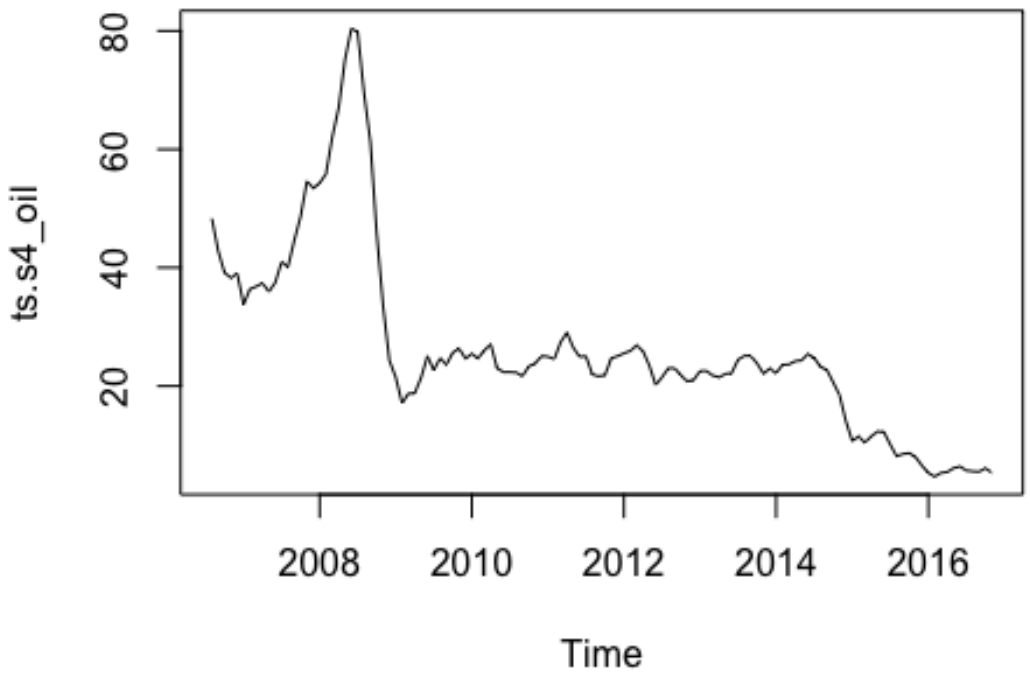



```
ts.all_gold<-ts(timeseries_gold)
plot.ts(ts.all_gold)
```

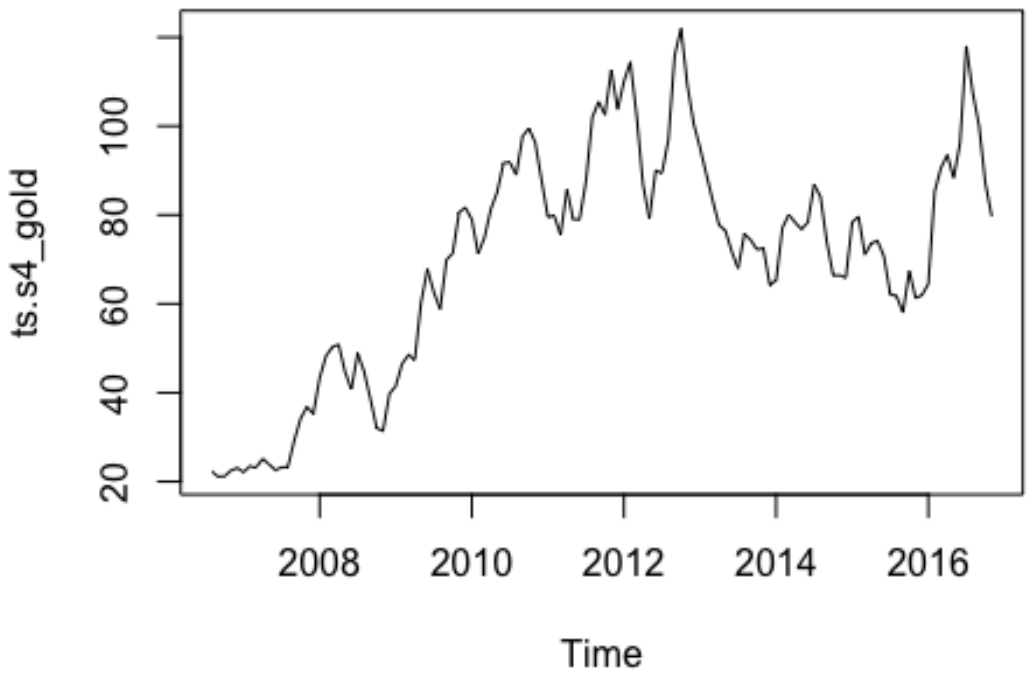


Plotting both the timeseries on one chart

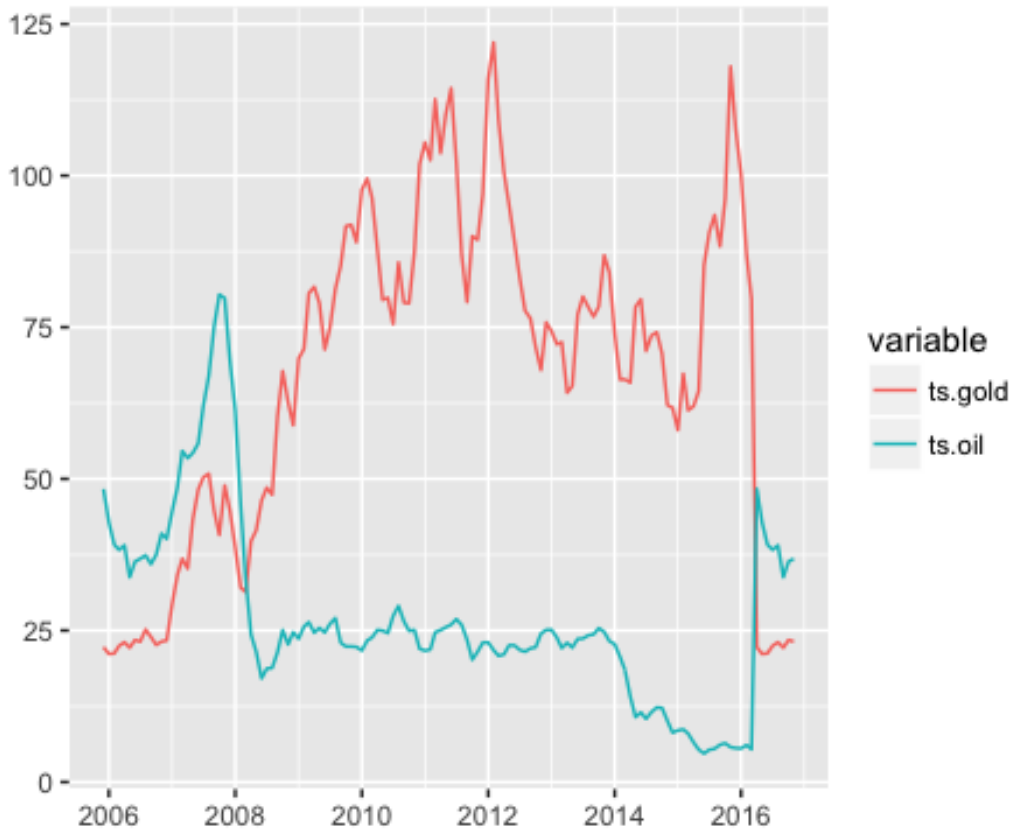
```
ts.s4_oil<-ts(timeseries_oil$Close, start = c(2006,8), frequency = 12)
plot(ts.s4_oil)
```




```
ts.s4_gold<-ts(timeseries_gold$Close, start = c(2006,8), frequency = 12)
plot(ts.s4_gold)
```

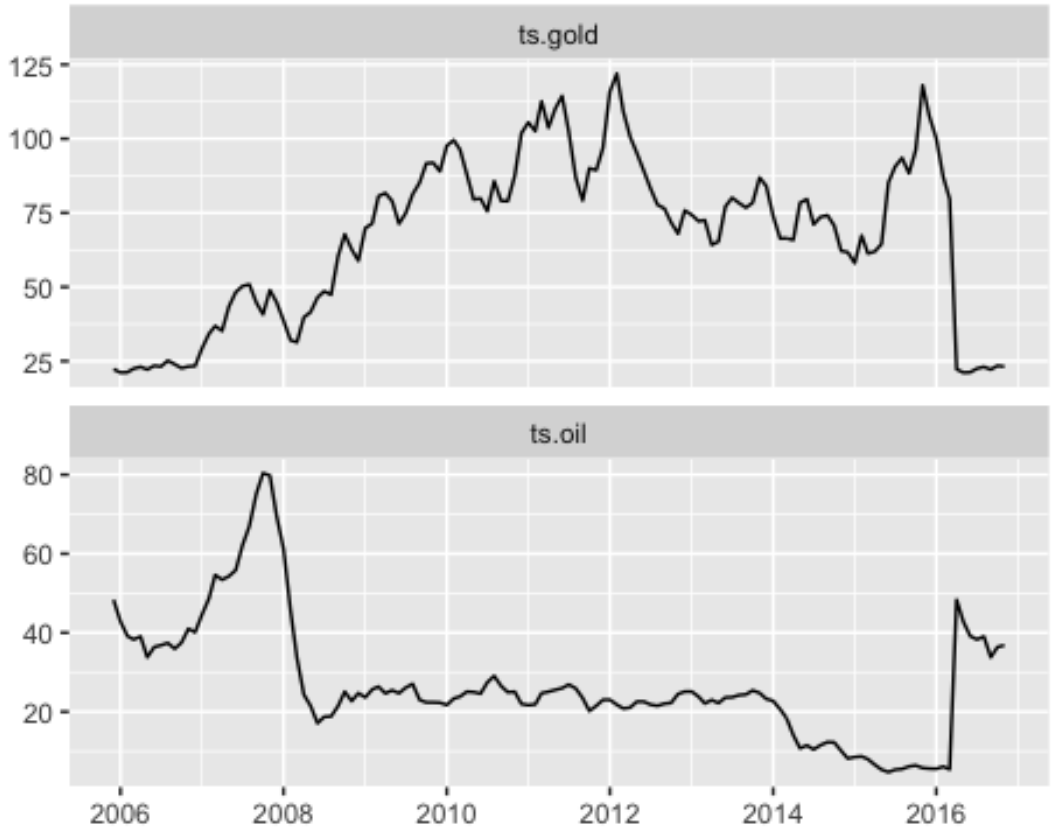



```
library(ggfortify)

## Loading required package: ggplot2

ts.oil<-ts(ts.s4_oil)

ts.gold<-ts(ts.s4_gold)

autoplot(ts( cbind(ts.oil, ts.gold) , start = c(2006,0),end=c(2016,11), frequ
ency = 12 ),facets = FALSE)
```



With Different Y axis

```
autoplot(ts( cbind(ts.oil, ts.gold) , start = c(2006,0),end=c(2016,11), frequ
ency = 12 ),facets = TRUE)
```




```
cor(ts.gold,ts.oil)
```

```
## [1] -0.5566924
```

This chart proves the negative correlation between GOLD & OIL which is of -0.556

Investment Strategy

Having proven the negative correlation between oil and gold gives us a good idea on how to invest in gold vs oil. The oil forecast tells us that oil price is going to increase slightly next year while gold prices are going to stay similar. Recent events over the last decade or so like the efforts of the US to become energy independent by increasing oil extraction and subsequently Saudi Arabia reducing the price of oil have made oil prices plummet. Knowing the relationship between gold and oil we are quite certain that oil prices will soon bounce up and in turn, the price of gold fall. The forecasted small increase in oil prices indicate that oil prices are in fact on the way up even though we don't think they will go as high as they were around 10 years ago because of the enormous impact previous mentioned events have had on the prices and us being less an less dependent on oil.

Our recommendation is that you take a position with the oil and benefit from the increase in oil prices over the next years or that you take up a short position in gold and benefit from the decrease in gold prices.

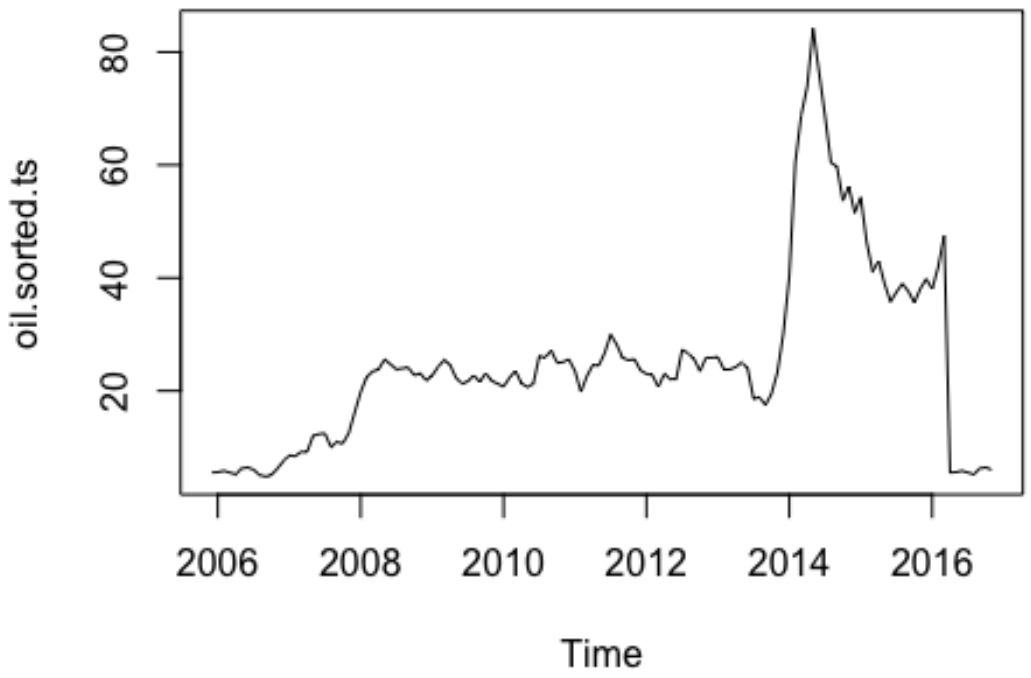
OIL analysis and forecast

Load the data and explore.

```
oil<- read.csv("~/Desktop/DATA/OIL1.csv", header=TRUE, stringsAsFactors=FALSE
)
oil.sorted<-oil[rev(order(as.Date(oil$Date, format = "%y/%m/%d"))),]
names(oil)

## [1] "Date"      "Open"      "High"      "Low"       "Close"     "Volume"
## [7] "Adj.Close"

head(oil$Date)

## [1] "2016-11-01" "2016-10-03" "2016-09-01" "2016-08-01" "2016-07-01"
## [6] "2016-06-01"
```

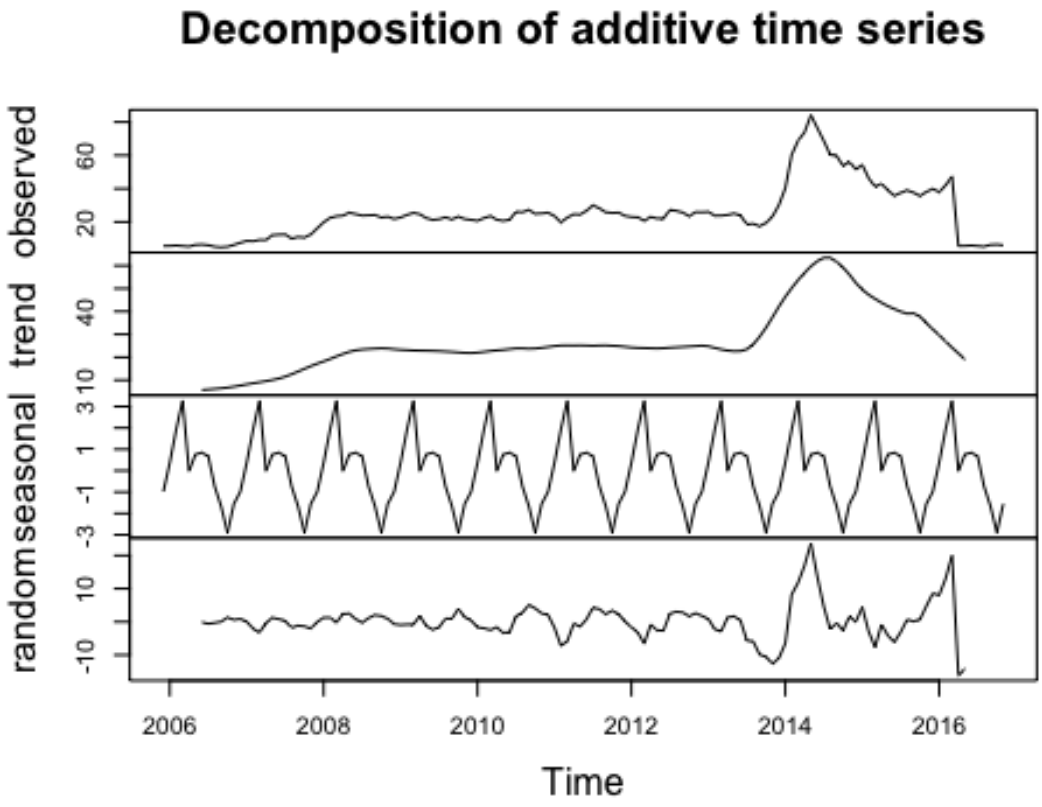
Sorting the data by date and creating a time series object. Data spans for 10 years. Data is monthly (end of month).

```
oil.sorted<-oil[order(as.Date(oil$Date, format="%d/%m/%Y")),]
oil.sorted.ts<-ts(oil.sorted$Close,start=c(2006,0), end=c(2016,11),frequency
= 12)
plot(oil.sorted.ts)
```



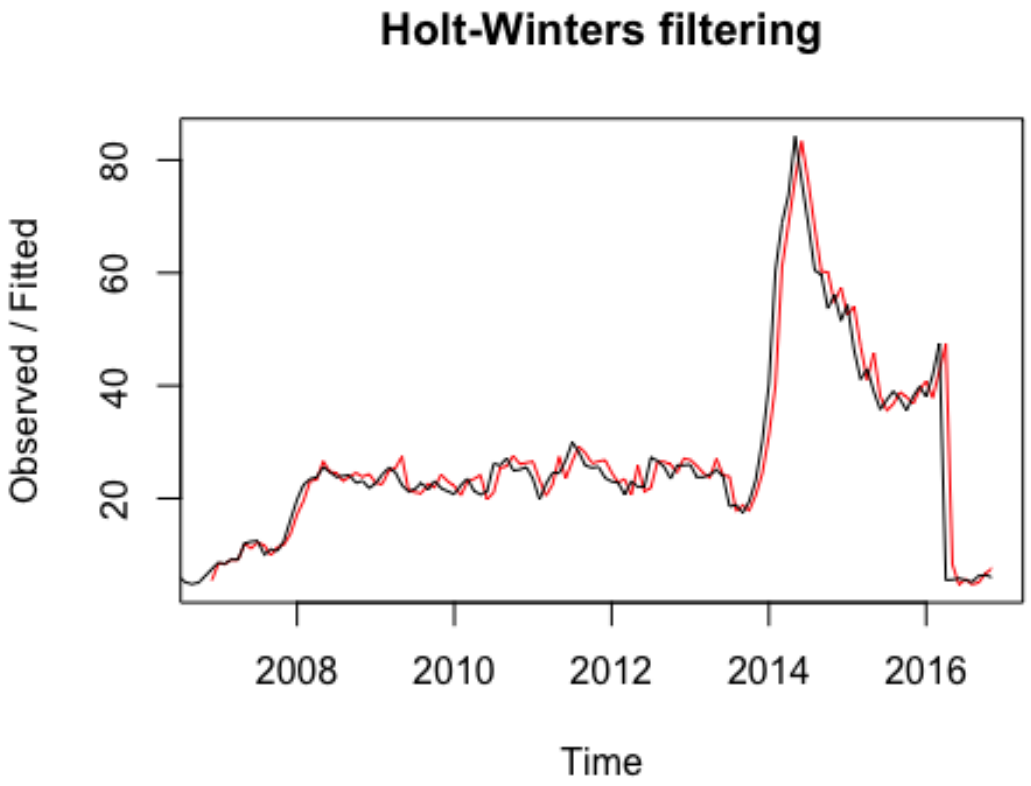
Decomposing data to three components: a trend, seasonal and irregular component.

```
oil.sorted.ts.d<-decompose(oil.sorted.ts)
plot(oil.sorted.ts.d)
```



Exponential Smoothing

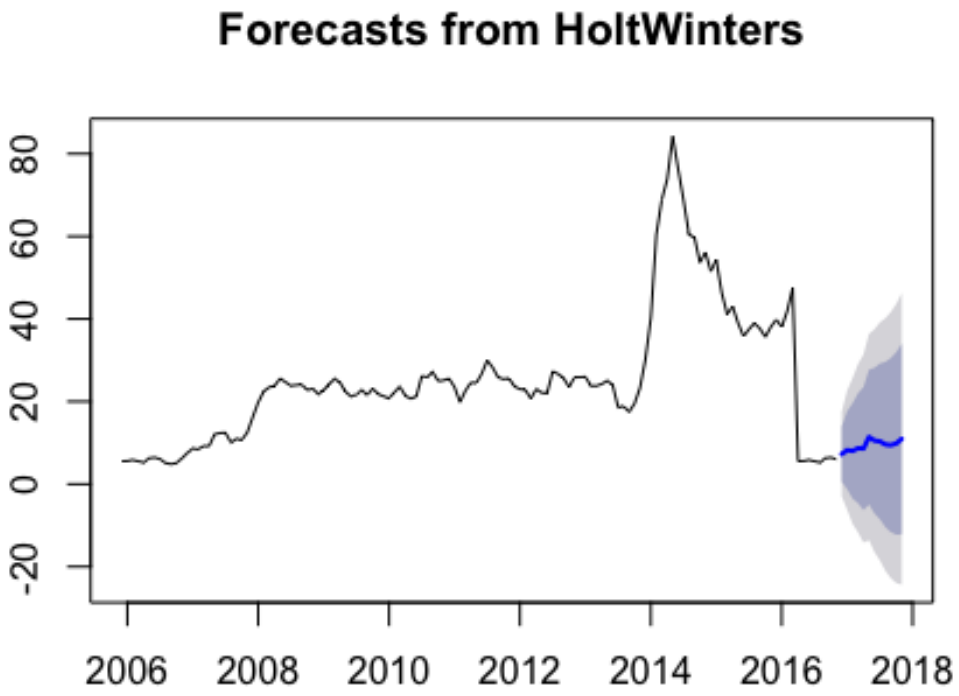
```
library(forecast)

## Loading required package: timeDate

## This is forecast 7.3

##
## Attaching package: 'forecast'

## The following object is masked from 'package:ggfortify':
##
##     gglagplot

## The following object is masked from 'package:hydroTSM':
##
##     ma

oil.holt.T<- HoltWinters(oil.sorted.ts, gamma=TRUE)
plot(oil.holt.T)
```



1 year

forecast with Holt Winters

```
oil.forecasts <- forecast.HoltWinters(oil.holt.T, h=12)  # forecast 1 year (12 months)
plot.forecast(oil.forecasts)
```

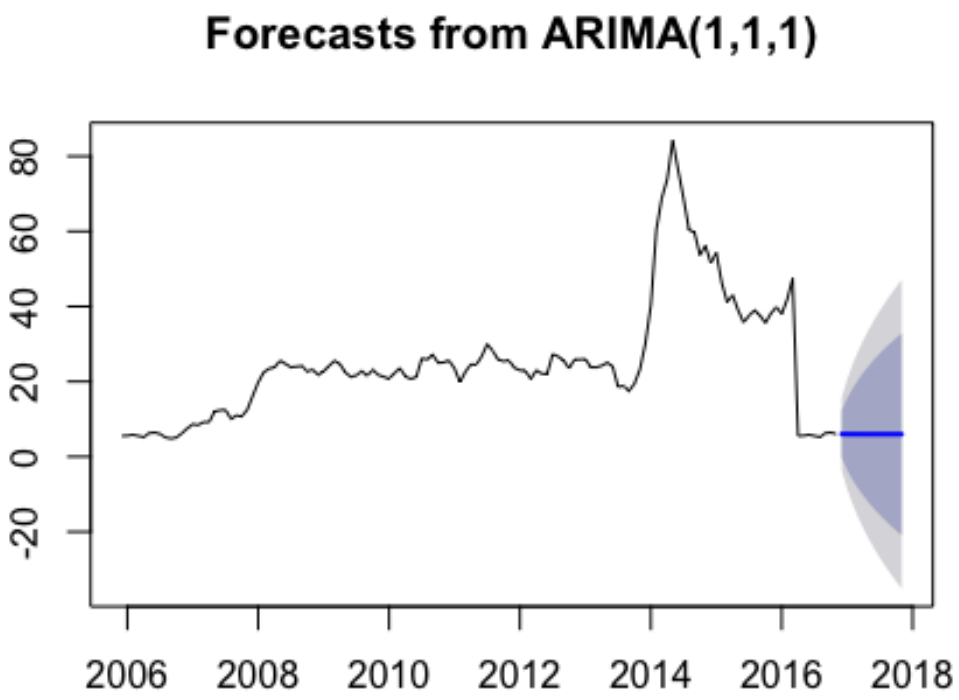


Forecasting Using an ARIMA model

```
auto.arima(oil.sorted.ts)
```

```
## Series: oil.sorted.ts
## ARIMA(0,1,1)(0,0,1)[12]
##
## Coefficients:
##          ma1     sma1
##       0.1215  -0.2591
## s.e.  0.0800   0.1284
##
## sigma^2 estimated as 24:  log likelihood=-393.46
## AIC=792.93   AICc=793.12   BIC=801.55
```

```
oil.arima<-arima(oil.sorted.ts, c(1,1,1))
oil.arima.forecasts <- forecast.Arima(oil.arima, h=12)
plot(oil.arima.forecasts)
```



GOLD analysis and forecast

Load the data and explore.

```
library(hydroTSM)
library(forecast)

gold<- read.csv("~/Desktop/DATA/GOLD.csv", header=TRUE, stringsAsFactors=FALS
E)
gold.sorted<-gold[rev(order(as.Date(gold$Date, format = "%y/%m/%d"))),]
gold.sorted
```

```
##         Date   Open   High    Low  Close  Volume  Adj.Close
## 173 7/30/02  12.40  12.84  12.40  12.80   64400   3.049217
## 48  12/3/12 107.62 107.86  96.26  99.21  503100  96.431114
## 108 12/3/07  35.00  37.66  32.25  37.13  496600  35.533146
## 36  12/2/13  69.09  69.25  60.90  62.81  810300  61.443851
## 168 12/2/02  17.00  31.80  16.95  29.36  854900   6.994142
## 12  12/1/15  61.68  65.35  59.08  61.93  639600  61.487930
## 24  12/1/14  66.48  69.52  61.11  67.41  958600  66.351013
## 60  12/1/11 106.72 109.64  97.15 102.10  568700  98.729279
## 72  12/1/10  94.89  95.72  80.66  82.33  787600  79.412361
## 84  12/1/09  86.69  90.30  77.78  79.14 1439600  76.150551
```

```
## 96  12/1/08  35.30  46.49  31.70  43.92 1086900  42.140133
## 120 12/1/06  23.00  23.73  22.35  23.46  338000  22.354572
## 132 12/1/05  16.12  16.91  14.66  16.13  444400  15.369959
## 144 12/1/04  12.80  13.06  11.10  11.42  276500  10.881893
## 156 12/1/03  27.70  29.19  24.29  27.35  729400  13.030639
## 25  11/3/14  60.16  71.36  58.40  64.68 1284700  63.663898
## 97  11/3/08  31.16  38.23  25.05  38.23 1114000  36.680721
## 157 11/3/03  22.01  28.08  20.90  27.30  954900  13.006816
## 13  11/2/15  66.12  67.20  58.77  60.60  880700  60.167423
## 85  11/2/09  68.12  87.90  66.50  84.74 1845300  81.539009
## 1   11/1/16  90.34  93.87  71.37  73.69 1677100  73.690002
## 37  11/1/13  73.15  79.33  67.52  70.75  943600  69.211151
## 49  11/1/12 119.73 122.29 100.06 107.36  566000 104.352837
## 61  11/1/11 106.56 120.73  95.75 106.91  801300 103.380493
## 73  11/1/10  94.80 101.92  92.00  94.06  799700  90.726669
## 109 11/1/07  36.06  39.90  34.10  35.18 1020300  33.667007
## 121 11/1/06  22.99  23.58  20.51  22.94  453800  21.859076
## 133 11/1/05  13.41  16.75  13.30  15.73  606100  14.988807
## 145 11/1/04  10.92  13.25  10.24  12.68  437700  12.082522
## 169 11/1/02  16.80  17.81  16.75  17.00  103400   4.049741
## 2   10/3/16 100.72 100.93  82.49  88.73 1058300  88.730003
## 62  10/3/11 100.06 114.58  89.90 109.57  673200 105.952667
## 134 10/3/05  15.72  15.95  13.59  13.62  444000  12.978230
## 122 10/2/06  20.64  22.67  19.10  22.67  412800  21.601797
## 14  10/1/15  60.27  72.07  58.34  66.87  990700  66.392670
## 26  10/1/14  67.44  70.91  58.00  58.21 1196200  57.295536
## 38  10/1/13  69.60  79.77  67.68  73.90  783000  72.292641
## 50  10/1/12 123.43 127.27 116.74 119.59  558500 116.240265
## 74  10/1/10 102.11 106.44  90.48  93.92  834000  90.591629
## 86  10/1/09  68.85  76.97  63.57  66.71 1726000  64.190079
## 98  10/1/08  40.98  42.35  22.28  31.01 1270700  29.753313
## 110 10/1/07  33.31  38.05  30.50  35.94  707300  34.394321
## 146 10/1/04   9.97  11.45   9.61  10.88  353800  10.367338
## 158 10/1/03  23.24  24.43  21.51  22.03  956700  10.495977
## 170 10/1/02  18.09  18.10  14.60  16.80   51800   4.002097
## 51   9/4/12 102.10 124.80 100.68 123.00  888100 119.554756
## 111  9/4/07  24.43  34.13  24.38  33.24  771900  31.810444
## 39   9/3/13  79.68  80.43  69.79  71.53 1032600  69.974182
## 171  9/3/02  15.75  19.50  15.70  18.08  139100   4.307019
## 27   9/2/14  83.05  83.33  67.35  67.59  763700  66.528175
## 99   9/2/08  39.82  46.83  31.08  41.03 1533100  39.367249
## 159  9/2/03  24.20  27.27  21.90  23.00 1120700  10.958124
## 3    9/1/16  93.47 106.01  93.32 100.07  929700 100.070000
## 15   9/1/15  60.28  61.20  54.88  59.09 1017300  58.668205
## 63   9/1/11 104.62 115.00  92.50  96.72 1005600  93.526901
## 75   9/1/10  93.58 104.22  90.74 101.46  724400  97.864426
## 87   9/1/09  57.90  76.08  56.78  69.88 2003000  67.240334
## 123  9/1/06  22.46  25.26  18.96  20.36  441200  19.400644
## 135  9/1/05  13.60  16.70  13.53  15.72  647800  14.979279
## 147  9/1/04   9.60  10.05   9.16   9.87  303500   9.404928
```

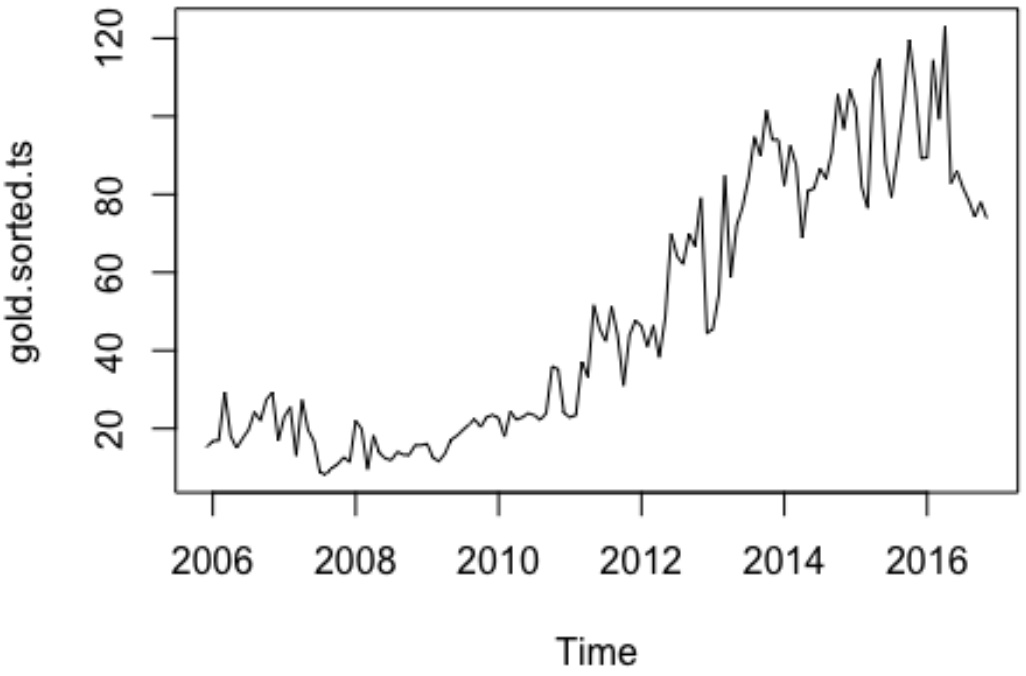
```
## 16   8/3/15  59.09  68.12  57.85  60.29  954600  59.859638
## 88   8/3/09  64.33  65.50  55.06  58.81  894900  56.588501
## 76   8/2/10  90.38  93.74  85.11  92.49  677500  89.212303
## 148  8/2/04   8.25   9.67   7.90   9.52  384200   9.071421
## 4    8/1/16 117.61 120.72  93.03  93.65  986300  93.650002
## 28   8/1/14  85.61  86.92  80.06  84.15  467200  82.828033
## 40   8/1/13  75.10  84.61  66.05  78.02 1030100  76.323021
## 52   8/1/12  89.73 103.61  86.85 102.97  466300 100.085800
## 64   8/1/11  90.59 114.50  89.43 105.55 1378100 102.065392
## 100  8/1/08  50.07  50.89  40.22  43.89 1002600  42.111347
## 112  8/1/07  22.60  25.23  20.83  23.95  557400  22.919979
## 124  8/1/06  22.04  23.72  21.13  22.44  294000  21.382635
## 136  8/1/05  13.37  15.22  12.77  13.32  465500  12.692366
## 160  8/1/03  19.20  25.59  19.20  24.24  885000  11.548909
## 172  8/1/02  12.80  15.99  12.80  15.25  132800   3.632856
## 125  7/3/06  21.33  23.20  19.92  22.23  348400  21.182529
## 53   7/2/12  89.89  94.10  82.52  89.48  505300  86.973656
## 113  7/2/07  22.22  24.45  21.85  22.90  422600  21.915136
## 5    7/1/16 117.18 126.55 110.73 117.61 1253900 117.610001
## 17   7/1/15  66.04  67.62  57.06  60.37  738000  59.939068
## 29   7/1/14  85.60  89.89  84.48  86.14  558800  84.786766
## 41   7/1/13  63.82  75.41  60.17  74.27 1143200  72.654587
## 65   7/1/11  83.33  93.57  82.05  90.81  645300  87.812004
## 77   7/1/10  94.71  96.21  87.08  89.88  810200  86.694801
## 89   7/1/09  66.10  67.73  56.83  62.12 1219800  59.773464
## 101  7/1/08  45.10  56.28  43.84  51.18  954800  49.105919
## 137  7/1/05  14.19  14.27  12.70  13.30  310800  12.673308
## 149  7/1/04   8.62   9.70   7.75   8.21  431800   7.823147
## 161  7/1/03  17.38  20.40  15.09  19.69  514000   9.381107
## 42   6/3/13  78.50  80.50  60.44  64.00 1042500  62.607967
## 30   6/2/14  73.56  84.89  72.14  84.60  542300  83.270958
## 102  6/2/08  41.71  46.88  37.20  46.18  805900  44.308548
## 162  6/2/03  17.30  18.87  15.62  17.00  651700   8.099483
## 6    6/1/16  85.39 112.13  83.63 112.04 1162300 112.040001
## 18   6/1/15  72.25  73.69  66.90  66.95  498700  66.472092
## 54   6/1/12  80.58  96.70  80.58  90.01  917200  87.488808
## 66   6/1/11  81.83  84.48  73.10  84.05  657000  81.275185
## 78   6/1/10  88.79  99.67  85.01  94.75 1169400  91.392212
## 90   6/1/09  71.94  74.21  61.62  64.17 1613300  61.746029
## 114  6/1/07  23.68  24.30  20.90  22.19  353100  21.235672
## 126  6/1/06  19.00  21.25  16.29  21.00  535100  20.010487
## 138  6/1/05  12.35  15.08  12.35  14.06  429100  13.397498
## 150  6/1/04  18.60  18.69   8.13   8.82  349800   8.404404
## 79   5/3/10  84.79  91.75  78.50  87.45 1343900  84.350914
## 151  5/3/04  16.90  18.95  15.00  18.19  454700   8.666447
## 7    5/2/16 101.28 101.60  82.85  84.31 1072200  84.309998
## 67   5/2/11  85.89  86.34  74.53  81.96  678700  79.254181
## 139  5/2/05  11.75  13.34  11.05  12.49  273300  11.901475
## 19   5/1/15  75.33  77.79  70.56  72.23  510700  71.714409
## 31   5/1/14  79.12  81.35  72.69  73.93  418200  72.768585
```

```
## 43   5/1/13  80.90  81.53  70.92  78.38  919900  76.675194
## 55   5/1/12  87.26  88.83  72.91  79.35  757000  77.127396
## 91   5/1/09  48.96  73.27  48.60  69.81 1649600  67.172981
## 103  5/1/08  44.34  48.60  41.37  42.40  606500  40.681732
## 115  5/1/07  23.95  25.50  22.55  23.44  360100  22.431913
## 127  5/1/06  24.80  26.56  18.35  19.61  736100  18.685984
## 163  5/1/03  15.05  21.25  14.87  17.47  817500   8.323409
## 128  4/3/06  18.27  24.36  18.13  24.34  754200  23.193108
## 56   4/2/12  85.00  92.53  80.14  89.15  853000  86.206818
## 116  4/2/07  23.90  26.30  23.77  23.95  335300  22.919979
## 8    4/1/16  88.10 100.52  87.95 100.50  931600 100.500000
## 20   4/1/15  69.74  78.90  69.36  76.17  669000  75.626282
## 32   4/1/14  74.95  81.63  74.60  80.07  659100  78.812126
## 44   4/1/13  85.64  85.69  66.51  81.78 1067300  79.489334
## 68   4/1/11  81.07  88.68  80.60  86.57  786900  83.502098
## 80   4/1/10  78.64  86.11  77.39  84.24  905400  81.254669
## 92   4/1/09  54.72  56.89  40.41  48.40 1231400  46.571732
## 104  4/1/08  44.62  55.96  42.97  45.52  683100  43.675293
## 140  4/1/05  12.38  12.89  11.00  11.89  291500  11.329747
## 152  4/1/04  20.48  23.00  16.27  16.71  795700   7.961315
## 164  4/1/03  13.50  16.05  12.25  15.01  451900   7.151367
## 33   3/3/14  82.13  85.48  74.04  75.00  804700  73.821770
## 105  3/3/08  52.71  56.15  42.82  46.34  864000  44.462063
## 165  3/3/03  24.23  24.95   9.55  13.06  716200   6.222309
## 21   3/2/15  79.00  79.33  66.45  69.27  927800  68.775536
## 93   3/2/09  45.02  55.25  41.24  54.35 1169800  52.296970
## 9    3/1/16  89.89  96.50  86.61  90.81  961000  90.809998
## 45   3/1/13  81.88  86.66  79.51  85.98  617100  83.571693
## 57   3/1/12 115.69 117.28  85.33  87.98 1125300  85.075439
## 69   3/1/11  82.16  82.79  70.18  81.54  922500  78.650360
## 81   3/1/10  71.28  79.06  71.15  76.83  957800  74.107269
## 117  3/1/07  22.49  24.38  21.11  23.91  387900  22.881699
## 129  3/1/06  17.29  18.35  15.50  18.17  427100  17.313835
## 141  3/1/05  13.40  14.24  11.47  12.36  386700  11.777600
## 153  3/1/04  20.12  20.75  17.41  19.67  692000   9.371578
## 34   2/3/14  71.80  81.89  70.11  79.04  946500  77.320839
## 166  2/3/03  29.40  33.70  24.50  25.45 1502200   6.062701
## 22   2/2/15  83.64  85.46  75.12  79.19  810200  77.945953
## 94   2/2/09  43.36  50.89  42.37  45.48 1195900  43.762028
## 154  2/2/04  21.78  23.91  19.17  19.87  684800   9.466866
## 10   2/1/16  72.00  93.67  71.59  91.25 1315900  90.598640
## 46   2/1/13  95.85 100.78  81.31  82.87  589400  80.548805
## 58   2/1/12 115.81 119.73 108.63 114.73  517900 110.942322
## 70   2/1/11  77.48  83.55  76.85  80.95  774700  78.081261
## 82   2/1/10  70.39  74.81  64.91  72.01 1090800  69.458084
## 106  2/1/08  50.94  53.13  42.54  51.64  811200  49.547279
## 118  2/1/07  23.83  24.75  22.30  22.90  473100  21.915136
## 130  2/1/06  18.10  18.70  16.24  17.10  592500  16.294254
## 142  2/1/05  11.52  13.87  10.33  13.69  354900  13.044931
## 11   1/4/16  63.03  70.78  59.96  70.72  846600  70.215187
```

```
## 83   1/4/10  82.25  86.63  68.59  68.93 1014100  66.326225
## 59   1/3/12 105.69 115.44 105.21 114.41  476900 110.632889
## 71   1/3/11  82.60  83.55  75.05  76.49 1052100  73.779320
## 119  1/3/07  23.64  24.00  20.72  23.51  413800  22.402216
## 131  1/3/06  16.49  18.44  16.30  17.94  785200  17.094673
## 143  1/3/05  11.06  11.70   9.95  11.61  248700  11.062941
## 23   1/2/15  66.83  85.84  66.69  85.26 1272200  83.920593
## 35   1/2/14  63.37  71.50  59.19  68.90  880100  67.401390
## 47   1/2/13 101.14 102.02  91.91  94.16  512300  91.522568
## 95   1/2/09  43.98  46.49  36.24  44.46 1266300  42.658249
## 107  1/2/08  37.39  50.74  36.32  47.71  978500  45.658127
## 155  1/2/04  28.30  28.72  20.75  22.00  832500  10.481684
## 167  1/2/03  29.70  34.25  27.55  29.25 1363100   6.967937

names(gold)

## [1] "Date"      "Open"      "High"      "Low"       "Close"     "Volume"
## [7] "Adj.Close"

head(gold$Date)

## [1] "11/1/16" "10/3/16" "9/1/16"  "8/1/16"  "7/1/16"  "6/1/16"
```

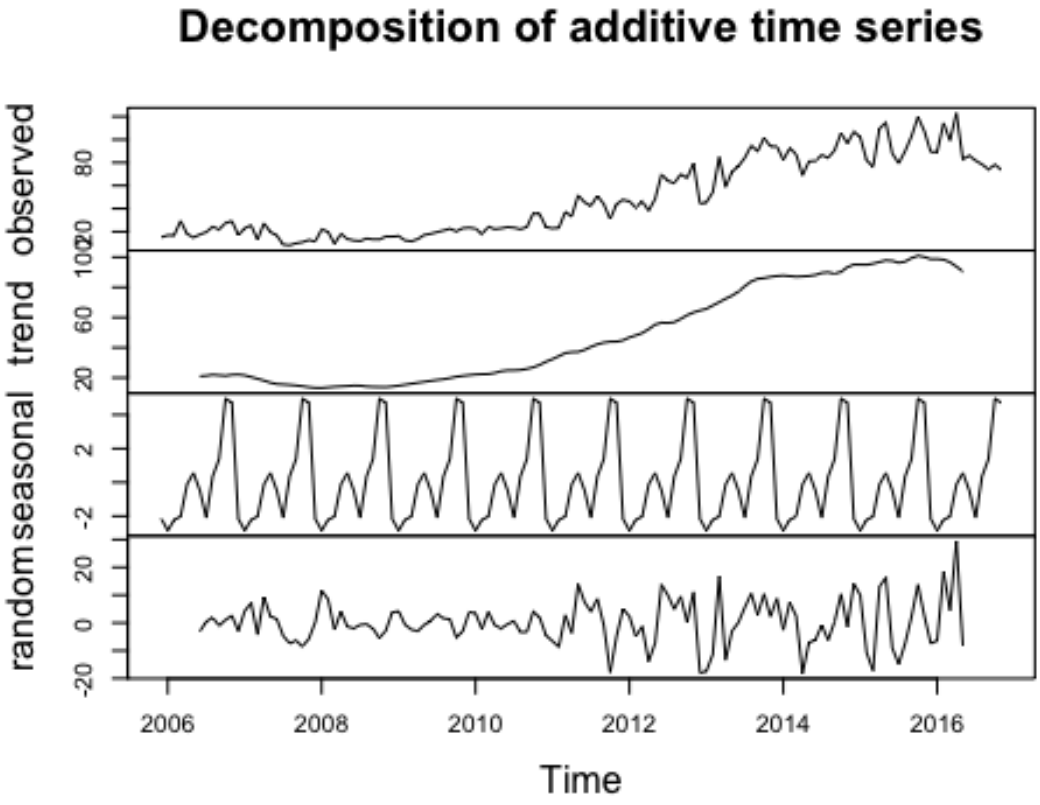
Sorting the data by date and creating a time series object. Data spans for 10 years. Data is monthly (end of month).

```
gold.sorted<-gold[order(as.Date(gold$Date, format="%d/%m/%Y")),]
gold.sorted.ts<-ts(gold.sorted$Close,start=c(2006,0),end = c(2016,11),frequen
cy = 12)
plot(gold.sorted.ts)
```



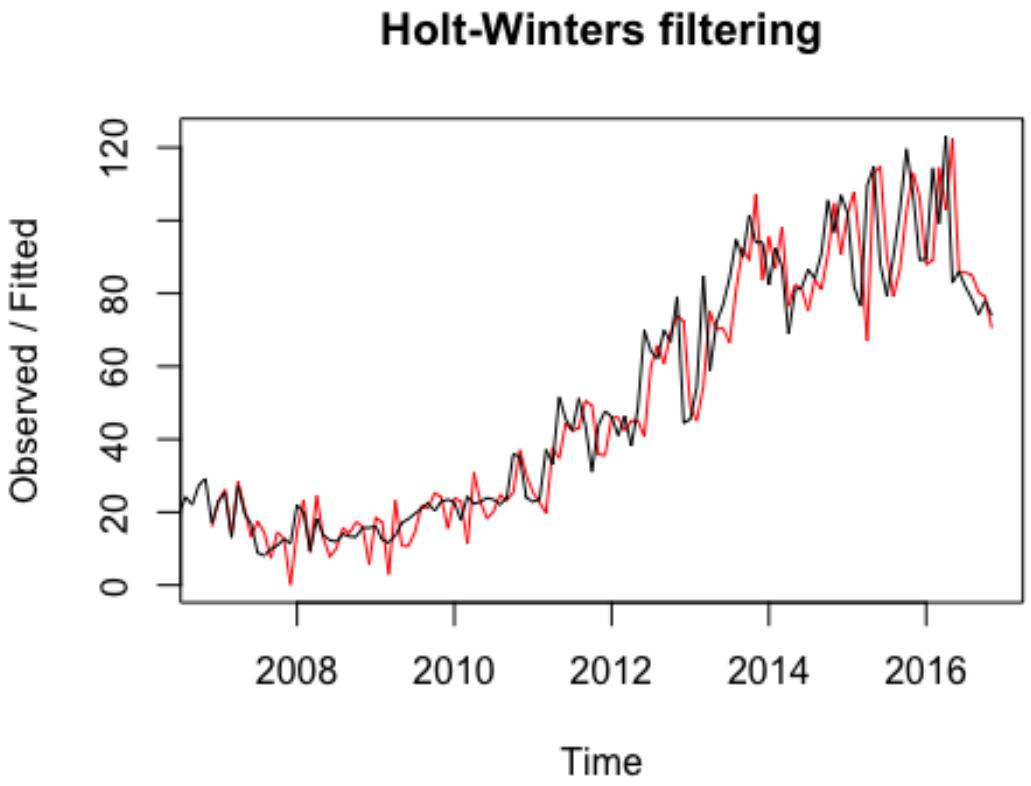
Decomposing data to three components: a trend, seasonal and irregular component.

```
gold.sorted.ts.d<-decompose(gold.sorted.ts)
plot(gold.sorted.ts.d)
```



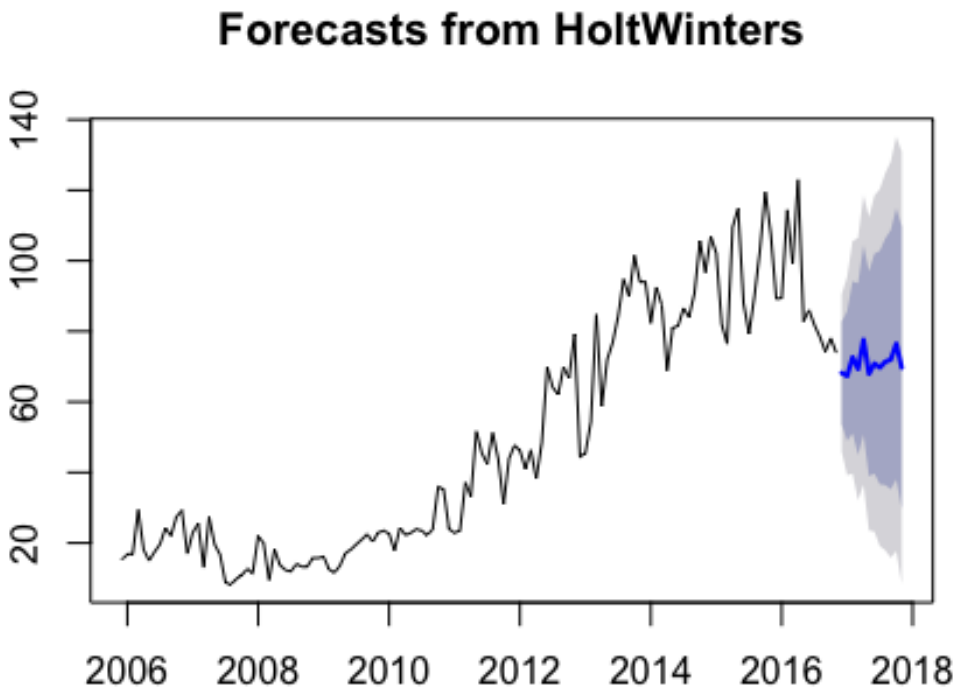
Exponential Smoothing

```
gold.holt.T <- HoltWinters(gold.sorted.ts, gamma=TRUE)
plot(gold.holt.T)
```



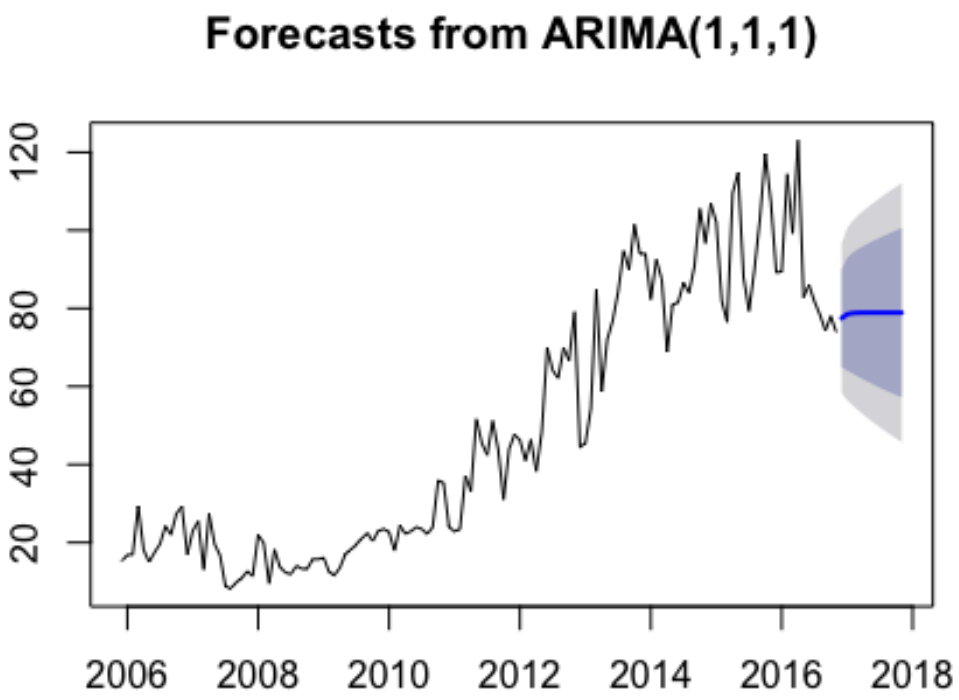
1 year forecast with Holt Winters

```
gold.forecasts <- forecast.HoltWinters(gold.holt.T, h=12)  # forecast 1 year
(12 months)
plot.forecast(gold.forecasts)
```



Forecasting Using an ARIMA model

```
auto.arima(gold.sorted.ts)

## Series: gold.sorted.ts
## ARIMA(1,1,1) with drift
##
## Coefficients:
##          ar1      ma1   drift
##       0.3140  -0.7595  0.4968
## s.e.  0.1326   0.0898  0.3041
##
## sigma^2 estimated as 95.76:  log likelihood=-483.37
## AIC=974.75   AICc=975.06   BIC=986.25

gold.arima<-arima(gold.sorted.ts, c(1,1,1))   # this models is equivalent to
ARMA(1,1,0)
gold.arima.forecasts <- forecast.Arima(gold.arima, h=12)
plot(gold.arima.forecasts)
```




```
#Gold Investment Strategy
```

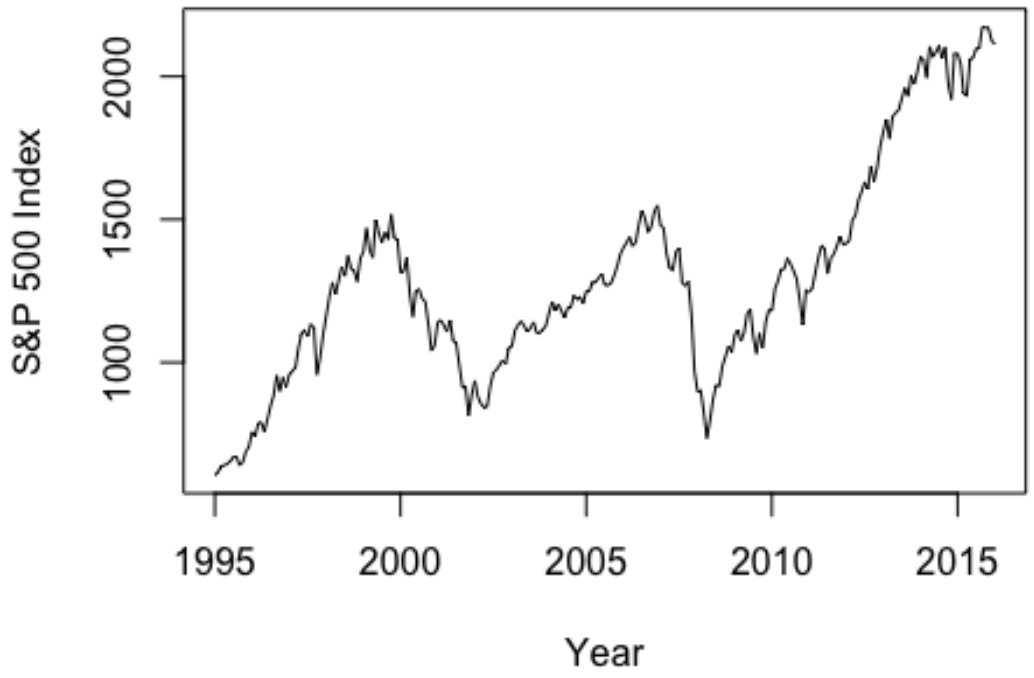
S&P 500 analysis and forecast

Load the data and explore.

```
sp500 <- read.csv('~/Desktop/DATA/sp500_95.csv', header = TRUE, stringsAsFact
ors = FALSE)
names(sp500)

## [1] "Date"      "Open"      "High"      "Low"       "Close"     "Volume"
## [7] "Adj.Close"

head(sp500)

##         Date    Open    High     Low   Close     Volume Adj.Close
## 1 2016-11-01 2128.68 2131.45 2097.85 2111.72 9064320000   2111.72
## 2 2016-10-03 2164.33 2169.60 2114.72 2126.15 3672334700   2126.15
## 3 2016-09-01 2171.33 2187.87 2119.12 2168.27 3878265700   2168.27
## 4 2016-08-01 2173.15 2193.81 2147.58 2170.95 3451160800   2170.95
## 5 2016-07-01 2099.34 2177.09 2074.02 2173.60 3678454500   2173.60
## 6 2016-06-01 2093.94 2120.55 1991.68 2098.86 4157978100   2098.86
```

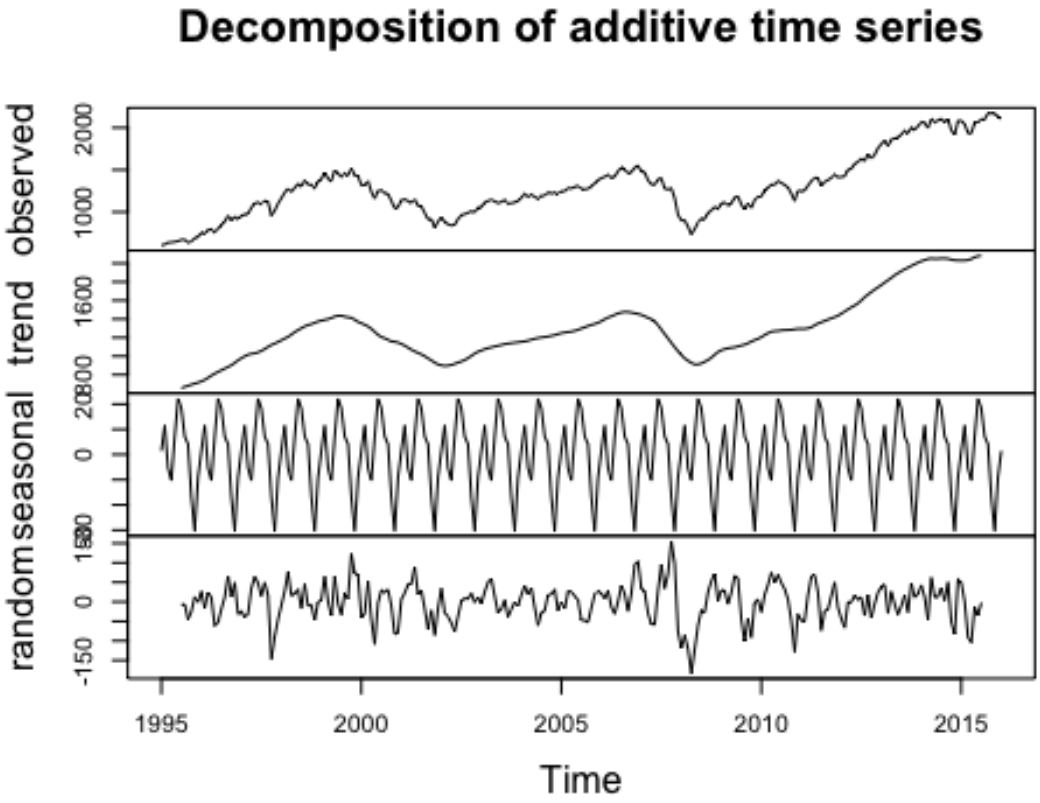
Sorting the data by date and creating a time series object.spans Data spans last 21 years up to Oct 31st 1995. Data is monthly (end of month). years.

```
sp500.sorted <- sp500[rev(order(as.Date(sp500$Date, format = "%y/%m/%d"))),]

sp500.sorted.ts <- ts(sp500.sorted$Close, start = c(1995), frequency = 12)

plot(sp500.sorted.ts,
     xlab = "Year",
     ylab = 'S&P 500 Index')
```



Decomposing data to three components: a trend, seasonal and irregular component.

```
sp500.ts.dec <- decompose(sp500.sorted.ts)
plot(sp500.ts.dec)
```

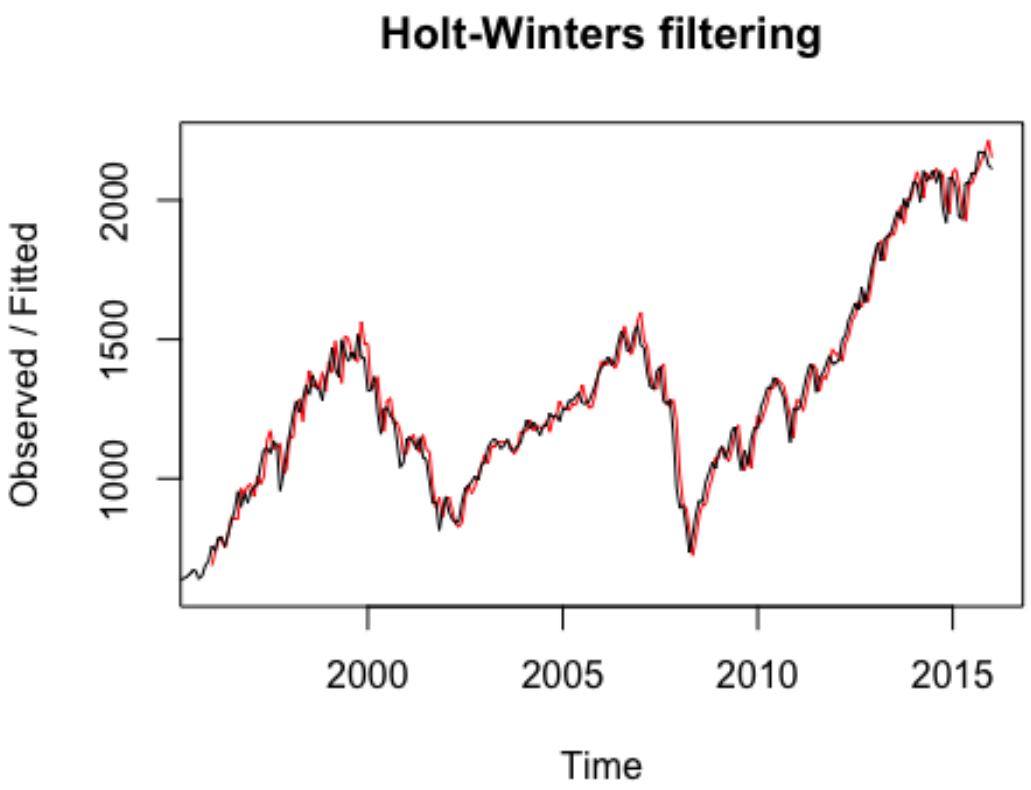


On average there has been an upward trend in the index from 1995. In addition we have 5-7 year cycles (see trend/observed components). It looks like at this point in time the index has plateaued and will soon start falling if previous pattern is any indicator.

There seems to be high seasonality with primary peaks in Oct/Nov secondary peaks in Jul/Aug.

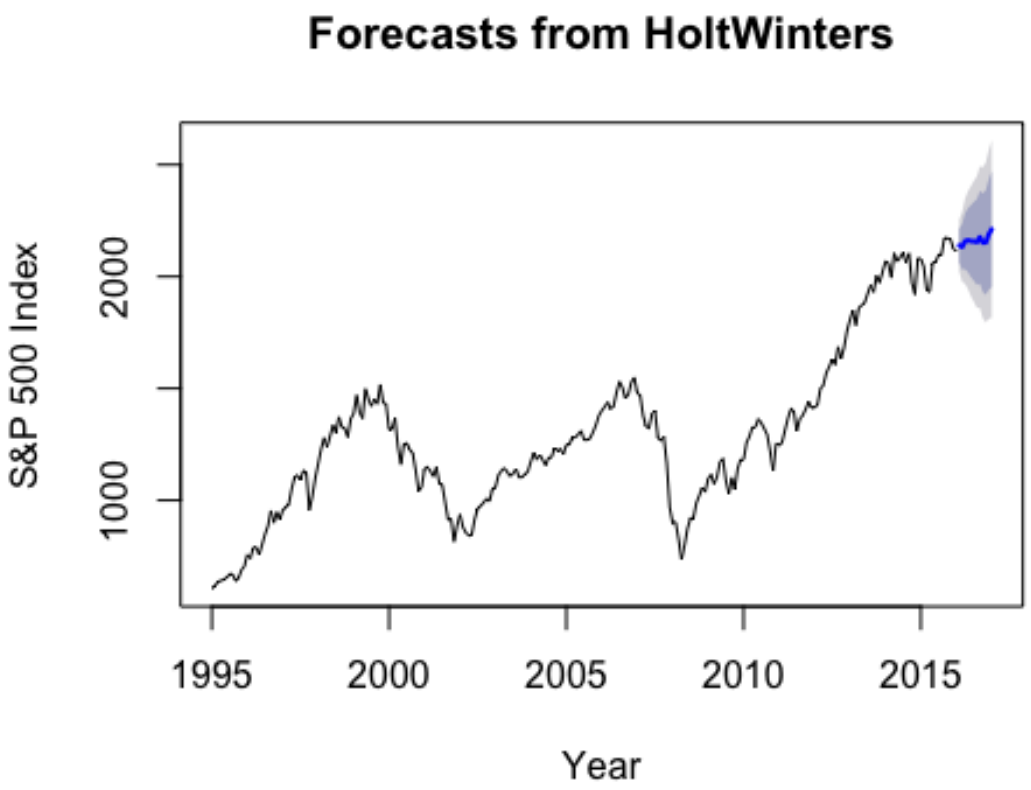
Exponential Smoothing

```
sp500.ts.holt <- HoltWinters(sp500.sorted.ts, gamma=TRUE)
plot(sp500.ts.holt)
```



1 year forecast with Holt Winters

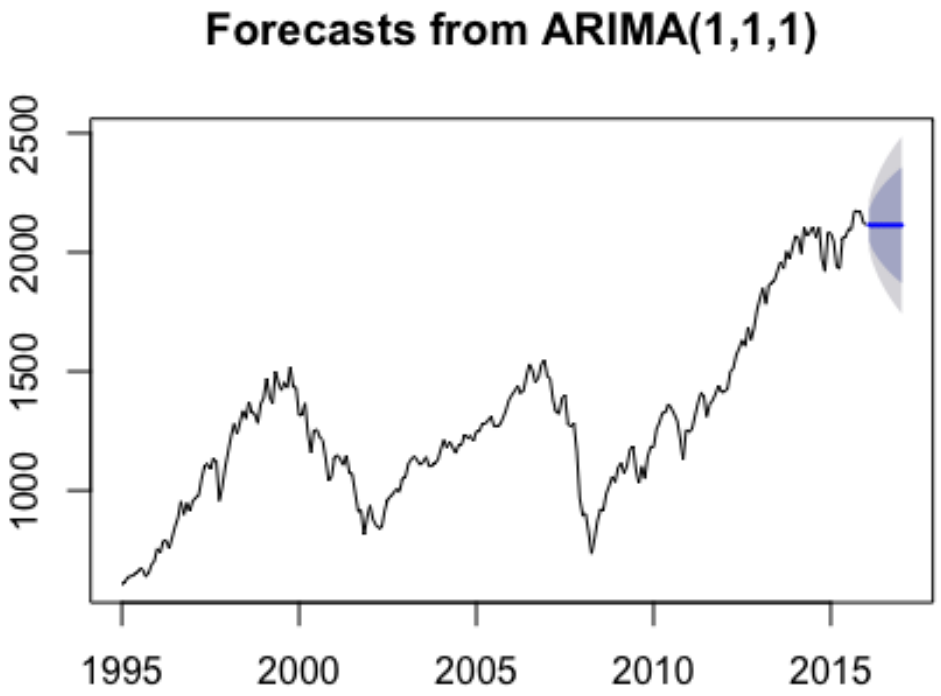
```
library(forecast)
sp500.forecast <- forecast.HoltWinters(sp500.ts.holt, h = 12)
  plot(sp500.forecast,
       xlab = "Year",
       ylab = 'S&P 500 Index')
```



The model predicts a slight increase but the confidence interval indicates it could start falling.

Forecasting Using an ARIMA model

```
sp500.arima <- arima(sp500.sorted.ts, c(1,1,1))
sp500.arima.forecast <- forecast.Arima(sp500.arima, h=12)
plot(sp500.arima.forecast)
```



Both models are not forecasting big change in the index. The Holt Winter forecasts a slight increase while the ARIMA model forecasts almost no change at all.

Based on historical cycles we can expect the index to fall soon. If you are looking to invest in S&P 500 stocks next year, there are a few things you have to keep in mind.

1. If you are looking to invest long term in the stocks I do not advice you to do it at this point in time. The stocks will soon go down and right now they are as high as they have been in years. We are in the middle of a cycle and if you wait for 2-3 years or until the cycle reaches its bottom you can expect to be able to buy cheap stocks with a high probability of increasing in value over the next 5-7 years.

2. If you want to try to capitalize on the falling index you can short the stocks now and then acquire them in about 2 years time based on cycles.

3. For small short term profits you can exploit the seasonality in the index. By buying stocks when they are cheap in Jan/Feb or Septemeber and then selling them in either Jul/August or Oct/Nov you can make marginal but quick profits. You can also short the stocks in the same manner and capitalize on the seasonal downhill slope.

My professional advice would be to not invest in S&P 500 today but rather in 2-3 years towards the end of the cycle and then sell at the the peak of the cycle, in 5-7 years time. If you have to invest then I would suggest shorting the stocks long term.

Quantifying Variance

```
library(timeSeries)
```

```
##
## Attaching package: 'timeSeries'
```

```
## The following object is masked from 'package:hydroTSM':
##
##     daily2monthly
```

```
## The following object is masked from 'package:zoo':
##
##     time<-
```

```
gold<- gold.sorted.ts[c(1:124,1)]
oil<- oil.sorted.ts[c(1:124,1)]
sp500<-sp500.sorted.ts[c(1:124,1)]
```

```
colVars(gold)
```

```
## [1] 1092.716
```

```
colVars(oil)
```

```
## [1] 249.2757
```

```
colVars(sp500)
```

```
## [1] 52722.92
```

```
###Variance is used to measure a stock's volatility.
##Being able to express in a single number just how far a given stocks value
can travel away from the mean is a very useful indicator of how much risk a p
articular stock comes with.
### Its really hard to predict for long term as the variance of GOLD and SP50
0 stocks is very high as compared to OIL.
```