

```
#install.packages("forecast")
#install.packages("plotly")
#install.packages("tidyverse")
#install.packages("dplyr")
```

```
library(forecast)
```

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

```
data(EuStockMarkets)
summary(EuStockMarkets)
```

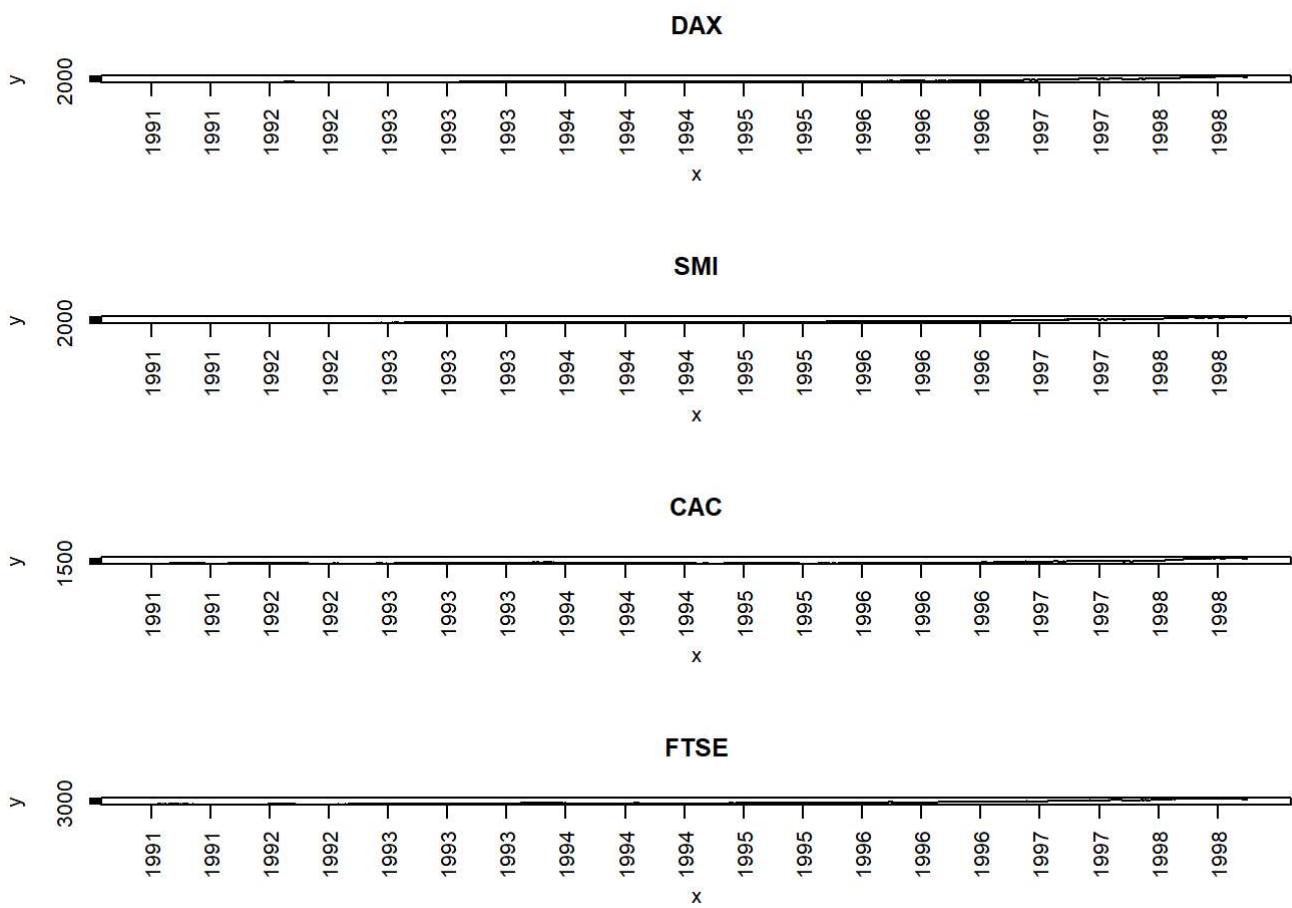
```
##      DAX          SMI          CAC          FTSE
## Min. :1402    Min. :1587    Min. :1611    Min. :2281
## 1st Qu.:1744   1st Qu.:2166   1st Qu.:1875   1st Qu.:2843
## Median :2141   Median :2796   Median :1992   Median :3247
## Mean   :2531   Mean   :3376   Mean   :2228   Mean   :3566
## 3rd Qu.:2722   3rd Qu.:3812   3rd Qu.:2274   3rd Qu.:3994
## Max.  :6186   Max.  :8412   Max.  :4388   Max.  :6179
```

```
class(EuStockMarkets)
```

```
## [1] "mts"     "ts"      "matrix"
```

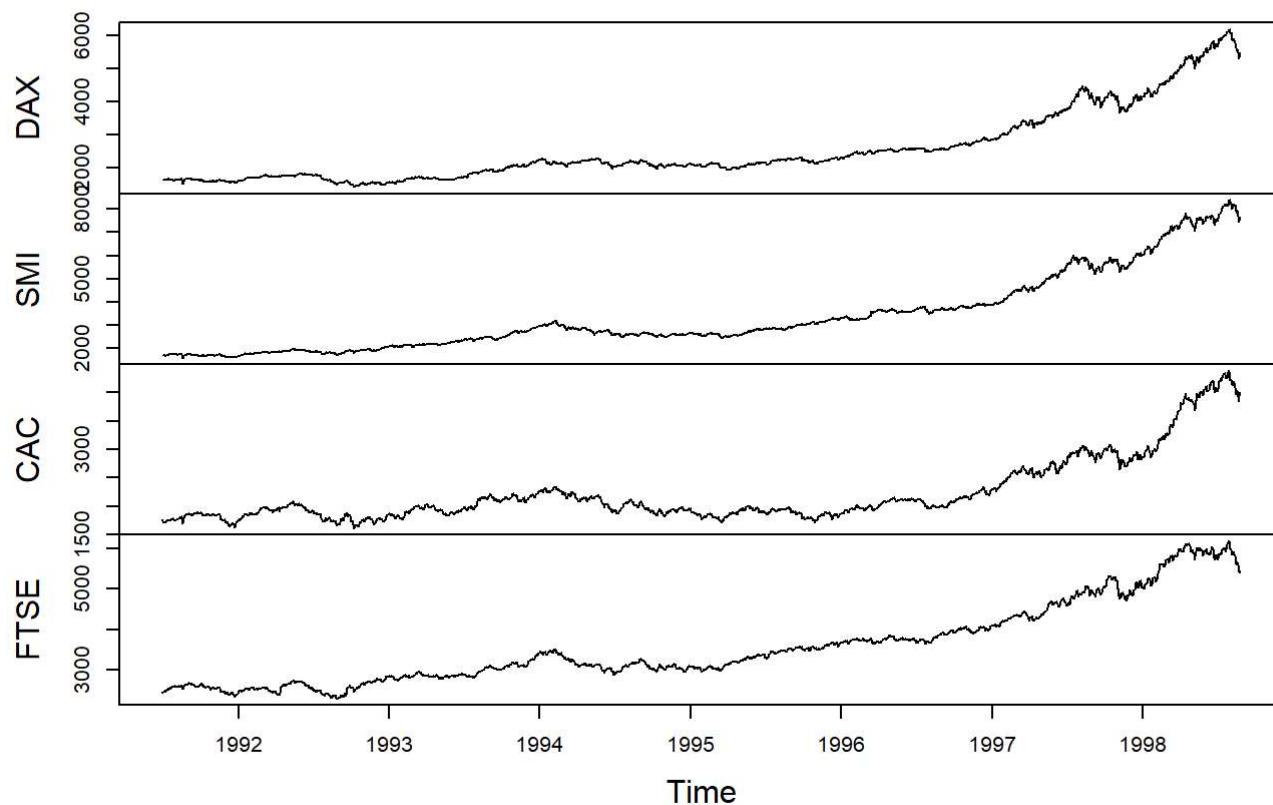
```
par(mfrow=c(4,1))

x <- seq_len(nrow(EuStockMarkets))
for (i in seq_len(ncol(EuStockMarkets))) {
  y <- EuStockMarkets[,i]
  heading <- colnames(EuStockMarkets)[i]
  plot(x, y, type="n", main = heading, xaxt = "n")
  lines(x, EuStockMarkets[,i])
  years <- as.integer(time(EuStockMarkets))
  tick.posis <- seq(10, length(years), by = 100)
  axis(1, at = tick.posis, las = 2, labels = years[tick.posis])
}
```



```
plot(EuStockMarkets)
```

## EuStockMarkets



```
library(plotly)
```

```
## Loading required package: ggplot2
```

```
##  
## Attaching package: 'plotly'
```

```
## The following object is masked from 'package:ggplot2':  
##  
##     last_plot
```

```
## The following object is masked from 'package:stats':  
##  
##     filter
```

```
## The following object is masked from 'package:graphics':  
##  
##     layout
```

```
library(tidyr)  
library(dplyr)
```

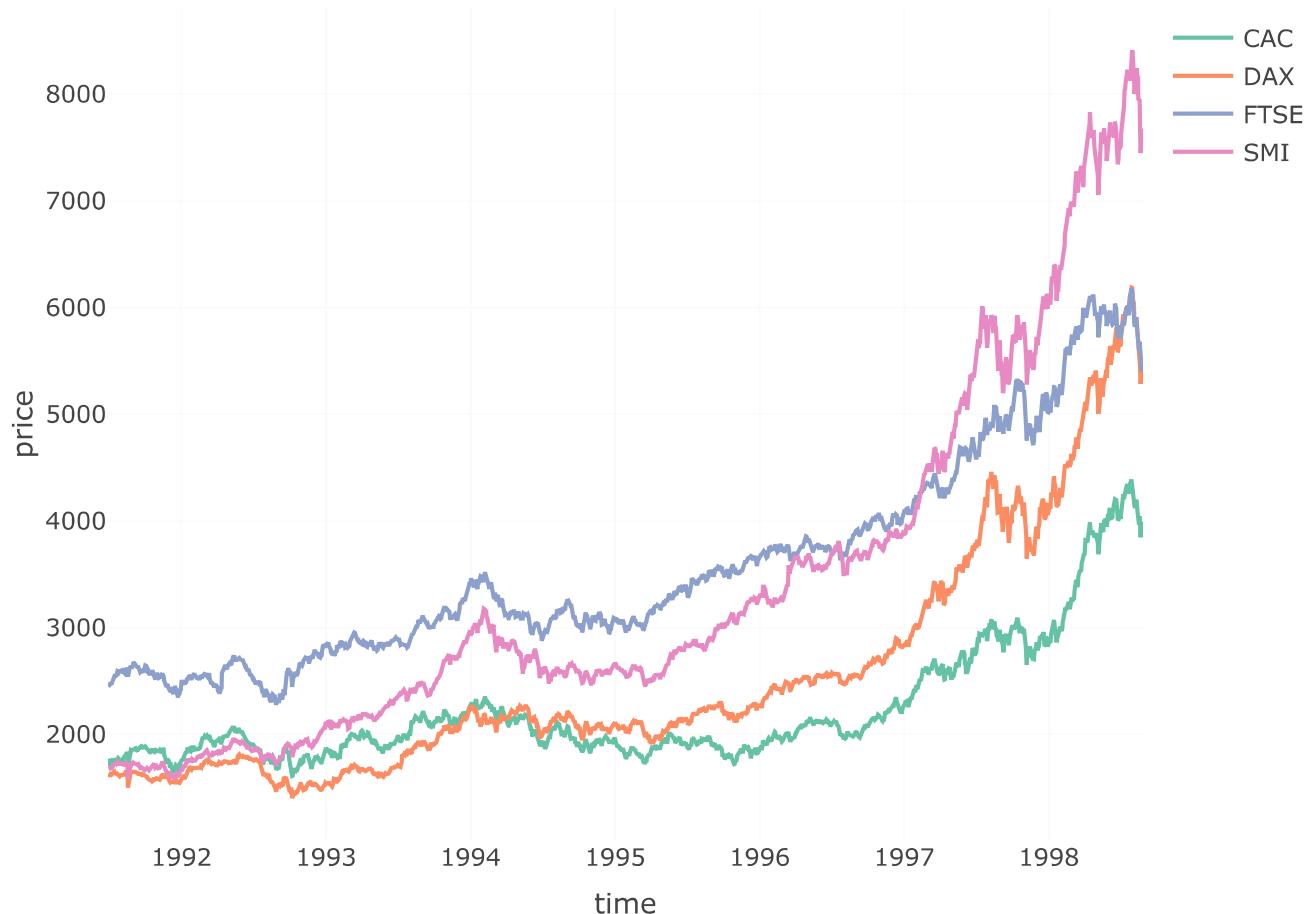
```
##  
## Attaching package: 'dplyr'
```

```
## The following objects are masked from 'package:stats':  
##  
##     filter, lag
```

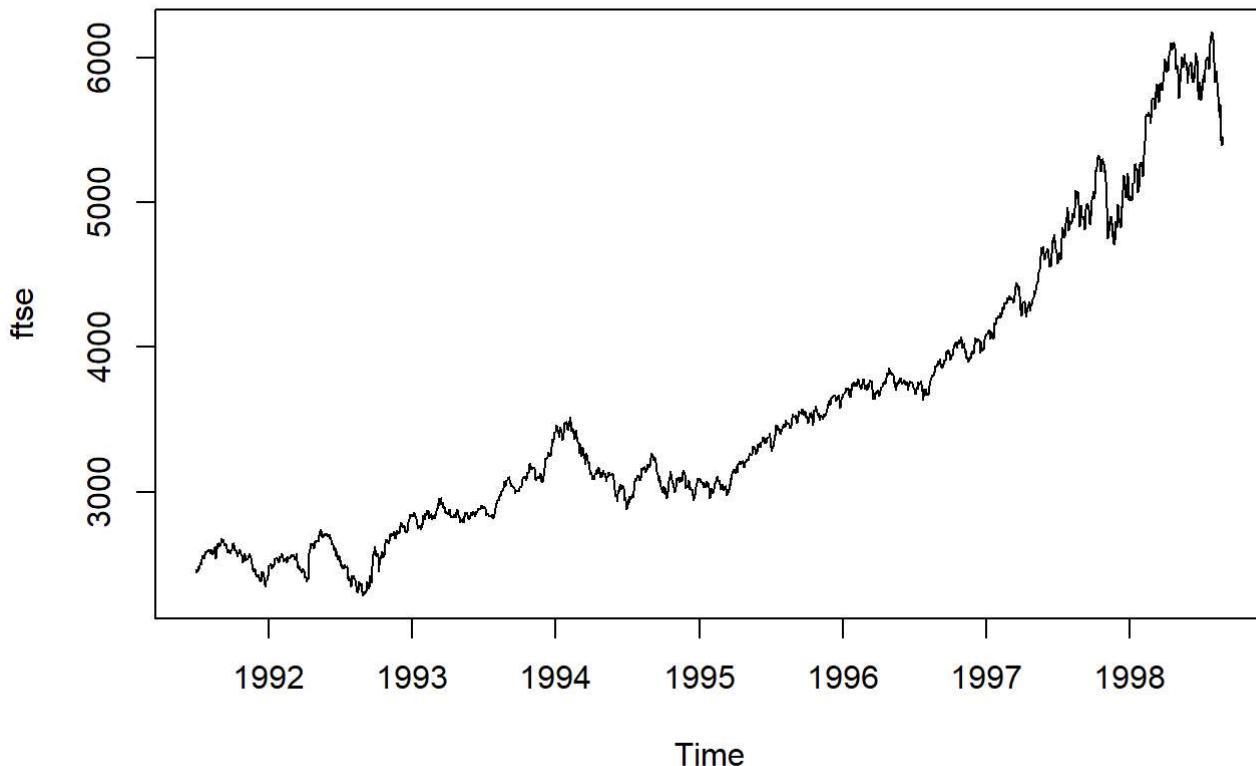
```
## The following objects are masked from 'package:base':  
##  
##     intersect, setdiff, setequal, union
```

```
stocks <- as.data.frame(EuStockMarkets) %>%  
  gather(index, price) %>%  
  mutate(time = rep(time(EuStockMarkets), 4))  
plot_ly(stocks, x = ~time, y = ~price, color = ~index, mode = "lines")
```

```
## No trace type specified:  
##   Based on info supplied, a 'scatter' trace seems appropriate.  
##   Read more about this trace type -> https://plotly.com/r/reference/#scatter
```

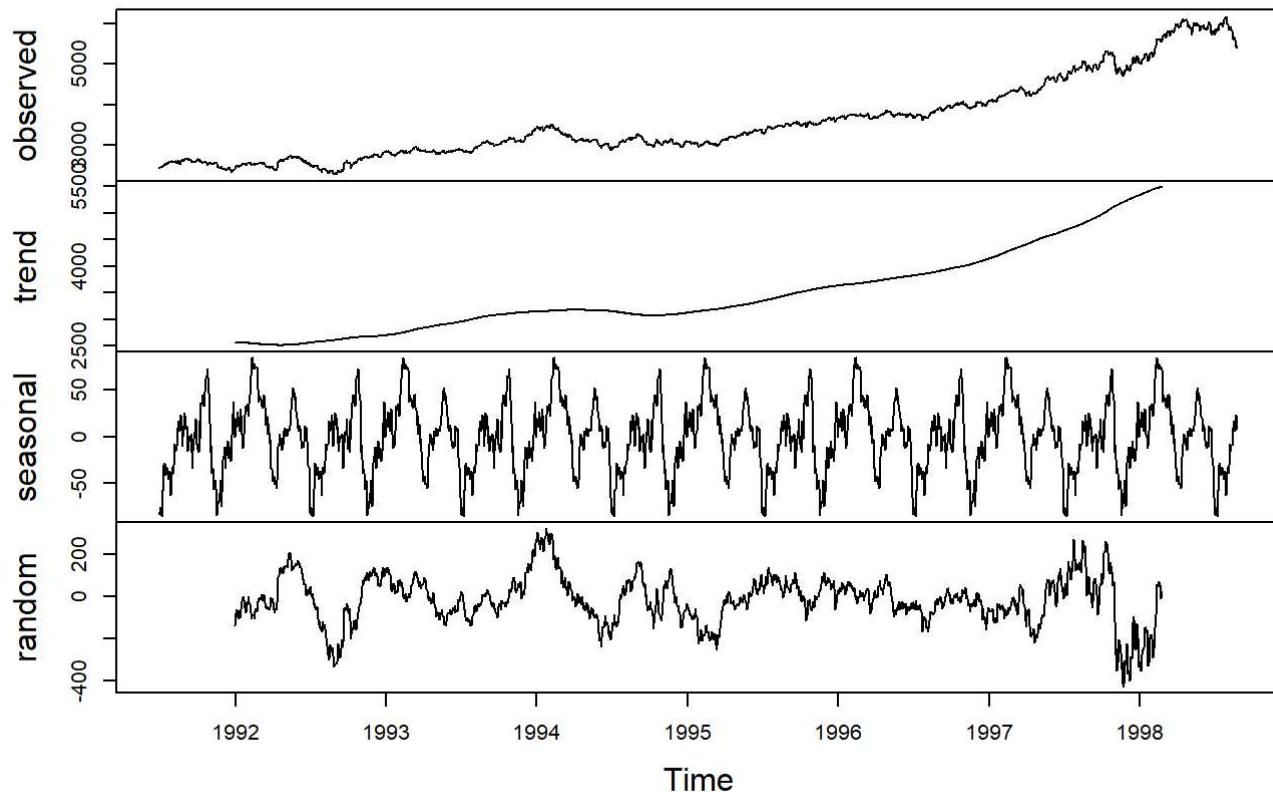


```
ftse=(EuStockMarkets[,4])  
plot(ftse)
```



```
components.ts = decompose(ftse)  
plot(components.ts)
```

## Decomposition of additive time series



```
fit_ftse <- auto.arima(ftse, trace=TRUE)
```

```

## 
## Fitting models using approximations to speed things up...
##
## ARIMA(2,1,2)(1,0,1)[260] with drift      : Inf
## ARIMA(0,1,0)          with drift      : 17994.59
## ARIMA(1,1,0)(1,0,0)[260] with drift      : Inf
## ARIMA(0,1,1)(0,0,1)[260] with drift      : Inf
## ARIMA(0,1,0)          : 17997.78
## ARIMA(0,1,0)(1,0,0)[260] with drift      : Inf
## ARIMA(0,1,0)(0,0,1)[260] with drift      : Inf
## ARIMA(0,1,0)(1,0,1)[260] with drift      : Inf
## ARIMA(1,1,0)          with drift      : 17968.54
## ARIMA(1,1,0)(0,0,1)[260] with drift      : Inf
## ARIMA(1,1,0)(1,0,1)[260] with drift      : Inf
## ARIMA(2,1,0)          with drift      : 17970.46
## ARIMA(1,1,1)          with drift      : 17969.53
## ARIMA(0,1,1)          with drift      : 17966.98
## ARIMA(0,1,1)(1,0,0)[260] with drift      : Inf
## ARIMA(0,1,1)(1,0,1)[260] with drift      : Inf
## ARIMA(0,1,2)          with drift      : 17968.91
## ARIMA(1,1,2)          with drift      : Inf
## ARIMA(0,1,1)          : 17969.15
##
## Now re-fitting the best model(s) without approximations...
##
## ARIMA(0,1,1)          with drift      : 17973.84
##
## Best model: ARIMA(0,1,1)          with drift

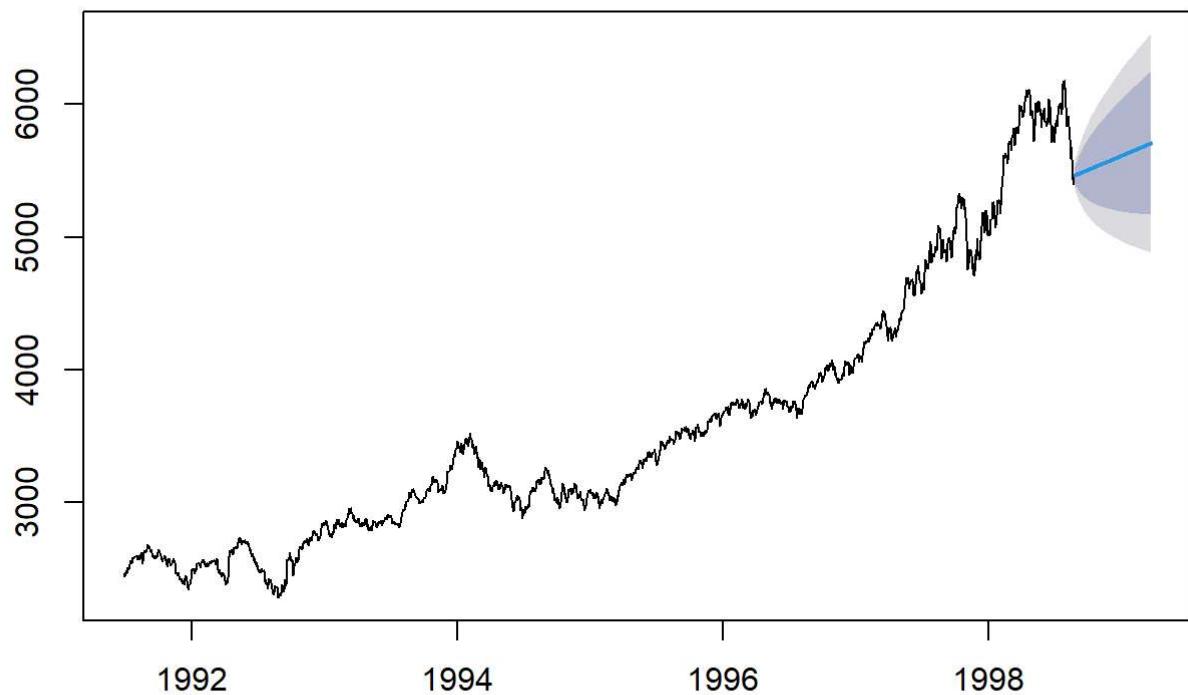
```

```

forecaste_ftse <- forecast(fit_ftse, 150)
plot(forecaste_ftse, main = "Graph with forecasting of ftse", col.main = "darkgreen")

```

## Graph with forecasting of ftse



```
print(forecaste_ftse)
```

	##	Point Forecast	Lo 80	Hi 80	Lo 95	Hi 95
##	1998.650	5464.642	5425.690	5503.594	5405.070	5524.214
##	1998.654	5466.263	5407.555	5524.970	5376.477	5556.048
##	1998.658	5467.883	5394.563	5541.204	5355.749	5580.017
##	1998.662	5469.504	5384.033	5554.974	5338.788	5600.220
##	1998.665	5471.124	5375.028	5567.221	5324.157	5618.091
##	1998.669	5472.745	5367.086	5578.404	5311.153	5634.337
##	1998.673	5474.366	5359.940	5588.791	5299.367	5649.364
##	1998.677	5475.986	5353.420	5598.552	5288.537	5663.435
##	1998.681	5477.607	5347.408	5607.806	5278.484	5676.729
##	1998.685	5479.227	5341.819	5616.636	5269.079	5689.376
##	1998.688	5480.848	5336.590	5625.106	5260.224	5701.472
##	1998.692	5482.468	5331.671	5633.266	5251.844	5713.093
##	1998.696	5484.089	5327.025	5641.153	5243.881	5724.298
##	1998.700	5485.710	5322.620	5648.800	5236.285	5735.135
##	1998.704	5487.330	5318.429	5656.232	5229.018	5745.643
##	1998.708	5488.951	5314.431	5663.470	5222.046	5755.855
##	1998.712	5490.571	5310.609	5670.534	5215.343	5765.800
##	1998.715	5492.192	5306.947	5677.437	5208.884	5775.500
##	1998.719	5493.813	5303.431	5684.194	5202.650	5784.976
##	1998.723	5495.433	5300.051	5690.816	5196.622	5794.245
##	1998.727	5497.054	5296.795	5697.313	5190.784	5803.323
##	1998.731	5498.674	5293.655	5703.694	5185.124	5812.225
##	1998.735	5500.295	5290.623	5709.967	5179.630	5820.960
##	1998.738	5501.916	5287.692	5716.139	5174.290	5829.542
##	1998.742	5503.536	5284.856	5722.216	5169.094	5837.978
##	1998.746	5505.157	5282.109	5728.204	5164.035	5846.279
##	1998.750	5506.777	5279.446	5734.109	5159.104	5854.451
##	1998.754	5508.398	5276.862	5739.934	5154.294	5862.502
##	1998.758	5510.019	5274.353	5745.684	5149.600	5870.438
##	1998.762	5511.639	5271.915	5751.363	5145.013	5878.265
##	1998.765	5513.260	5269.545	5756.975	5140.530	5885.989
##	1998.769	5514.880	5267.239	5762.522	5136.146	5893.615
##	1998.773	5516.501	5264.995	5768.007	5131.855	5901.147
##	1998.777	5518.122	5262.809	5773.435	5127.654	5908.589
##	1998.781	5519.742	5260.678	5778.806	5123.538	5915.946
##	1998.785	5521.363	5258.602	5784.124	5119.504	5923.221
##	1998.788	5522.983	5256.576	5789.391	5115.549	5930.418
##	1998.792	5524.604	5254.600	5794.608	5111.669	5937.539
##	1998.796	5526.225	5252.671	5799.778	5107.861	5944.588
##	1998.800	5527.845	5250.788	5804.902	5104.123	5951.568
##	1998.804	5529.466	5248.948	5809.983	5100.451	5958.480
##	1998.808	5531.086	5247.151	5815.022	5096.845	5965.328
##	1998.812	5532.707	5245.394	5820.020	5093.300	5972.114
##	1998.815	5534.328	5243.677	5824.979	5089.815	5978.840
##	1998.819	5535.948	5241.997	5829.899	5086.389	5985.508
##	1998.823	5537.569	5240.354	5834.784	5083.018	5992.120
##	1998.827	5539.189	5238.747	5839.632	5079.702	5998.677
##	1998.831	5540.810	5237.173	5844.447	5076.438	6005.182
##	1998.835	5542.431	5235.633	5849.228	5073.225	6011.637
##	1998.838	5544.051	5234.126	5853.977	5070.061	6018.042
##	1998.842	5545.672	5232.649	5858.695	5066.945	6024.399

## 1998.846	5547.292	5231.203	5863.382	5063.875	6030.710
## 1998.850	5548.913	5229.786	5868.040	5060.851	6036.975
## 1998.854	5550.534	5228.398	5872.669	5057.870	6043.197
## 1998.858	5552.154	5227.038	5877.270	5054.932	6049.376
## 1998.862	5553.775	5225.705	5881.845	5052.035	6055.514
## 1998.865	5555.395	5224.398	5886.393	5049.179	6061.612
## 1998.869	5557.016	5223.117	5890.915	5046.362	6067.670
## 1998.873	5558.637	5221.861	5895.412	5043.583	6073.690
## 1998.877	5560.257	5220.629	5899.885	5040.841	6079.673
## 1998.881	5561.878	5219.421	5904.334	5038.136	6085.620
## 1998.885	5563.498	5218.237	5908.760	5035.466	6091.531
## 1998.888	5565.119	5217.074	5913.164	5032.831	6097.407
## 1998.892	5566.740	5215.934	5917.545	5030.229	6103.250
## 1998.896	5568.360	5214.816	5921.905	5027.661	6109.060
## 1998.900	5569.981	5213.718	5926.243	5025.124	6114.837
## 1998.904	5571.601	5212.641	5930.561	5022.619	6120.583
## 1998.908	5573.222	5211.585	5934.859	5020.145	6126.299
## 1998.912	5574.843	5210.547	5939.138	5017.701	6131.984
## 1998.915	5576.463	5209.530	5943.397	5015.287	6137.640
## 1998.919	5578.084	5208.531	5947.637	5012.901	6143.267
## 1998.923	5579.704	5207.550	5951.859	5010.543	6148.865
## 1998.927	5581.325	5206.587	5956.063	5008.213	6154.437
## 1998.931	5582.946	5205.643	5960.249	5005.910	6159.981
## 1998.935	5584.566	5204.715	5964.417	5003.634	6165.498
## 1998.938	5586.187	5203.805	5968.569	5001.384	6170.990
## 1998.942	5587.807	5202.911	5972.704	4999.159	6176.456
## 1998.946	5589.428	5202.033	5976.823	4996.959	6181.897
## 1998.950	5591.049	5201.171	5980.926	4994.783	6187.314
## 1998.954	5592.669	5200.326	5985.013	4992.631	6192.707
## 1998.958	5594.290	5199.495	5989.084	4990.504	6198.076
## 1998.962	5595.910	5198.680	5993.141	4988.399	6203.422
## 1998.965	5597.531	5197.879	5997.183	4986.317	6208.745
## 1998.969	5599.152	5197.093	6001.210	4984.257	6214.046
## 1998.973	5600.772	5196.322	6005.222	4982.219	6219.326
## 1998.977	5602.393	5195.564	6009.221	4980.202	6224.583
## 1998.981	5604.013	5194.821	6013.206	4978.207	6229.820
## 1998.985	5605.634	5194.090	6017.177	4976.233	6235.035
## 1998.988	5607.255	5193.374	6021.135	4974.278	6240.231
## 1998.992	5608.875	5192.670	6025.080	4972.344	6245.406
## 1998.996	5610.496	5191.979	6029.012	4970.430	6250.561
## 1999.000	5612.116	5191.301	6032.931	4968.535	6255.697
## 1999.004	5613.737	5190.636	6036.838	4966.660	6260.814
## 1999.008	5615.358	5189.982	6040.733	4964.803	6265.913
## 1999.012	5616.978	5189.341	6044.615	4962.964	6270.992
## 1999.015	5618.599	5188.712	6048.485	4961.144	6276.054
## 1999.019	5620.219	5188.094	6052.344	4959.341	6281.097
## 1999.023	5621.840	5187.488	6056.191	4957.557	6286.123
## 1999.027	5623.461	5186.894	6060.027	4955.789	6291.132
## 1999.031	5625.081	5186.310	6063.852	4954.039	6296.123
## 1999.035	5626.702	5185.738	6067.666	4952.306	6301.098
## 1999.038	5628.322	5185.176	6071.468	4950.589	6306.056
## 1999.042	5629.943	5184.625	6075.261	4948.888	6310.998

```

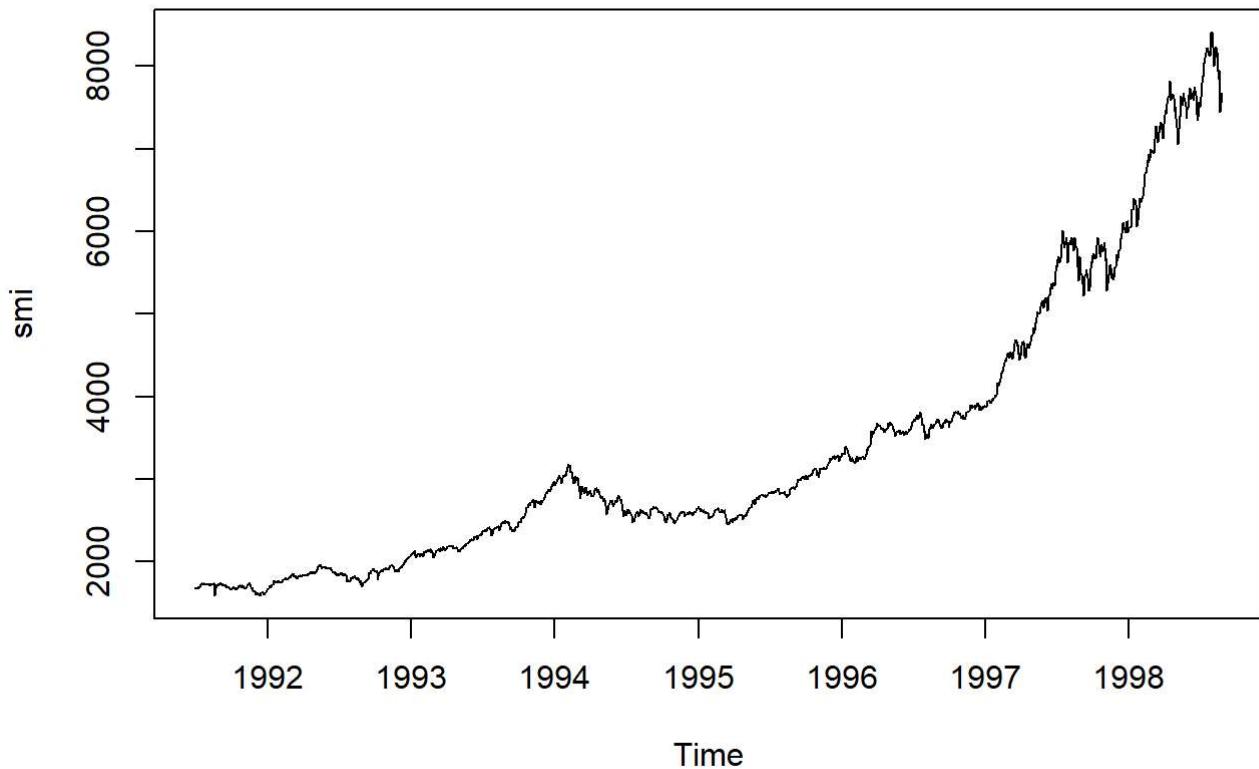
## 1999.046 5631.564 5184.085 6079.042 4947.204 6315.923
## 1999.050 5633.184 5183.555 6082.813 4945.536 6320.833
## 1999.054 5634.805 5183.035 6086.574 4943.883 6325.727
## 1999.058 5636.425 5182.525 6090.325 4942.245 6330.605
## 1999.062 5638.046 5182.026 6094.066 4940.623 6335.469
## 1999.065 5639.667 5181.536 6097.797 4939.016 6340.317
## 1999.069 5641.287 5181.056 6101.519 4937.424 6345.150
## 1999.073 5642.908 5180.585 6105.231 4935.846 6349.969
## 1999.077 5644.528 5180.124 6108.933 4934.283 6354.774
## 1999.081 5646.149 5179.672 6112.626 4932.734 6359.564
## 1999.085 5647.770 5179.229 6116.310 4931.198 6364.341
## 1999.088 5649.390 5178.795 6119.985 4929.677 6369.103
## 1999.092 5651.011 5178.370 6123.651 4928.170 6373.852
## 1999.096 5652.631 5177.954 6127.308 4926.675 6378.587
## 1999.100 5654.252 5177.547 6130.957 4925.195 6383.309
## 1999.104 5655.872 5177.148 6134.597 4923.727 6388.018
## 1999.108 5657.493 5176.758 6138.228 4922.272 6392.714
## 1999.112 5659.114 5176.376 6141.851 4920.830 6397.397
## 1999.115 5660.734 5176.003 6145.466 4919.401 6402.068
## 1999.119 5662.355 5175.637 6149.073 4917.984 6406.725
## 1999.123 5663.975 5175.280 6152.671 4916.580 6411.371
## 1999.127 5665.596 5174.930 6156.262 4915.188 6416.005
## 1999.131 5667.217 5174.589 6159.844 4913.807 6420.626
## 1999.135 5668.837 5174.255 6163.419 4912.439 6425.235
## 1999.138 5670.458 5173.929 6166.987 4911.083 6429.833
## 1999.142 5672.078 5173.611 6170.546 4909.738 6434.419
## 1999.146 5673.699 5173.300 6174.098 4908.404 6438.994
## 1999.150 5675.320 5172.996 6177.643 4907.082 6443.557
## 1999.154 5676.940 5172.700 6181.180 4905.772 6448.109
## 1999.158 5678.561 5172.411 6184.710 4904.472 6452.650
## 1999.162 5680.181 5172.130 6188.233 4903.183 6457.180
## 1999.165 5681.802 5171.855 6191.749 4901.905 6461.699
## 1999.169 5683.423 5171.587 6195.258 4900.638 6466.207
## 1999.173 5685.043 5171.327 6198.760 4899.382 6470.705
## 1999.177 5686.664 5171.073 6202.255 4898.136 6475.192
## 1999.181 5688.284 5170.826 6205.743 4896.900 6479.669
## 1999.185 5689.905 5170.586 6209.224 4895.675 6484.136
## 1999.188 5691.526 5170.352 6212.699 4894.459 6488.592
## 1999.192 5693.146 5170.125 6216.168 4893.254 6493.038
## 1999.196 5694.767 5169.904 6219.629 4892.059 6497.475
## 1999.200 5696.387 5169.690 6223.085 4890.874 6501.901
## 1999.204 5698.008 5169.483 6226.534 4889.698 6506.318
## 1999.208 5699.629 5169.281 6229.976 4888.532 6510.725
## 1999.212 5701.249 5169.086 6233.413 4887.376 6515.123
## 1999.215 5702.870 5168.897 6236.843 4886.229 6519.511
## 1999.219 5704.490 5168.714 6240.267 4885.091 6523.890
## 1999.223 5706.111 5168.537 6243.685 4883.963 6528.260

```

```

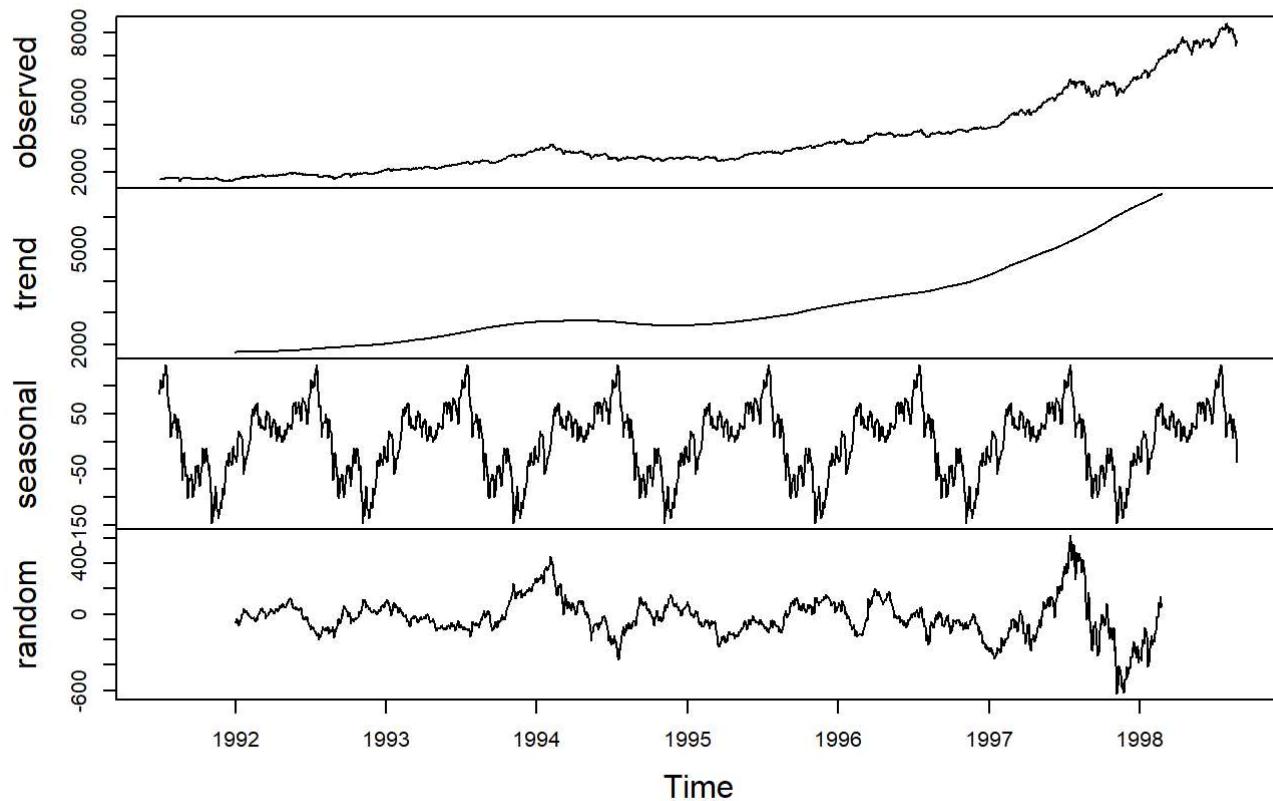
smi=(EuStockMarkets[,2])
plot(smi)

```



```
components.ts = decompose(smi)
plot(components.ts)
```

## Decomposition of additive time series



```
fit_smi <- auto.arima(smi, trace=TRUE)
```

```

## 
## Fitting models using approximations to speed things up...
## 
## ARIMA(2,2,2)(1,0,1)[260] : Inf
## ARIMA(0,2,0) : 20131.81
## ARIMA(1,2,0)(1,0,0)[260] : Inf
## ARIMA(0,2,1)(0,0,1)[260] : Inf
## ARIMA(0,2,0)(1,0,0)[260] : Inf
## ARIMA(0,2,0)(0,0,1)[260] : Inf
## ARIMA(0,2,0)(1,0,1)[260] : Inf
## ARIMA(1,2,0) : 19656.54
## ARIMA(1,2,0)(0,0,1)[260] : Inf
## ARIMA(1,2,0)(1,0,1)[260] : Inf
## ARIMA(2,2,0) : 19471.95
## ARIMA(2,2,0)(1,0,0)[260] : Inf
## ARIMA(2,2,0)(0,0,1)[260] : Inf
## ARIMA(2,2,0)(1,0,1)[260] : Inf
## ARIMA(3,2,0) : 19389.41
## ARIMA(3,2,0)(1,0,0)[260] : Inf
## ARIMA(3,2,0)(0,0,1)[260] : Inf
## ARIMA(3,2,0)(1,0,1)[260] : Inf
## ARIMA(4,2,0) : 19351.77
## ARIMA(4,2,0)(1,0,0)[260] : Inf
## ARIMA(4,2,0)(0,0,1)[260] : Inf
## ARIMA(4,2,0)(1,0,1)[260] : Inf
## ARIMA(5,2,0) : 19282.73
## ARIMA(5,2,0)(1,0,0)[260] : Inf
## ARIMA(5,2,0)(0,0,1)[260] : Inf
## ARIMA(5,2,0)(1,0,1)[260] : Inf
## ARIMA(5,2,1) : Inf
## ARIMA(4,2,1) : Inf
## 
## Now re-fitting the best model(s) without approximations...
## 
## ARIMA(5,2,0) : 19295.02
## 
## Best model: ARIMA(5,2,0)

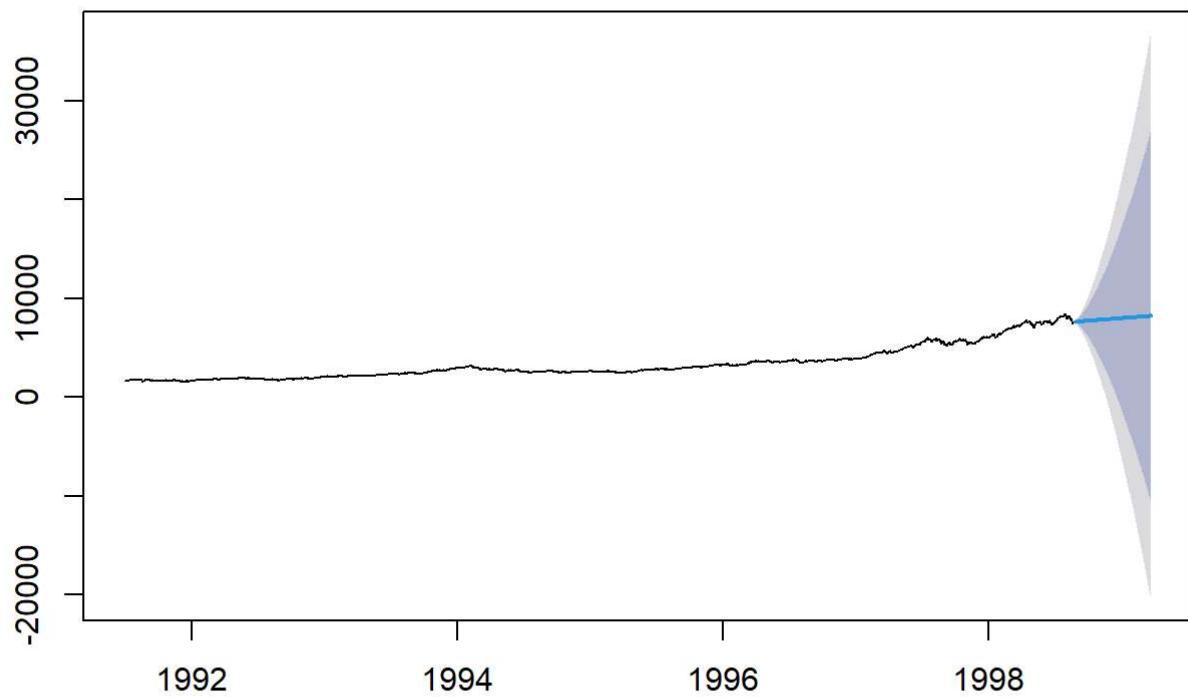
```

```

forecase_smi <- forecast(fit_smi, 150)
plot(forecase_smi, main = "Graph with forecasting of smi", col.main = "darkgreen")

```

## Graph with forecasting of smi



```
print(forecaste_smi)
```

##	Point Forecast	Lo 80	Hi 80	Lo 95	Hi 95
## 1998.650	7687.499	7631.83090	7743.168	7602.36172	7772.637
## 1998.654	7652.238	7563.18203	7741.293	7516.03889	7788.436
## 1998.658	7617.448	7495.74729	7739.148	7431.32291	7803.573
## 1998.662	7646.633	7490.80986	7802.457	7408.32188	7884.945
## 1998.665	7644.052	7451.92849	7836.176	7350.22426	7937.880
## 1998.669	7664.777	7434.10988	7895.444	7312.00220	8017.551
## 1998.673	7668.581	7393.15781	7944.004	7247.35772	8089.804
## 1998.677	7666.203	7344.07701	7988.329	7173.55370	8158.853
## 1998.681	7664.865	7294.12510	8035.604	7097.86750	8231.862
## 1998.685	7672.903	7251.52019	8094.287	7028.45340	8317.353
## 1998.688	7676.172	7202.08064	8150.262	6951.11208	8401.231
## 1998.692	7682.438	7153.62980	8211.246	6873.69566	8491.180
## 1998.696	7686.193	7100.28876	8272.097	6790.12987	8582.256
## 1998.700	7689.157	7044.30095	8334.014	6702.93465	8675.380
## 1998.704	7692.413	6986.80416	8398.023	6613.27722	8771.549
## 1998.708	7697.032	6928.89039	8465.173	6522.26091	8871.803
## 1998.712	7700.925	6868.50419	8533.346	6427.84717	8974.003
## 1998.715	7705.198	6806.79484	8603.602	6331.20874	9079.188
## 1998.719	7709.104	6743.00807	8675.200	6231.58780	9186.620
## 1998.723	7712.914	6677.51184	8748.316	6129.40315	9296.424
## 1998.727	7716.786	6610.50075	8823.071	6024.86874	9408.703
## 1998.731	7720.854	6542.13781	8899.570	5918.16313	9523.545
## 1998.735	7724.811	6472.14567	8977.476	5809.02475	9640.597
## 1998.738	7728.815	6400.71350	9056.917	5697.65897	9759.971
## 1998.742	7732.766	6327.76405	9137.769	5584.00075	9881.532
## 1998.746	7736.707	6253.37408	9220.040	5468.14514	10005.269
## 1998.750	7740.659	6177.59172	9303.727	5350.15378	10131.165
## 1998.754	7744.639	6100.45656	9388.822	5230.07875	10259.200
## 1998.758	7748.602	6021.94634	9475.258	5107.90983	10389.295
## 1998.762	7752.571	5942.10613	9563.036	4983.70379	10521.439
## 1998.765	7756.533	5860.94293	9652.122	4857.47840	10655.587
## 1998.769	7760.493	5778.48425	9742.501	4729.27228	10791.713
## 1998.773	7764.455	5694.75230	9834.158	4599.11778	10929.793
## 1998.777	7768.421	5609.76712	9927.076	4467.04453	11069.798
## 1998.781	7772.385	5523.53961	10021.231	4333.07273	11211.697
## 1998.785	7776.349	5436.09000	10116.609	4197.23151	11355.467
## 1998.788	7780.313	5347.43262	10213.193	4059.54372	11501.082
## 1998.792	7784.276	5257.58413	10310.968	3920.03432	11648.517
## 1998.796	7788.239	5166.55990	10409.919	3778.72658	11797.752
## 1998.800	7792.204	5074.37449	10510.033	3635.64270	11948.764
## 1998.804	7796.167	4981.04082	10611.294	3490.80294	12101.531
## 1998.808	7800.131	4886.57281	10713.689	3344.22829	12256.034
## 1998.812	7804.095	4790.98316	10817.206	3195.93831	12412.251
## 1998.815	7808.058	4694.28453	10921.832	3045.95230	12570.164
## 1998.819	7812.022	4596.48907	11027.555	2894.28881	12729.755
## 1998.823	7815.986	4497.60852	11134.363	2740.96576	12891.006
## 1998.827	7819.949	4397.65405	11242.245	2586.00035	13053.898
## 1998.831	7823.913	4296.63676	11351.189	2429.40948	13218.417
## 1998.835	7827.877	4194.56726	11461.186	2271.20940	13384.544
## 1998.838	7831.840	4091.45593	11572.225	2111.41598	13552.265
## 1998.842	7835.804	3987.31282	11684.295	1950.04458	13721.564

## 1998.846	7839.768	3882.14769	11797.388	1787.11013	13892.426
## 1998.850	7843.732	3775.97000	11911.493	1622.62713	14064.836
## 1998.854	7847.695	3668.78901	12026.601	1456.60969	14238.781
## 1998.858	7851.659	3560.61369	12142.704	1289.07155	14414.246
## 1998.862	7855.623	3451.45277	12259.792	1120.02609	14591.219
## 1998.865	7859.586	3341.31480	12377.858	949.48634	14769.686
## 1998.869	7863.550	3230.20805	12496.892	777.46498	14949.635
## 1998.873	7867.514	3118.14062	12616.887	603.97438	15131.053
## 1998.877	7871.477	3005.12041	12737.834	429.02663	15313.928
## 1998.881	7875.441	2891.15511	12859.727	252.63350	15498.249
## 1998.885	7879.405	2776.25225	12982.557	74.80647	15684.003
## 1998.888	7883.368	2660.41915	13106.318	-104.44321	15871.180
## 1998.892	7887.332	2543.66300	13231.001	-285.10459	16059.769
## 1998.896	7891.296	2425.99079	13356.601	-467.16696	16249.759
## 1998.900	7895.260	2307.40939	13483.110	-650.61982	16441.139
## 1998.904	7899.223	2187.92547	13610.521	-835.45295	16633.899
## 1998.908	7903.187	2067.54561	13738.828	-1021.65632	16828.030
## 1998.912	7907.151	1946.27621	13868.025	-1209.22012	17023.521
## 1998.915	7911.114	1824.12354	13998.105	-1398.13476	17220.363
## 1998.919	7915.078	1701.09375	14129.062	-1588.39084	17418.547
## 1998.923	7919.042	1577.19286	14260.891	-1779.97915	17618.063
## 1998.927	7923.005	1452.42676	14393.584	-1972.89069	17818.902
## 1998.931	7926.969	1326.80123	14527.137	-2167.11661	18021.055
## 1998.935	7930.933	1200.32194	14661.544	-2362.64825	18224.514
## 1998.938	7934.897	1072.99443	14796.799	-2559.47712	18429.270
## 1998.942	7938.860	944.82416	14932.896	-2757.59489	18635.315
## 1998.946	7942.824	815.81646	15069.831	-2956.99339	18842.641
## 1998.950	7946.788	685.97658	15207.599	-3157.66460	19051.240
## 1998.954	7950.751	555.30967	15346.193	-3359.60066	19261.103
## 1998.958	7954.715	423.82076	15485.609	-3562.79384	19472.224
## 1998.962	7958.679	291.51483	15625.843	-3767.23656	19684.594
## 1998.965	7962.642	158.39674	15766.888	-3972.92136	19898.206
## 1998.969	7966.606	24.47127	15908.741	-4179.84094	20113.053
## 1998.973	7970.570	-110.25687	16051.396	-4387.98811	20329.128
## 1998.977	7974.533	-245.78306	16194.850	-4597.35579	20546.423
## 1998.981	7978.497	-382.10277	16339.097	-4807.93705	20764.931
## 1998.985	7982.461	-519.21153	16484.133	-5019.72505	20984.647
## 1998.988	7986.425	-657.10495	16629.954	-5232.71309	21205.562
## 1998.992	7990.388	-795.77871	16776.555	-5446.89456	21427.671
## 1998.996	7994.352	-935.22857	16923.933	-5662.26297	21650.967
## 1999.000	7998.316	-1075.45035	17072.082	-5878.81193	21875.443
## 1999.004	8002.279	-1216.43994	17220.999	-6096.53516	22101.094
## 1999.008	8006.243	-1358.19329	17370.679	-6315.42645	22327.913
## 1999.012	8010.207	-1500.70642	17521.120	-6535.47973	22555.893
## 1999.015	8014.170	-1643.97541	17672.316	-6756.68900	22785.030
## 1999.019	8018.134	-1787.99640	17824.265	-6979.04834	23015.317
## 1999.023	8022.098	-1932.76558	17976.961	-7202.55195	23246.748
## 1999.027	8026.062	-2078.27921	18130.402	-7427.19410	23479.317
## 1999.031	8030.025	-2224.53361	18284.584	-7652.96915	23713.020
## 1999.035	8033.989	-2371.52513	18439.503	-7879.87153	23947.849
## 1999.038	8037.953	-2519.25019	18595.155	-8107.89577	24183.801
## 1999.042	8041.916	-2667.70526	18751.538	-8337.03646	24420.869

```

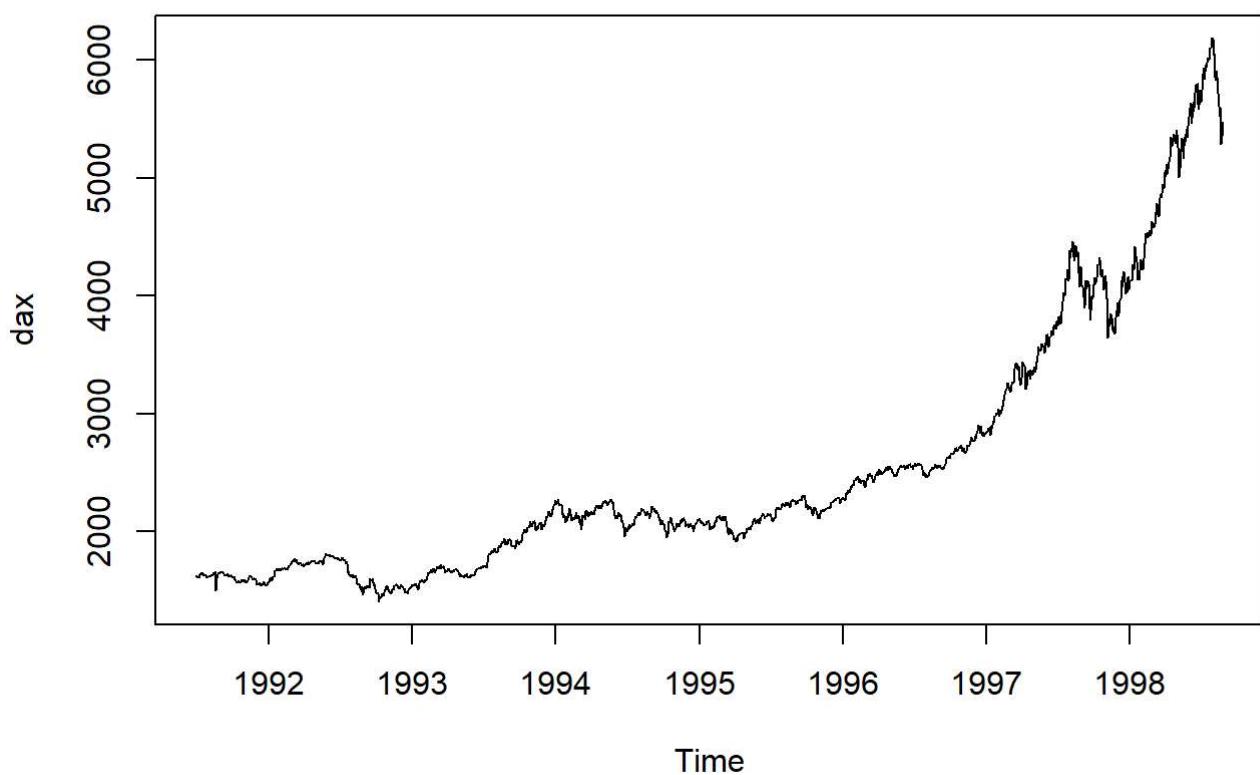
## 1999.046 8045.880 -2816.88686 18908.647 -8567.28829 24659.048
## 1999.050 8049.844 -2966.79157 19066.479 -8798.64601 24898.333
## 1999.054 8053.807 -3117.41600 19225.031 -9031.10445 25138.719
## 1999.058 8057.771 -3268.75681 19384.299 -9264.65850 25380.201
## 1999.062 8061.735 -3420.81071 19544.280 -9499.30313 25622.773
## 1999.065 8065.698 -3573.57446 19704.971 -9735.03338 25866.430
## 1999.069 8069.662 -3727.04487 19866.369 -9971.84436 26111.169
## 1999.073 8073.626 -3881.21876 20028.471 -10209.73123 26356.983
## 1999.077 8077.590 -4036.09302 20191.272 -10448.68924 26603.868
## 1999.081 8081.553 -4191.66459 20354.771 -10688.71367 26851.820
## 1999.085 8085.517 -4347.93042 20518.964 -10929.79989 27100.834
## 1999.088 8089.481 -4504.88753 20683.849 -11171.94332 27350.905
## 1999.092 8093.444 -4662.53294 20849.422 -11415.13943 27602.028
## 1999.096 8097.408 -4820.86375 21015.680 -11659.38376 27854.200
## 1999.100 8101.372 -4979.87707 21182.621 -11904.67190 28107.415
## 1999.104 8105.335 -5139.57005 21350.241 -12150.99950 28361.670
## 1999.108 8109.299 -5299.93989 21518.538 -12398.36225 28616.961
## 1999.112 8113.263 -5460.98381 21687.509 -12646.75592 28873.282
## 1999.115 8117.227 -5622.69906 21857.152 -12896.17631 29130.629
## 1999.119 8121.190 -5785.08293 22027.463 -13146.61927 29389.000
## 1999.123 8125.154 -5948.13275 22198.441 -13398.08070 29648.389
## 1999.127 8129.118 -6111.84588 22370.081 -13650.55658 29908.792
## 1999.131 8133.081 -6276.21969 22542.382 -13904.04289 30170.206
## 1999.135 8137.045 -6441.25161 22715.342 -14158.53568 30432.626
## 1999.138 8141.009 -6606.93909 22888.957 -14414.03106 30696.048
## 1999.142 8144.972 -6773.27959 23063.224 -14670.52517 30960.470
## 1999.146 8148.936 -6940.27063 23238.143 -14928.01418 31225.886
## 1999.150 8152.900 -7107.90974 23413.709 -15186.49433 31492.294
## 1999.154 8156.863 -7276.19448 23589.921 -15445.96188 31759.689
## 1999.158 8160.827 -7445.12244 23766.777 -15706.41315 32028.068
## 1999.162 8164.791 -7614.69124 23944.273 -15967.84450 32297.426
## 1999.165 8168.755 -7784.89851 24122.408 -16230.25232 32567.761
## 1999.169 8172.718 -7955.74193 24301.178 -16493.63303 32839.070
## 1999.173 8176.682 -8127.21919 24480.583 -16757.98312 33111.347
## 1999.177 8180.646 -8299.32800 24660.619 -17023.29909 33384.590
## 1999.181 8184.609 -8472.06612 24841.285 -17289.57749 33658.796
## 1999.185 8188.573 -8645.43130 25022.577 -17556.81491 33933.961
## 1999.188 8192.537 -8819.42134 25204.495 -17825.00796 34210.081
## 1999.192 8196.500 -8994.03404 25387.035 -18094.15331 34487.154
## 1999.196 8200.464 -9169.26726 25570.196 -18364.24764 34765.176
## 1999.200 8204.428 -9345.11884 25753.975 -18635.28768 35044.143
## 1999.204 8208.392 -9521.58667 25938.370 -18907.27018 35324.053
## 1999.208 8212.355 -9698.66864 26123.379 -19180.19194 35604.902
## 1999.212 8216.319 -9876.36269 26309.001 -19454.04979 35886.688
## 1999.215 8220.283 -10054.66675 26495.232 -19728.84058 36169.406
## 1999.219 8224.246 -10233.57880 26682.071 -20004.56119 36453.054
## 1999.223 8228.210 -10413.09681 26869.517 -20281.20855 36737.629

```

```

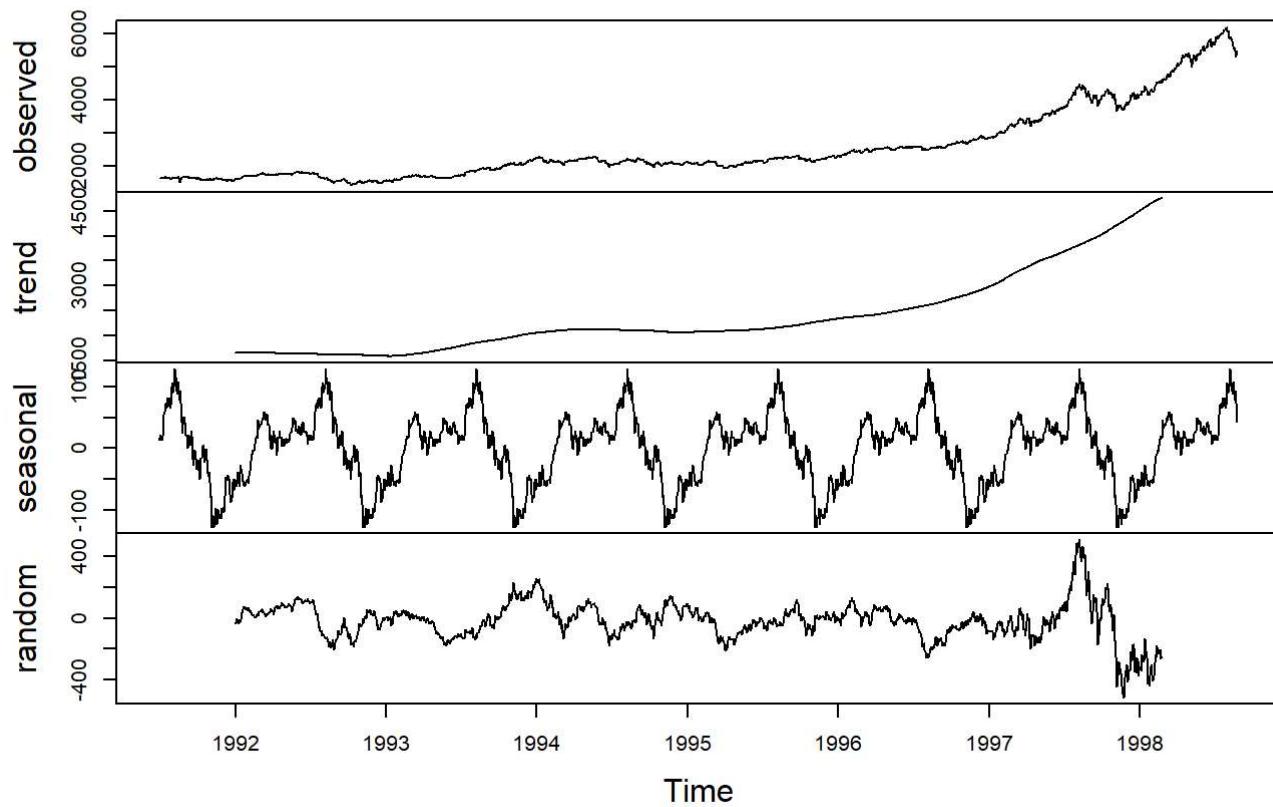
dax=(EuStockMarkets[,1])
plot(dax)

```



```
components.ts = decompose(dax)
plot(components.ts)
```

## Decomposition of additive time series



```
fit_dax <- auto.arima(dax, trace=TRUE)
```

```

## 
## Fitting models using approximations to speed things up...
##
## ARIMA(2,2,2)(1,0,1)[260] : Inf
## ARIMA(0,2,0) : 19475.21
## ARIMA(1,2,0)(1,0,0)[260] : Inf
## ARIMA(0,2,1)(0,0,1)[260] : Inf
## ARIMA(0,2,0)(1,0,0)[260] : Inf
## ARIMA(0,2,0)(0,0,1)[260] : Inf
## ARIMA(0,2,0)(1,0,1)[260] : Inf
## ARIMA(1,2,0) : 18963.57
## ARIMA(1,2,0)(0,0,1)[260] : Inf
## ARIMA(1,2,0)(1,0,1)[260] : Inf
## ARIMA(2,2,0) : 18749.75
## ARIMA(2,2,0)(1,0,0)[260] : Inf
## ARIMA(2,2,0)(0,0,1)[260] : Inf
## ARIMA(2,2,0)(1,0,1)[260] : Inf
## ARIMA(3,2,0) : 18635.06
## ARIMA(3,2,0)(1,0,0)[260] : Inf
## ARIMA(3,2,0)(0,0,1)[260] : Inf
## ARIMA(3,2,0)(1,0,1)[260] : Inf
## ARIMA(4,2,0) : 18584.6
## ARIMA(4,2,0)(1,0,0)[260] : Inf
## ARIMA(4,2,0)(0,0,1)[260] : Inf
## ARIMA(4,2,0)(1,0,1)[260] : Inf
## ARIMA(5,2,0) : 18495.78
## ARIMA(5,2,0)(1,0,0)[260] : Inf
## ARIMA(5,2,0)(0,0,1)[260] : Inf
## ARIMA(5,2,0)(1,0,1)[260] : Inf
## ARIMA(5,2,1) : 18223.75
## ARIMA(5,2,1)(1,0,0)[260] : Inf
## ARIMA(5,2,1)(0,0,1)[260] : Inf
## ARIMA(5,2,1)(1,0,1)[260] : Inf
## ARIMA(4,2,1) : Inf
## ARIMA(5,2,2) : Inf
## ARIMA(4,2,2) : Inf
##
## Now re-fitting the best model(s) without approximations...
##
## ARIMA(5,2,1) : Inf
## ARIMA(5,2,0) : 18508.04
##
## Best model: ARIMA(5,2,0)

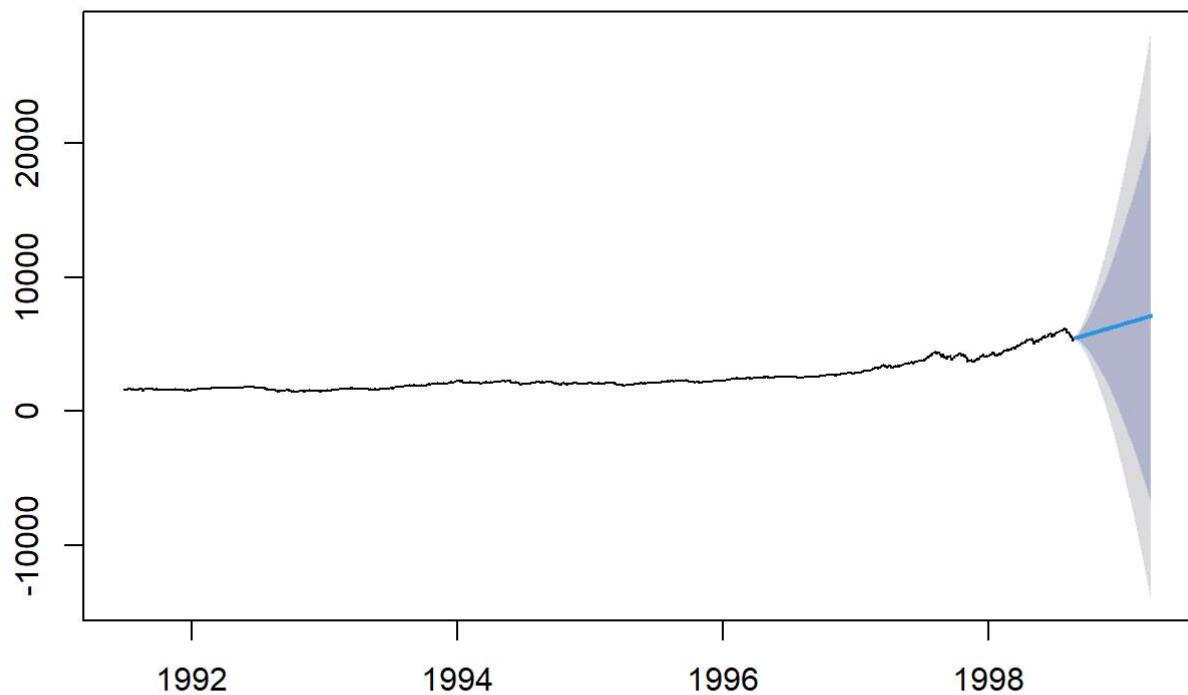
```

```

forecaste_dax <- forecast(fit_dax, 150)
plot(forecaste_dax, main = "Graph with forecasting of dax", col.main = "darkgreen")

```

## Graph with forecasting of dax



```
print(forecaste_dax)
```

##	Point	Forecast	Lo 80	Hi 80	Lo 95	Hi 95
##	1998.650	5477.071	5432.02996	5522.113	5408.18642	5545.957
##	1998.654	5455.437	5385.72621	5525.148	5348.82337	5562.051
##	1998.658	5438.930	5345.83957	5532.020	5296.56051	5581.299
##	1998.662	5470.902	5353.45411	5588.349	5291.28107	5650.522
##	1998.665	5478.529	5334.55983	5622.498	5258.34723	5698.710
##	1998.669	5505.691	5333.18248	5678.199	5241.86212	5769.519
##	1998.673	5512.314	5306.11510	5718.513	5196.95988	5827.669
##	1998.677	5517.260	5276.48198	5758.037	5149.02196	5885.497
##	1998.681	5524.894	5248.36282	5801.426	5101.97581	5947.813
##	1998.685	5540.523	5226.76715	5854.279	5060.67485	6020.371
##	1998.688	5551.386	5198.74638	5904.026	5012.07011	6090.702
##	1998.692	5564.652	5171.57225	5957.732	4963.48846	6165.815
##	1998.696	5574.519	5139.17198	6009.867	4908.71301	6240.326
##	1998.700	5584.631	5105.76102	6063.500	4852.26279	6316.998
##	1998.704	5595.439	5071.76273	6119.116	4794.54513	6396.333
##	1998.708	5607.468	5037.67149	6177.265	4736.03925	6478.897
##	1998.712	5618.547	5001.31322	6235.781	4674.56945	6562.524
##	1998.715	5629.916	4963.98087	6295.852	4611.45597	6648.377
##	1998.719	5640.767	4924.86387	6356.669	4545.88789	6735.645
##	1998.723	5651.753	4884.71802	6418.789	4478.67404	6824.833
##	1998.727	5662.881	4843.55822	6482.203	4409.83510	6915.926
##	1998.731	5674.177	4801.42576	6546.928	4339.41932	7008.934
##	1998.735	5685.286	4757.98422	6612.588	4267.10015	7103.472
##	1998.738	5696.434	4713.48573	6679.383	4193.14411	7199.725
##	1998.742	5707.511	4667.83780	6747.183	4117.46828	7297.553
##	1998.746	5718.625	4621.18019	6816.069	4040.22809	7397.022
##	1998.750	5729.763	4573.51383	6886.012	3961.43262	7498.093
##	1998.754	5740.921	4524.85105	6956.990	3881.10266	7600.739
##	1998.758	5752.044	4475.15311	7028.934	3799.20816	7704.879
##	1998.762	5763.173	4424.47891	7101.867	3715.81718	7810.528
##	1998.765	5774.293	4372.82833	7175.758	3630.93759	7917.649
##	1998.769	5785.422	4320.23458	7250.610	3544.61107	8026.233
##	1998.773	5796.554	4266.70582	7326.403	3456.85286	8136.256
##	1998.777	5807.688	4212.25375	7403.123	3367.68162	8247.695
##	1998.781	5818.816	4156.88315	7480.749	3277.10896	8360.523
##	1998.785	5829.945	4100.61431	7559.276	3185.16182	8474.729
##	1998.788	5841.073	4043.45681	7638.690	3091.85605	8590.291
##	1998.792	5852.203	3985.42473	7718.982	2997.21186	8707.195
##	1998.796	5863.333	3926.52760	7800.139	2901.24452	8825.422
##	1998.800	5874.464	3866.77568	7882.152	2803.96987	8944.957
##	1998.804	5885.593	3806.17809	7965.007	2705.40246	9065.783
##	1998.808	5896.722	3744.74611	8048.698	2605.55878	9187.886
##	1998.812	5907.852	3682.48886	8133.214	2504.45299	9311.250
##	1998.815	5918.981	3619.41589	8218.547	2402.09950	9435.863
##	1998.819	5930.111	3555.53576	8304.686	2298.51159	9561.710
##	1998.823	5941.241	3490.85706	8391.624	2193.70237	9688.779
##	1998.827	5952.370	3425.38798	8479.352	2087.68447	9817.056
##	1998.831	5963.500	3359.13686	8567.862	1980.47049	9946.529
##	1998.835	5974.629	3292.11145	8657.147	1872.07234	10077.186
##	1998.838	5985.759	3224.31940	8747.198	1762.50169	10209.016
##	1998.842	5996.888	3155.76803	8838.009	1651.76977	10342.007

## 1998.846	6008.018	3086.46452	8929.571	1539.88756	10476.148
## 1998.850	6019.147	3016.41583	9021.879	1426.86570	10611.429
## 1998.854	6030.277	2945.62878	9114.925	1312.71461	10747.840
## 1998.858	6041.407	2874.10996	9208.703	1197.44438	10885.369
## 1998.862	6052.536	2801.86580	9303.207	1081.06484	11024.008
## 1998.865	6063.666	2728.90256	9398.429	963.58554	11163.746
## 1998.869	6074.795	2655.22633	9494.364	845.01583	11304.575
## 1998.873	6085.925	2580.84306	9591.007	725.36480	11446.485
## 1998.877	6097.054	2505.75855	9688.350	604.64132	11589.468
## 1998.881	6108.184	2429.97848	9786.390	482.85405	11733.514
## 1998.885	6119.314	2353.50835	9885.119	360.01145	11878.616
## 1998.888	6130.443	2276.35357	9984.533	236.12176	12024.765
## 1998.892	6141.573	2198.51941	10084.626	111.19305	12171.953
## 1998.896	6152.702	2120.01102	10185.394	-14.76681	12320.172
## 1998.900	6163.832	2040.83344	10286.830	-141.75012	12469.414
## 1998.904	6174.961	1960.99158	10388.931	-269.74933	12619.672
## 1998.908	6186.091	1880.49028	10491.692	-398.75710	12770.939
## 1998.912	6197.221	1799.33423	10595.107	-528.76620	12923.207
## 1998.915	6208.350	1717.52806	10699.172	-659.76958	13076.470
## 1998.919	6219.480	1635.07628	10803.883	-791.76033	13230.720
## 1998.923	6230.609	1551.98332	10909.235	-924.73168	13385.950
## 1998.927	6241.739	1468.25352	11015.224	-1058.67701	13542.155
## 1998.931	6252.868	1383.89111	11121.846	-1193.58981	13699.327
## 1998.935	6263.998	1298.90027	11229.096	-1329.46372	13857.460
## 1998.938	6275.128	1213.28509	11336.970	-1466.29250	14016.548
## 1998.942	6286.257	1127.04955	11445.465	-1604.07001	14176.584
## 1998.946	6297.387	1040.19760	11554.576	-1742.79025	14337.564
## 1998.950	6308.516	952.73308	11664.300	-1882.44732	14499.480
## 1998.954	6319.646	864.65978	11774.632	-2023.03544	14662.327
## 1998.958	6330.775	775.98142	11885.570	-2164.54893	14826.100
## 1998.962	6341.905	686.70164	11997.108	-2306.98221	14990.792
## 1998.965	6353.035	596.82402	12109.245	-2450.32981	15156.399
## 1998.969	6364.164	506.35208	12221.976	-2594.58634	15322.915
## 1998.973	6375.294	415.28928	12335.298	-2739.74651	15490.334
## 1998.977	6386.423	323.63902	12449.208	-2885.80514	15658.652
## 1998.981	6397.553	231.40463	12563.701	-3032.75710	15827.863
## 1998.985	6408.682	138.58939	12678.776	-3180.59739	15997.962
## 1998.988	6419.812	45.19655	12794.428	-3329.32106	16168.945
## 1998.992	6430.942	-48.77074	12910.654	-3478.92326	16340.807
## 1998.996	6442.071	-143.30934	13027.452	-3629.39922	16513.542
## 1999.000	6453.201	-238.41619	13144.818	-3780.74422	16687.146
## 1999.004	6464.330	-334.08825	13262.749	-3932.95366	16861.614
## 1999.008	6475.460	-430.32256	13381.242	-4086.02297	17036.943
## 1999.012	6486.589	-527.11618	13500.295	-4239.94768	17213.127
## 1999.015	6497.719	-624.46623	13619.904	-4394.72337	17390.161
## 1999.019	6508.849	-722.36987	13740.067	-4550.34571	17568.043
## 1999.023	6519.978	-820.82431	13860.781	-4706.81041	17746.767
## 1999.027	6531.108	-919.82678	13982.042	-4864.11327	17926.329
## 1999.031	6542.237	-1019.37458	14103.849	-5022.25012	18106.725
## 1999.035	6553.367	-1119.46502	14226.199	-5181.21689	18287.951
## 1999.038	6564.496	-1220.09548	14349.088	-5341.00954	18470.002
## 1999.042	6575.626	-1321.26336	14472.515	-5501.62410	18652.876

## 1999.046	6586.756	-1422.96610	14596.477	-5663.05665	18836.568
## 1999.050	6597.885	-1525.20117	14720.972	-5825.30334	19021.074
## 1999.054	6609.015	-1627.96609	14845.996	-5988.36036	19206.390
## 1999.058	6620.144	-1731.25840	14971.547	-6152.22395	19392.513
## 1999.062	6631.274	-1835.07568	15097.623	-6316.89042	19579.438
## 1999.065	6642.403	-1939.41555	15224.222	-6482.35612	19767.163
## 1999.069	6653.533	-2044.27565	15351.342	-6648.61744	19955.684
## 1999.073	6664.663	-2149.65365	15478.979	-6815.67083	20144.996
## 1999.077	6675.792	-2255.54727	15607.132	-6983.51279	20335.097
## 1999.081	6686.922	-2361.95425	15735.798	-7152.13985	20525.983
## 1999.085	6698.051	-2468.87234	15864.975	-7321.54860	20717.651
## 1999.088	6709.181	-2576.29936	15994.661	-7491.73568	20910.097
## 1999.092	6720.310	-2684.23311	16124.854	-7662.69775	21103.319
## 1999.096	6731.440	-2792.67146	16255.552	-7834.43153	21297.312
## 1999.100	6742.570	-2901.61228	16386.751	-8006.93378	21492.073
## 1999.104	6753.699	-3011.05348	16518.452	-8180.20129	21687.600
## 1999.108	6764.829	-3120.99299	16650.650	-8354.23091	21883.888
## 1999.112	6775.958	-3231.42877	16783.345	-8529.01949	22080.936
## 1999.115	6787.088	-3342.35880	16916.535	-8704.56397	22278.740
## 1999.119	6798.217	-3453.78109	17050.216	-8880.86130	22477.296
## 1999.123	6809.347	-3565.69366	17184.388	-9057.90845	22676.603
## 1999.127	6820.477	-3678.09458	17319.048	-9235.70245	22876.656
## 1999.131	6831.606	-3790.98191	17454.194	-9414.24037	23077.453
## 1999.135	6842.736	-3904.35377	17589.825	-9593.51930	23278.991
## 1999.138	6853.865	-4018.20826	17725.939	-9773.53636	23481.267
## 1999.142	6864.995	-4132.54353	17862.533	-9954.28871	23684.278
## 1999.146	6876.124	-4247.35776	17999.607	-10135.77355	23888.022
## 1999.150	6887.254	-4362.64911	18137.157	-10317.98810	24092.496
## 1999.154	6898.384	-4478.41580	18275.183	-10500.92962	24297.697
## 1999.158	6909.513	-4594.65606	18413.682	-10684.59539	24503.622
## 1999.162	6920.643	-4711.36813	18552.654	-10868.98274	24710.268
## 1999.165	6931.772	-4828.55028	18692.095	-11054.08900	24917.634
## 1999.169	6942.902	-4946.20078	18832.005	-11239.91156	25125.715
## 1999.173	6954.031	-5064.31795	18972.381	-11426.44782	25334.511
## 1999.177	6965.161	-5182.90010	19113.222	-11613.69520	25544.017
## 1999.181	6976.291	-5301.94557	19254.527	-11801.65118	25754.232
## 1999.185	6987.420	-5421.45272	19396.293	-11990.31324	25965.154
## 1999.188	6998.550	-5541.41993	19538.519	-12179.67888	26176.778
## 1999.192	7009.679	-5661.84558	19681.204	-12369.74566	26389.104
## 1999.196	7020.809	-5782.72808	19824.346	-12560.51113	26602.129
## 1999.200	7031.938	-5904.06586	19967.943	-12751.97289	26815.850
## 1999.204	7043.068	-6025.85735	20111.993	-12944.12854	27030.265
## 1999.208	7054.198	-6148.10102	20256.496	-13136.97574	27245.371
## 1999.212	7065.327	-6270.79533	20401.450	-13330.51214	27461.166
## 1999.215	7076.457	-6393.93878	20546.852	-13524.73543	27677.649
## 1999.219	7087.586	-6517.52987	20692.702	-13719.64332	27894.816
## 1999.223	7098.716	-6641.56710	20838.999	-13915.23354	28112.665

#Library(prophet)

```
#stocks <- as.data.frame(EuStockMarkets[,4])
#summary(stocks)
#pro_time <- time(EuStockMarkets[,4])
#pro_ftse <- EuStockMarkets[,4]
#head(pro_time)
```

```
#df <- data.frame (
#  ds = as.POSIXct(pro_time, format="%Y-%m-%d", tz="UTC"),
#  y = pro_ftse
#)
#summary(df)
```

```
#modpro <- prophet(df)
#forecate_pro_ftse <- make_future_dataframe(modpro, 100)
#plot(forecate_pro_ftse, main = "Graph with forecasting of ftse", col.main = "darkgreen")
```