

Hong Kong Macroeconomic Data

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Contents

Import all libraries need for the Project.

Data is available from: <https://www.kaggle.com/stanley11291985/hk-macroeconomics-data>

This data set is economic data for the Hong Kong private housing market collected between 2003 and 2019.

The data contains variables connected to the following:

- Hang Seng Index (total volume and close price)
- Index data for Consumer Price and Private Domestic Housing
- Unemployment Rate and Bank Interest Rate
- Inventory (built/sold/vacant)
- Sales Metrics (quantity/amount)

Read in the CSV file and perform summary statistics on the data. There are no missing data or outliers in our data.

```
hk_eco <- read.csv(file.choose(), header = TRUE)

head(hk_eco)

##   i..Date Private_Domestic.Price_Index. First_hand_sales_quantity
## 1 1/2/2003                64.55977          1854.689
## 2 1/3/2003                64.50685          1892.762
## 3 1/6/2003                64.45385          1931.339
## 4 1/7/2003                64.40077          1970.419
## 5 1/8/2003                64.34761          2010.002
## 6 1/9/2003                64.29437          2050.088
##   First_hand_sales_amount Total_completions Total_stock Total_take_up
## 1           5846897326        33983.76     1092844    19914.08
## 2           5927522759        33932.82     1092244    19900.01
## 3           5998876299        33882.04     1091646    19886.13
## 4           6060957947        33831.43     1091050    19872.44
## 5           6113767702        33780.98     1090457    19858.95
## 6           6157305564        33730.70     1089865    19845.65
##   Total_vacancy Unemployment_rate      CPI HIBOR_1_month HK._million HSI._close
## 1      74177.82       7.301525 73.72149      1.44420  3562189    9365.52
## 2      74155.62       7.299043 73.71708      1.41741  3562586    9583.85
## 3      74133.43       7.296561 73.71268      1.40402  3563044    9665.96
```

```

## 4      74111.24      7.294081 73.70830      1.39063      3563562      9652.40
## 5      74089.06      7.291601 73.70393      1.39732      3564141      9688.21
## 6      74066.89      7.289122 73.69957      1.43080      3564781      9675.41
##   HSI_volume
## 1 126907400
## 2 291454400
## 3 234912800
## 4 267021800
## 5 202439200
## 6 129623200

hk_eda <- hk_eco

str(hk_eda)

## 'data.frame': 4233 obs. of 14 variables:
## $ i..Date           : chr "1/2/2003" "1/3/2003" "1/6/2003" "1/7/2003" ...
## $ Private_Domestic.Price_Index.: num 64.6 64.5 64.5 64.4 64.3 ...
## $ First_hand_sales_quantity    : num 1855 1893 1931 1970 2010 ...
## $ First_hand_sales_amount     : num 5.85e+09 5.93e+09 6.00e+09 6.06e+09 6.11e+09 ...
## $ Total_completions         : num 33984 33933 33882 33831 33781 ...
## $ Total_stock               : num 1092844 1092244 1091646 1091050 1090457 ...
## $ Total_take_up             : num 19914 19900 19886 19872 19859 ...
## $ Total_vacancy             : num 74178 74156 74133 74111 74089 ...
## $ Unemployment_rate         : num 7.3 7.3 7.3 7.29 7.29 ...
## $ CPI                       : num 73.7 73.7 73.7 73.7 73.7 ...
## $ HIBOR_1_month              : num 1.44 1.42 1.4 1.39 1.4 ...
## $ HK._million                : num 3562189 3562586 3563044 3563562 3564141 ...
## $ HSI._close                 : num 9366 9584 9666 9652 9688 ...
## $ HSI_volume                 : num 1.27e+08 2.91e+08 2.35e+08 2.67e+08 2.02e+08 ...

summary(hk_eda)

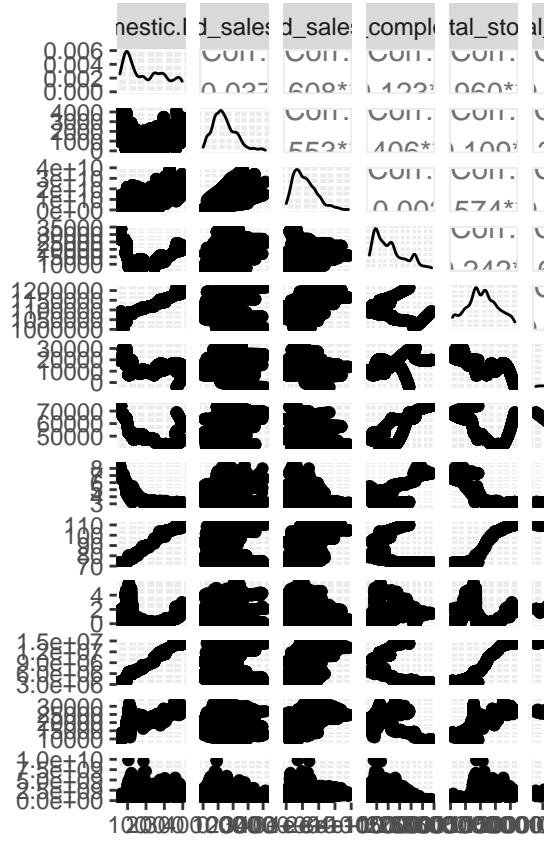
##      i..Date           Private_Domestic.Price_Index. First_hand_sales_quantity
## Length:4233          Min.    : 58.40                  Min.    : -2.691
## Class :character      1st Qu.: 96.83                  1st Qu.: 863.245
## Mode  :character      Median :181.30                  Median :1292.924
##                  Mean   :197.06                  Mean   :1406.732
##                  3rd Qu.:284.14                  3rd Qu.:1845.393
##                  Max.   :397.10                  Max.   :4151.299
## 
##      First_hand_sales_amount Total_completions  Total_stock      Total_take_up
## Min.   :4.424e+05       Min.   : 6793       Min.   :1006630      Min.   :-4077
## 1st Qu.:6.124e+09       1st Qu.: 9943       1st Qu.:1073121     1st Qu.: 9517
## Median :1.039e+10       Median :13811       Median :1106639      Median :12693
## Mean   :1.145e+10       Mean   :15387       Mean   :1106643      Mean   :14036
## 3rd Qu.:1.568e+10       3rd Qu.:19112       3rd Qu.:1142288     3rd Qu.:16988
## Max.   :3.834e+10       Max.   :33984       Max.   :1214837      Max.   :31536
## 
##      Total_vacancy      Unemployment_rate        CPI           HIBOR_1_month
## Min.   :41976       Min.   :2.800       Min.   : 71.70      Min.   :0.04018
## 1st Qu.:45759       1st Qu.:3.135       1st Qu.: 75.52      1st Qu.:0.21286
## Median :49973       Median :3.649       Median : 86.19      Median :0.34500
## Mean   :52835       Mean   :4.203       Mean   : 88.19      Mean   :1.18032
## 3rd Qu.:62995       3rd Qu.:5.077       3rd Qu.:100.30      3rd Qu.:1.74714

```

```

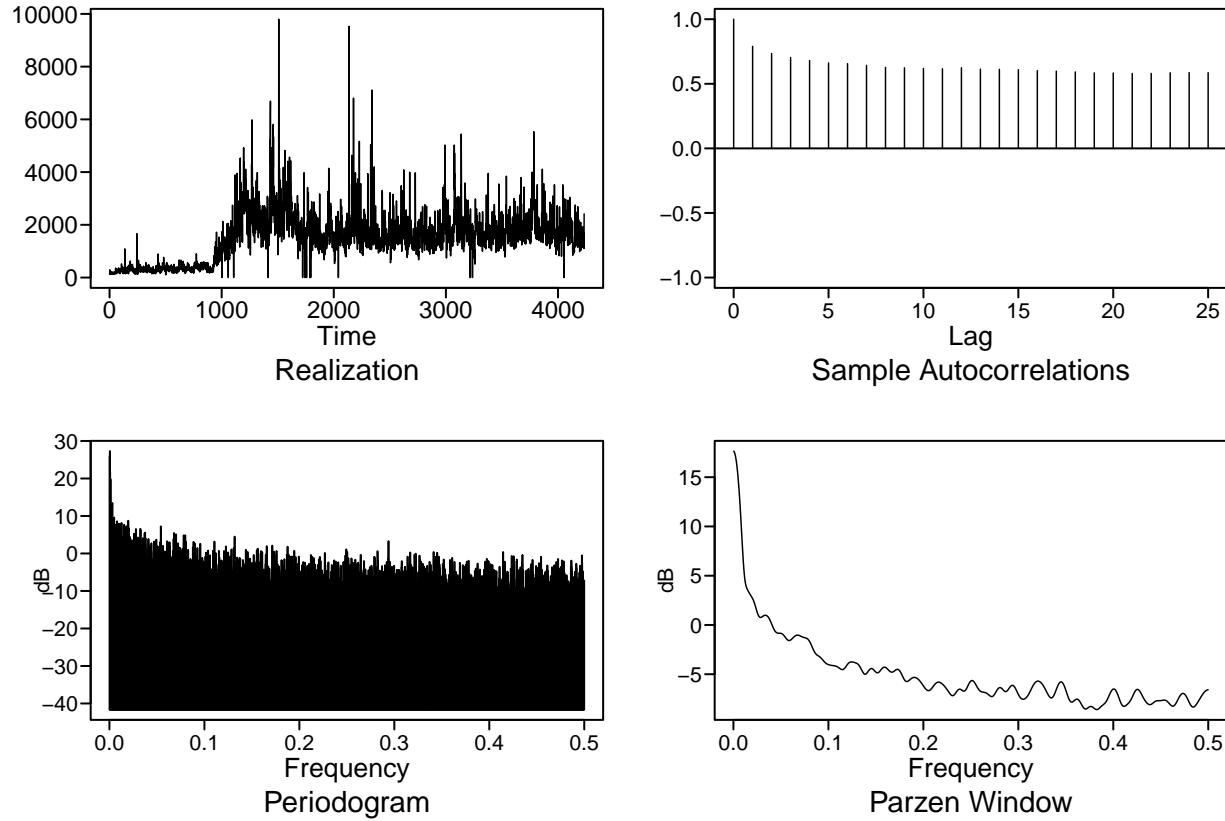
##   Max.    :74178   Max.    :8.500   Max.    :111.00   Max.    :5.70357
##   HK._million      HSI._close      HSI._volume
##   Min.    : 3548561   Min.    : 8409   Min.    :0.000e+00
##   1st Qu.: 5279677   1st Qu.:17048   1st Qu.:9.294e+08
##   Median  : 7660015   Median :21654   Median :1.495e+09
##   Mean    : 8375635   Mean    :20781   Mean    :1.492e+09
##   3rd Qu.:11478616   3rd Qu.:23920   3rd Qu.:1.947e+09
##   Max.    :14701080   Max.    :33154   Max.    :9.799e+09

```



Produce a scatter plot of columns in our dataset. All Columns are continuous.

Univariate analysis on the HSI_Volume column. This is the transaction volume for the Hang Seng Index.



```

## $autplt
## [1] 1.0000000 0.7900923 0.7342826 0.7035989 0.6804431 0.6613900 0.6558556
## [8] 0.6424089 0.6268992 0.6237527 0.6191124 0.6160999 0.6239552 0.6136393
## [15] 0.6115774 0.6094800 0.6016324 0.5980130 0.5918270 0.5845080 0.5832721
## [22] 0.5798364 0.5802631 0.5850600 0.5866467 0.5860914
##
## $freq
## [1] 0.0002362391 0.0004724781 0.0007087172 0.0009449563 0.0011811954
## [6] 0.0014174344 0.0016536735 0.0018899126 0.0021261517 0.0023623907
## [11] 0.0025986298 0.0028348689 0.0030711080 0.0033073470 0.0035435861
## [16] 0.0037798252 0.0040160643 0.0042523033 0.0044885424 0.0047247815
## [21] 0.0049610206 0.0051972596 0.0054334987 0.0056697378 0.0059059768
## [26] 0.0061422159 0.0063784550 0.0066146941 0.0068509331 0.0070871722
## [31] 0.0073234113 0.0075596504 0.0077958894 0.0080321285 0.0082683676
## [36] 0.0085046067 0.0087408457 0.0089770848 0.0092133239 0.0094495630
## [41] 0.0096858020 0.0099220411 0.0101582802 0.0103945193 0.0106307583
## [46] 0.0108669974 0.0111032365 0.0113394755 0.0115757146 0.0118119537
## [51] 0.0120481928 0.0122844318 0.0125206709 0.0127569100 0.0129931491
## [56] 0.0132293881 0.0134656272 0.0137018663 0.0139381054 0.0141743444
## [61] 0.0144105835 0.0146468226 0.0148830617 0.0151193007 0.0153555398
## [66] 0.0155917789 0.0158280180 0.0160642570 0.0163004961 0.0165367352
## [71] 0.0167729742 0.0170092133 0.0172454524 0.0174816915 0.0177179305
## [76] 0.0179541696 0.0181904087 0.0184266478 0.0186628868 0.0188991259
## [81] 0.0191353650 0.0193716041 0.0196078431 0.0198440822 0.0200803213
## [86] 0.0203165604 0.0205527994 0.0207890385 0.0210252776 0.0212615167
## [91] 0.0214977557 0.0217339948 0.0219702339 0.0222064730 0.0224427120

```

```

## [96] 0.0226789511 0.0229151902 0.0231514292 0.0233876683 0.0236239074
## [101] 0.0238601465 0.0240963855 0.0243326246 0.0245688637 0.0248051028
## [106] 0.0250413418 0.0252775809 0.0255138200 0.0257500591 0.0259862981
## [111] 0.0262225372 0.0264587763 0.0266950154 0.0269312544 0.0271674935
## [116] 0.0274037326 0.0276399717 0.0278762107 0.0281124498 0.0283486889
## [121] 0.0285849279 0.0288211670 0.0290574061 0.0292936452 0.0295298842
## [126] 0.0297661233 0.0300023624 0.0302386015 0.0304748405 0.0307110796
## [131] 0.0309473187 0.0311835578 0.0314197968 0.0316560359 0.0318922750
## [136] 0.0321285141 0.0323647531 0.0326009922 0.0328372313 0.0330734704
## [141] 0.0333097094 0.0335459485 0.0337821876 0.0340184266 0.0342546657
## [146] 0.0344909048 0.0347271439 0.0349633829 0.0351996220 0.0354358611
## [151] 0.0356721002 0.0359083392 0.0361445783 0.0363808174 0.0366170565
## [156] 0.0368532955 0.0370895346 0.0373257737 0.0375620128 0.0377982518
## [161] 0.0380344909 0.0382707300 0.0385069691 0.0387432081 0.0389794472
## [166] 0.0392156863 0.0394519253 0.0396881644 0.0399244035 0.0401606426
## [171] 0.0403968816 0.0406331207 0.0408693598 0.0411055989 0.0413418379
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## [181] 0.0427592724 0.0429955115 0.0432317505 0.0434679896 0.0437042287
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## [196] 0.0463028585 0.0465390976 0.0467753366 0.0470115757 0.0472478148
## [201] 0.0474840539 0.0477202929 0.0479565320 0.0481927711 0.0484290102
## [206] 0.0486652492 0.0489014883 0.0491377274 0.0493739665 0.0496102055
## [211] 0.0498464446 0.0500826837 0.0503189227 0.0505551618 0.0507914009
## [216] 0.0510276400 0.0512638790 0.0515001181 0.0517363572 0.0519725963
## [221] 0.0522088353 0.0524450744 0.0526813135 0.0529175526 0.0531537916
## [226] 0.0533900307 0.0536262698 0.0538625089 0.0540987479 0.0543349870
## [231] 0.0545712261 0.0548074652 0.0550437042 0.0552799433 0.0555161824
## [236] 0.0557524215 0.0559886605 0.0562248996 0.0564611387 0.0566973777
## [241] 0.0569336168 0.0571698559 0.0574060950 0.0576423340 0.0578785731
## [246] 0.0581148122 0.0583510513 0.0585872903 0.0588235294 0.0590597685
## [251] 0.0592960076 0.0595322466 0.0597684857 0.0600047248 0.0602409639
## [256] 0.0604772029 0.0607134420 0.0609496811 0.0611859202 0.0614221592
## [261] 0.0616583983 0.0618946374 0.0621308764 0.0623671155 0.0626033546
## [266] 0.0628395937 0.0630758327 0.0633120718 0.0635483109 0.0637845500
## [271] 0.0640207890 0.0642570281 0.0644932672 0.0647295063 0.0649657453
## [276] 0.0652019844 0.0654382235 0.0656744626 0.0659107016 0.0661469407
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## [361] 0.0852823057 0.0855185448 0.0857547838 0.0859910229 0.0862272620

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## [366] 0.0864635011 0.0866997401 0.0869359792 0.0871722183 0.0874084574
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```

```

## [636] 0.1502480510 0.1504842901 0.1507205292 0.1509567682 0.1511930073
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## [721] 0.1703283723 0.1705646114 0.1708008505 0.1710370895 0.1712733286
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## [751] 0.1774155445 0.1776517836 0.1778880227 0.1781242618 0.1783605008
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## [1571] -8.5256555230 -8.520733929 -8.513360632 -8.503774295 -8.492236176
## [1576] -8.479025402 -8.464434423 -8.448764473 -8.432321114 -8.415409954
## [1581] -8.398332603 -8.381382913 -8.364843533 -8.348982805 -8.334051998
## [1586] -8.320282888 -8.307885660 -8.297047132 -8.287929267 -8.280667961
## [1591] -8.275372093 -8.272122802 -8.270973001 -8.271947100 -8.275040946
## [1596] -8.280221965 -8.287429536 -8.296575580 -8.307545394 -8.320198747
## [1601] -8.334371245 -8.349876005 -8.366505626 -8.384034503 -8.402221472
## [1606] -8.420812788 -8.439545433 -8.458150732 -8.476358222 -8.493899750
## [1611] -8.510513708 -8.525949323 -8.539970926 -8.552362059 -8.562929331
## [1616] -8.571505896 -8.577954437 -8.582169559 -8.584079499 -8.583647096
## [1621] -8.580869958 -8.575779849 -8.568441269 -8.558949311 -8.547426831
## [1626] -8.534021044 -8.518899649 -8.502246580 -8.484257541 -8.465135415
## [1631] -8.445085672 -8.424311894 -8.403011489 -8.381371692 -8.359565904
## [1636] -8.337750434 -8.316061667 -8.294613697 -8.273496431 -8.252774184
## [1641] -8.232484764 -8.212639039 -8.193220996 -8.174188276 -8.155473177
## [1646] -8.136984119 -8.118607549 -8.100210275 -8.081642195 -8.062739403
## [1651] -8.043327622 -8.023225911 -8.002250608 -7.980219414 -7.956955550
## [1656] -7.932291908 -7.906075086 -7.878169212 -7.848459472 -7.816855234
## [1661] -7.783292692 -7.747736952 -7.710183513 -7.670659103 -7.629221857
## [1666] -7.585960847 -7.540994994 -7.494471422 -7.446563303 -7.397467296
## [1671] -7.347400656 -7.296598111 -7.245308607 -7.193791996 -7.142315771
## [1676] -7.091151899 -7.040573822 -6.990853678 -6.942259768 -6.895054288
## [1681] -6.849491354 -6.805815299 -6.764259251 -6.725043965 -6.688376897
## [1686] -6.654451493 -6.623446667 -6.595526436 -6.570839697 -6.549520100
## [1691] -6.531686011 -6.517440522 -6.506871499 -6.500051642 -6.497038538
## [1696] -6.497874692 -6.502587527 -6.511189337 -6.523677186 -6.540032749
## [1701] -6.560222093 -6.584195394 -6.611886599 -6.643213033 -6.678074969
## [1706] -6.716355159 -6.757918368 -6.802610908 -6.850260207 -6.900674454
## [1711] -6.953642334 -7.008932911 -7.066295687 -7.125460896 -7.186140070
## [1716] -7.248026931 -7.310798659 -7.374117565 -7.437633230 -7.500985109
## [1721] -7.563805629 -7.625723776 -7.686369135 -7.745376339 -7.802389864
## [1726] -7.857069042 -7.909093192 -7.958166709 -8.004023948 -8.046433732
## [1731] -8.085203306 -8.120181570 -8.151261462 -8.178381341 -8.201525333
## [1736] -8.220722558 -8.236045286 -8.247606053 -8.255553835 -8.260069425
## [1741] -8.261360156 -8.259654159 -8.255194332 -8.248232212 -8.239021920
## [1746] -8.227814337 -8.214851647 -8.200362374 -8.184556982 -8.167624141
## [1751] -8.149727669 -8.131004212 -8.111561662 -8.091478318 -8.070802778
## [1756] -8.049554554 -8.027725370 -8.005281131 -7.982164489 -7.958297994
## [1761] -7.933587736 -7.907927427 -7.881202832 -7.853296455 -7.824092373
## [1766] -7.793481100 -7.761364361 -7.727659642 -7.692304387 -7.655259734
## [1771] -7.616513658 -7.576083448 -7.534017432 -7.490395912 -7.445331290

```

```

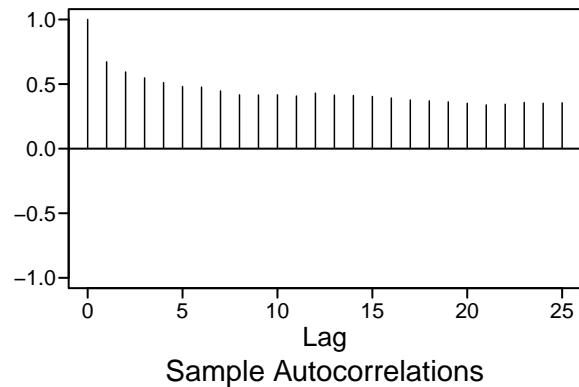
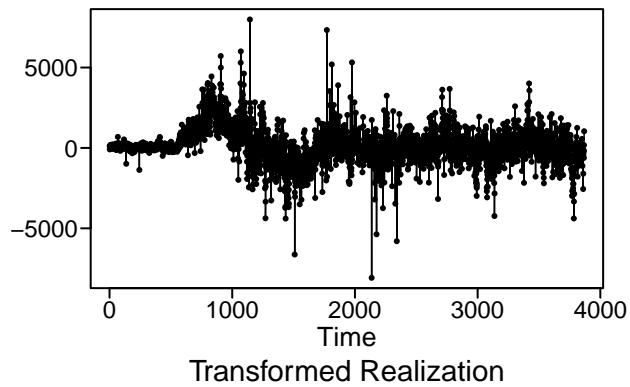
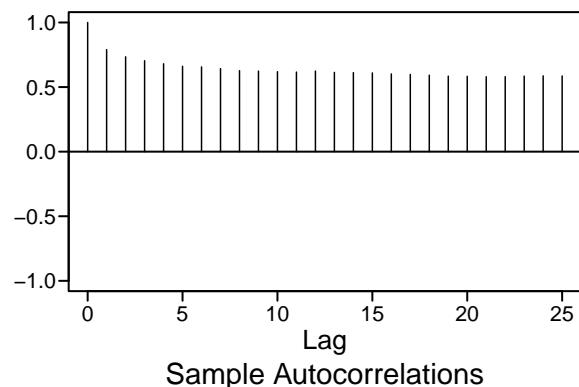
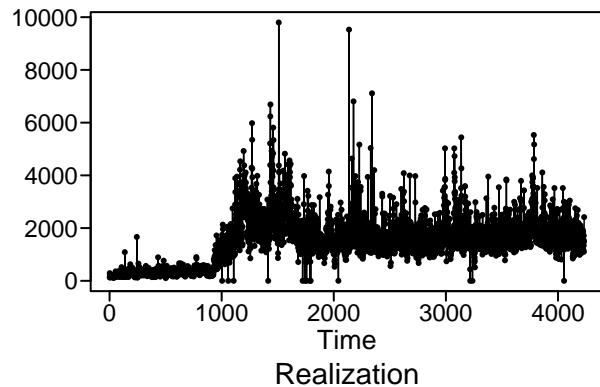
## [1776] -7.398967396 -7.351478055 -7.303064966 -7.253954973 -7.204396827
## [1781] -7.154657568 -7.105018621 -7.055771748 -7.007214938 -6.959648364
## [1786] -6.913370466 -6.868674247 -6.825843830 -6.785151321 -6.746854000
## [1791] -6.711191846 -6.678385410 -6.648634017 -6.622114296 -6.598978999
## [1796] -6.579356120 -6.563348260 -6.551032243 -6.542458950 -6.537653363
## [1801] -6.536614796 -6.539317323 -6.545710365 -6.555719466 -6.569247231
## [1806] -6.586174442 -6.606361342 -6.629649100 -6.655861447 -6.684806491
## [1811] -6.716278699 -6.750061043 -6.785927296 -6.823644450 -6.862975247
## [1816] -6.903680771 -6.945523073 -6.988267778 -7.031686626 -7.075559884
## [1821] -7.119678584 -7.163846514 -7.207881919 -7.251618865 -7.294908206
## [1826] -7.337618149 -7.379634377 -7.420859742 -7.461213520 -7.500630272
## [1831] -7.539058337 -7.576458009 -7.612799473 -7.648060550 -7.682224353
## [1836] -7.715276914 -7.747204876 -7.777993322 -7.807623821 -7.836072755
## [1841] -7.863309983 -7.889297901 -7.913990923 -7.937335411 -7.959270074
## [1846] -7.979726813 -7.998632012 -8.015908230 -8.031476253 -8.045257440
## [1851] -8.057176297 -8.067163186 -8.075157087 -8.081108312 -8.084981070
## [1856] -8.086755803 -8.086431178 -8.084025695 -8.079578804 -8.073151526
## [1861] -8.064826513 -8.054707574 -8.042918649 -8.029602283 -8.014917647
## [1866] -7.999038152 -7.982148749 -7.964442990 -7.946119923 -7.927380913
## [1871] -7.908426474 -7.889453164 -7.870650635 -7.852198868 -7.834265662
## [1876] -7.817004392 -7.800552086 -7.785027822 -7.770531462 -7.757142735
## [1881] -7.744920666 -7.733903340 -7.724108005 -7.715531503 -7.708151005
## [1886] -7.701925056 -7.696794894 -7.692686036 -7.689510105 -7.687166871
## [1891] -7.685546484 -7.684531861 -7.684001185 -7.683830489 -7.683896272
## [1896] -7.684078092 -7.684261105 -7.684338480 -7.684213649 -7.683802342
## [1901] -7.683034359 -7.681855041 -7.680226413 -7.678127963 -7.675557052
## [1906] -7.672528945 -7.669076480 -7.665249372 -7.661113196 -7.656748067
## [1911] -7.652247072 -7.647714485 -7.643263814 -7.639015742 -7.635095987
## [1916] -7.631633144 -7.628756545 -7.626594168 -7.625270636 -7.624905324
## [1921] -7.625610598 -7.627490203 -7.630637800 -7.635135676 -7.641053603
## [1926] -7.648447864 -7.657360441 -7.667818344 -7.679833088 -7.693400309
## [1931] -7.708499508 -7.725093914 -7.743130472 -7.762539938 -7.783237086
## [1936] -7.805121025 -7.828075628 -7.851970065 -7.876659455 -7.901985641
## [1941] -7.927778081 -7.953854875 -7.980023924 -8.006084232 -8.031827348
## [1946] -8.057038960 -8.081500621 -8.104991630 -8.127291028 -8.148179722
## [1951] -8.167442696 -8.184871306 -8.200265611 -8.213436710 -8.224209056
## [1956] -8.232422689 -8.237935349 -8.240624425 -8.240388686 -8.237149767
## [1961] -8.230853352 -8.221470032 -8.208995825 -8.193452320 -8.174886463
## [1966] -8.153369975 -8.128998429 -8.101890009 -8.072183974 -8.040038893
## [1971] -8.005630665 -7.969150397 -7.930802185 -7.890800831 -7.849369573
## [1976] -7.806737837 -7.763139081 -7.718808731 -7.673982270 -7.628893472
## [1981] -7.583772803 -7.538846013 -7.494332892 -7.450446218 -7.407390873
## [1986] -7.365363122 -7.324550048 -7.285129130 -7.247267941 -7.211123956
## [1991] -7.176844465 -7.144566548 -7.114417134 -7.086513092 -7.060961367
## [1996] -7.037859138 -7.017293988 -6.999344063 -6.984078239 -6.971556259
## [2001] -6.961828841 -6.954937768 -6.950915922 -6.949787292 -6.951566927
## [2006] -6.956260844 -6.963865895 -6.974369571 -6.987749783 -7.003974575
## [2011] -7.023001822 -7.044778877 -7.069242204 -7.096316993 -7.125916759
## [2016] -7.157942967 -7.192284654 -7.228818108 -7.267406586 -7.307900112
## [2021] -7.350135368 -7.393935697 -7.439111246 -7.485459271 -7.532764625
## [2026] -7.580800444 -7.629329068 -7.678103195 -7.726867285 -7.775359227
## [2031] -7.823312257 -7.870457122 -7.916524480 -7.961247489 -8.004364559
## [2036] -8.045622223 -8.084778051 -8.121603550 -8.155886984 -8.187436025
## [2041] -8.216080159 -8.241672786 -8.264092936 -8.283246539 -8.299067226

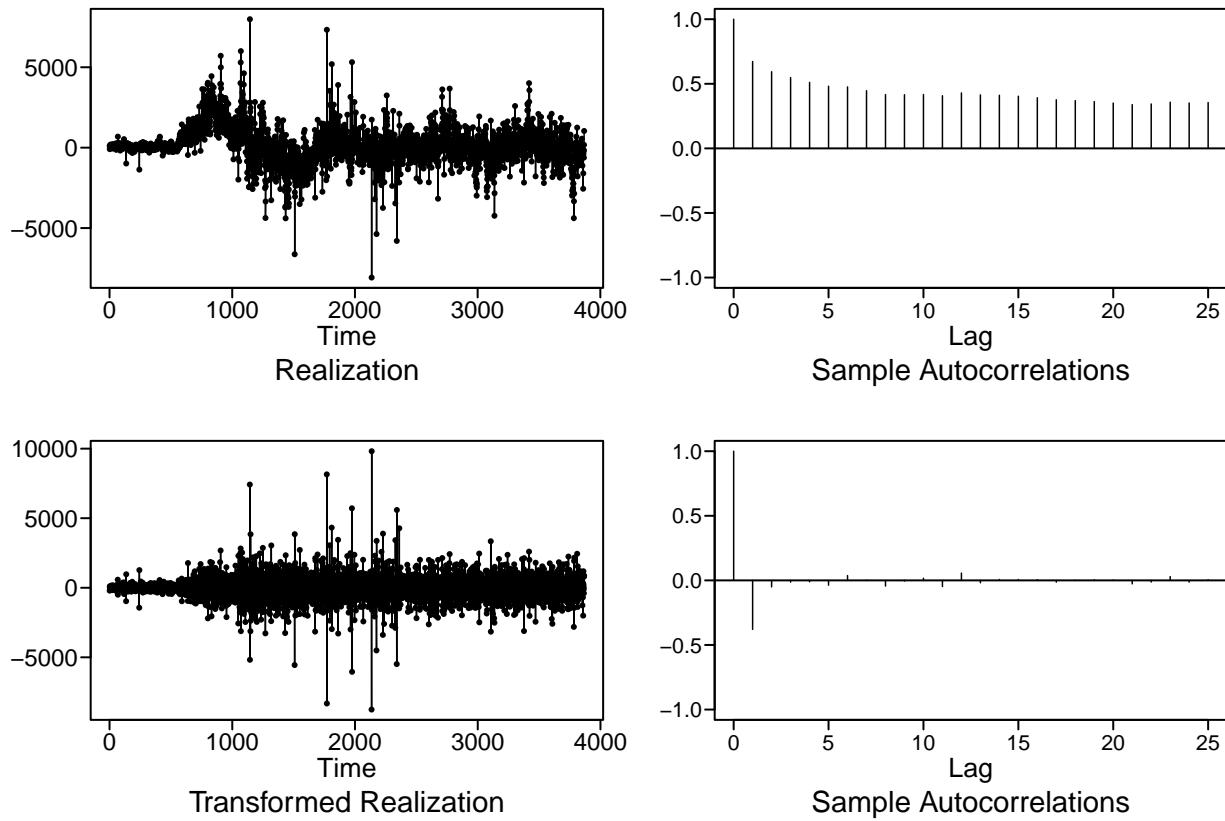
```

```

## [2046] -8.311516610 -8.320584058 -8.326285937 -8.328664395 -8.327785682
## [2051] -8.323738096 -8.316629609 -8.306585248 -8.293744323 -8.278257567
## [2056] -8.260284279 -8.239989530 -8.217541515 -8.193109081 -8.166859500
## [2061] -8.138956503 -8.109558602 -8.078817714 -8.046878089 -8.013875534
## [2066] -7.979936920 -7.945179948 -7.909713170 -7.873636203 -7.837040148
## [2071] -7.800008143 -7.762616051 -7.724933233 -7.687023386 -7.648945410
## [2076] -7.610754282 -7.572501920 -7.534237999 -7.496010722 -7.457867506
## [2081] -7.419855602 -7.382022607 -7.344416896 -7.307087937 -7.270086521
## [2086] -7.233464892 -7.197276779 -7.161577356 -7.126423121 -7.091871707
## [2091] -7.057981643 -7.024812071 -6.992422432 -6.960872128 -6.930220173
## [2096] -6.900524849 -6.871843362 -6.844231518 -6.817743418 -6.792431182
## [2101] -6.768344698 -6.745531410 -6.724036133 -6.703900902 -6.685164859
## [2106] -6.667864166 -6.652031943 -6.637698232 -6.624889991 -6.613631085
## [2111] -6.603942311 -6.595841416 -6.589343127 -6.584459183 -6.581198358
## [2116] -6.579566489

```





Identification of the HSI_Volume for ARIMA/ARMA model identification.

```
## -----WORKING... PLEASE WAIT...
##
##
## Five Smallest Values of aic

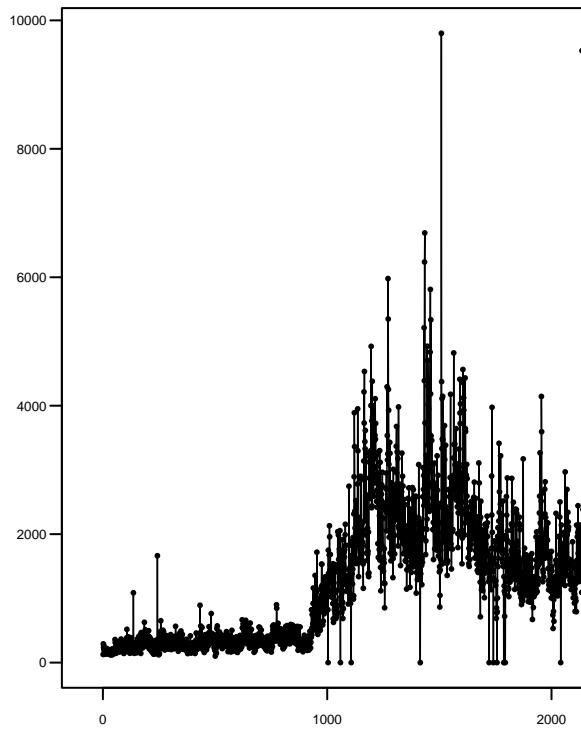
##      p      q      aic
## 80     13     1 13.19636
## 54      8     5 13.19659
## 81     13     2 13.19698
## 82     13     3 13.19781
## 83     13     4 13.19815

## -----WORKING... PLEASE WAIT...
##
##
## Five Smallest Values of bic

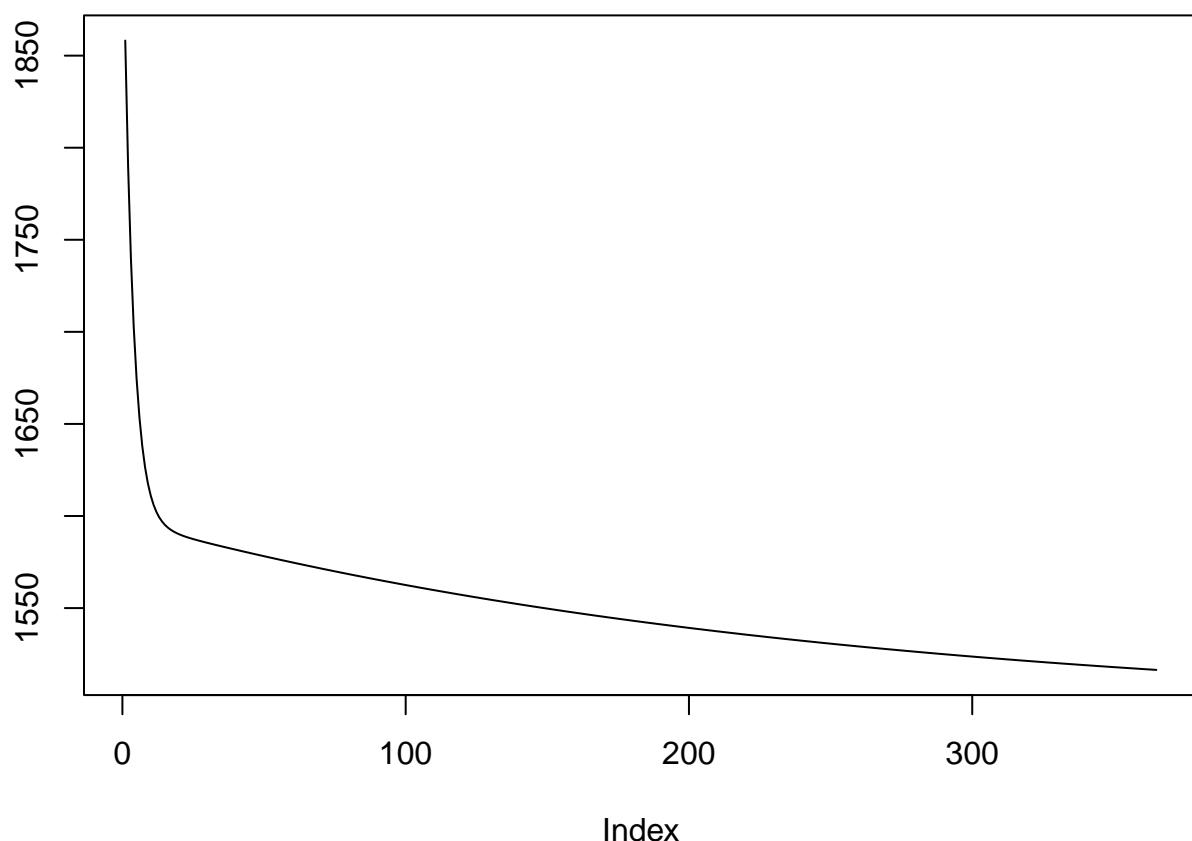
##      p      q      bic
## 15     2     2 13.20790
## 21     3     2 13.20946
## 16     2     3 13.20999
## 26     4     1 13.21050
## 22     3     3 13.21167
```

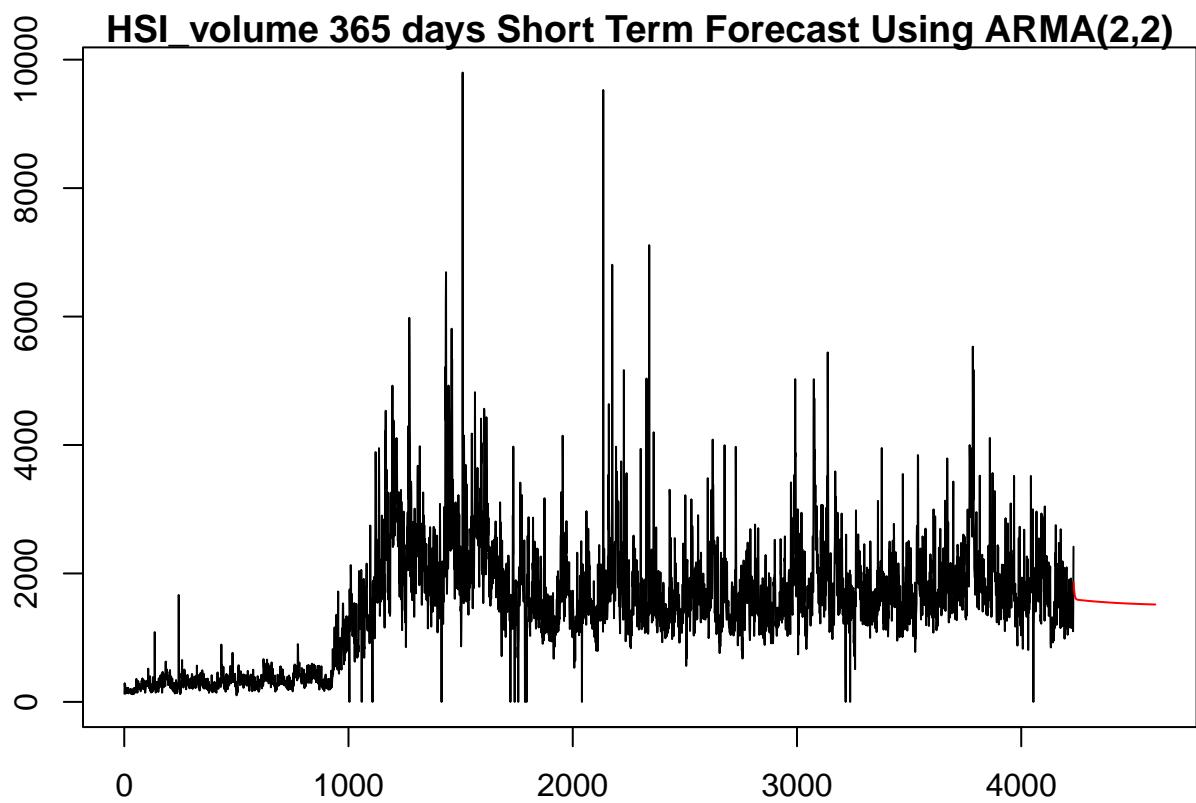
Estimation of the coefficients for the HSI_Volume for the ARIMA(2,1,2) model.

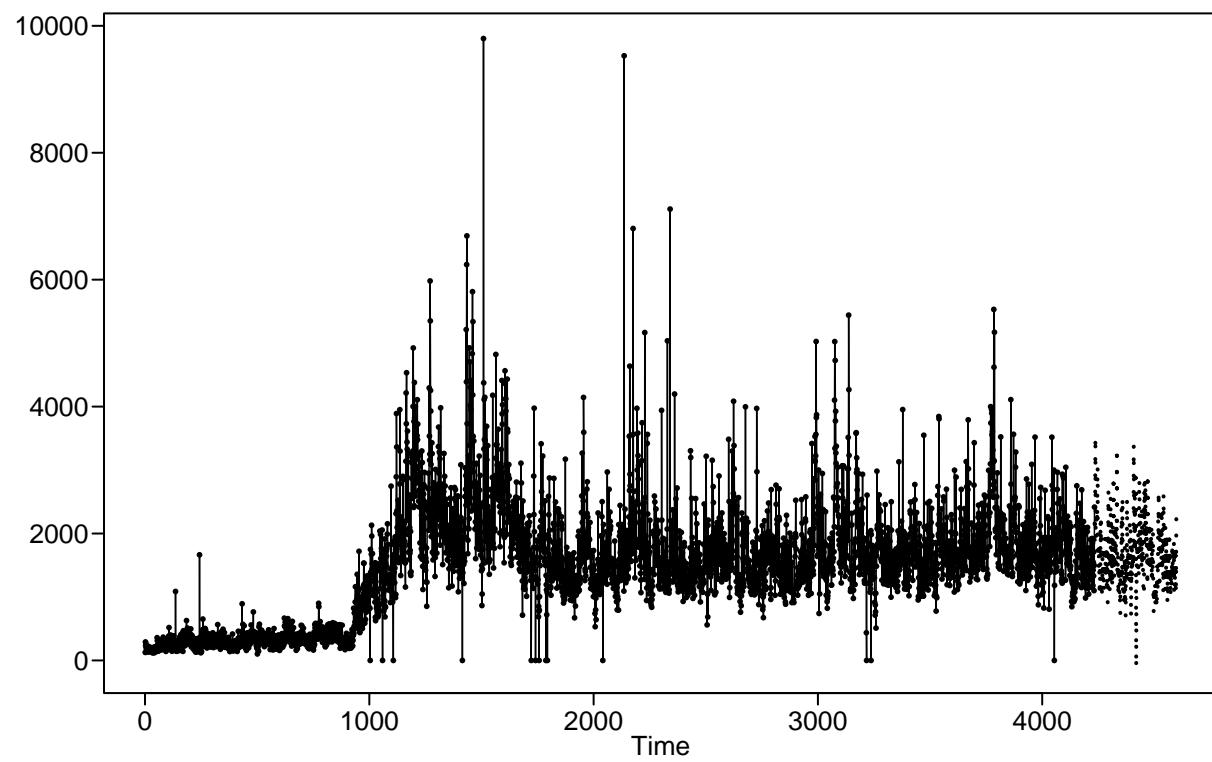
```
## Obs -0.3794781 -0.05063467 -0.01306263 -0.01130787 -0.03736239 0.03703119 0.001527033 -0.04393259 -0
## [1] 0
## Obs -0.3794781 -0.05063467 -0.01306263 -0.01130787 -0.03736239 0.03703119 0.001527033 -0.04393259 -0
## [1] 0
##
## Coefficients of Original polynomial:
## 1.7383 -0.7394
##
## Factor Roots Abs Recip System Freq
## 1-0.9960B 1.0040 0.9960 0.0000
## 1-0.7424B 1.3471 0.7424 0.0000
##
## [1] 538864.1
## [1] 1492.191
```

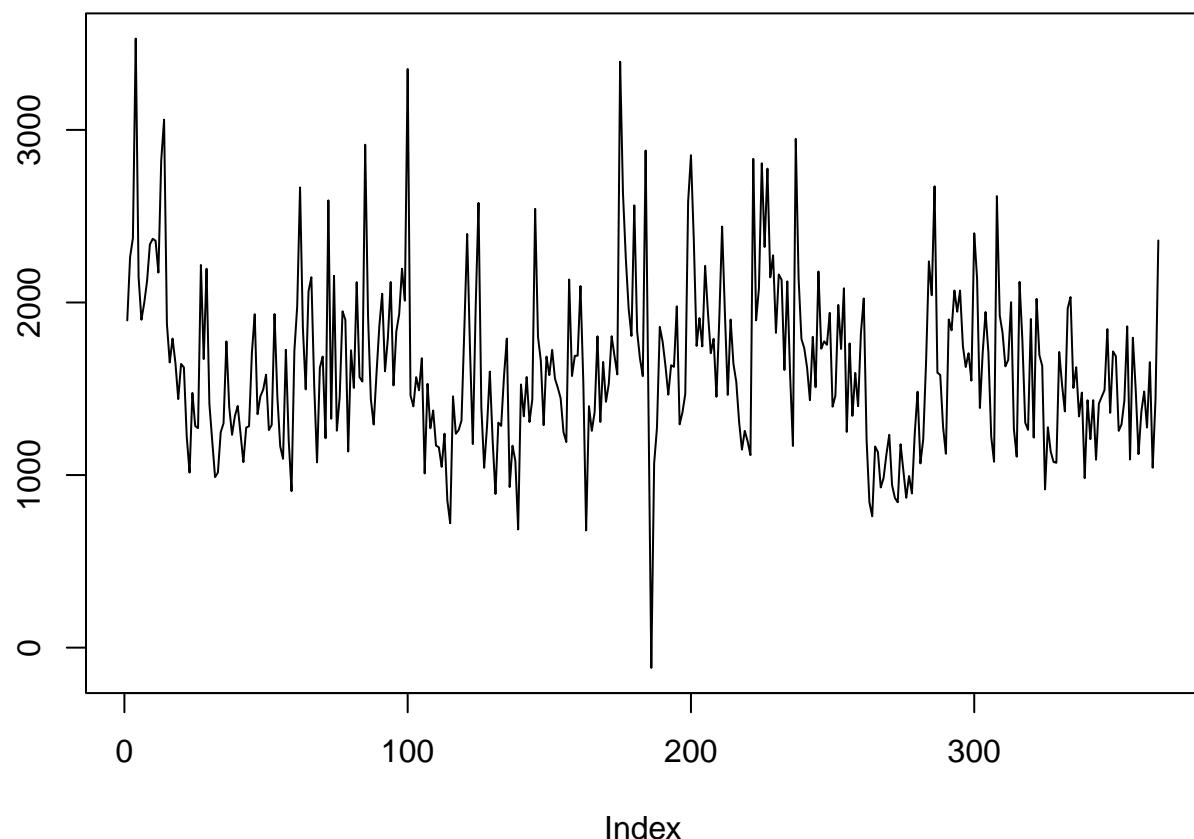


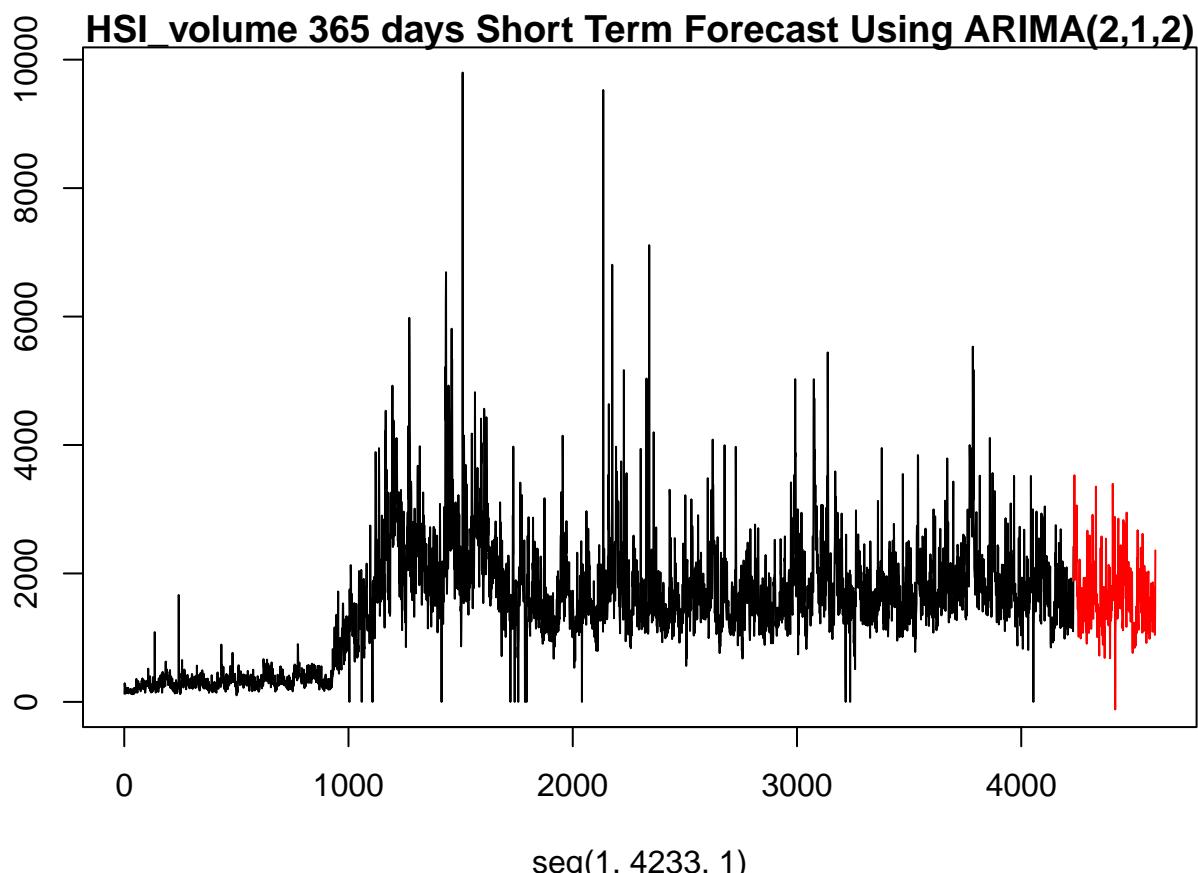
Forecasts for the HSI_Volume ARMA(2,2) and ARMA(2,1,2) models ..

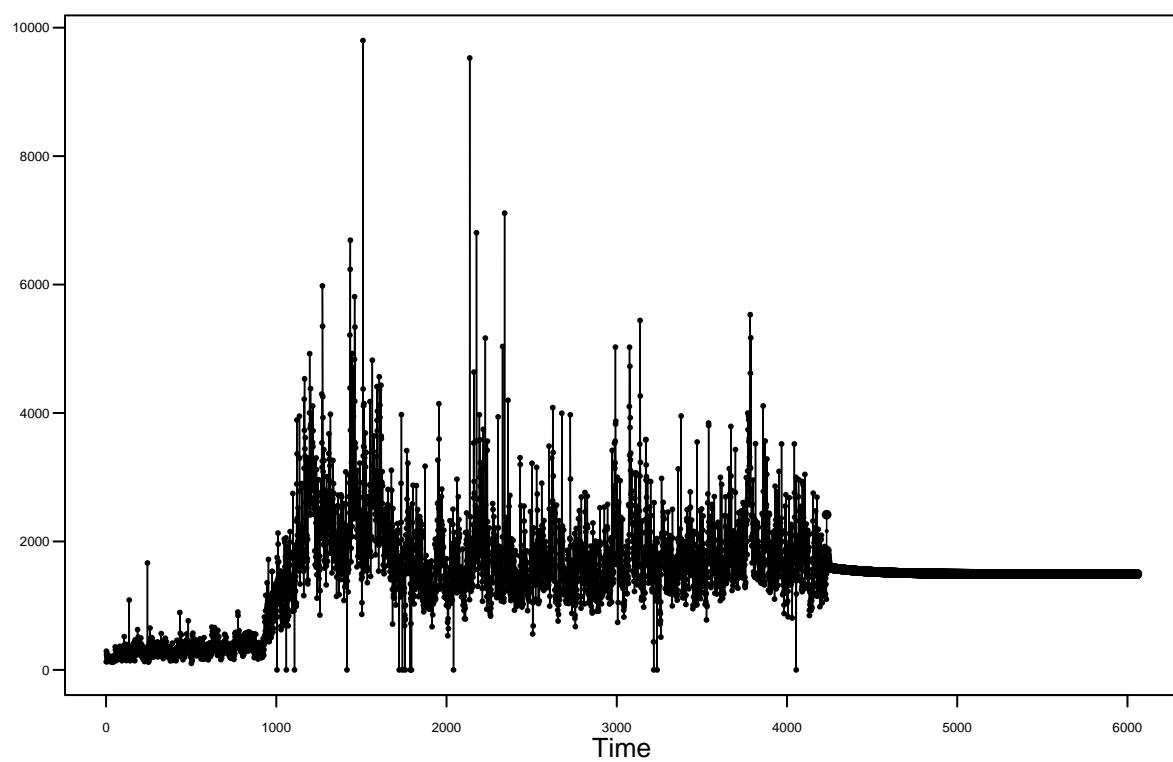


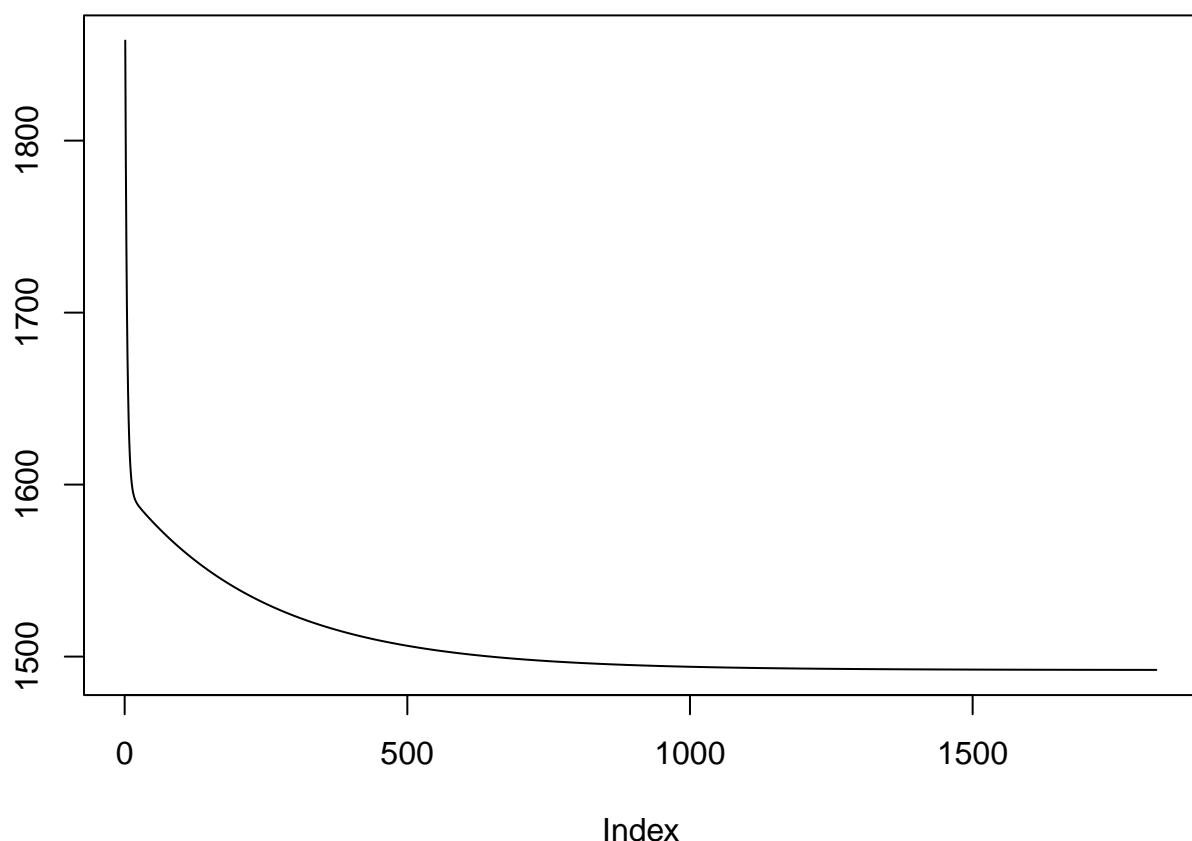


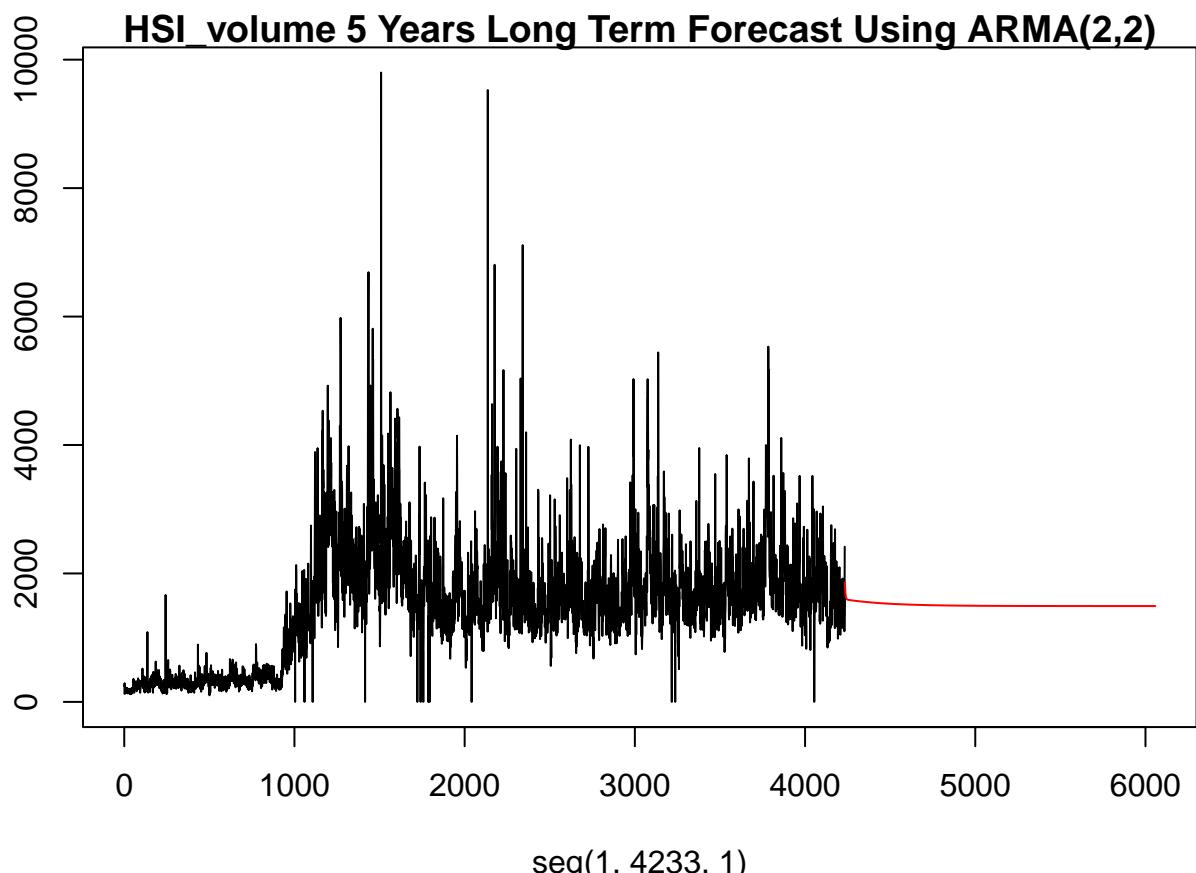


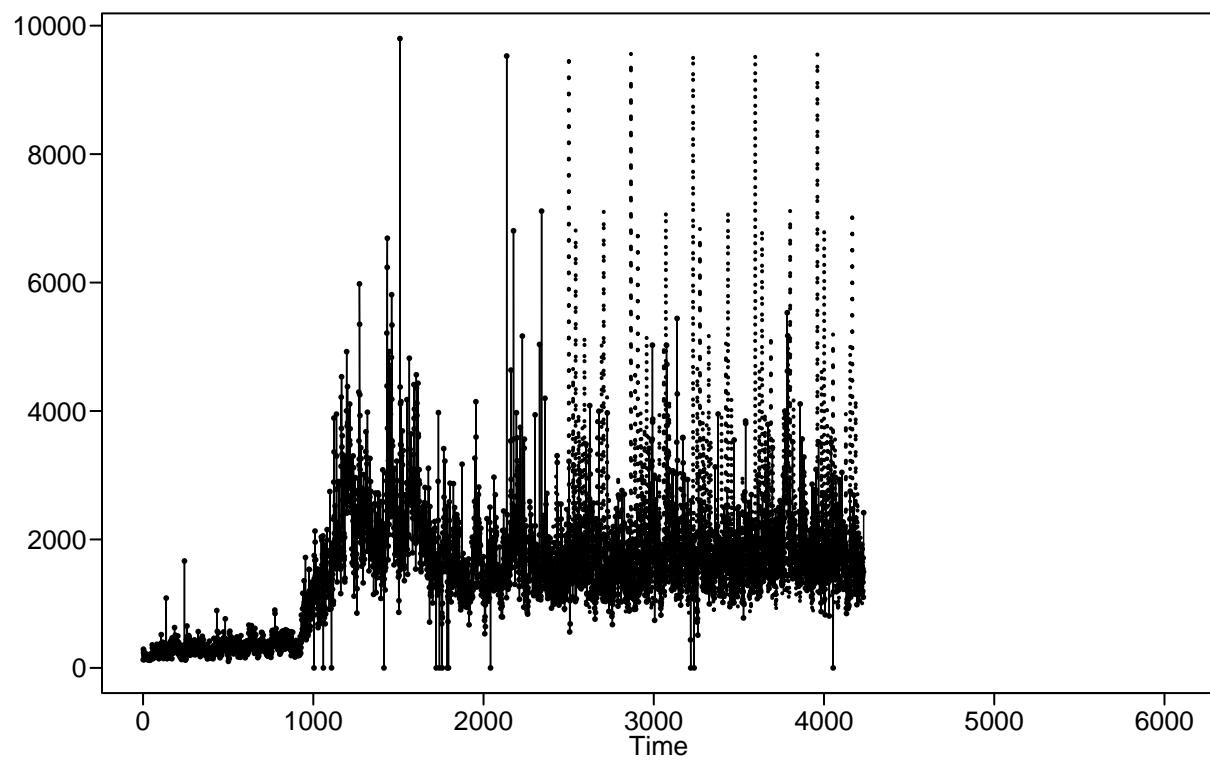


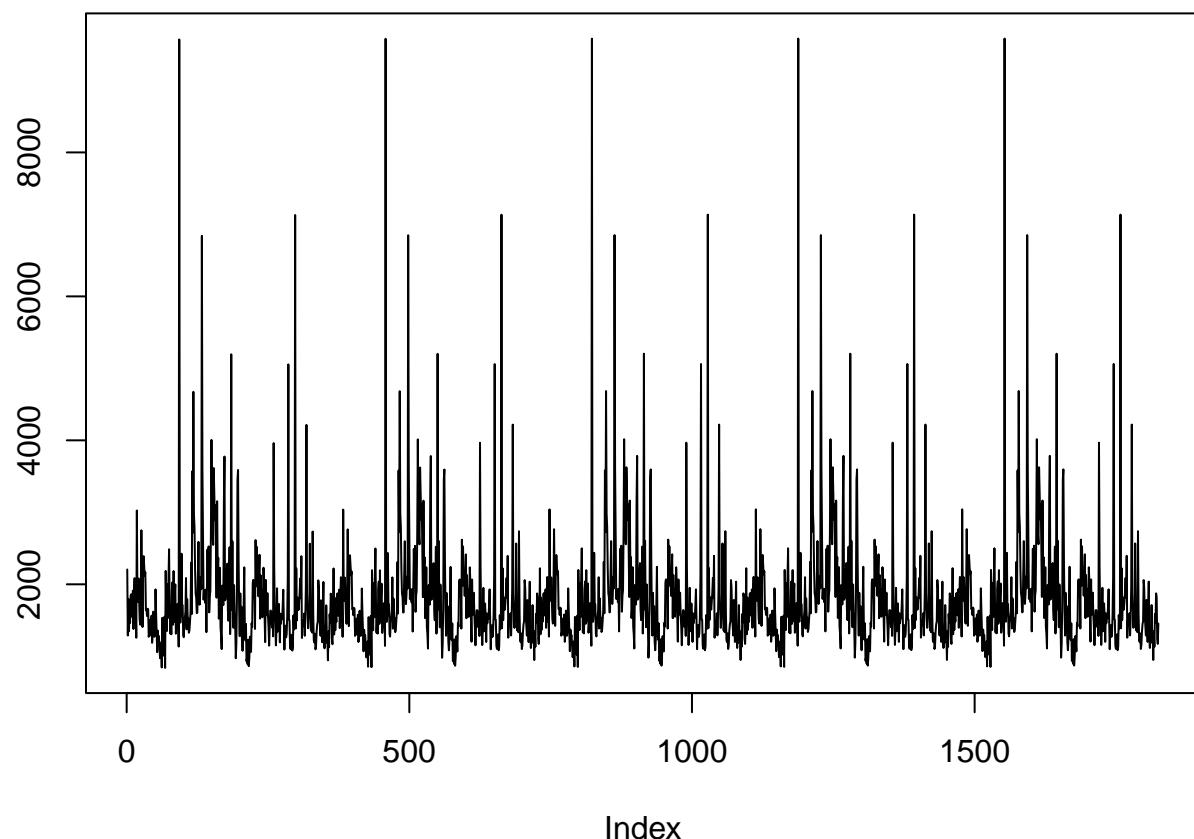


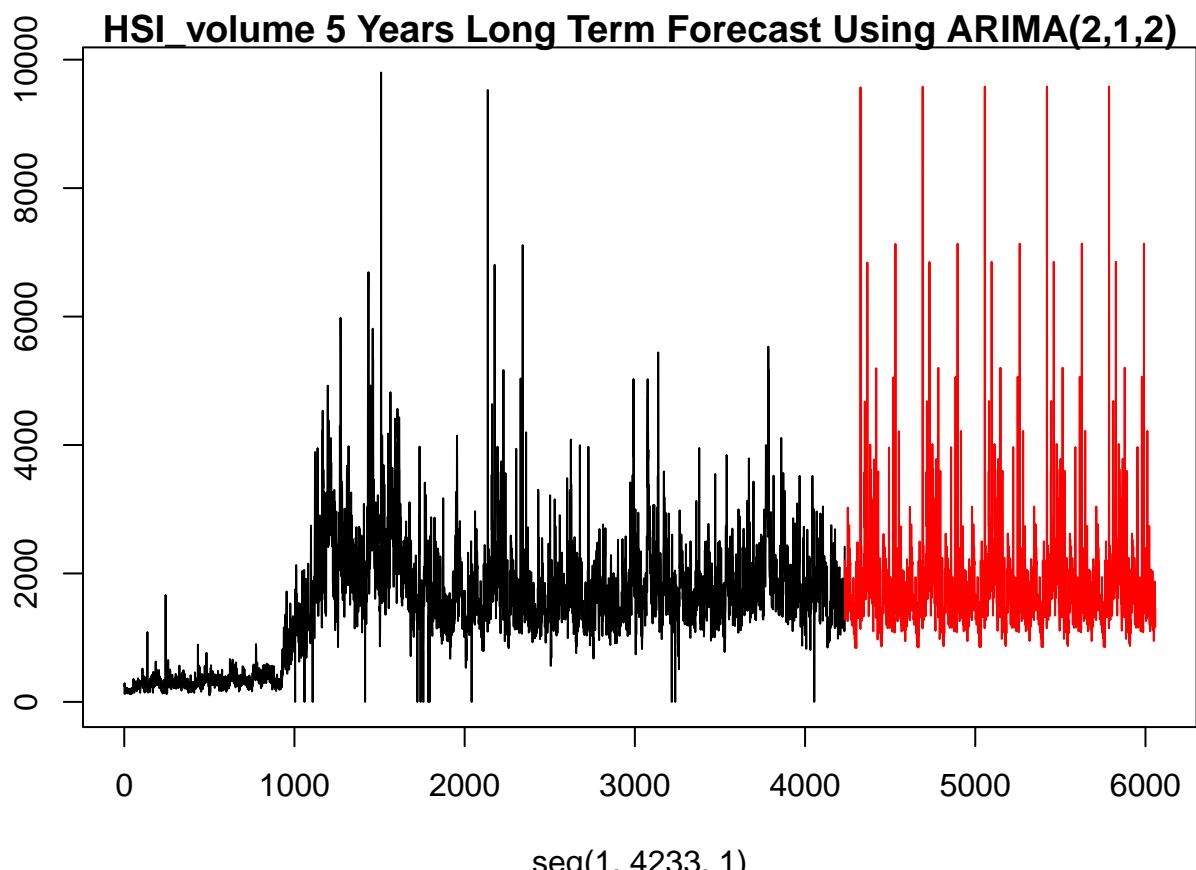


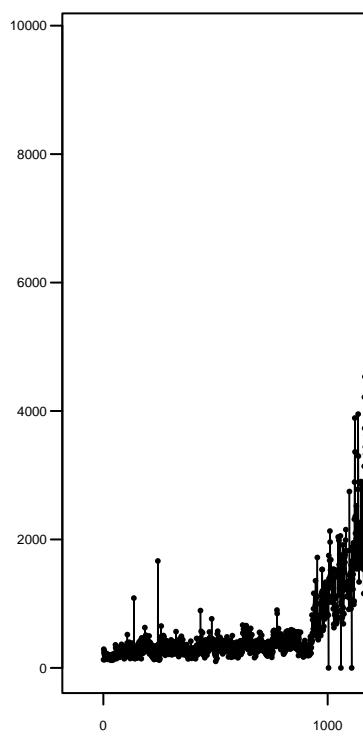






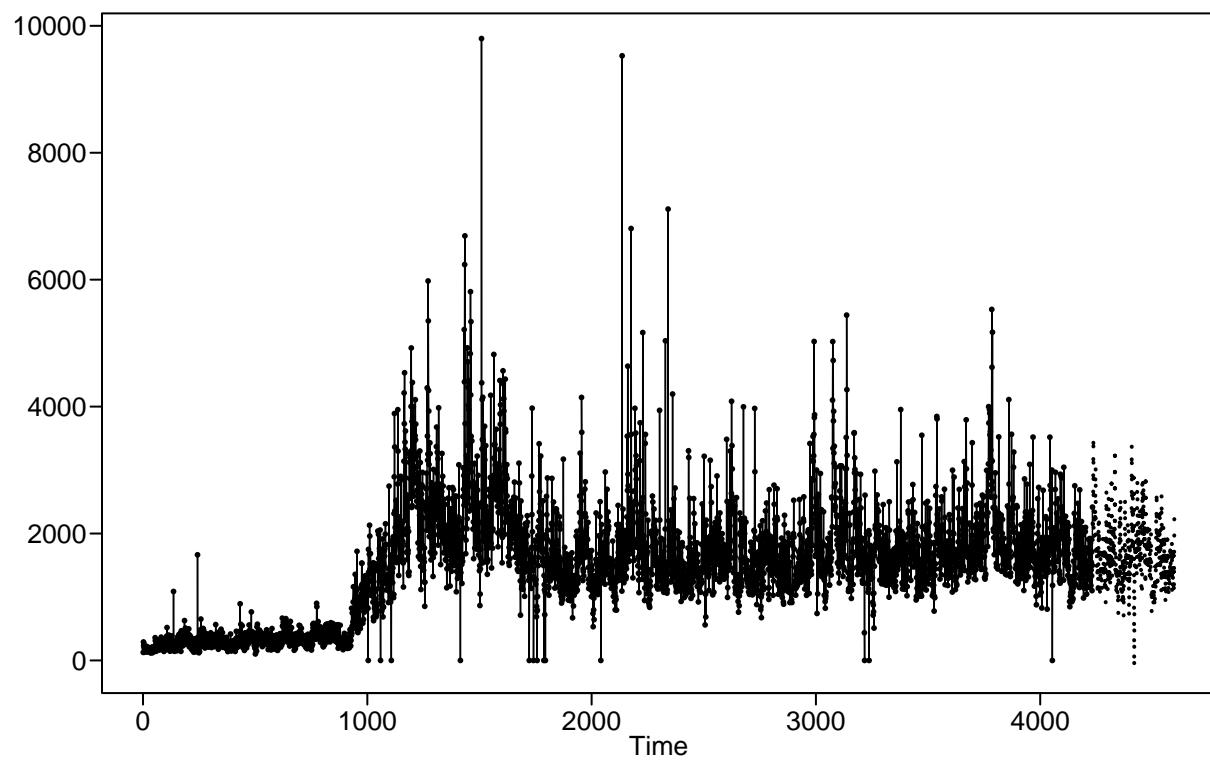




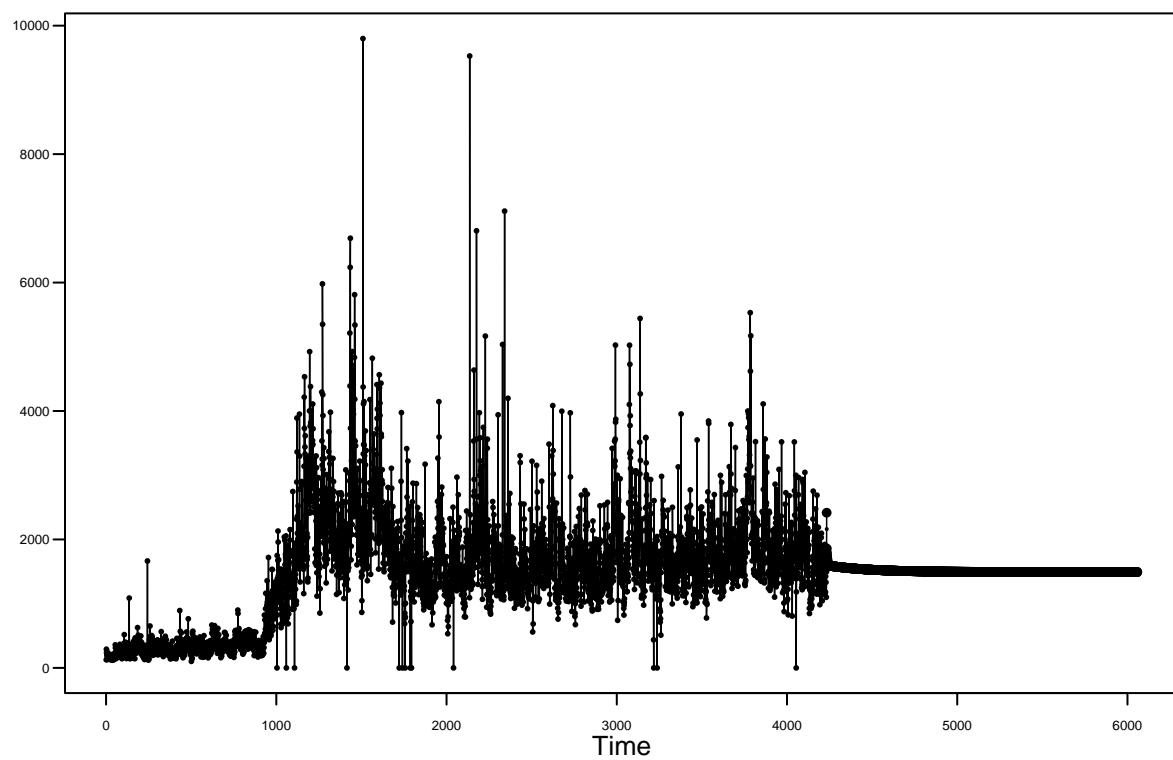


Calculation of the ASE values for the HSI_Volume ARMA(2,2) and ARMA(2,1,2) modelS .

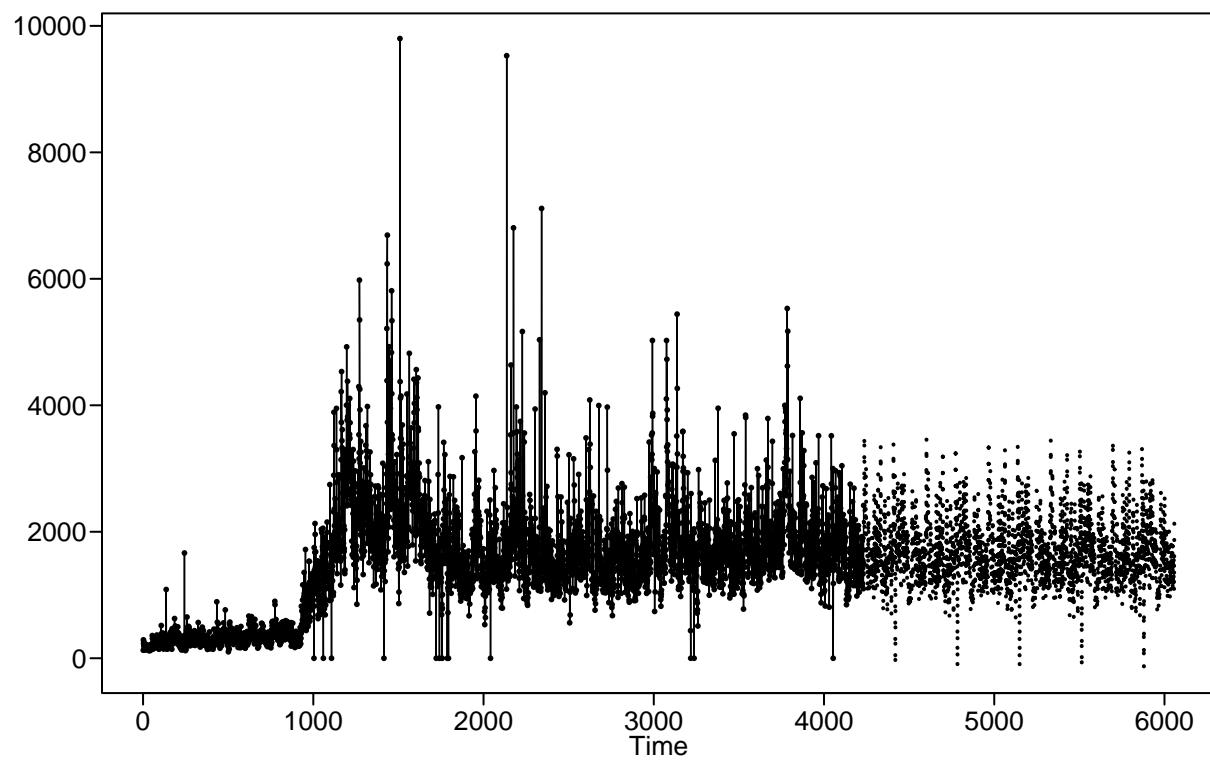
```
## [1] "Short Term ARMA(2,2) ASE: 271120.67"
```



```
## [1] "Short Term ARIMA(2,1,2) ASE: 18729.93"
```

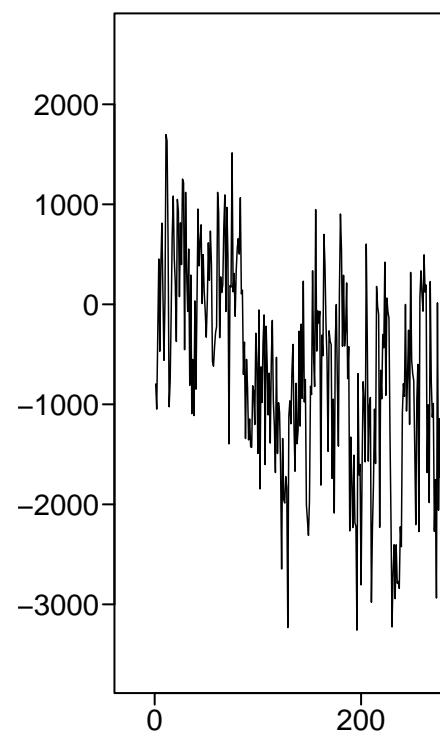


```
## [1] "Long Term ARMA(2,2) ASE: 413770.67"
```

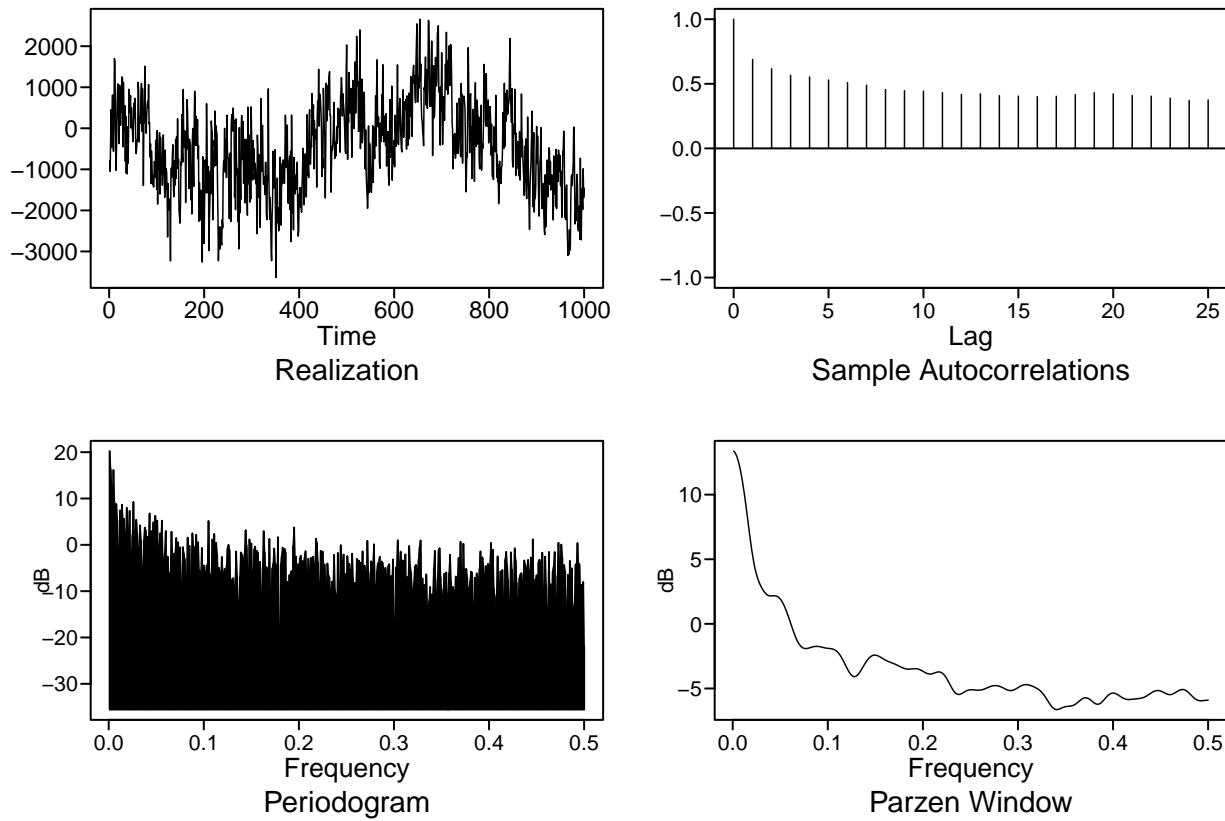


```
## [1] "Long Term ARIMA(2,1,2) ASE: 538957.77"
```

Calculation of the Rolling Window ASE for the HSI_Volume ARMA(2,2) and ARMA(2,1,2) modelS . Please uncomment the Rolling_Window_ASE to run the Rolling Window ASE.



Comparison of the HSI_Volume ARMA(2,2) modeled against the generated realizations.



```

## $autplt
## [1] 1.0000000 0.6888257 0.6162816 0.5659510 0.5524303 0.5291999 0.5098864
## [8] 0.4896648 0.4548213 0.4459708 0.4436421 0.4319062 0.4188410 0.4223597
## [15] 0.4080896 0.4047986 0.4005067 0.4037891 0.4164524 0.4309095 0.4219787
## [22] 0.4090771 0.4045452 0.3888871 0.3714070 0.3748346
##
## $freq
## [1] 0.001 0.002 0.003 0.004 0.005 0.006 0.007 0.008 0.009 0.010 0.011 0.012
## [13] 0.013 0.014 0.015 0.016 0.017 0.018 0.019 0.020 0.021 0.022 0.023 0.024
## [25] 0.025 0.026 0.027 0.028 0.029 0.030 0.031 0.032 0.033 0.034 0.035 0.036
## [37] 0.037 0.038 0.039 0.040 0.041 0.042 0.043 0.044 0.045 0.046 0.047 0.048
## [49] 0.049 0.050 0.051 0.052 0.053 0.054 0.055 0.056 0.057 0.058 0.059 0.060
## [61] 0.061 0.062 0.063 0.064 0.065 0.066 0.067 0.068 0.069 0.070 0.071 0.072
## [73] 0.073 0.074 0.075 0.076 0.077 0.078 0.079 0.080 0.081 0.082 0.083 0.084
## [85] 0.085 0.086 0.087 0.088 0.089 0.090 0.091 0.092 0.093 0.094 0.095 0.096
## [97] 0.097 0.098 0.099 0.100 0.101 0.102 0.103 0.104 0.105 0.106 0.107 0.108
## [109] 0.109 0.110 0.111 0.112 0.113 0.114 0.115 0.116 0.117 0.118 0.119 0.120
## [121] 0.121 0.122 0.123 0.124 0.125 0.126 0.127 0.128 0.129 0.130 0.131 0.132
## [133] 0.133 0.134 0.135 0.136 0.137 0.138 0.139 0.140 0.141 0.142 0.143 0.144
## [145] 0.145 0.146 0.147 0.148 0.149 0.150 0.151 0.152 0.153 0.154 0.155 0.156
## [157] 0.157 0.158 0.159 0.160 0.161 0.162 0.163 0.164 0.165 0.166 0.167 0.168
## [169] 0.169 0.170 0.171 0.172 0.173 0.174 0.175 0.176 0.177 0.178 0.179 0.180
## [181] 0.181 0.182 0.183 0.184 0.185 0.186 0.187 0.188 0.189 0.190 0.191 0.192
## [193] 0.193 0.194 0.195 0.196 0.197 0.198 0.199 0.200 0.201 0.202 0.203 0.204
## [205] 0.205 0.206 0.207 0.208 0.209 0.210 0.211 0.212 0.213 0.214 0.215 0.216
## [217] 0.217 0.218 0.219 0.220 0.221 0.222 0.223 0.224 0.225 0.226 0.227 0.228

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## [229] 0.229 0.230 0.231 0.232 0.233 0.234 0.235 0.236 0.237 0.238 0.239 0.240
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## [253] 0.253 0.254 0.255 0.256 0.257 0.258 0.259 0.260 0.261 0.262 0.263 0.264
## [265] 0.265 0.266 0.267 0.268 0.269 0.270 0.271 0.272 0.273 0.274 0.275 0.276
## [277] 0.277 0.278 0.279 0.280 0.281 0.282 0.283 0.284 0.285 0.286 0.287 0.288
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## [301] 0.301 0.302 0.303 0.304 0.305 0.306 0.307 0.308 0.309 0.310 0.311 0.312
## [313] 0.313 0.314 0.315 0.316 0.317 0.318 0.319 0.320 0.321 0.322 0.323 0.324
## [325] 0.325 0.326 0.327 0.328 0.329 0.330 0.331 0.332 0.333 0.334 0.335 0.336
## [337] 0.337 0.338 0.339 0.340 0.341 0.342 0.343 0.344 0.345 0.346 0.347 0.348
## [349] 0.349 0.350 0.351 0.352 0.353 0.354 0.355 0.356 0.357 0.358 0.359 0.360
## [361] 0.361 0.362 0.363 0.364 0.365 0.366 0.367 0.368 0.369 0.370 0.371 0.372
## [373] 0.373 0.374 0.375 0.376 0.377 0.378 0.379 0.380 0.381 0.382 0.383 0.384
## [385] 0.385 0.386 0.387 0.388 0.389 0.390 0.391 0.392 0.393 0.394 0.395 0.396
## [397] 0.397 0.398 0.399 0.400 0.401 0.402 0.403 0.404 0.405 0.406 0.407 0.408
## [409] 0.409 0.410 0.411 0.412 0.413 0.414 0.415 0.416 0.417 0.418 0.419 0.420
## [421] 0.421 0.422 0.423 0.424 0.425 0.426 0.427 0.428 0.429 0.430 0.431 0.432
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##  [11] -9.38272400 7.41936883 1.77026475 8.64667735 5.10145450
##  [16] 5.60788775 1.39939143 0.03563066 7.97029887 0.57688801
##  [21] 2.75834903 7.31243872 -9.34144758 -2.80945135 2.03881894
##  [26] 9.23324459 -4.56389071 2.72469259 5.38389419 2.39373003
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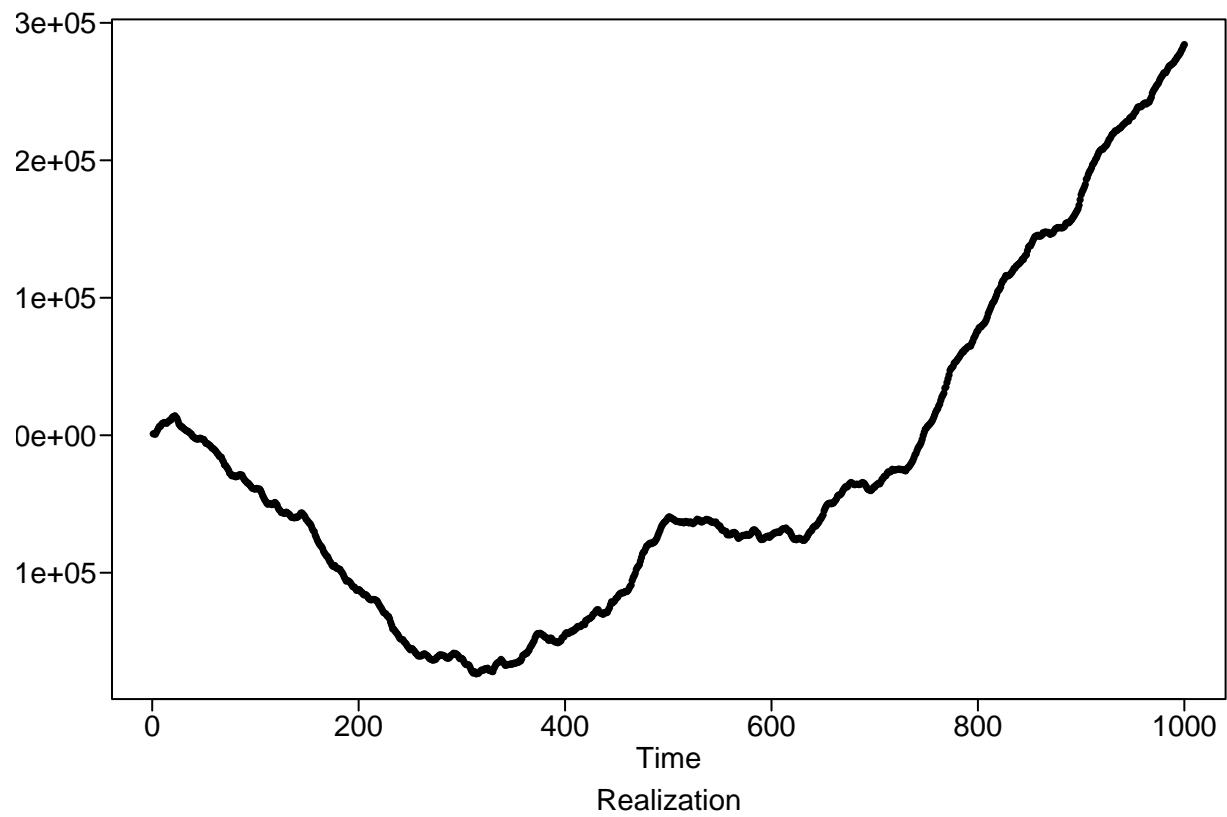
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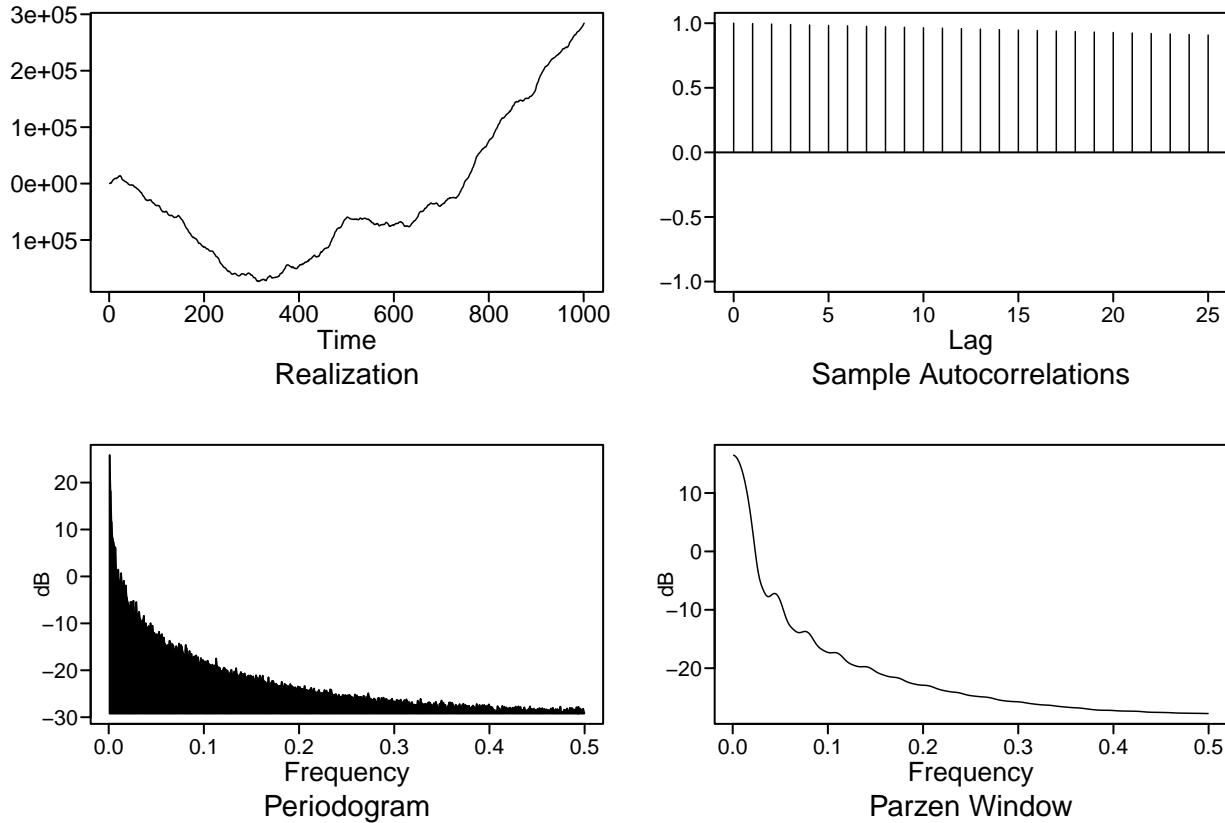
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##  [43] -7.2374843 -7.2049073 -7.2354241 -7.3361514 -7.5102710 -7.7576255
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```

```

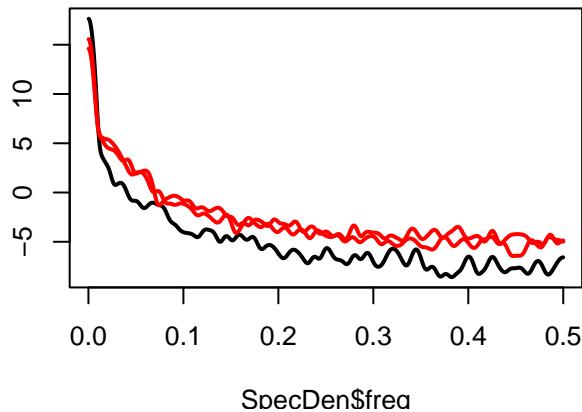
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## [67] -13.7683774 -13.8488915 -13.8979263 -13.9137692 -13.8991796 -13.8613462
## [73] -13.8108173 -13.7598569 -13.7207617 -13.7045180 -13.7199336 -13.7731923
## [79] -13.8677004 -14.0040944 -14.1803262 -14.3917988 -14.6315827 -14.8907780
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## [367] -26.8591321 -26.8779647 -26.8983724 -26.9199260 -26.9421348 -26.9645037
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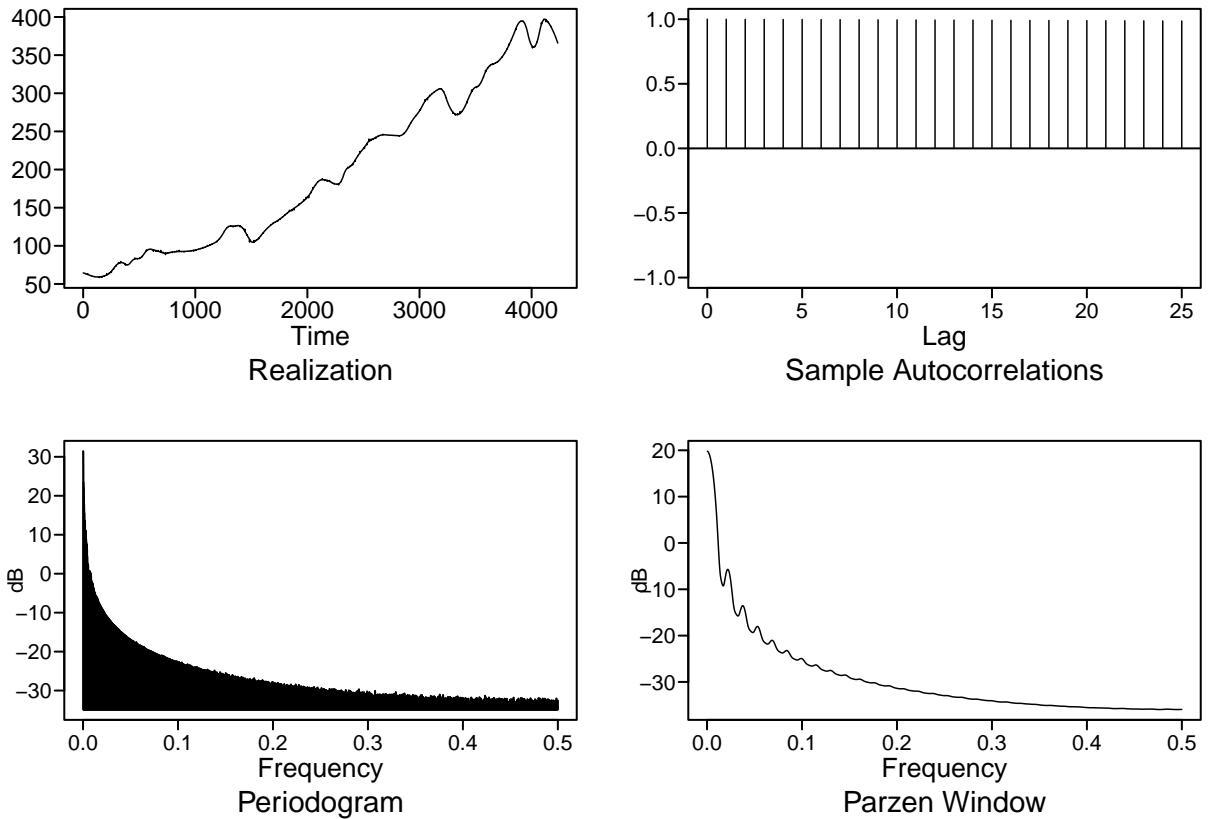
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## [499] -27.7683261 -27.7695834

```



Univariate analysis on the HSI Private Domestic Price Index. This is the Price Index of private housing in



Hong Kong.

```
## $autplt
## [1] 1.0000000 0.9994938 0.9989872 0.9984759 0.9979598 0.9974389 0.9969134
## [8] 0.9963831 0.9958482 0.9953086 0.9947644 0.9942156 0.9936622 0.9931043
## [15] 0.9925418 0.9919749 0.9914036 0.9908277 0.9902477 0.9896632 0.9890745
## [22] 0.9884819 0.9878847 0.9872833 0.9866778 0.9860682
##
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## [1] 0.0002362391 0.0004724781 0.0007087172 0.0009449563 0.0011811954
## [6] 0.0014174344 0.0016536735 0.0018899126 0.0021261517 0.0023623907
## [11] 0.0025986298 0.0028348689 0.0030711080 0.0033073470 0.0035435861
## [16] 0.0037798252 0.0040160643 0.0042523033 0.0044885424 0.0047247815
## [21] 0.0049610206 0.0051972596 0.0054334987 0.0056697378 0.0059059768
## [26] 0.0061422159 0.0063784550 0.0066146941 0.0068509331 0.0070871722
## [31] 0.0073234113 0.0075596504 0.0077958894 0.0080321285 0.0082683676
## [36] 0.0085046067 0.0087408457 0.0089770848 0.0092133239 0.0094495630
## [41] 0.0096858020 0.0099220411 0.0101582802 0.0103945193 0.0106307583
## [46] 0.0108669974 0.0111032365 0.0113394755 0.0115757146 0.0118119537
## [51] 0.0120481928 0.0122844318 0.0125206709 0.0127569100 0.0129931491
## [56] 0.0132293881 0.0134656272 0.0137018663 0.0139381054 0.0141743444
## [61] 0.0144105835 0.0146468226 0.0148830617 0.0151193007 0.0153555398
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## [71] 0.0167729742 0.0170092133 0.0172454524 0.0174816915 0.0177179305
## [76] 0.0179541696 0.0181904087 0.0184266478 0.0186628868 0.0188991259
## [81] 0.0191353650 0.0193716041 0.0196078431 0.0198440822 0.0200803213
## [86] 0.0203165604 0.0205527994 0.0207890385 0.0210252776 0.0212615167
## [91] 0.0214977557 0.0217339948 0.0219702339 0.0222064730 0.0224427120
```

```

## [96] 0.0226789511 0.0229151902 0.0231514292 0.0233876683 0.0236239074
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## [111] 0.0262225372 0.0264587763 0.0266950154 0.0269312544 0.0271674935
## [116] 0.0274037326 0.0276399717 0.0278762107 0.0281124498 0.0283486889
## [121] 0.0285849279 0.0288211670 0.0290574061 0.0292936452 0.0295298842
## [126] 0.0297661233 0.0300023624 0.0302386015 0.0304748405 0.0307110796
## [131] 0.0309473187 0.0311835578 0.0314197968 0.0316560359 0.0318922750
## [136] 0.0321285141 0.0323647531 0.0326009922 0.0328372313 0.0330734704
## [141] 0.0333097094 0.0335459485 0.0337821876 0.0340184266 0.0342546657
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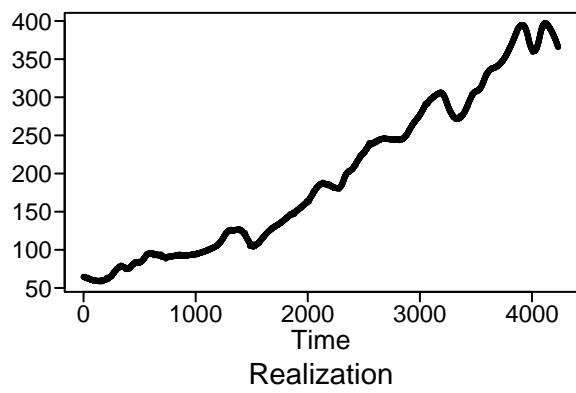
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## [1753] -35.6104862 -35.6111354 -35.6118932 -35.6127785 -35.6138051 -35.6149812
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## [1795] -35.6807697 -35.6851525 -35.6897358 -35.6944752 -35.6993216 -35.7042230
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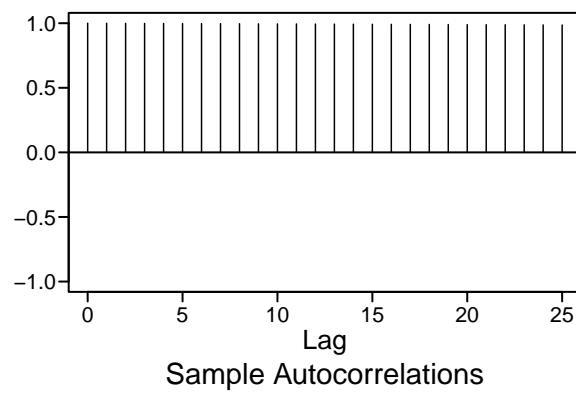
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## [1825] -35.7504457 -35.7493836 -35.7482692 -35.7471129 -35.7459225 -35.7447029
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## [1867] -35.7663866 -35.7704004 -35.7743725 -35.7782738 -35.7820791 -35.7857681
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## [1885] -35.8220757 -35.8243036 -35.8265078 -35.8286914 -35.8308539 -35.8329909
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## [1897] -35.8462046 -35.8476379 -35.8489051 -35.8499932 -35.8508925 -35.8515981
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## [2017] -35.9561490 -35.9558768 -35.9553642 -35.9546199 -35.9536519 -35.9524663
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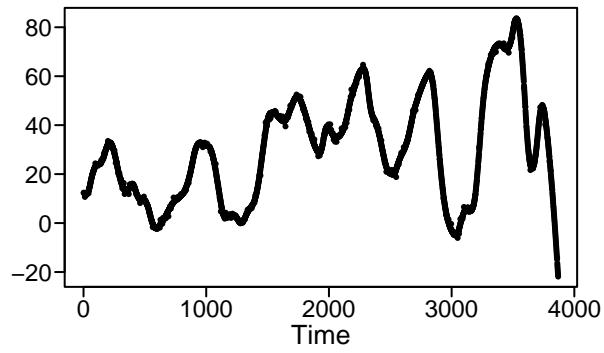
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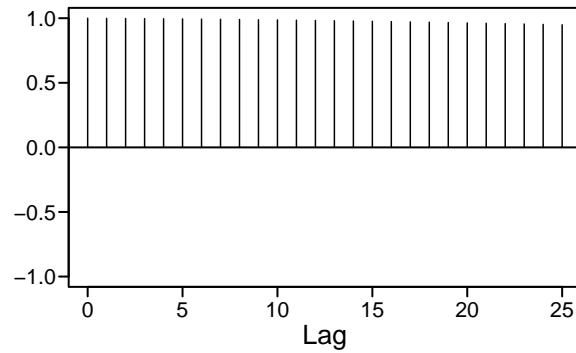
Realization



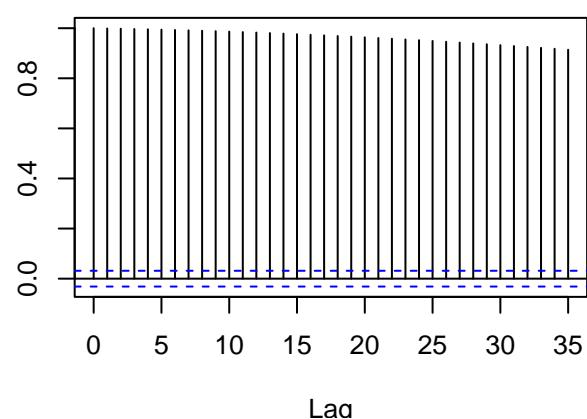
Sample Autocorrelations

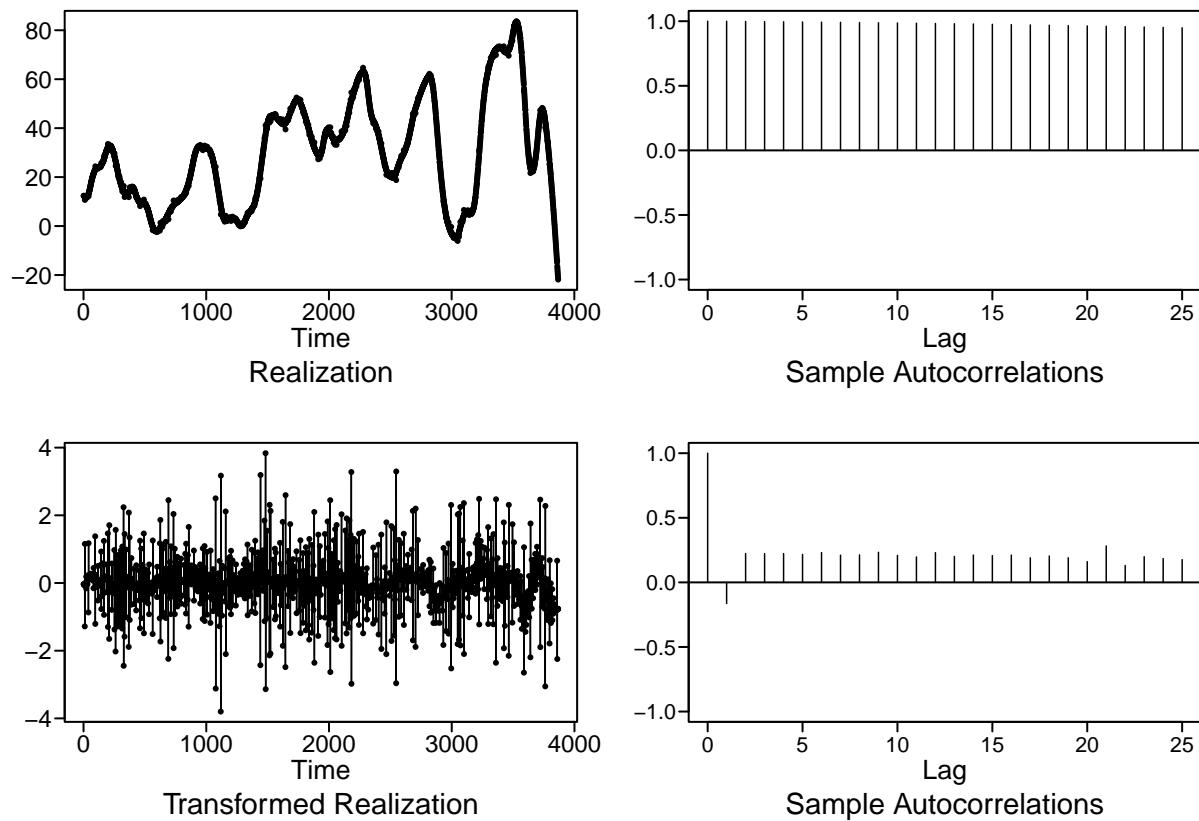


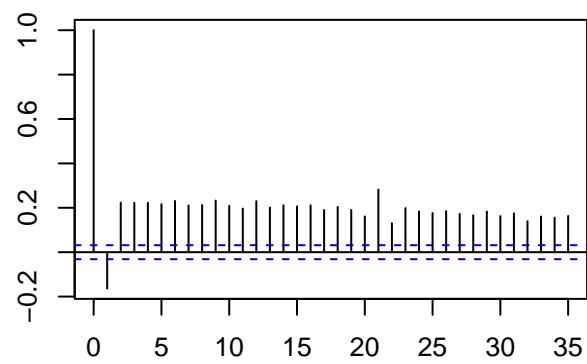
Transformed Realization

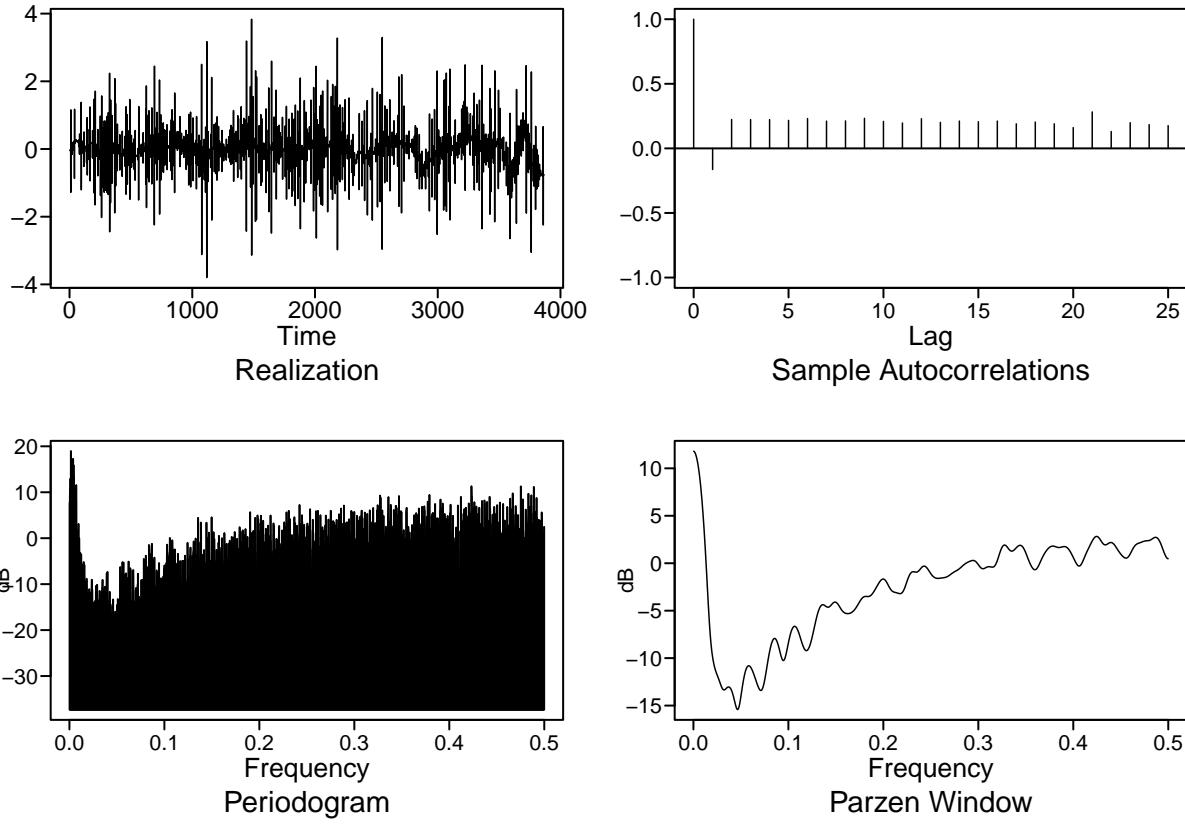


Sample Autocorrelations









```

## $autplt
## [1] 1.0000000 -0.1637651 0.2235413 0.2229094 0.2227523 0.2166267
## [7] 0.2306943 0.2108177 0.2125658 0.2327446 0.2089698 0.1964647
## [13] 0.2299355 0.2014374 0.2116238 0.2069320 0.2112658 0.1898986
## [19] 0.2040502 0.1905429 0.1610573 0.2821135 0.1307800 0.1987769
## [25] 0.1838943 0.1762919
##
## $freq
## [1] 0.0002585984 0.0005171968 0.0007757952 0.0010343936 0.0012929920
## [6] 0.0015515904 0.0018101888 0.0020687872 0.0023273856 0.0025859840
## [11] 0.0028445824 0.0031031808 0.0033617792 0.0036203776 0.0038789760
## [16] 0.0041375743 0.0043961727 0.0046547711 0.0049133695 0.0051719679
## [21] 0.0054305663 0.0056891647 0.0059477631 0.0062063615 0.0064649599
## [26] 0.0067235583 0.0069821567 0.0072407551 0.0074993535 0.0077579519
## [31] 0.0080165503 0.0082751487 0.0085337471 0.0087923455 0.0090509439
## [36] 0.0093095423 0.0095681407 0.0098267391 0.0100853375 0.0103439359
## [41] 0.0106025343 0.0108611327 0.0111197311 0.0113783295 0.0116369279
## [46] 0.0118955262 0.0121541246 0.0124127230 0.0126713214 0.0129299198
## [51] 0.0131885182 0.0134471166 0.0137057150 0.0139643134 0.0142229118
## [56] 0.0144815102 0.0147401086 0.0149987070 0.0152573054 0.0155159038
## [61] 0.0157745022 0.0160331006 0.0162916990 0.0165502974 0.0168088958
## [66] 0.0170674942 0.0173260926 0.0175846910 0.0178432894 0.0181018878
## [71] 0.0183604862 0.0186190846 0.0188776830 0.0191362814 0.0193948798
## [76] 0.0196534781 0.0199120765 0.0201706749 0.0204292733 0.0206878717
## [81] 0.0209464701 0.0212050685 0.0214636669 0.0217222653 0.0219808637
## [86] 0.0222394621 0.0224980605 0.0227566589 0.0230152573 0.0232738557

```

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## [91] 0.0235324541 0.0237910525 0.0240496509 0.0243082493 0.0245668477
## [96] 0.0248254461 0.0250840445 0.0253426429 0.0256012413 0.0258598397
## [101] 0.0261184381 0.0263770365 0.0266356349 0.0268942333 0.0271528317
## [106] 0.0274114300 0.0276700284 0.0279286268 0.0281872252 0.0284458236
## [111] 0.0287044220 0.0289630204 0.0292216188 0.0294802172 0.0297388156
## [116] 0.0299974140 0.0302560124 0.0305146108 0.0307732092 0.0310318076
## [121] 0.0312904060 0.0315490044 0.0318076028 0.0320662012 0.0323247996
## [126] 0.0325833980 0.0328419964 0.0331005948 0.0333591932 0.0336177916
## [131] 0.0338763900 0.0341349884 0.0343935868 0.0346521852 0.0349107836
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## [166] 0.0429273339 0.0431859322 0.0434445306 0.0437031290 0.0439617274
## [171] 0.0442203258 0.0444789242 0.0447375226 0.0449961210 0.0452547194
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## [201] 0.0519782777 0.0522368761 0.0524954745 0.0527540729 0.0530126713
## [206] 0.0532712697 0.0535298681 0.0537884665 0.0540470649 0.0543056633
## [211] 0.0545642617 0.0548228601 0.0550814585 0.0553400569 0.0555986553
## [216] 0.0558572537 0.0561158521 0.0563744505 0.0566330489 0.0568916473
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## [231] 0.0597362296 0.0599948280 0.0602534264 0.0605120248 0.0607706232
## [236] 0.0610292216 0.0612878200 0.0615464184 0.0618050168 0.0620636152
## [241] 0.0623222136 0.0625808120 0.0628394104 0.0630980088 0.0633566072
## [246] 0.0636152056 0.0638738040 0.0641324024 0.0643910008 0.0646495992
## [251] 0.0649081976 0.0651667960 0.0654253944 0.0656839928 0.0659425912
## [256] 0.0662011896 0.0664597879 0.0667183863 0.0669769847 0.0672355831
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## [361] 0.0933540212 0.0936126196 0.0938712180 0.0941298164 0.0943884148
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## [1746]	1.79032870	-8.01661712	-11.73718470	-15.58154499	-4.36414692
## [1751]	-8.13840366	-5.93033735	7.74406395	1.63432957	0.57596100
## [1756]	-1.83385287	-4.74374304	-8.36816749	-4.23532409	-3.06726368
## [1761]	1.00983938	-1.06905193	-5.55941426	0.65702194	0.73175858
## [1766]	7.42471389	0.61739361	-7.44845547	-11.17691908	-22.93752586
## [1771]	-2.77311817	-5.21038831	3.83291847	0.76959307	0.84766589
## [1776]	2.15156502	-4.16245543	-3.13990792	-4.09112816	-8.59762163
## [1781]	-1.27292312	-11.68851270	6.77803459	1.17835220	2.80142938
## [1786]	-1.57273018	0.89293047	-4.90773250	1.10768179	-4.74069176
## [1791]	-3.69187761	-9.62251054	0.31800967	2.09507479	8.59896647
## [1796]	2.93503780	6.35330407	-0.48555781	1.66226076	-3.52810063
## [1801]	-10.08481622	-7.61169170	-8.17695064	1.09851188	9.73528092
## [1806]	4.96498899	-1.79639723	5.13104017	2.55180047	-0.44037696
## [1811]	-10.68148606	-16.12386241	-2.06069671	-5.09329411	-0.58717853
## [1816]	1.64504788	6.97880389	3.36173881	5.24178779	2.25241406
## [1821]	-5.86815927	-4.49744726	-6.61385596	2.85410163	-7.33071090
## [1826]	1.04652295	5.00122996	-7.24687000	0.06771191	2.07327307
## [1831]	-2.49306894	-10.99954236	-4.96981838	-0.85273806	-0.80641614
## [1836]	0.89924803	-4.38367358	11.25327572	5.43557460	6.82980102
## [1841]	5.72621177	0.66129487	-22.79199094	-15.09733288	-5.76615967
## [1846]	4.87436093	8.41956076	1.59953720	-3.34839530	-10.87782275
## [1851]	0.12376397	-2.48751161	-8.39727946	-14.59907647	-27.17605719
## [1856]	-7.32212016	-2.26425577	6.21103199	0.93246289	4.44161003
## [1861]	3.38978356	3.14301471	-10.35434652	-5.07734545	-7.33713262
## [1866]	-4.42101508	-9.89292427	-0.45391321	9.65143355	4.85748125
## [1871]	3.87769932	6.79705050	-0.97929310	-10.62481414	-12.57318597
## [1876]	-8.02571863	0.39967375	3.45203757	-23.63461451	6.95134046
## [1881]	9.30862892	5.36841819	-10.81354019	0.85718977	-8.65440215
## [1886]	-8.50176632	-4.90201779	-2.89751349	3.19996765	-4.56050542
## [1891]	11.13520986	2.89389184	1.64066120	-3.17774537	-3.85737644
## [1896]	-8.53714881	-14.91246058	-1.15655426	5.70117442	3.40704180
## [1901]	2.41119104	8.72756975	4.37786955	-5.18858567	-1.00428167
## [1906]	-3.28583452	-6.16707525	-0.46923545	-4.52601830	-2.98223344
## [1911]	3.99307515	-2.45236165	1.68371442	-1.31188202	2.42687984
## [1916]	3.50860146	-6.75216033	-5.71859841	-1.13381338	3.80207594
## [1921]	1.14811049	-6.37685948	5.58838455	1.12237141	2.59892686

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## [1926] -3.13765268 -5.60519174 -11.00982207 -14.94145200 -6.20234471
## [1931] 0.96517873 -4.30143107 2.43532575
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## [6] 1.166299e+01 1.161010e+01 1.154898e+01 1.147961e+01 1.140194e+01
## [11] 1.131593e+01 1.122153e+01 1.111869e+01 1.100735e+01 1.088745e+01
## [16] 1.075892e+01 1.062169e+01 1.047568e+01 1.032083e+01 1.015705e+01
## [21] 9.984261e+00 9.802367e+00 9.611284e+00 9.410918e+00 9.201177e+00
## [26] 8.981965e+00 8.753185e+00 8.514740e+00 8.266535e+00 8.008473e+00
## [31] 7.740463e+00 7.462413e+00 7.174238e+00 6.875860e+00 6.567206e+00
## [36] 6.248214e+00 5.918836e+00 5.579036e+00 5.228799e+00 4.868131e+00
## [41] 4.497063e+00 4.115659e+00 3.724019e+00 3.322286e+00 2.910657e+00
## [46] 2.489384e+00 2.058790e+00 1.619276e+00 1.171332e+00 7.155538e-01
## [51] 2.526475e-01 -2.165512e-01 -6.910676e-01 -1.169776e+00 -1.651391e+00
## [56] -2.134463e+00 -2.617378e+00 -3.098362e+00 -3.575503e+00 -4.046769e+00
## [61] -4.510052e+00 -4.963216e+00 -5.404155e+00 -5.830866e+00 -6.241519e+00
## [66] -6.634527e+00 -7.008614e+00 -7.362861e+00 -7.696735e+00 -8.010093e+00
## [71] -8.303167e+00 -8.576522e+00 -8.830998e+00 -9.067641e+00 -9.287635e+00
## [76] -9.492231e+00 -9.682684e+00 -9.860209e+00 -1.002594e+01 -1.018091e+01
## [81] -1.032604e+01 -1.046215e+01 -1.058993e+01 -1.071002e+01 -1.082297e+01
## [86] -1.092930e+01 -1.102947e+01 -1.112397e+01 -1.121328e+01 -1.129787e+01
## [91] -1.137827e+01 -1.145501e+01 -1.152863e+01 -1.159970e+01 -1.166879e+01
## [96] -1.173644e+01 -1.180320e+01 -1.186955e+01 -1.193595e+01 -1.200278e+01
## [101] -1.207036e+01 -1.213891e+01 -1.220859e+01 -1.227944e+01 -1.235139e+01
## [106] -1.242430e+01 -1.249792e+01 -1.257189e+01 -1.264578e+01 -1.271907e+01
## [111] -1.279117e+01 -1.286146e+01 -1.292927e+01 -1.299390e+01 -1.305470e+01
## [116] -1.311101e+01 -1.316224e+01 -1.320787e+01 -1.324749e+01 -1.328077e+01
## [121] -1.330754e+01 -1.332772e+01 -1.334138e+01 -1.334873e+01 -1.335009e+01
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## [141] -1.305156e+01 -1.304433e+01 -1.304123e+01 -1.304250e+01 -1.304839e+01
## [146] -1.305907e+01 -1.307472e+01 -1.309548e+01 -1.312146e+01 -1.315277e+01
## [151] -1.318947e+01 -1.323161e+01 -1.327924e+01 -1.333235e+01 -1.339095e+01
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## [191] -1.442984e+01 -1.426877e+01 -1.410246e+01 -1.393249e+01 -1.376032e+01
## [196] -1.358730e+01 -1.341467e+01 -1.324353e+01 -1.307485e+01 -1.290949e+01
## [201] -1.274819e+01 -1.259159e+01 -1.244023e+01 -1.229458e+01 -1.215500e+01
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## [241] -1.136652e+01 -1.143022e+01 -1.149602e+01 -1.156371e+01 -1.163311e+01
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## [266] -1.314278e+01 -1.319575e+01 -1.324411e+01 -1.328736e+01 -1.332495e+01
## [271] -1.335635e+01 -1.338103e+01 -1.339847e+01 -1.340817e+01 -1.340967e+01
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## [321] -8.240262e+00 -8.177673e+00 -8.121821e+00 -8.072782e+00 -8.030617e+00
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## [426] -7.127003e+00 -7.192966e+00 -7.262098e+00 -7.334140e+00 -7.408822e+00
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## [446] -8.693275e+00 -8.760533e+00 -8.824097e+00 -8.883662e+00 -8.938942e+00
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## [456] -9.167980e+00 -9.187497e+00 -9.201403e+00 -9.209649e+00 -9.212208e+00
## [461] -9.209072e+00 -9.200254e+00 -9.185781e+00 -9.165693e+00 -9.140045e+00
## [466] -9.108901e+00 -9.072336e+00 -9.030433e+00 -8.983282e+00 -8.930984e+00
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## [476] -8.515689e+00 -8.430861e+00 -8.342012e+00 -8.249337e+00 -8.153044e+00
## [481] -8.053356e+00 -7.950508e+00 -7.844752e+00 -7.736351e+00 -7.625582e+00
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## [511] -4.897675e+00 -4.831363e+00 -4.769531e+00 -4.712240e+00 -4.659531e+00
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## [526] -4.375645e+00 -4.374312e+00 -4.376331e+00 -4.381459e+00 -4.389429e+00
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## [556] -4.538504e+00 -4.514787e+00 -4.489230e+00 -4.462150e+00 -4.433887e+00
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## [591] -4.411477e+00 -4.451338e+00 -4.492312e+00 -4.534125e+00 -4.576502e+00
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## [611] -5.144591e+00 -5.166065e+00 -5.185683e+00 -5.203506e+00 -5.219605e+00
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## [621] -5.284762e+00 -5.291188e+00 -5.296554e+00 -5.300922e+00 -5.304342e+00
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## [631] -5.306493e+00 -5.303838e+00 -5.300284e+00 -5.295802e+00 -5.290360e+00
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## [641] -5.235449e+00 -5.222252e+00 -5.207818e+00 -5.192123e+00 -5.175148e+00
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## [676] -4.095884e+00 -4.053034e+00 -4.010890e+00 -3.969607e+00 -3.929342e+00
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## [711] -3.508059e+00 -3.506959e+00 -3.504548e+00 -3.500637e+00 -3.495059e+00
## [716] -3.487668e+00 -3.478341e+00 -3.466980e+00 -3.453514e+00 -3.437895e+00
## [721] -3.420103e+00 -3.400140e+00 -3.378032e+00 -3.353826e+00 -3.327586e+00
## [726] -3.299393e+00 -3.269342e+00 -3.237537e+00 -3.204090e+00 -3.169119e+00
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## [781] -1.789657e+00 -1.819933e+00 -1.853128e+00 -1.889068e+00 -1.927558e+00
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## [811] -2.965418e+00 -2.982231e+00 -2.997166e+00 -3.010400e+00 -3.022120e+00
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## [831] -3.143437e+00 -3.151777e+00 -3.160112e+00 -3.168300e+00 -3.176175e+00
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## [916] -8.397555e-01 -8.166122e-01 -7.914658e-01 -7.645439e-01 -7.361050e-01
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## [1086] -5.117219e-01 -4.894472e-01 -4.667910e-01 -4.438112e-01 -4.205710e-01
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## [1096] -2.796075e-01 -2.565366e-01 -2.337714e-01 -2.113730e-01 -1.893969e-01
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## [1146] 2.377921e-01 2.218892e-01 2.038471e-01 1.836842e-01 1.614403e-01
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## [1156] -1.056956e-02 -4.431432e-02 -7.899087e-02 -1.143600e-01 -1.501667e-01
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## [1186] -5.289931e-01 -5.163734e-01 -5.031176e-01 -4.894756e-01 -4.756894e-01
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## [1271] 1.879849e+00 1.861728e+00 1.840442e+00 1.816297e+00 1.789619e+00
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## [1291] 1.318250e+00 1.303180e+00 1.291190e+00 1.282349e+00 1.276687e+00
## [1296] 1.274197e+00 1.274835e+00 1.278525e+00 1.285161e+00 1.294611e+00
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## [1306] 1.400442e+00 1.424340e+00 1.449432e+00 1.475493e+00 1.502296e+00
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## [1316] 1.6666577e+00 1.692614e+00 1.717750e+00 1.741804e+00 1.764601e+00
## [1321] 1.785969e+00 1.805744e+00 1.823765e+00 1.839878e+00 1.853936e+00
## [1326] 1.865796e+00 1.875324e+00 1.882392e+00 1.886881e+00 1.888678e+00

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## [1346] 1.504600e+00 1.455196e+00 1.403283e+00 1.349014e+00 1.292552e+00
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## [1511] 1.754888e+00 1.752882e+00 1.749270e+00 1.743961e+00 1.736873e+00
## [1516] 1.727938e+00 1.717099e+00 1.704308e+00 1.689531e+00 1.672745e+00
## [1521] 1.653938e+00 1.633107e+00 1.610263e+00 1.585423e+00 1.558615e+00
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## [1536] 1.148588e+00 1.102595e+00 1.055480e+00 1.007321e+00 9.582007e-01
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## [1611]	1.680335e+00	1.733088e+00	1.785729e+00	1.838262e+00	1.890673e+00
## [1616]	1.942927e+00	1.994973e+00	2.046739e+00	2.098135e+00	2.149053e+00
## [1621]	2.199369e+00	2.248943e+00	2.297620e+00	2.345236e+00	2.391617e+00
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## [1906] 1.855318e+00 1.788068e+00 1.719695e+00 1.650441e+00 1.580563e+00
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##  [11] 1.131593e+01 1.122153e+01 1.111869e+01 1.100735e+01 1.088745e+01
##  [16] 1.075892e+01 1.062169e+01 1.047568e+01 1.032083e+01 1.015705e+01
##  [21] 9.984261e+00 9.802367e+00 9.611284e+00 9.410918e+00 9.201177e+00
##  [26] 8.981965e+00 8.753185e+00 8.514740e+00 8.266535e+00 8.008473e+00
##  [31] 7.740463e+00 7.462413e+00 7.174238e+00 6.875860e+00 6.567206e+00
##  [36] 6.248214e+00 5.918836e+00 5.579036e+00 5.228799e+00 4.868131e+00
##  [41] 4.497063e+00 4.115659e+00 3.724019e+00 3.322286e+00 2.910657e+00
##  [46] 2.489384e+00 2.058790e+00 1.619276e+00 1.171332e+00 7.155538e-01
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## [566] -4.259514e+00 -4.232965e+00 -4.208018e+00 -4.184964e+00 -4.164072e+00
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## [581] -4.127040e+00 -4.143167e+00 -4.162443e+00 -4.184753e+00 -4.209957e+00
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## [591] -4.411477e+00 -4.451338e+00 -4.492312e+00 -4.534125e+00 -4.576502e+00
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## [631] -5.306493e+00 -5.303838e+00 -5.300284e+00 -5.295802e+00 -5.290360e+00
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## [1041] -1.297945e+00 -1.279702e+00 -1.261058e+00 -1.242087e+00 -1.222866e+00
## [1046] -1.203471e+00 -1.183978e+00 -1.164462e+00 -1.144991e+00 -1.125633e+00
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## [1146] 2.377921e-01 2.218892e-01 2.038471e-01 1.836842e-01 1.614403e-01
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## [1291] 1.318250e+00 1.303180e+00 1.291190e+00 1.282349e+00 1.276687e+00
## [1296] 1.274197e+00 1.274835e+00 1.278525e+00 1.285161e+00 1.294611e+00
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## [1366] 2.521016e-01 1.886881e-01 1.265117e-01 6.570682e-02 6.400359e-03
## [1371] -5.128740e-02 -1.072412e-01 -1.613493e-01 -2.135018e-01 -2.635890e-01
## [1376] -3.114999e-01 -3.571210e-01 -4.003348e-01 -4.410193e-01 -4.790475e-01
## [1381] -5.142877e-01 -5.466035e-01 -5.758557e-01 -6.019030e-01 -6.246046e-01
## [1386] -6.438228e-01 -6.594253e-01 -6.712890e-01 -6.793032e-01 -6.833727e-01
## [1391] -6.834217e-01 -6.793967e-01 -6.712692e-01 -6.590381e-01 -6.427318e-01
## [1396] -6.224090e-01 -5.981589e-01 -5.701017e-01 -5.383864e-01 -5.031899e-01
## [1401] -4.647141e-01 -4.231831e-01 -3.788399e-01 -3.319422e-01 -2.827589e-01
## [1406] -2.315660e-01 -1.786425e-01 -1.242664e-01 -6.871153e-02 -1.224387e-02
## [1411] 4.488120e-02 1.024215e-01 1.601501e-01 2.178569e-01 2.753502e-01
## [1416] 3.324570e-01 3.890237e-01 4.449160e-01 5.000189e-01 5.542355e-01
## [1421] 6.074866e-01 6.597095e-01 7.108566e-01 7.608938e-01 8.097993e-01
## [1426] 8.575617e-01 9.041782e-01 9.496534e-01 9.939970e-01 1.037223e+00
## [1431] 1.079346e+00 1.120383e+00 1.160350e+00 1.199261e+00 1.237127e+00
## [1436] 1.273955e+00 1.309749e+00 1.344508e+00 1.378223e+00 1.410884e+00
## [1441] 1.442473e+00 1.472967e+00 1.502339e+00 1.530559e+00 1.557592e+00
## [1446] 1.583401e+00 1.607946e+00 1.631188e+00 1.653087e+00 1.673603e+00
## [1451] 1.692700e+00 1.710343e+00 1.726502e+00 1.741151e+00 1.754271e+00
## [1456] 1.765847e+00 1.775875e+00 1.784355e+00 1.791297e+00 1.796720e+00
## [1461] 1.800652e+00 1.803131e+00 1.804203e+00 1.803925e+00 1.802364e+00
## [1466] 1.799594e+00 1.795700e+00 1.790775e+00 1.784921e+00 1.778245e+00
## [1471] 1.770862e+00 1.762892e+00 1.754461e+00 1.745696e+00 1.736727e+00
## [1476] 1.727685e+00 1.718701e+00 1.709902e+00 1.701412e+00 1.693351e+00
## [1481] 1.685830e+00 1.678953e+00 1.672814e+00 1.667496e+00 1.663070e+00
## [1486] 1.659592e+00 1.657105e+00 1.655636e+00 1.655197e+00 1.655782e+00

```

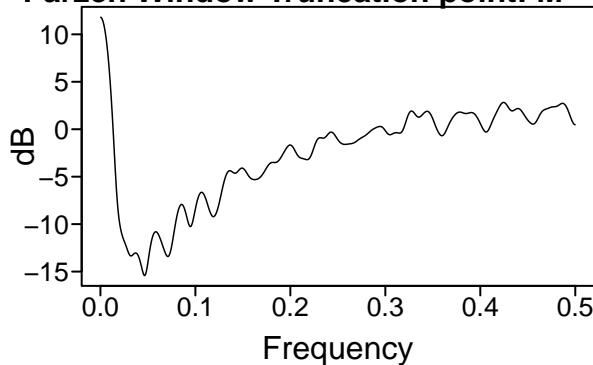
## [1491]	1.657372e+00	1.659928e+00	1.663398e+00	1.667713e+00	1.672792e+00
## [1496]	1.678538e+00	1.684844e+00	1.691590e+00	1.698647e+00	1.705879e+00
## [1501]	1.713144e+00	1.720294e+00	1.727177e+00	1.733644e+00	1.739541e+00
## [1506]	1.744719e+00	1.749032e+00	1.752337e+00	1.754500e+00	1.755390e+00
## [1511]	1.754888e+00	1.752882e+00	1.749270e+00	1.743961e+00	1.736873e+00
## [1516]	1.727938e+00	1.717099e+00	1.704308e+00	1.689531e+00	1.672745e+00
## [1521]	1.653938e+00	1.633107e+00	1.610263e+00	1.585423e+00	1.558615e+00
## [1526]	1.529876e+00	1.499248e+00	1.466783e+00	1.432537e+00	1.396571e+00
## [1531]	1.358952e+00	1.319750e+00	1.279036e+00	1.236887e+00	1.193378e+00
## [1536]	1.148588e+00	1.102595e+00	1.055480e+00	1.007321e+00	9.582007e-01
## [1541]	9.082017e-01	8.574086e-01	8.059083e-01	7.537916e-01	7.011536e-01
## [1546]	6.480952e-01	5.947245e-01	5.411579e-01	4.875217e-01	4.339536e-01
## [1551]	3.806036e-01	3.276359e-01	2.752290e-01	2.235775e-01	1.728916e-01
## [1556]	1.233976e-01	7.533733e-02	2.896716e-02	-1.544358e-02	-5.761479e-02
## [1561]	-9.725840e-02	-1.340819e-01	-1.677921e-01	-1.981005e-01	-2.247272e-01
## [1566]	-2.474075e-01	-2.658964e-01	-2.799748e-01	-2.894548e-01	-2.941843e-01
## [1571]	-2.940515e-01	-2.889885e-01	-2.789736e-01	-2.640331e-01	-2.442409e-01
## [1576]	-2.197182e-01	-1.906309e-01	-1.571868e-01	-1.196308e-01	-7.824015e-02
## [1581]	-3.331903e-02	1.480795e-02	6.580179e-02	1.193155e-01	1.750001e-01
## [1586]	2.325106e-01	2.915114e-01	3.516806e-01	4.127150e-01	4.743328e-01
## [1591]	5.362769e-01	5.983171e-01	6.602511e-01	7.219061e-01	7.831381e-01
## [1596]	8.438325e-01	9.039026e-01	9.632886e-01	1.021956e+00	1.079893e+00
## [1601]	1.137108e+00	1.193628e+00	1.249495e+00	1.304763e+00	1.359494e+00
## [1606]	1.413754e+00	1.467614e+00	1.521143e+00	1.574403e+00	1.627451e+00
## [1611]	1.680335e+00	1.733088e+00	1.785729e+00	1.838262e+00	1.890673e+00
## [1616]	1.942927e+00	1.994973e+00	2.046739e+00	2.098135e+00	2.149053e+00
## [1621]	2.199369e+00	2.248943e+00	2.297620e+00	2.345236e+00	2.391617e+00
## [1626]	2.436581e+00	2.479943e+00	2.521514e+00	2.561106e+00	2.598534e+00
## [1631]	2.633617e+00	2.666180e+00	2.696059e+00	2.723098e+00	2.747156e+00
## [1636]	2.768105e+00	2.785831e+00	2.800238e+00	2.811250e+00	2.818807e+00
## [1641]	2.822869e+00	2.823419e+00	2.820460e+00	2.814018e+00	2.804140e+00
## [1646]	2.790898e+00	2.774386e+00	2.754722e+00	2.732049e+00	2.706531e+00
## [1651]	2.678358e+00	2.647739e+00	2.614908e+00	2.580120e+00	2.543648e+00
## [1656]	2.505784e+00	2.466834e+00	2.427122e+00	2.386979e+00	2.346746e+00
## [1661]	2.306767e+00	2.267387e+00	2.228947e+00	2.191780e+00	2.156208e+00
## [1666]	2.122532e+00	2.091035e+00	2.061970e+00	2.035562e+00	2.012000e+00
## [1671]	1.991436e+00	1.973983e+00	1.959709e+00	1.948642e+00	1.940765e+00
## [1676]	1.936020e+00	1.934308e+00	1.935491e+00	1.939396e+00	1.945816e+00
## [1681]	1.954520e+00	1.965250e+00	1.977732e+00	1.991674e+00	2.006778e+00
## [1686]	2.022738e+00	2.039249e+00	2.056008e+00	2.072716e+00	2.089087e+00
## [1691]	2.104845e+00	2.119729e+00	2.133495e+00	2.145917e+00	2.156787e+00
## [1696]	2.165919e+00	2.173148e+00	2.178328e+00	2.181338e+00	2.182074e+00
## [1701]	2.180457e+00	2.176427e+00	2.169944e+00	2.160990e+00	2.149564e+00
## [1706]	2.135684e+00	2.119385e+00	2.100719e+00	2.079753e+00	2.056569e+00
## [1711]	2.031262e+00	2.003939e+00	1.974718e+00	1.943726e+00	1.911100e+00
## [1716]	1.876982e+00	1.841519e+00	1.804863e+00	1.767167e+00	1.728587e+00
## [1721]	1.689275e+00	1.649384e+00	1.609062e+00	1.568451e+00	1.527688e+00
## [1726]	1.486902e+00	1.446215e+00	1.405737e+00	1.365570e+00	1.325806e+00
## [1731]	1.286527e+00	1.247801e+00	1.209691e+00	1.172245e+00	1.135506e+00
## [1736]	1.099508e+00	1.064276e+00	1.029832e+00	9.961919e-01	9.633704e-01
## [1741]	9.313805e-01	9.002362e-01	8.699540e-01	8.405548e-01	8.120652e-01
## [1746]	7.845193e-01	7.579600e-01	7.324402e-01	7.080237e-01	6.847857e-01
## [1751]	6.628138e-01	6.422071e-01	6.230769e-01	6.055449e-01	5.897431e-01
## [1756]	5.758116e-01	5.638971e-01	5.541504e-01	5.467237e-01	5.417678e-01

```

## [1761] 5.394290e-01 5.398454e-01 5.431438e-01 5.494359e-01 5.588152e-01
## [1766] 5.713534e-01 5.870982e-01 6.060702e-01 6.282613e-01 6.536331e-01
## [1771] 6.821163e-01 7.136106e-01 7.479851e-01 7.850797e-01 8.247069e-01
## [1776] 8.666539e-01 9.106862e-01 9.565501e-01 1.003977e+00 1.052686e+00
## [1781] 1.102389e+00 1.152796e+00 1.203613e+00 1.254555e+00 1.305339e+00
## [1786] 1.355696e+00 1.405370e+00 1.454120e+00 1.501722e+00 1.547975e+00
## [1791] 1.592697e+00 1.635731e+00 1.676943e+00 1.716221e+00 1.753482e+00
## [1796] 1.788665e+00 1.821734e+00 1.852675e+00 1.881502e+00 1.908246e+00
## [1801] 1.932961e+00 1.955722e+00 1.976619e+00 1.995759e+00 2.013263e+00
## [1806] 2.029263e+00 2.043902e+00 2.057327e+00 2.069691e+00 2.081147e+00
## [1811] 2.091847e+00 2.101941e+00 2.111568e+00 2.120864e+00 2.129948e+00
## [1816] 2.138930e+00 2.147903e+00 2.156945e+00 2.166117e+00 2.175459e+00
## [1821] 2.184998e+00 2.194740e+00 2.204676e+00 2.214780e+00 2.225012e+00
## [1826] 2.235319e+00 2.245640e+00 2.255904e+00 2.266033e+00 2.275948e+00
## [1831] 2.285571e+00 2.294822e+00 2.303630e+00 2.311928e+00 2.319660e+00
## [1836] 2.326781e+00 2.333258e+00 2.339075e+00 2.344230e+00 2.348736e+00
## [1841] 2.352624e+00 2.355942e+00 2.358754e+00 2.361138e+00 2.363190e+00
## [1846] 2.365014e+00 2.366729e+00 2.368459e+00 2.370337e+00 2.372499e+00
## [1851] 2.375080e+00 2.378214e+00 2.382027e+00 2.386639e+00 2.392156e+00
## [1856] 2.398668e+00 2.406250e+00 2.414956e+00 2.424818e+00 2.435844e+00
## [1861] 2.448018e+00 2.461298e+00 2.475620e+00 2.490891e+00 2.506998e+00
## [1866] 2.523805e+00 2.541154e+00 2.558871e+00 2.576765e+00 2.594633e+00
## [1871] 2.612261e+00 2.629429e+00 2.645911e+00 2.661480e+00 2.675909e+00
## [1876] 2.688977e+00 2.700466e+00 2.710166e+00 2.717880e+00 2.723419e+00
## [1881] 2.726607e+00 2.727283e+00 2.725302e+00 2.720532e+00 2.712859e+00
## [1886] 2.702185e+00 2.688429e+00 2.671528e+00 2.651435e+00 2.628120e+00
## [1891] 2.601571e+00 2.571791e+00 2.538801e+00 2.502638e+00 2.463354e+00
## [1896] 2.421018e+00 2.375712e+00 2.327536e+00 2.276602e+00 2.223039e+00
## [1901] 2.166987e+00 2.108603e+00 2.048055e+00 1.985525e+00 1.921211e+00
## [1906] 1.855318e+00 1.788068e+00 1.719695e+00 1.650441e+00 1.580563e+00
## [1911] 1.510329e+00 1.440013e+00 1.369904e+00 1.300294e+00 1.231487e+00
## [1916] 1.163792e+00 1.097521e+00 1.032992e+00 9.705225e-01 9.104305e-01
## [1921] 8.530307e-01 7.986326e-01 7.475375e-01 7.000362e-01 6.564055e-01
## [1926] 6.169057e-01 5.817773e-01 5.512383e-01 5.254815e-01 5.046717e-01
## [1931] 4.889438e-01 4.784006e-01 4.731115e-01

```

Parzen Window Truncation point: M = 12



Identification of the Price Index for ARIMA/ARMA model identification.

```
## -----WORKING... PLEASE WAIT...
```

```
##
```

```
##
```

```
## Five Smallest Values of aic
```

```
##      p    q      aic
## 71    11    4  -2.027128
## 72    11    5  -2.022557
## 66    10    5  -2.020375
## 70    11    3  -2.019919
## 82    13    3  -2.019166
```

```
## -----WORKING... PLEASE WAIT...
```

```
##
```

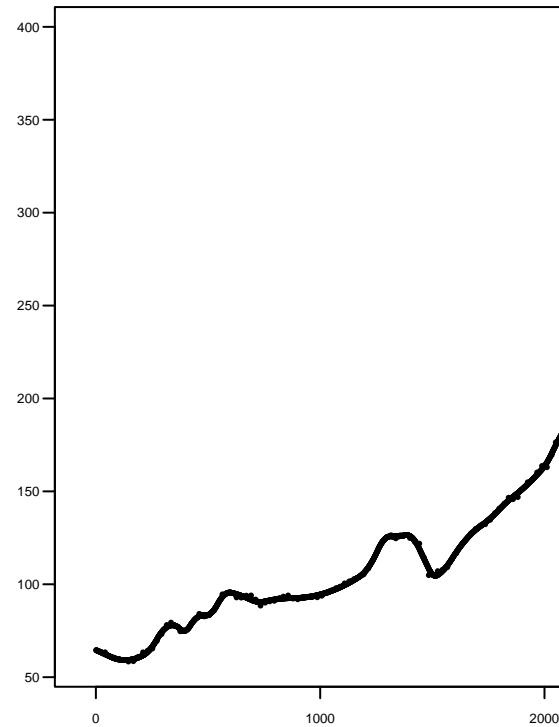
```
##
```

```
## Five Smallest Values of bic
```

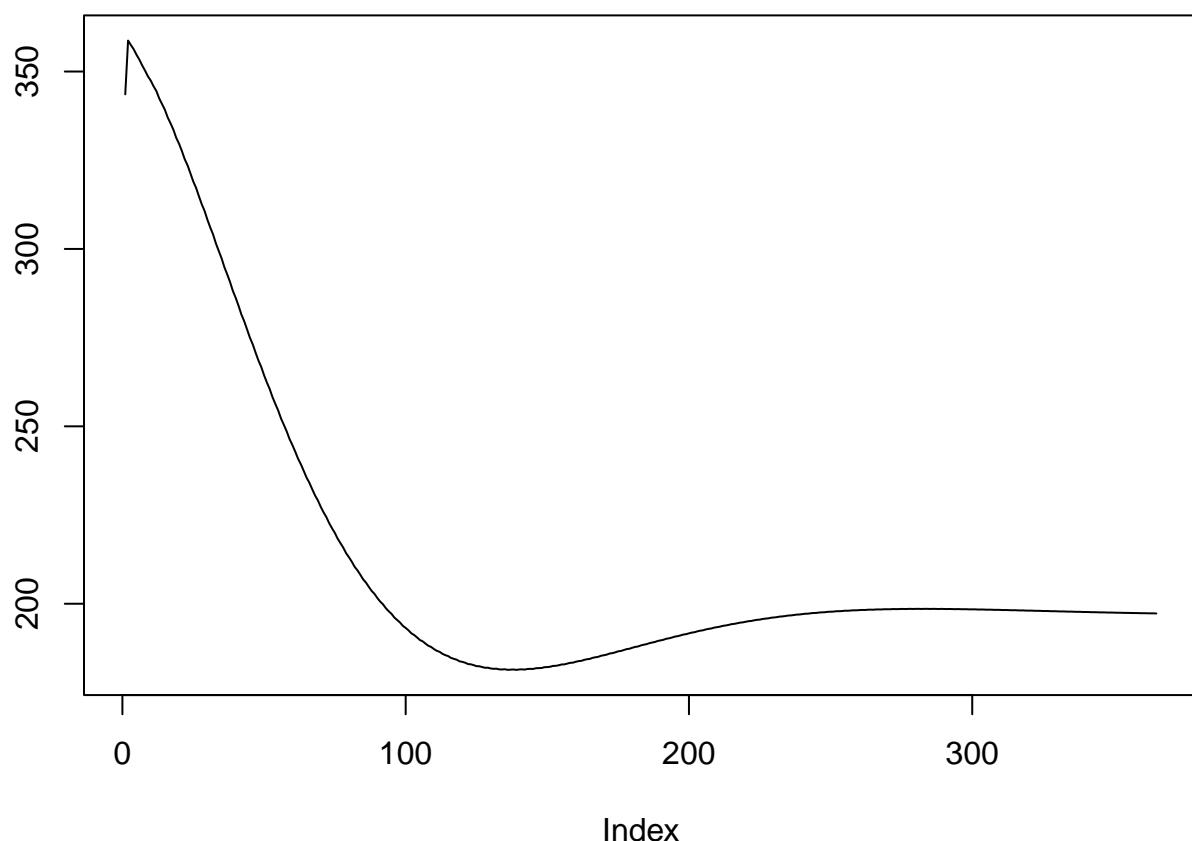
```
##      p    q      bic
## 71    11    4  -2.001226
## 70    11    3  -1.995635
## 72    11    5  -1.995036
## 66    10    5  -1.994473
## 60     9    5  -1.993425
```

Estimation of the coefficients for the Price Index for the ARIMA(11,2,4) model.

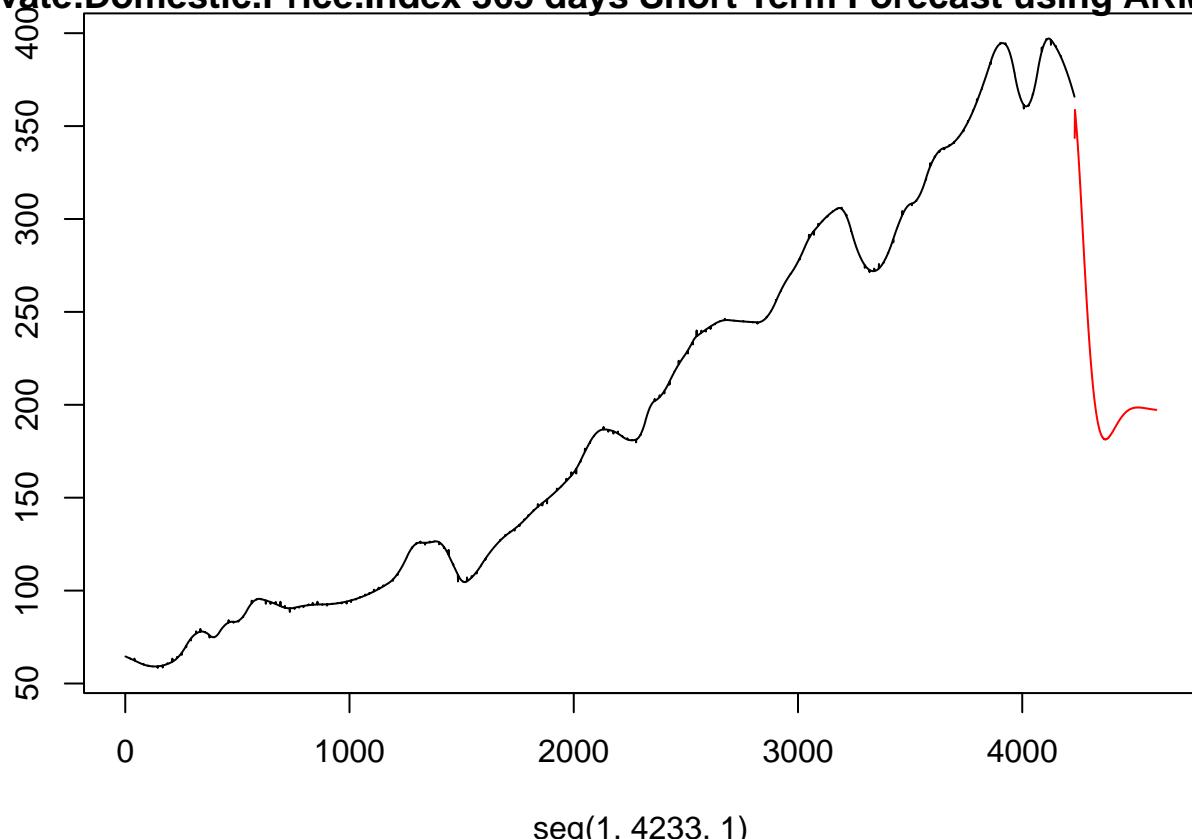
```
##  
## Coefficients of Original polynomial:  
## 0.0322 0.3918 1.1102 -0.0967 -0.0845 -0.0623 -0.0676 -0.0547 -0.0711 -0.0540 -0.0511  
##  
## Factor Roots Abs Recip System Freq  
## 1+1.1624B+0.9835B^2 -0.5909+-0.8170i 0.9917 0.3497  
## 1-1.9673B+0.9680B^2 1.0161+-0.0220i 0.9839 0.0035  
## 1-0.8646B+0.4568B^2 0.9464+-1.1373i 0.6759 0.1395  
## 1+0.9512B+0.4356B^2 -1.0917+-1.0506i 0.6600 0.3781  
## 1+0.6523B -1.5331 0.6523 0.5000  
## 1+0.0339B+0.4138B^2 -0.0409+-1.5540i 0.6433 0.2542  
##  
##  
## [1] 0.1306278  
## [1] 197.065
```

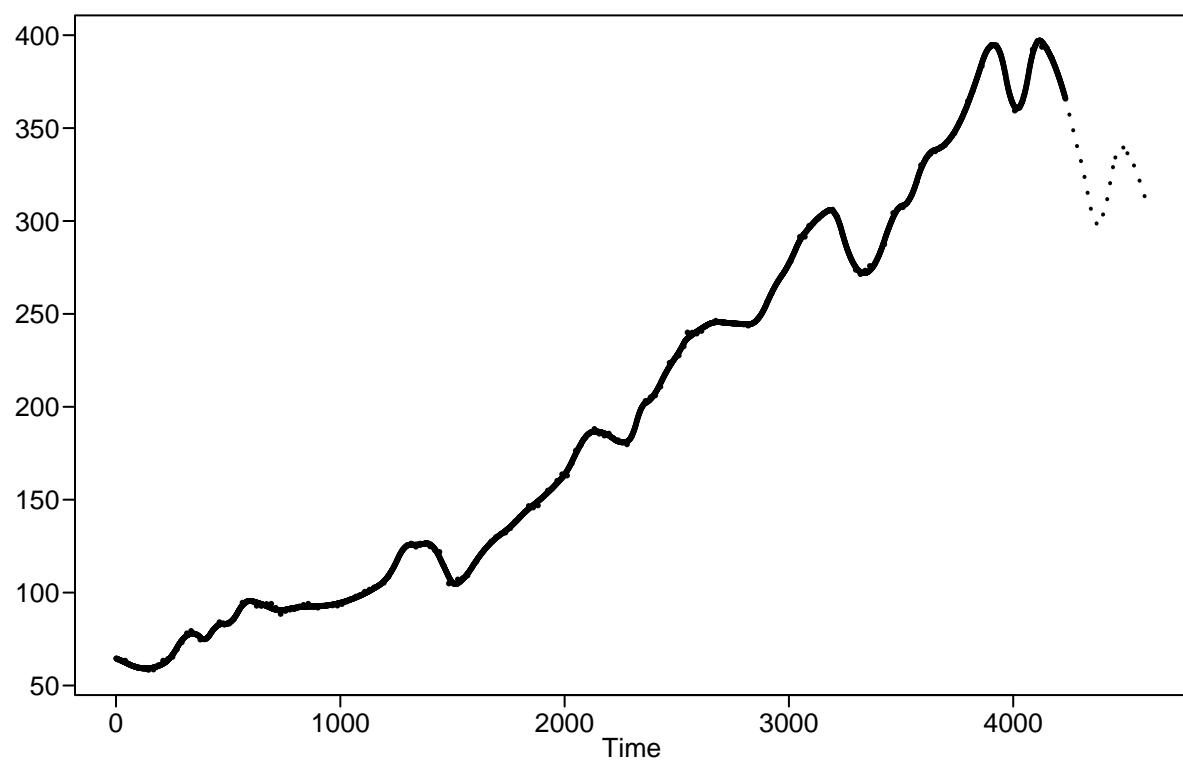


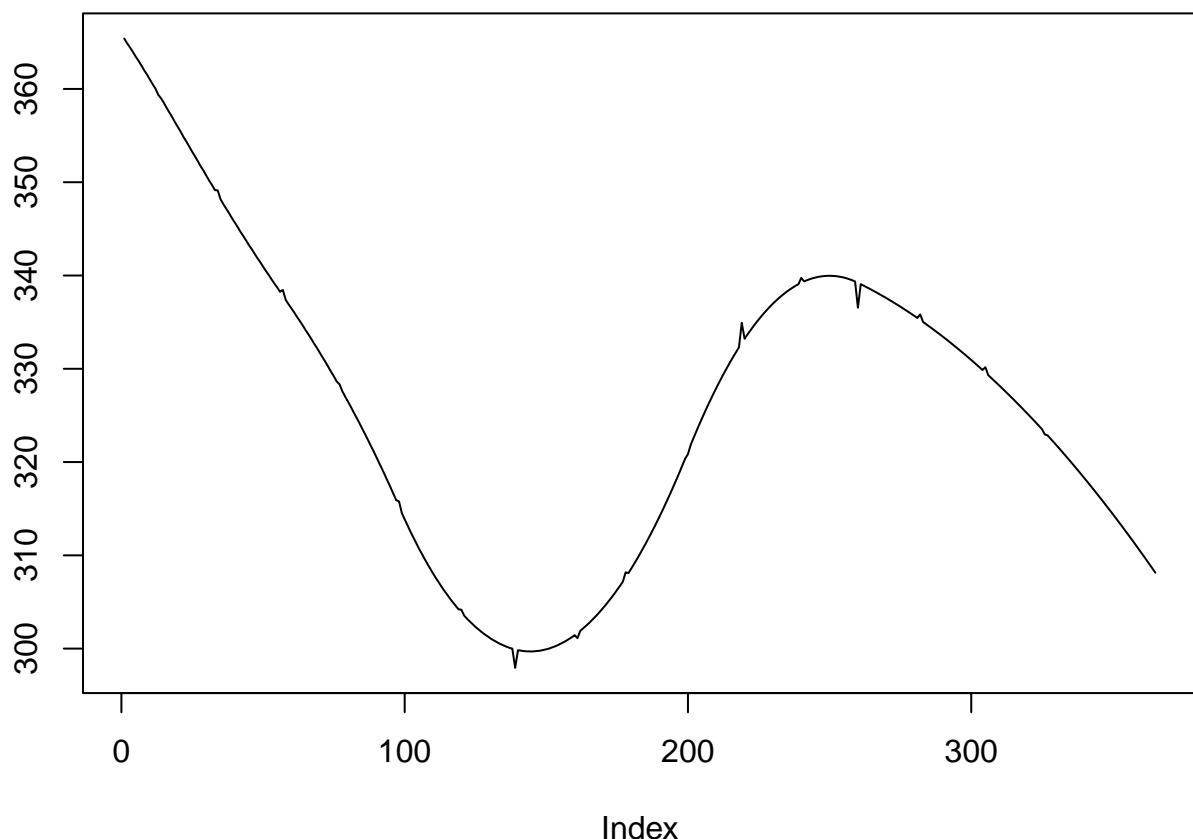
Forecasts for the Price Index ARMA(11,4) AND ARIMA(11,2,4) models.



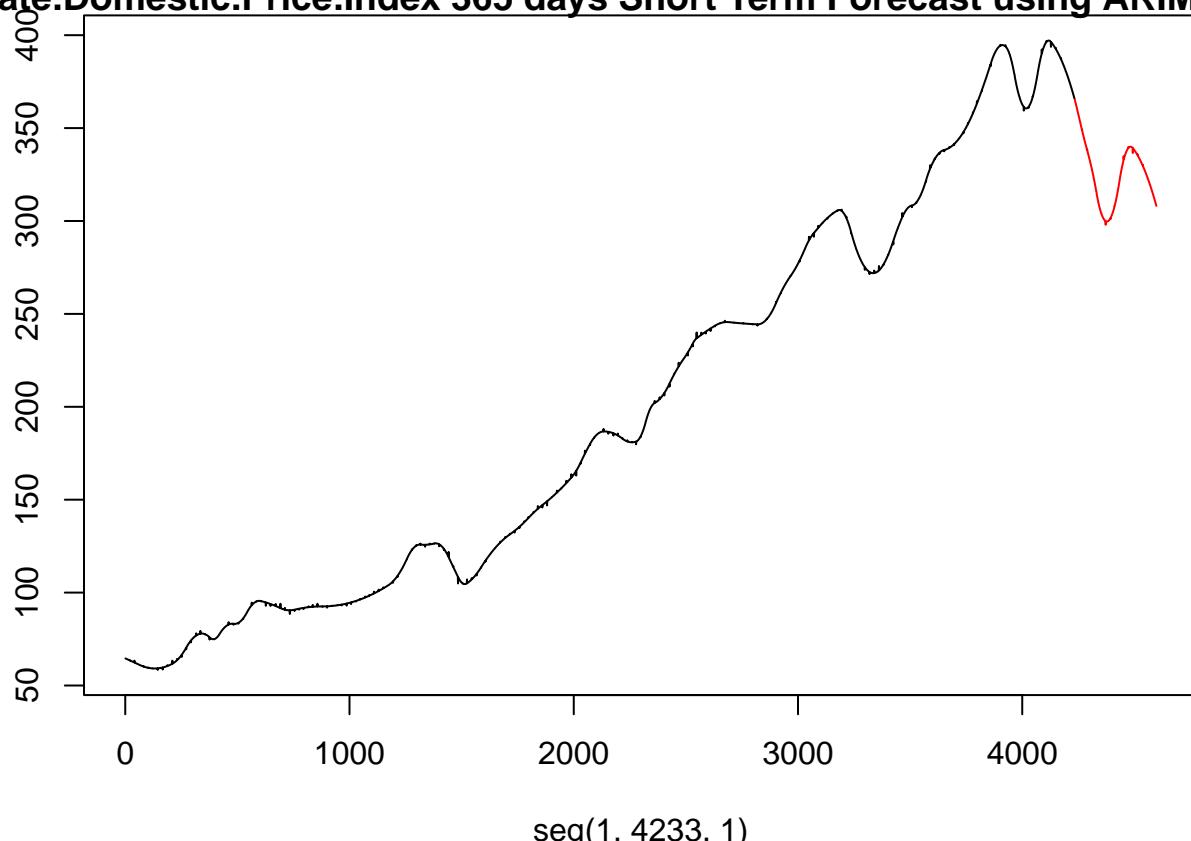
Private.Domestic.Price.Index 365 days Short Term Forecast using ARMA

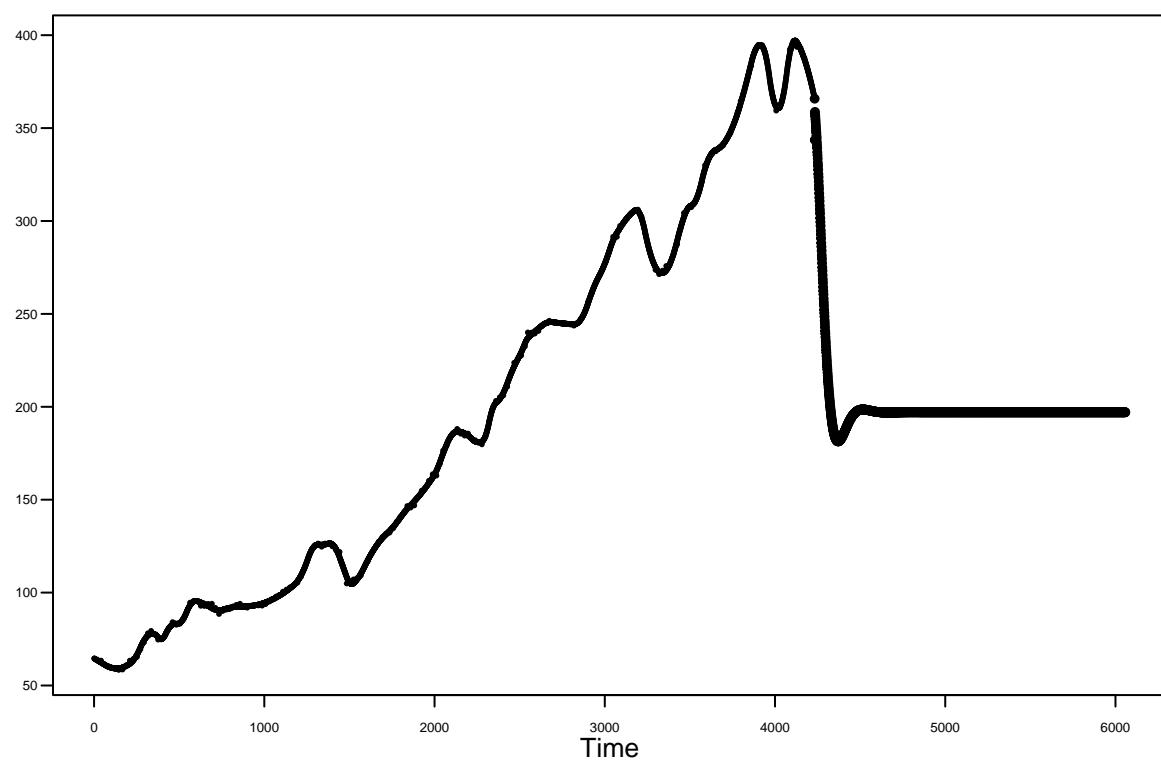


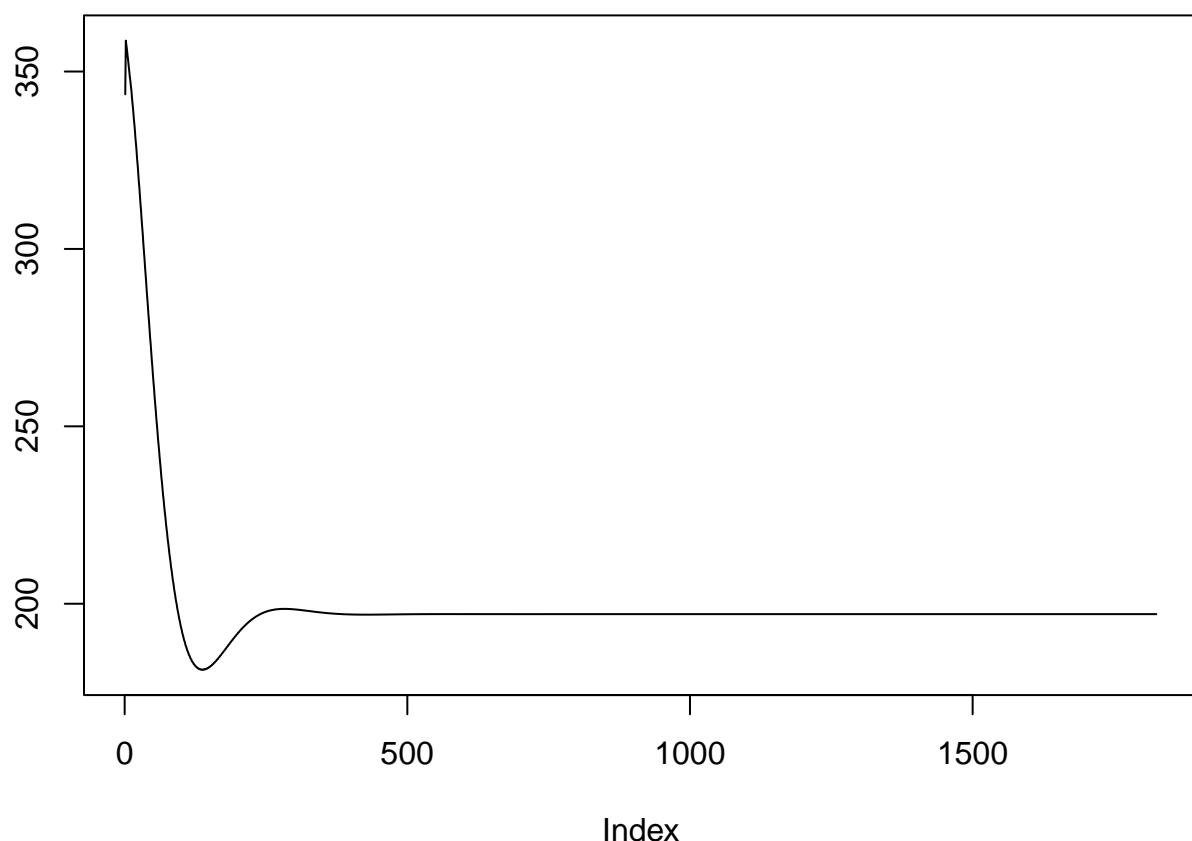




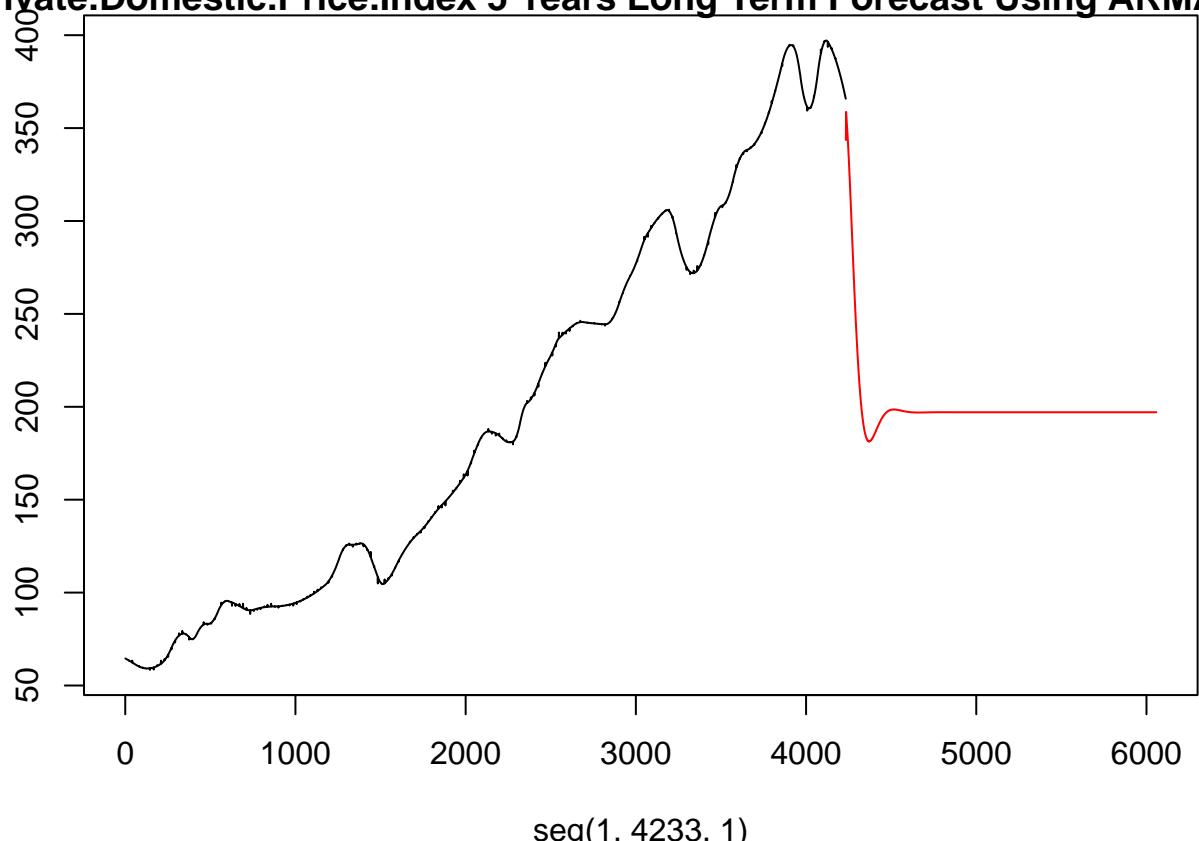
/rate.Domestic.Price.Index 365 days Short Term Forecast using ARIMA(

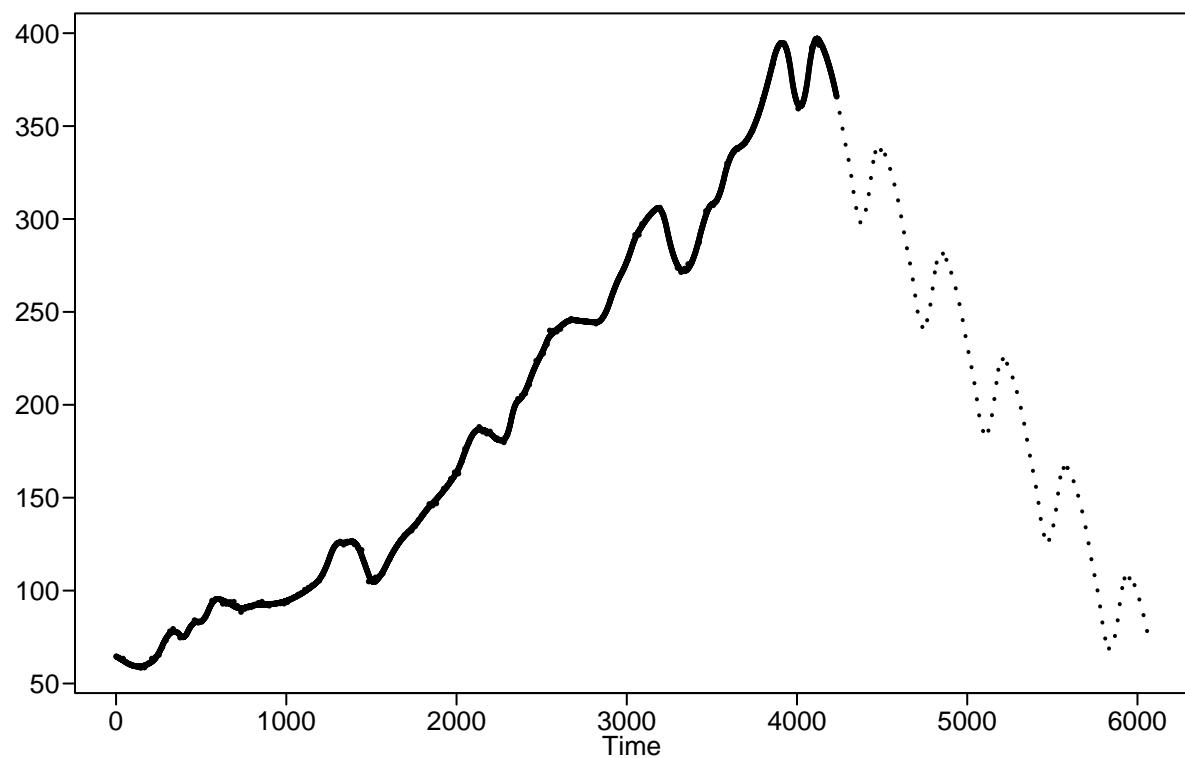


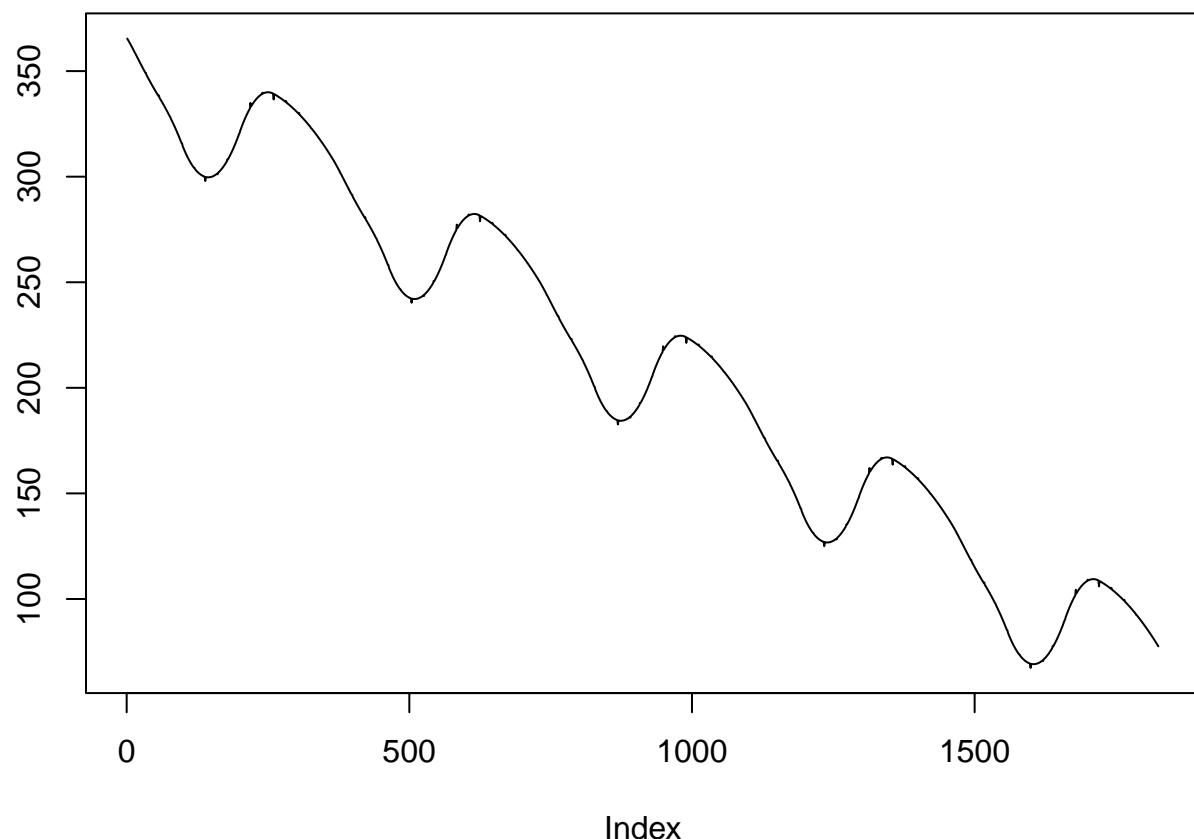




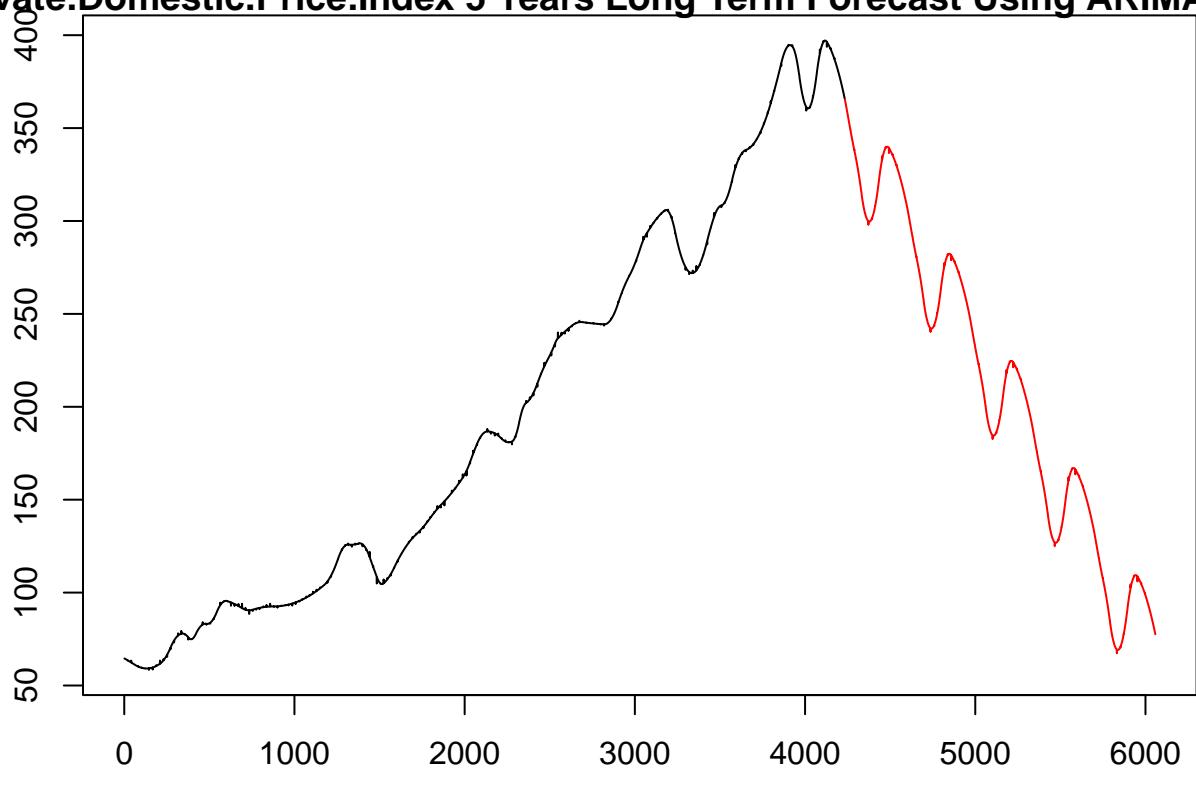
Private.Domestic.Price.Index 5 Years Long Term Forecast Using ARMA(





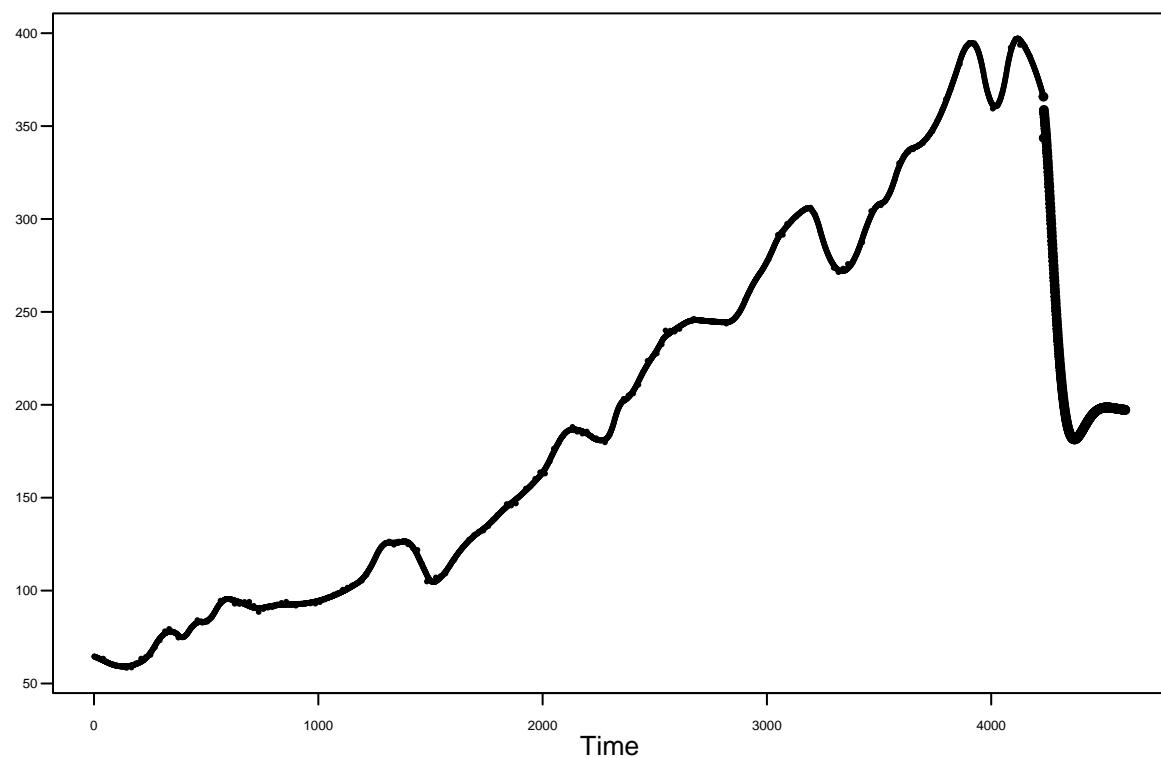


Private.Domestic.Price.Index 5 Years Long Term Forecast Using ARIMA(1)

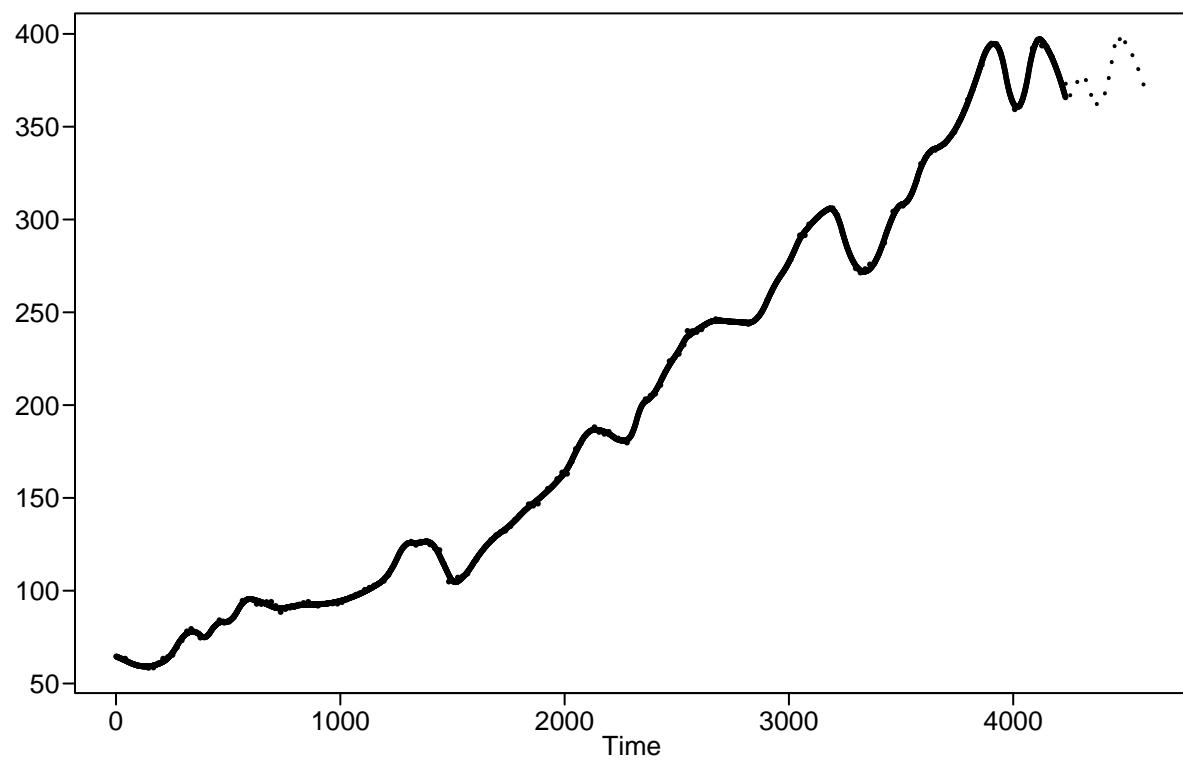


sea(1. 4233. 1)

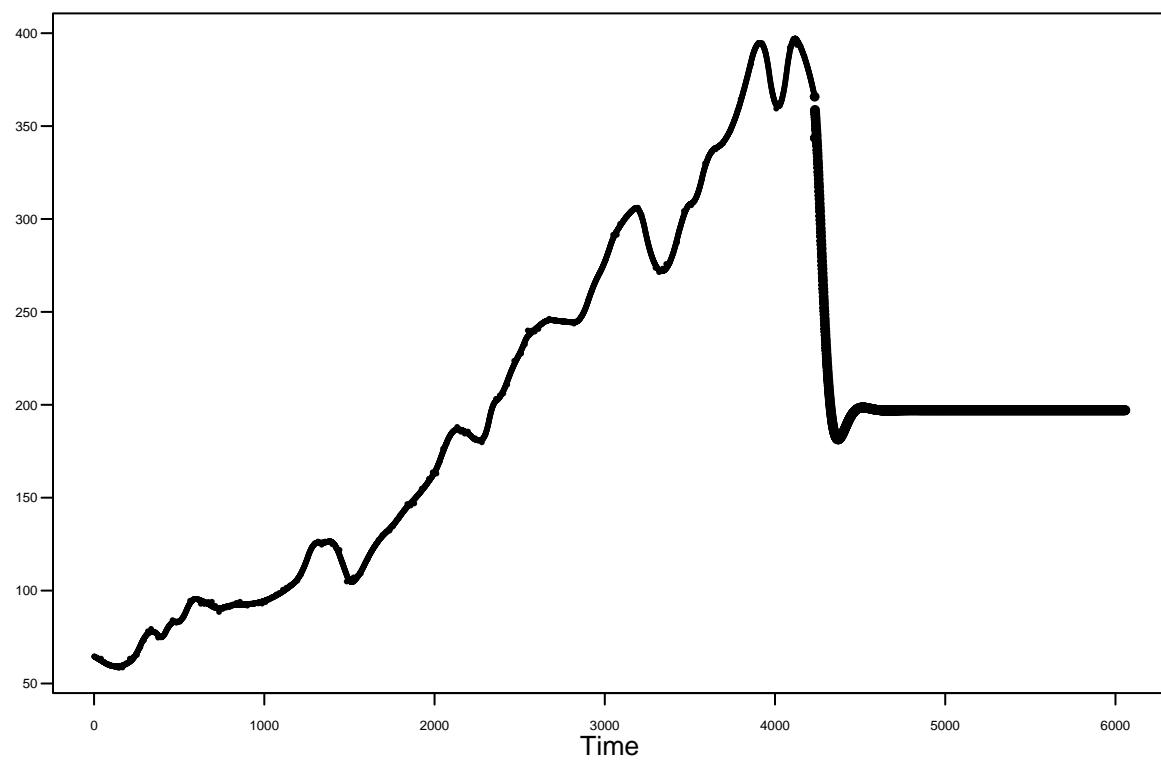
Calculation of the ASE values for the Price_Index ARMA(11,4) AND ARIMA(11,2,4) models.



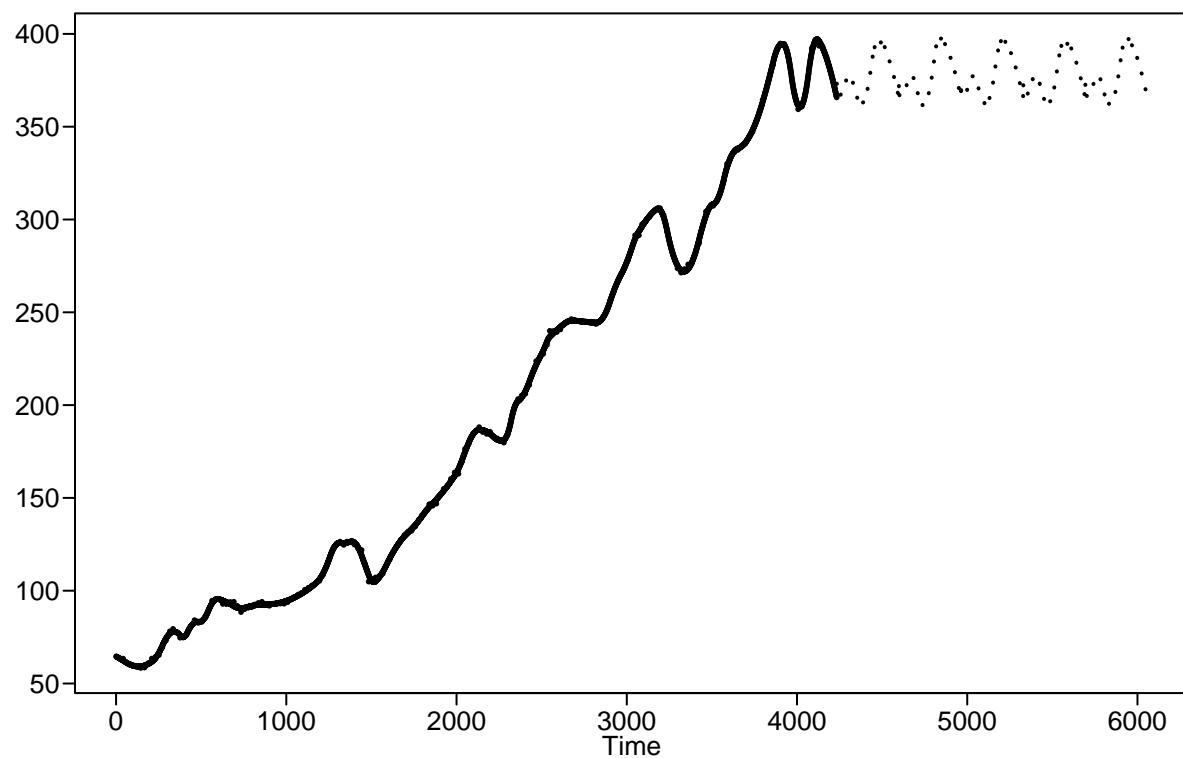
```
## [1] "Short Term ARMA(11,4) ASE: 29985.79"
```



```
## [1] "Short Term ARIMA(11,2,4) ASE: 104.97"
```

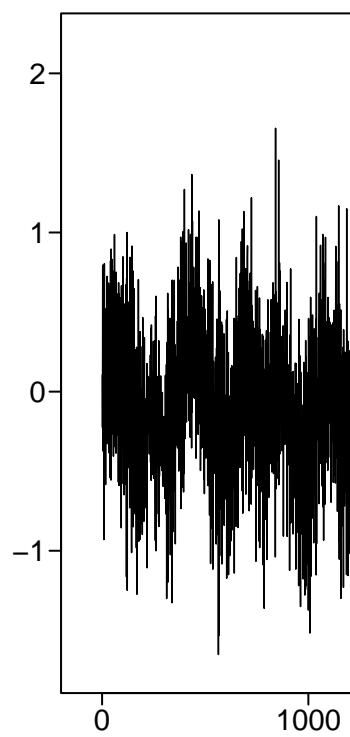


```
## [1] "Long Term ARMA(11,4) ASE: 14794.49"
```

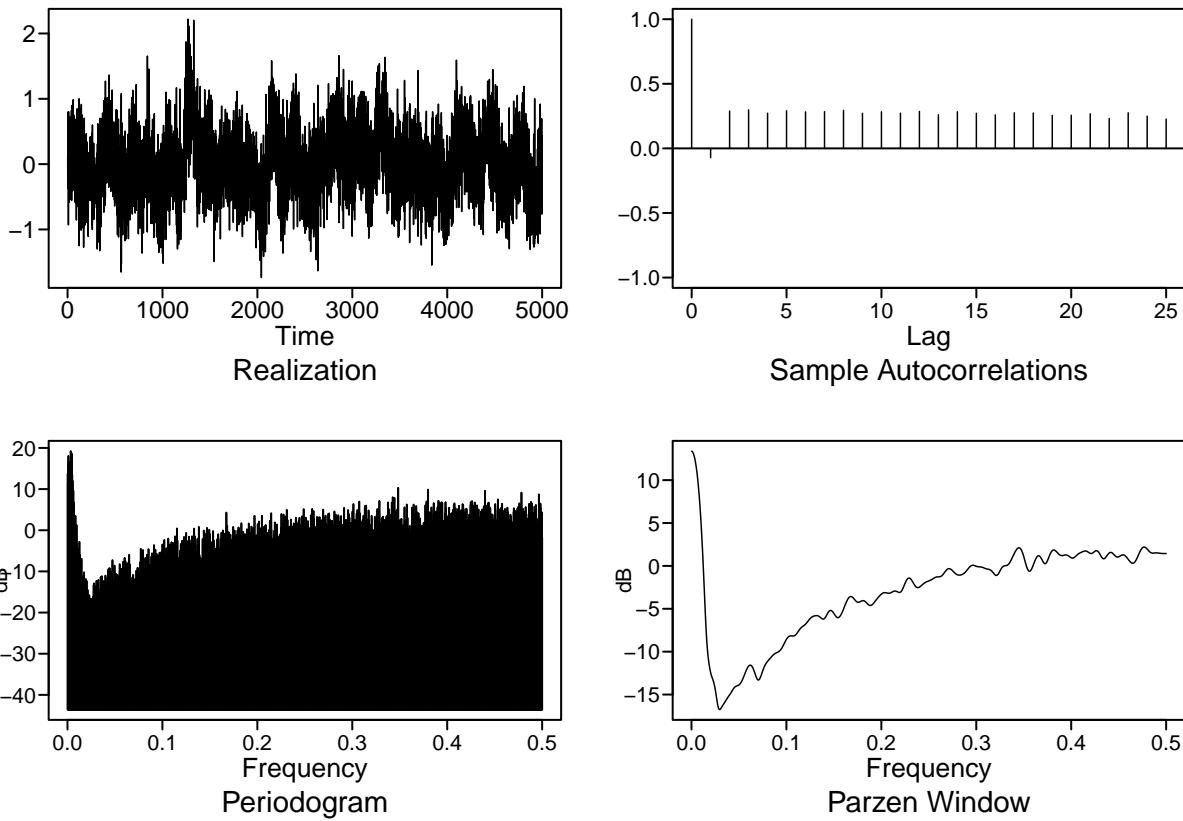


```
## [1] "Long Term ARIMA(11,2,4) ASE: 8384.81"
```

Calculation of the Rolling Window ASE for the Price_Index ARIMA(11,2,4) model . Please uncomment the Rolling_Window_ASE to run the Rolling Window ASE.



Comparison of the Price_Index ARIMA(11,2,4) modeled against the generated realizations.



```

## $autplt
## [1] 1.000000000 -0.07247692 0.28898994 0.29826172 0.27190139 0.29103404
## [7] 0.28256305 0.28390913 0.29436989 0.27124408 0.28318581 0.27230504
## [13] 0.28622291 0.26077860 0.28350807 0.27190432 0.25876606 0.27528441
## [19] 0.27375145 0.25492882 0.25679672 0.26787689 0.23161915 0.27534267
## [25] 0.24946616 0.22703459
##
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## [31] 0.0062 0.0064 0.0066 0.0068 0.0070 0.0072 0.0074 0.0076 0.0078 0.0080
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## [1811] 0.3622 0.3624 0.3626 0.3628 0.3630 0.3632 0.3634 0.3636 0.3638 0.3640
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## [1921] 0.3842 0.3844 0.3846 0.3848 0.3850 0.3852 0.3854 0.3856 0.3858 0.3860
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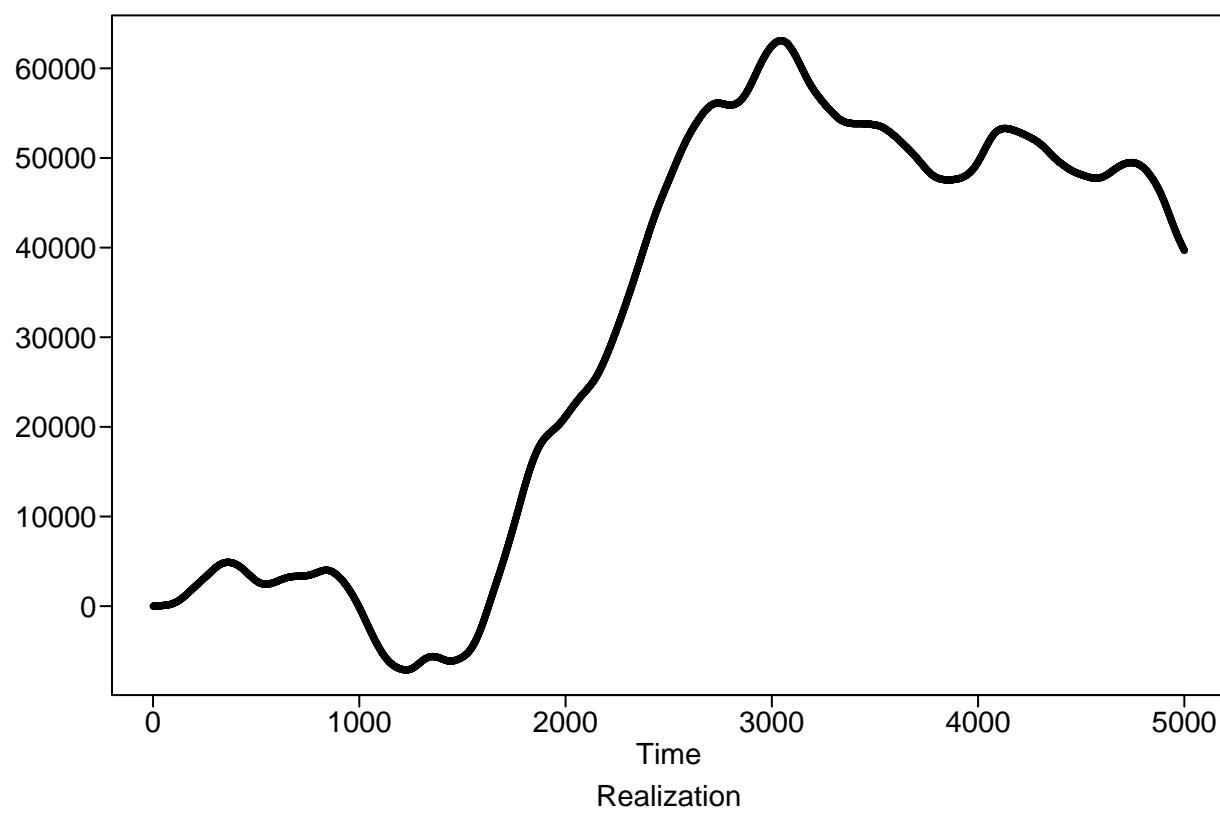
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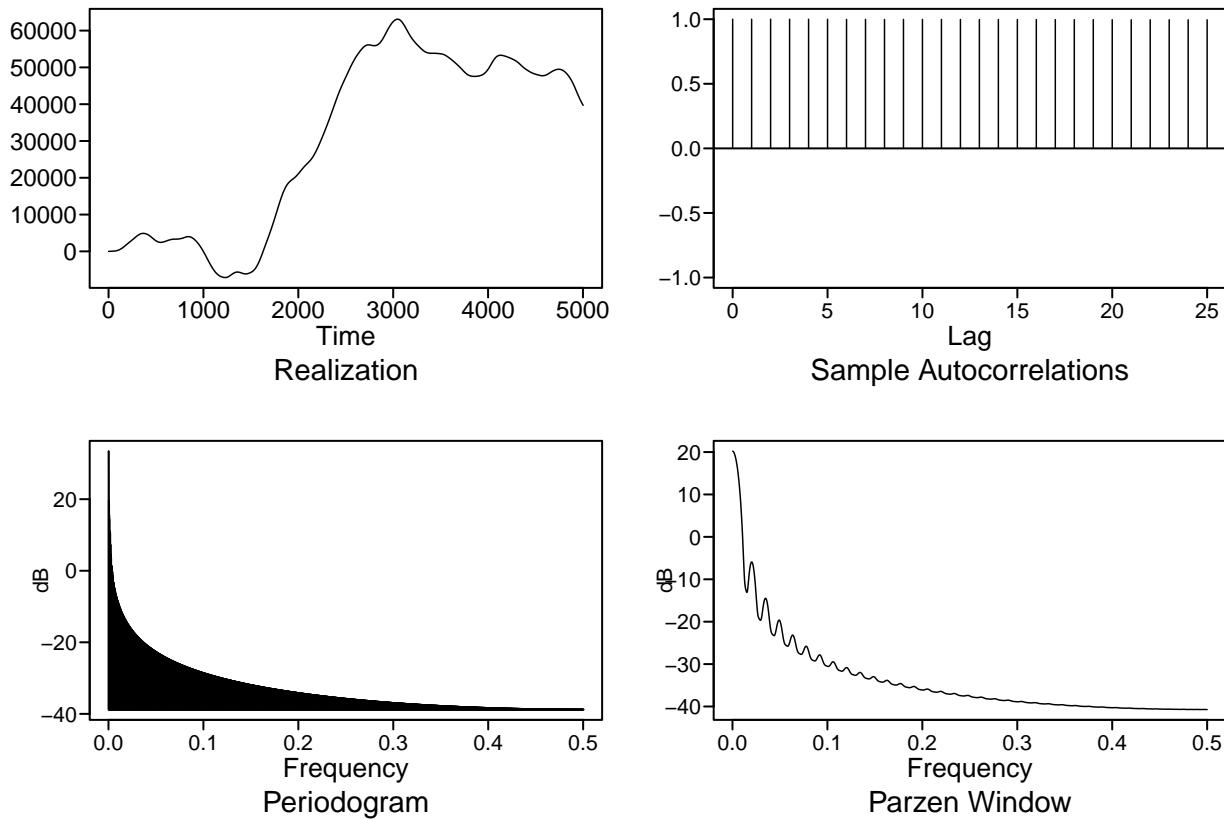
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## [1511]	-0.100231576	-0.102916791	-0.105252871	-0.107295248	-0.109104504
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## [1526]	-0.132535693	-0.136535953	-0.141031927	-0.146040870	-0.151571435
## [1531]	-0.157623554	-0.164188454	-0.171248815	-0.178779066	-0.186745816
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## [1761]	0.215244356	0.139385428	0.065563405	-0.005892294	-0.074660835
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## [1771]	-0.414703398	-0.457011935	-0.494714796	-0.527686886	-0.555833013
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## [1781]	-0.621764215	-0.615915230	-0.605498126	-0.590652693	-0.571536529
## [1786]	-0.548323075	-0.521199703	-0.490365900	-0.456031561	-0.418415414
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## [1801]	0.144281931	0.202618140	0.261092846	0.319468806	0.377512560
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## [1811]	0.706344047	0.755961218	0.803581474	0.849030012	0.892141056
## [1816]	0.932758307	0.970735373	1.005936188	1.038235427	1.067518904
## [1821]	1.093683976	1.116639939	1.136308435	1.152623861	1.165533794
## [1826]	1.174999425	1.180996014	1.183513365	1.182556318	1.178145262
## [1831]	1.170316672	1.159123654	1.144636507	1.126943289	1.106150370
## [1836]	1.082382978	1.055785703	1.026522950	0.994779316	0.960759864
## [1841]	0.924690268	0.886816784	0.847406023	0.806744478	0.765137762
## [1846]	0.722909525	0.680399997	0.637964129	0.595969298	0.554792556
## [1851]	0.514817414	0.476430166	0.440015775	0.405953377	0.374611461
## [1856]	0.346342813	0.321479356	0.300326992	0.283160616	0.270219443
## [1861]	0.261702813	0.257766616	0.258520486	0.264025848	0.274294921
## [1866]	0.289290702	0.308927932	0.333075013	0.361556797	0.394158125
## [1871]	0.430628011	0.470684291	0.514018603	0.560301530	0.609187756
## [1876]	0.660321116	0.713339408	0.767878884	0.823578357	0.880082861
## [1881]	0.937046852	0.994136939	1.051034147	1.107435744	1.163056650
## [1886]	1.217630476	1.270910222	1.322668680	1.372698593	1.420812586
## [1891]	1.466842939	1.510641204	1.552077716	1.591041027	1.627437267
## [1896]	1.661189471	1.692236884	1.720534246	1.746051083	1.768771001
## [1901]	1.788690992	1.805820762	1.820182073	1.831808108	1.840742853
## [1906]	1.847040506	1.850764898	1.851988932	1.850794039	1.847269642
## [1911]	1.841512629	1.833626834	1.823722516	1.811915844	1.798328373
## [1916]	1.783086513	1.766321000	1.748166337	1.728760245	1.708243078
## [1921]	1.686757237	1.664446560	1.641455696	1.617929464	1.594012193
## [1926]	1.569847045	1.545575333	1.521335816	1.497263992	1.473491391
## [1931]	1.450144857	1.427345844	1.405209719	1.383845077	1.363353090
## [1936]	1.343826875	1.325350898	1.308000437	1.291841077	1.276928276
## [1941]	1.263306993	1.251011388	1.240064601	1.230478608	1.222254171
## [1946]	1.215380877	1.209837259	1.205591024	1.202599358	1.200809335
## [1951]	1.200158397	1.200574932	1.201978914	1.204282629	1.207391446
## [1956]	1.211204664	1.215616390	1.220516462	1.225791408	1.231325415
## [1961]	1.237001322	1.242701615	1.248309416	1.253709470	1.258789113
## [1966]	1.263439220	1.267555123	1.271037506	1.273793253	1.275736272
## [1971]	1.276788260	1.276879439	1.275949227	1.273946869	1.270832009
## [1976]	1.266575199	1.261158349	1.254575110	1.246831181	1.237944539
## [1981]	1.227945587	1.216877206	1.204794708	1.191765692	1.177869771
## [1986]	1.163198189	1.147853299	1.131947915	1.115604511	1.098954281

## [1991]	1.082136052	1.065295043	1.048581492	1.032149140	1.016153594
## [1996]	1.000750590	0.986094162	0.972334753	0.959617306	0.948079341
## [2001]	0.937849090	0.929043698	0.921767549	0.916110747	0.912147799
## [2006]	0.909936515	0.909517181	0.910912004	0.914124857	0.919141335
## [2011]	0.925929112	0.934438600	0.944603884	0.956343921	0.969563965
## [2016]	0.984157185	1.000006439	1.016986159	1.034964315	1.053804406
## [2021]	1.073367450	1.093513926	1.114105644	1.135007514	1.156089185
## [2026]	1.177226534	1.198302999	1.219210736	1.239851586	1.260137873
## [2031]	1.279992994	1.299351838	1.318161014	1.336378896	1.353975502
## [2036]	1.370932201	1.387241264	1.402905263	1.417936335	1.432355317
## [2041]	1.446190768	1.459477883	1.472257331	1.484574019	1.496475798
## [2046]	1.508012147	1.519232839	1.530186609	1.540919865	1.551475442
## [2051]	1.561891434	1.572200120	1.582427012	1.592590028	1.602698830
## [2056]	1.612754313	1.622748287	1.632663325	1.642472814	1.652141179
## [2061]	1.661624305	1.670870121	1.679819357	1.688406449	1.696560580
## [2066]	1.704206836	1.711267462	1.717663188	1.723314622	1.728143665
## [2071]	1.732074949	1.735037271	1.736964995	1.737799423	1.737490100
## [2076]	1.735996055	1.733286947	1.729344113	1.724161504	1.717746490
## [2081]	1.710120528	1.701319677	1.691394947	1.680412473	1.668453495
## [2086]	1.655614139	1.642004976	1.627750366	1.612987554	1.597865537
## [2091]	1.582543673	1.567190056	1.551979643	1.537092161	1.522709797
## [2096]	1.509014713	1.496186404	1.484398956	1.473818238	1.464599098
## [2101]	1.456882610	1.450793454	1.446437468	1.443899472	1.443241384
## [2106]	1.444500719	1.447689485	1.452793531	1.459772343	1.468559324
## [2111]	1.479062518	1.491165772	1.504730298	1.519596591	1.535586638
## [2116]	1.552506374	1.570148307	1.588294262	1.606718172	1.625188870
## [2121]	1.643472823	1.661336772	1.678550238	1.694887869	1.710131616
## [2126]	1.724072705	1.736513432	1.747268751	1.756167681	1.763054533
## [2131]	1.7677789969	1.770251908	1.770336294	1.767957735	1.763050037
## [2136]	1.755566629	1.745480909	1.732786498	1.717497427	1.699648248
## [2141]	1.679294070	1.656510520	1.631393627	1.604059609	1.574644563
## [2146]	1.543304036	1.510212466	1.475562472	1.439563975	1.402443135
## [2151]	1.364441071	1.325812374	1.286823368	1.247750132	1.208876270
## [2156]	1.170490430	1.132883591	1.096346133	1.061164715	1.027619022
## [2161]	0.995978409	0.966498520	0.939417950	0.914955017	0.893304737
## [2166]	0.874636069	0.859089518	0.846775156	0.837771125	0.832122667
## [2171]	0.829841706	0.830906991	0.835264801	0.842830172	0.853488616
## [2176]	0.867098261	0.883492361	0.902482078	0.923859476	0.947400636
## [2181]	0.972868819	1.000017599	1.028593919	1.058340992	1.089001033
## [2186]	1.120317766	1.152038697	1.183917135	1.215713965	1.247199167
## [2191]	1.278153099	1.308367554	1.337646611	1.365807299	1.392680098
## [2196]	1.418109292	1.441953200	1.464084314	1.484389337	1.502769169
## [2201]	1.519138834	1.533427372	1.545577699	1.555546456	1.563303844
## [2206]	1.568833446	1.572132057	1.573209504	1.572088470	1.568804304
## [2211]	1.563404833	1.555950158	1.546512427	1.535175587	1.522035095
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## [2226]	1.295938916	1.272123582	1.248538007	1.225366279	1.202789468
## [2231]	1.180983847	1.160119074	1.140356357	1.121846638	1.104728828
## [2236]	1.089128135	1.075154511	1.062901265	1.052443874	1.043839012
## [2241]	1.037123843	1.032315576	1.029411306	1.028388154	1.029203685
## [2246]	1.031796611	1.036087750	1.041981226	1.049365875	1.058116831
## [2251]	1.068097244	1.079160101	1.091150118	1.103905644	1.117260574
## [2256]	1.131046208	1.145093053	1.159232528	1.173298564	1.187129074

## [2261]	1.200567292	1.213462963	1.225673398	1.237064368	1.247510870
## [2266]	1.256897738	1.265120137	1.272083917	1.277705859	1.281913805
## [2271]	1.284646696	1.285854509	1.285498118	1.283549081	1.279989358
## [2276]	1.274810969	1.268015607	1.259614201	1.249626446	1.238080297
## [2281]	1.225011441	1.210462751	1.194483722	1.177129907	1.158462344
## [2286]	1.138546992	1.117454179	1.095258056	1.072036086	1.047868551
## [2291]	1.022838092	0.997029291	0.970528291	0.943422458	0.915800101
## [2296]	0.887750235	0.859362396	0.830726516	0.801932838	0.773071893
## [2301]	0.744234510	0.715511875	0.686995621	0.658777945	0.630951744
## [2306]	0.603610759	0.576849717	0.550764456	0.525452031	0.501010775
## [2311]	0.477540319	0.455141544	0.433916463	0.413968031	0.395399856
## [2316]	0.378315821	0.362819611	0.349014138	0.337000870	0.326879071
## [2321]	0.318744956	0.312690771	0.308803824	0.307165459	0.307850028
## [2326]	0.310923844	0.316444169	0.324458246	0.335002393	0.348101202
## [2331]	0.363766841	0.381998494	0.402781948	0.426089337	0.451879062
## [2336]	0.480095871	0.510671119	0.543523187	0.578558059	0.615670037
## [2341]	0.654742590	0.695649294	0.738254874	0.782416297	0.827983916
## [2346]	0.874802625	0.922713026	0.971552567	1.021156649	1.071359685
## [2351]	1.121996097	1.172901242	1.223912261	1.274868849	1.325613943
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## [2366]	1.829617874	1.867361766	1.903327916	1.937438886	1.969623686
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## [2376]	2.119126562	2.136388188	2.151391930	2.164126787	2.174588846
## [2381]	2.182781408	2.188715121	2.192408112	2.193886114	2.193182598
## [2386]	2.190338880	2.185404222	2.178435902	2.169499262	2.158667714
## [2391]	2.146022706	2.131653633	2.115657694	2.098139682	2.079211698
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## [2401]	1.943122802	1.917978917	1.892522349	1.866903623	1.841272801
## [2406]	1.815778240	1.790565303	1.765775047	1.741542892	1.717997311
## [2411]	1.695258557	1.673437457	1.652634284	1.632937757	1.614424169
## [2416]	1.597156681	1.581184783	1.566543953	1.553255517	1.541326707
## [2421]	1.530750934	1.521508248	1.513565998	1.506879664	1.501393836
## [2426]	1.497043338	1.493754455	1.491446243	1.490031893	1.489420130
## [2431]	1.489516609	1.490225292	1.491449782	1.493094587	1.495066312
## [2436]	1.497274746	1.499633843	1.502062595	1.504485769	1.506834528
## [2441]	1.509046922	1.511068251	1.512851313	1.514356520	1.515551915
## [2446]	1.516413073	1.516922913	1.517071409	1.516855234	1.516277324
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## [2481]	1.446247253	1.445495434	1.444859855	1.444329938	1.443894981
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## $autplt
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## [8] 0.9987701 0.9985863 0.9984003 0.9982124 0.9980224 0.9978304 0.9976364
## [15] 0.9974403 0.9972423 0.9970421 0.9968400 0.9966358 0.9964297 0.9962215
## [22] 0.9960112 0.9957990 0.9955848 0.9953685 0.9951503
##
## $freq
## [1] 0.0001999200 0.0003998401 0.0005997601 0.0007996801 0.0009996002
## [6] 0.0011995202 0.0013994402 0.0015993603 0.0017992803 0.0019992003
## [11] 0.0021991204 0.0023990404 0.0025989604 0.0027988804 0.0029988005
## [16] 0.0031987205 0.0033986405 0.0035985606 0.0037984806 0.0039984006
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## [26] 0.0051979208 0.0053978409 0.0055977609 0.0057976809 0.0059976010
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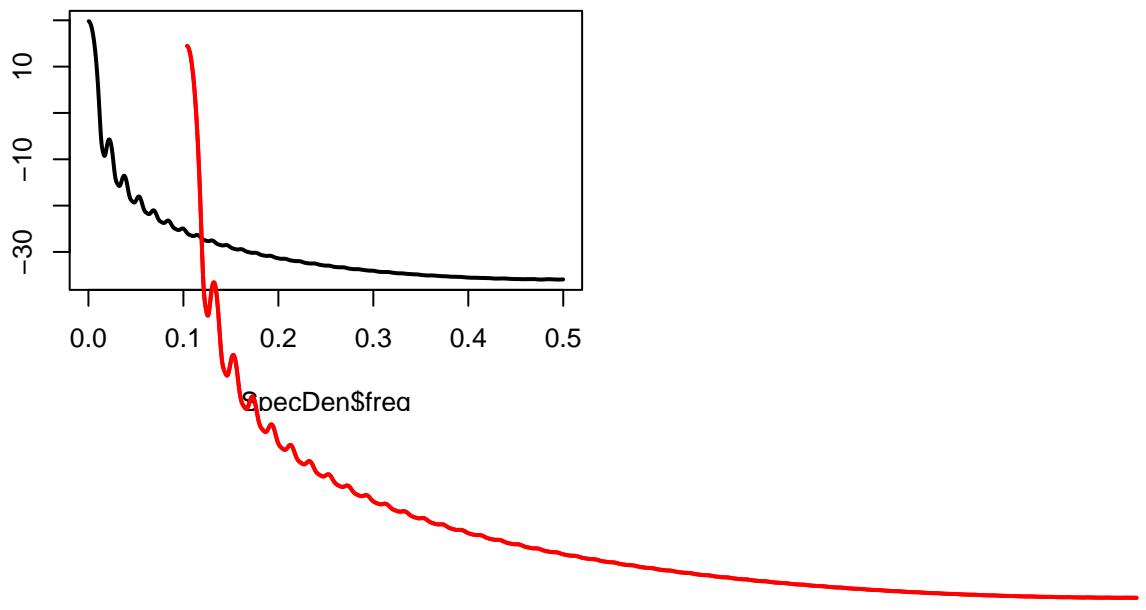
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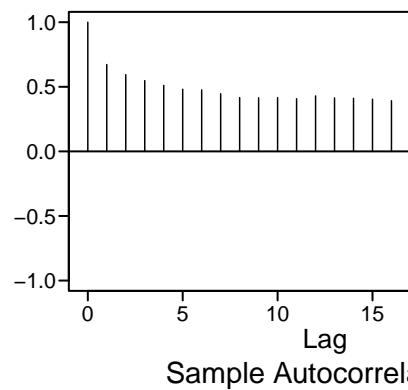
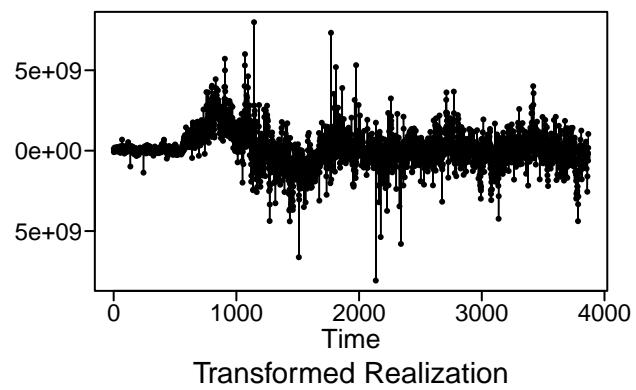
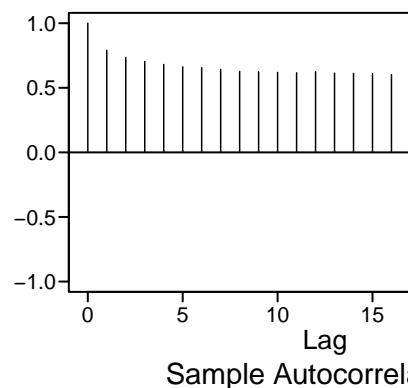
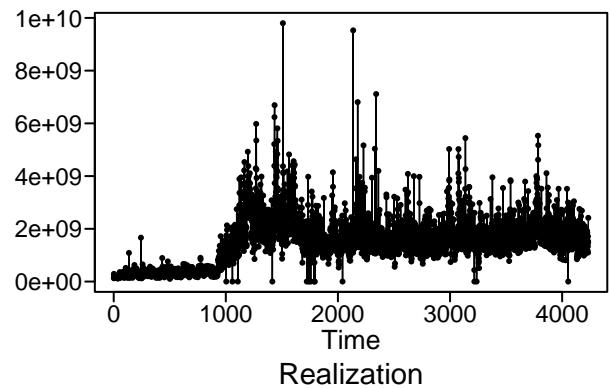
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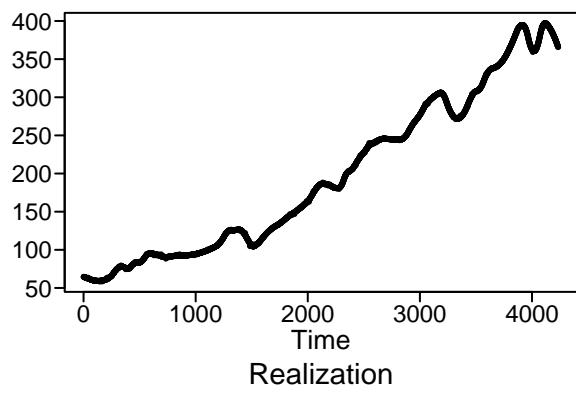
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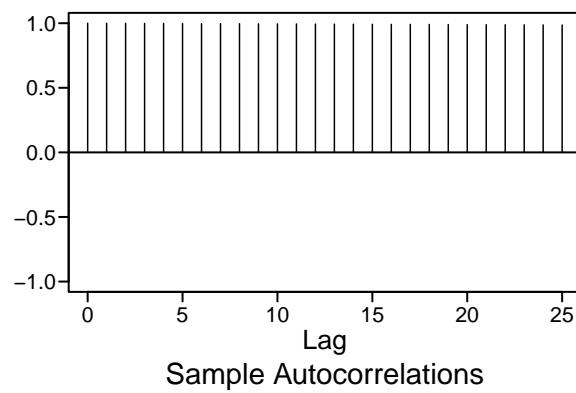
Vector Autoregressive (VAR) models to allow for Multivariate models. Explanatory variables are Price_Index , First_Hand_Sales_Amount, and HSI_Volume. Verify how these variables affect each other in



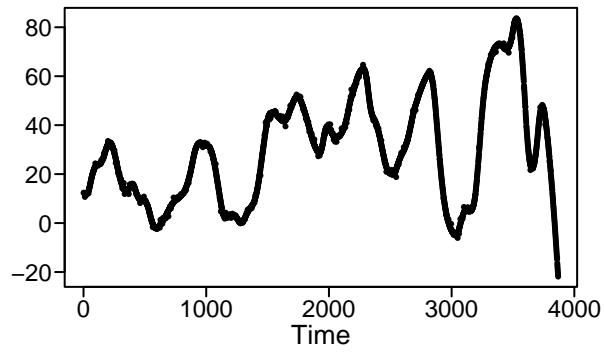
a short term and long term model.



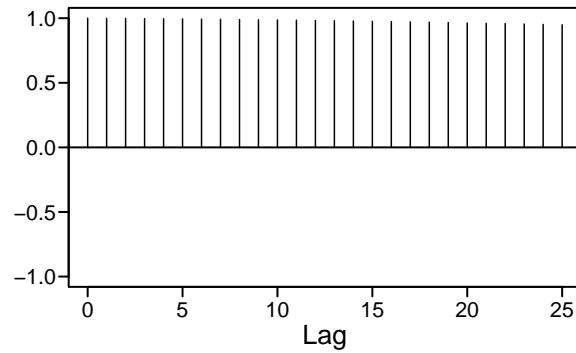
Realization



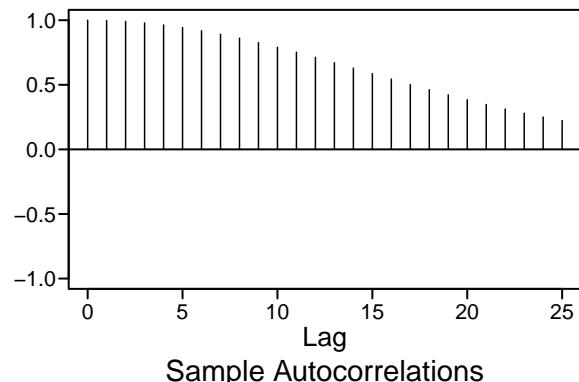
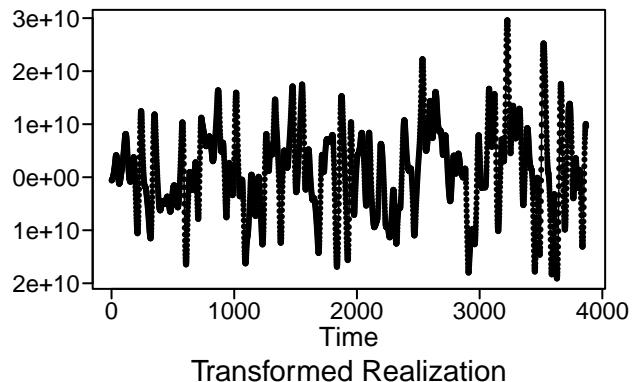
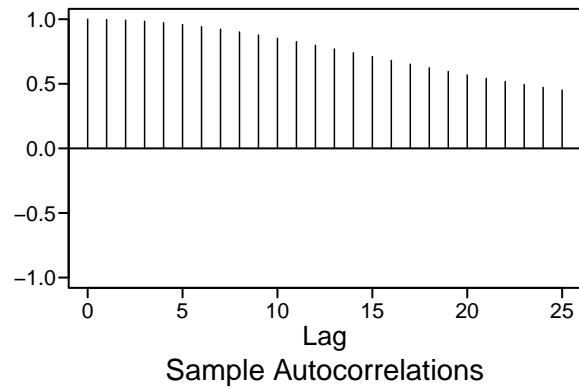
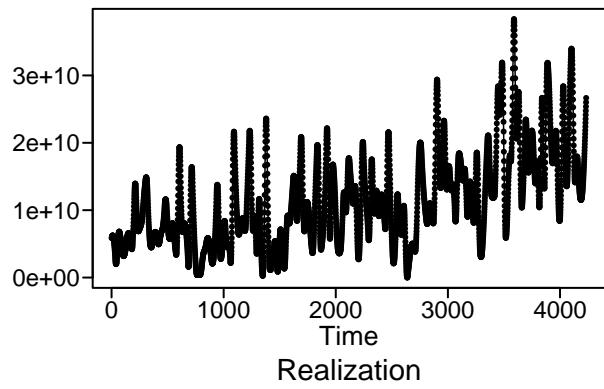
Sample Autocorrelations

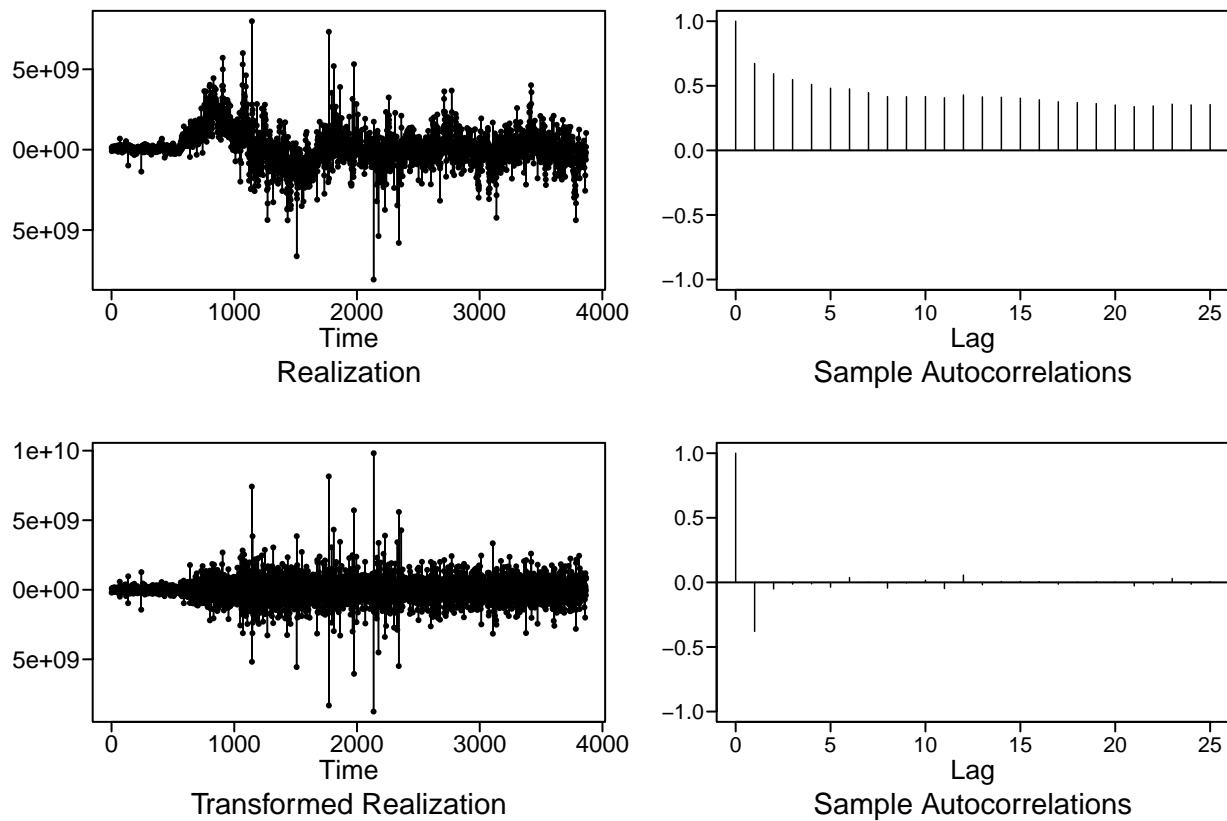


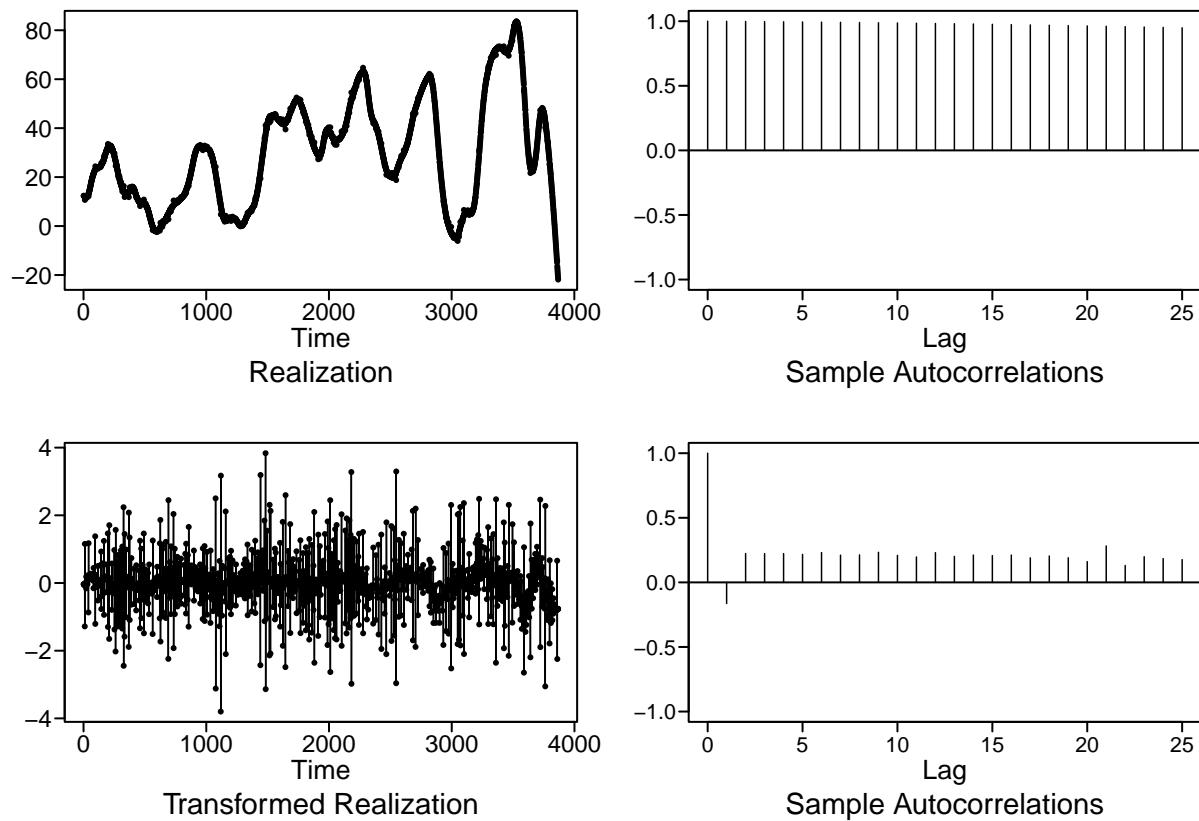
Transformed Realization

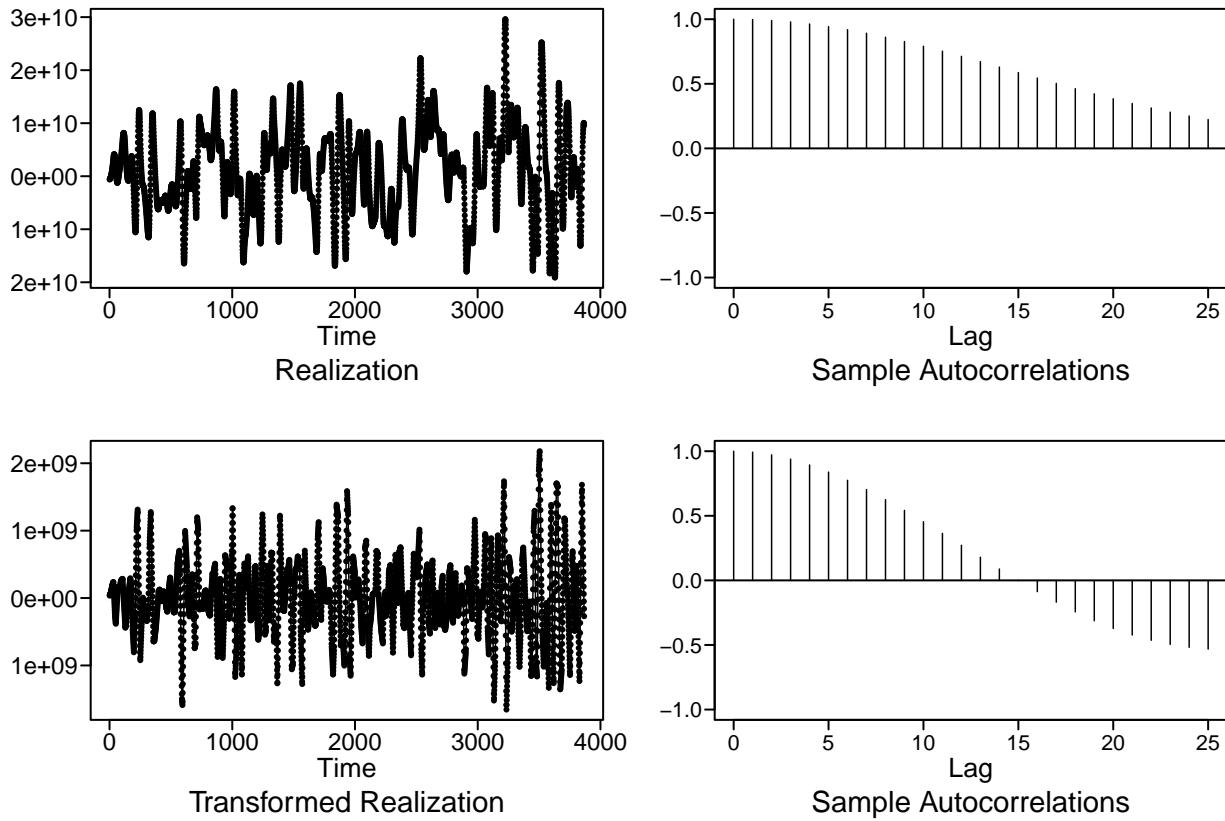


Sample Autocorrelations









Modeling a VAR Model for a Short Term Forecast (1 year).

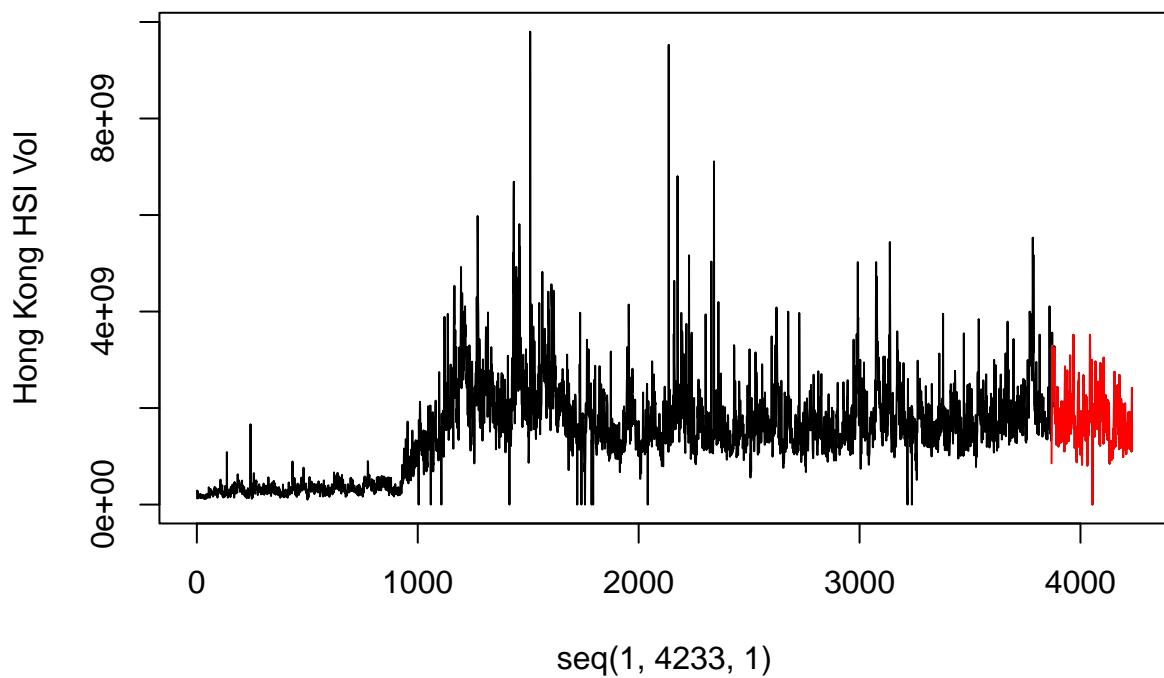
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## $selection
## AIC(n)  HQ(n)  SC(n) FPE(n)
##      20      20     11     20
##
## $criteria
##           1          2          3          4          5
## AIC(n) 7.564242e+01 7.295685e+01 7.271218e+01 7.254737e+01 7.245136e+01
## HQ(n)   7.565108e+01 7.297071e+01 7.273124e+01 7.257163e+01 7.248082e+01
## SC(n)   7.566681e+01 7.299588e+01 7.276584e+01 7.261566e+01 7.253429e+01
## FPE(n)  7.097159e+32 4.839033e+31 3.788782e+31 3.213100e+31 2.918953e+31
##           6          7          8          9          10
## AIC(n) 7.237224e+01 7.232033e+01 7.227550e+01 7.223165e+01 7.220224e+01
## HQ(n)   7.240689e+01 7.236018e+01 7.232055e+01 7.228189e+01 7.225768e+01
## SC(n)   7.246980e+01 7.243252e+01 7.240233e+01 7.237311e+01 7.235834e+01
## FPE(n)  2.696894e+31 2.560475e+31 2.448228e+31 2.343183e+31 2.275290e+31
##           11         12         13         14         15
## AIC(n) 7.216575e+01 7.215599e+01 7.214662e+01 7.214091e+01 7.214042e+01
## HQ(n)   7.222638e+01 7.222183e+01 7.221765e+01 7.221714e+01 7.222185e+01
## SC(n)   7.233647e+01 7.234135e+01 7.234661e+01 7.235554e+01 7.236968e+01
## FPE(n)  2.193746e+31 2.172449e+31 2.152177e+31 2.139934e+31 2.138898e+31
##           16         17         18         19         20
## AIC(n) 7.213177e+01 7.212747e+01 7.211970e+01 7.210470e+01 7.207823e+01
## HQ(n)   7.221840e+01 7.221930e+01 7.221672e+01 7.220692e+01 7.218565e+01
## SC(n)   7.237567e+01 7.238600e+01 7.239286e+01 7.239249e+01 7.238066e+01

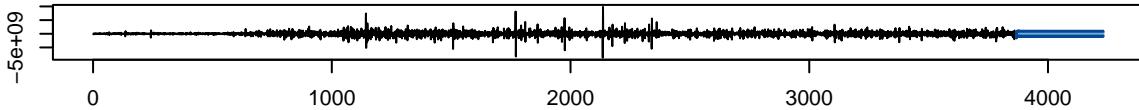
```

```
## FPE(n) 2.120477e+31 2.111378e+31 2.095033e+31 2.063837e+31 2.009931e+31  
## [1] 1095
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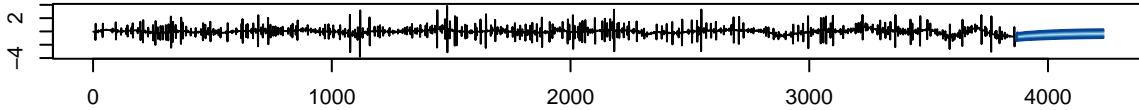
VAR Model Short Term Forecast for Hong Kong Housing Index Volume



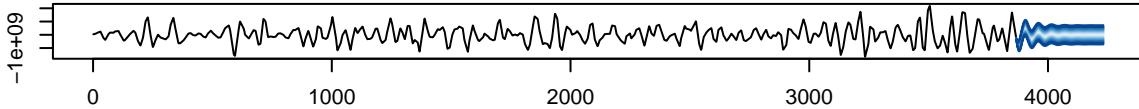
Fanchart for variable hk_vol_df2



Fanchart for variable hk_ind_df2



Fanchart for variable hk_sal_amt_df2

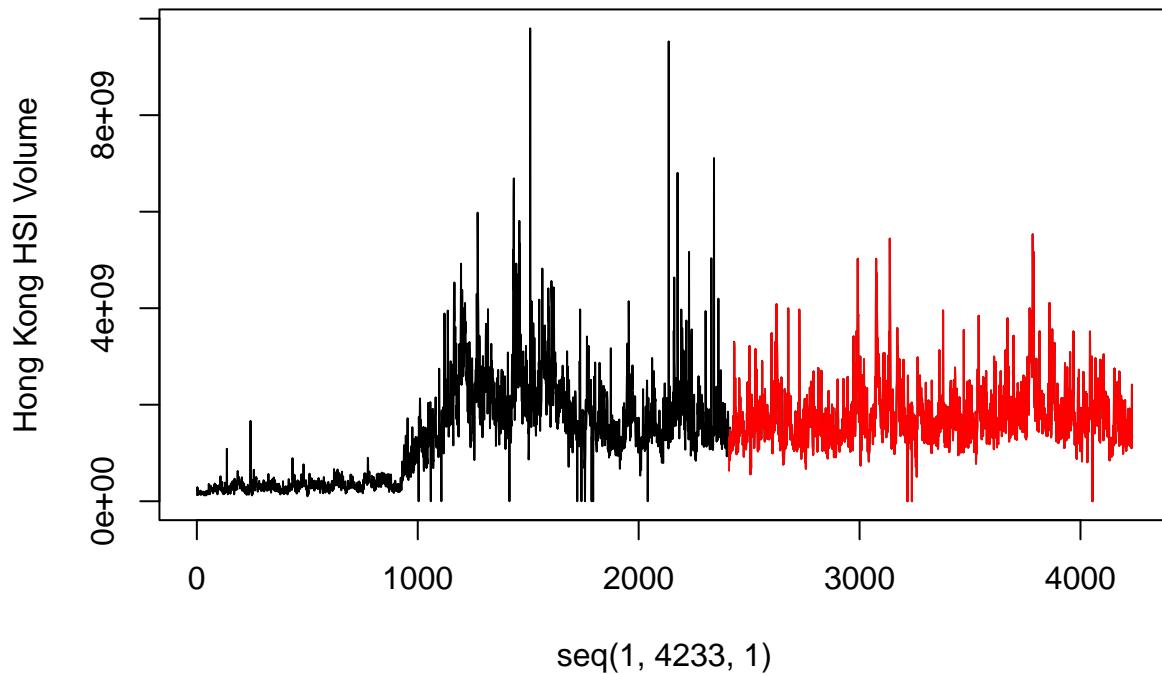


```
## [1] 2.156448e+15
```

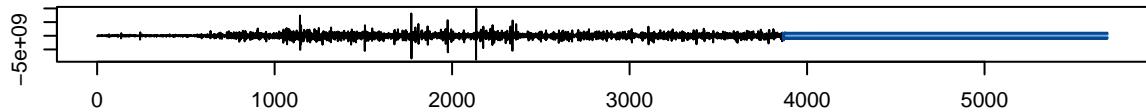
Modeling a VAR Model for a Long Term Forecast (5 years).

```
## $selection
## AIC(n)  HQ(n)  SC(n) FPE(n)
##      15     14     11     15
##
## $criteria
##          1         2         3         4         5
## AIC(n) 7.563858e+01 7.295299e+01 7.270829e+01 7.254348e+01 7.244763e+01
## HQ(n)   7.564723e+01 7.296683e+01 7.272733e+01 7.256770e+01 7.247705e+01
## SC(n)   7.566294e+01 7.299197e+01 7.276189e+01 7.261169e+01 7.253046e+01
## FPE(n)  7.069964e+32 4.820375e+31 3.774070e+31 3.200603e+31 2.908072e+31
##          6         7         8         9        10
## AIC(n) 7.236850e+01 7.231655e+01 7.227168e+01 7.222781e+01 7.219836e+01
## HQ(n)   7.240311e+01 7.235635e+01 7.231668e+01 7.227799e+01 7.225374e+01
## SC(n)   7.246595e+01 7.242862e+01 7.239837e+01 7.236911e+01 7.235428e+01
## FPE(n)  2.686840e+31 2.550823e+31 2.438901e+31 2.334204e+31 2.266470e+31
##          11        12        13        14        15
## AIC(n) 7.216186e+01 7.215211e+01 7.214273e+01 7.213702e+01 7.213653e+01
## HQ(n)   7.222242e+01 7.221787e+01 7.221368e+01 7.221316e+01 7.221786e+01
## SC(n)   7.233240e+01 7.233726e+01 7.234250e+01 7.235141e+01 7.236554e+01
## FPE(n)  2.185229e+31 2.164026e+31 2.143830e+31 2.131630e+31 2.130579e+31
```

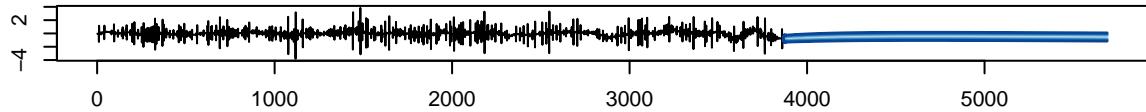
Hong Kong Housing Index Volume Long Term Forecast



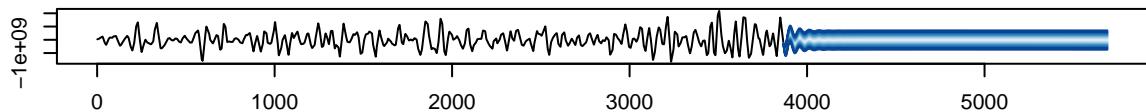
Fanchart for variable hk_vol_df2



Fanchart for variable hk_ind_df2



Fanchart for variable hk_sal_amt_df2



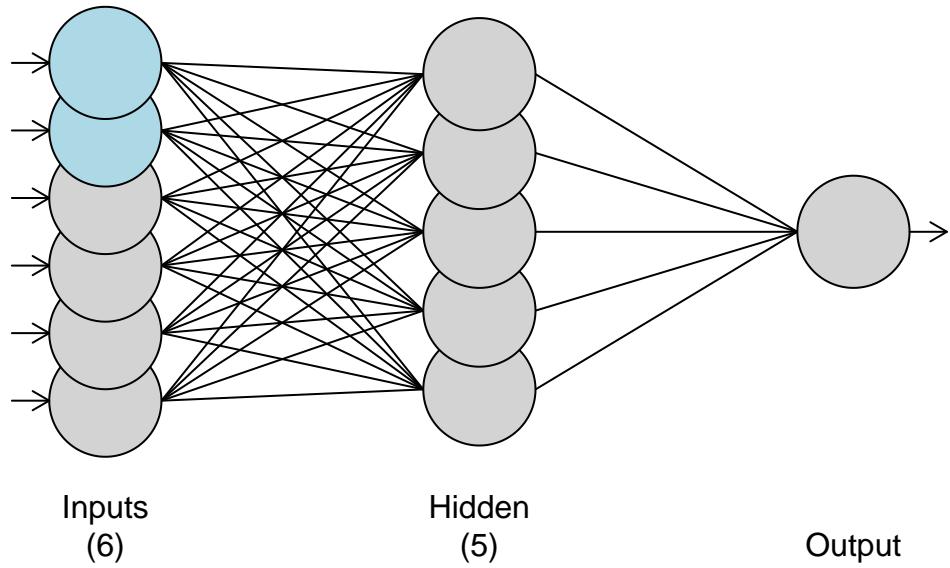
```
## [1] 4.187187e+14
```

Multi-Layer Perceptron (MLP) using neural networks to model the data.

Model Fitting for the Short Term (1 year) MLP Model.

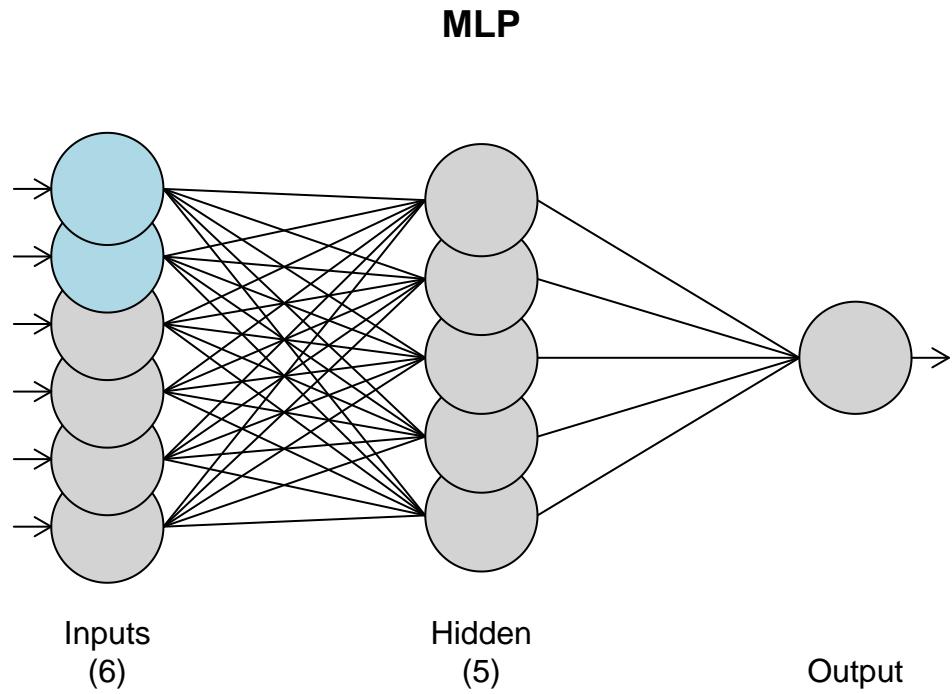
```
## MLP fit with 5 hidden nodes and 2 repetitions.  
## Series modelled in differences: D1D365.  
## Univariate lags: (1,2,3,4)  
## 1 regressor included.  
## - Regressor 1 lags: (2,3)  
## Forecast combined using the median operator.  
## MSE: 545979874595626880.
```

MLP



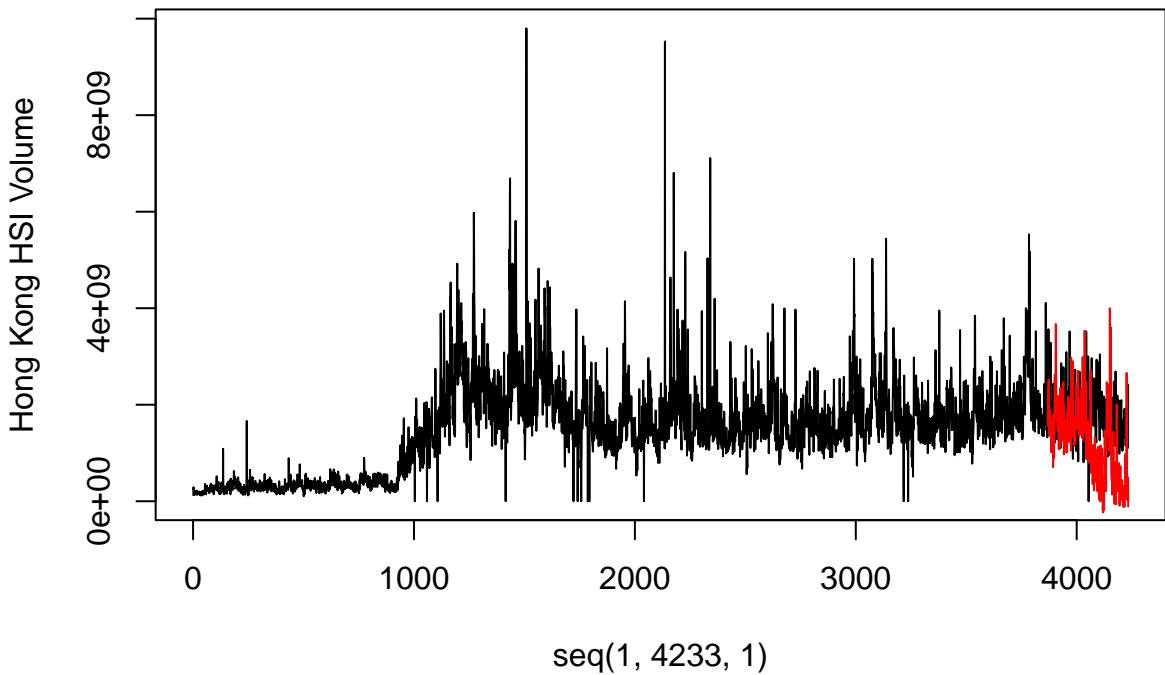
Model Fitting for the Long Term (5 years) MLP Model.

```
## MLP fit with 5 hidden nodes and 20 repetitions.  
## Series modelled in differences: D1D1825.  
## Univariate lags: (1,2,3,4)  
## 1 regressor included.  
## - Regressor 1 lags: (3,4)  
## Forecast combined using the median operator.  
## MSE: 478293860515281152.
```



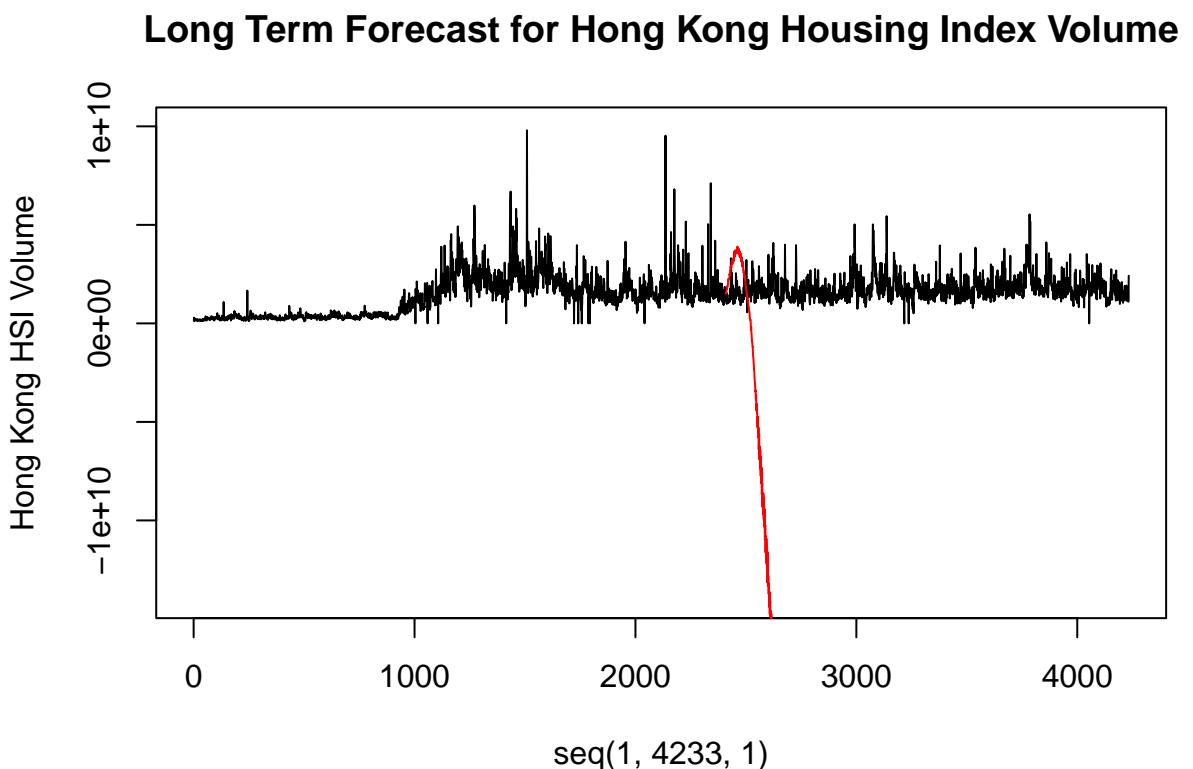
Model Forecasting for the Short Term (1 year) MLP Model. This shows every forecast with the MLP algo-

Short Term Forecast for Hong Kong Housing Index Volume



rithm.

MLP Model Forecasting for the Long Term (5 years) MLP Model. This shows every forecast with the MLP al-



gorithm.

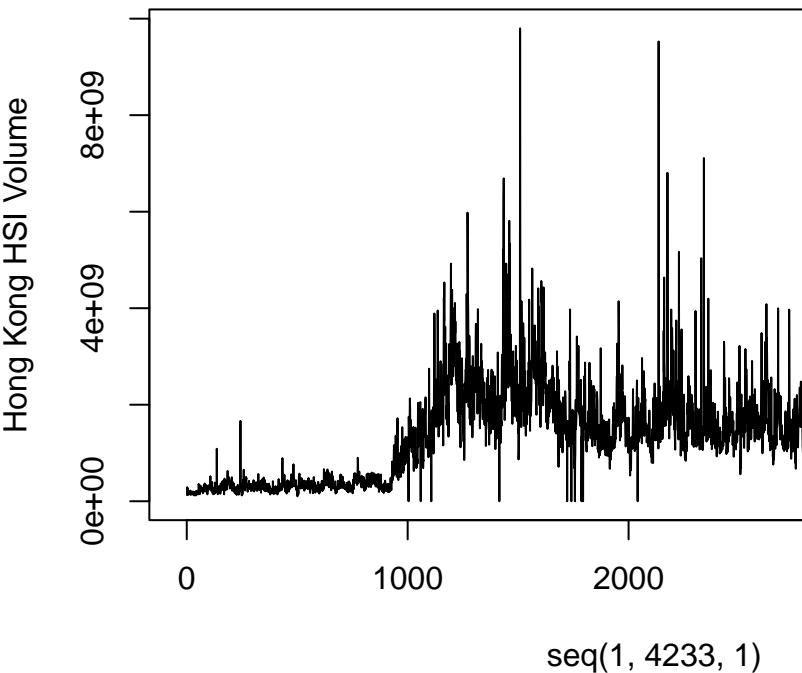
ASE Model calculation for the Short Term (1 year) MLP Model.

```
## [1] 1.172121e+18
```

ASE Model calculation for the Long Term (5 years) MLP Model.

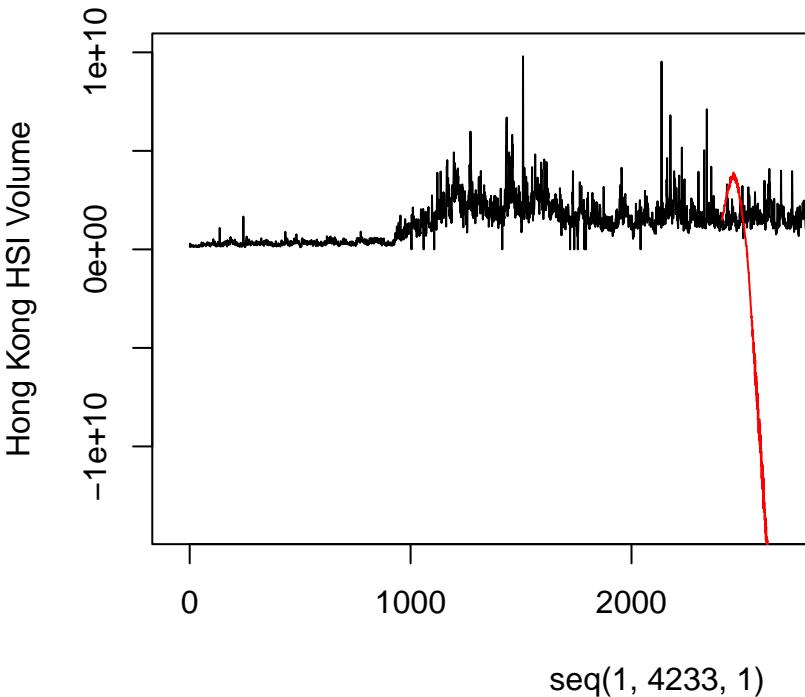
```
## [1] 2.266988e+23
```

Short Term Forecast for Hong Kong HSI



Model forecast for the short term (1 year) MLP Model.

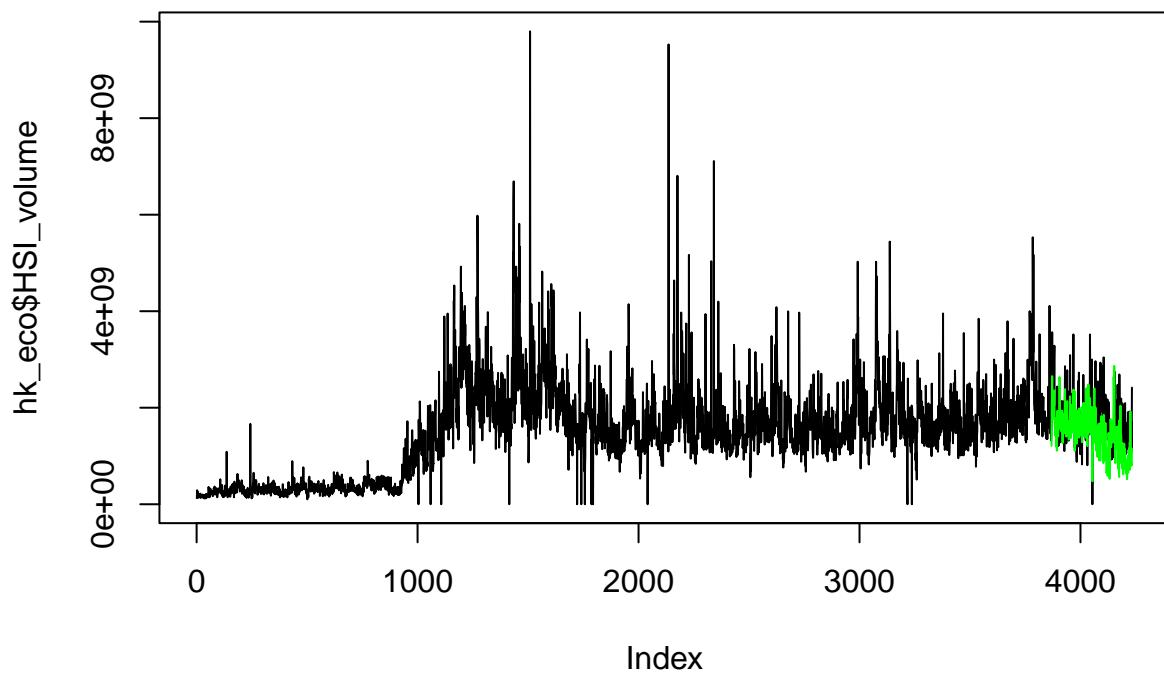
Long Term Forecast for Hong Kong H



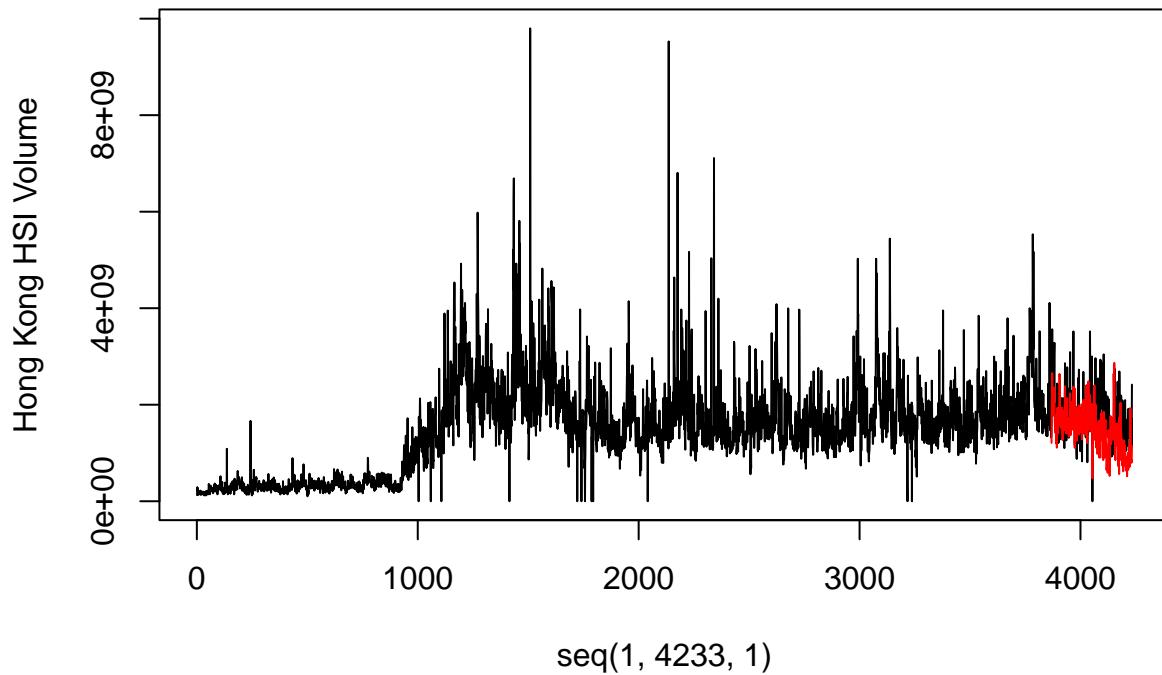
Model forecast for the long term (5 years) MLP Model.

Ensemble models combining the MLP and VAR models to produce a new model. Short Term Ensemble model.

```
## [1] 2.942115e+17
```

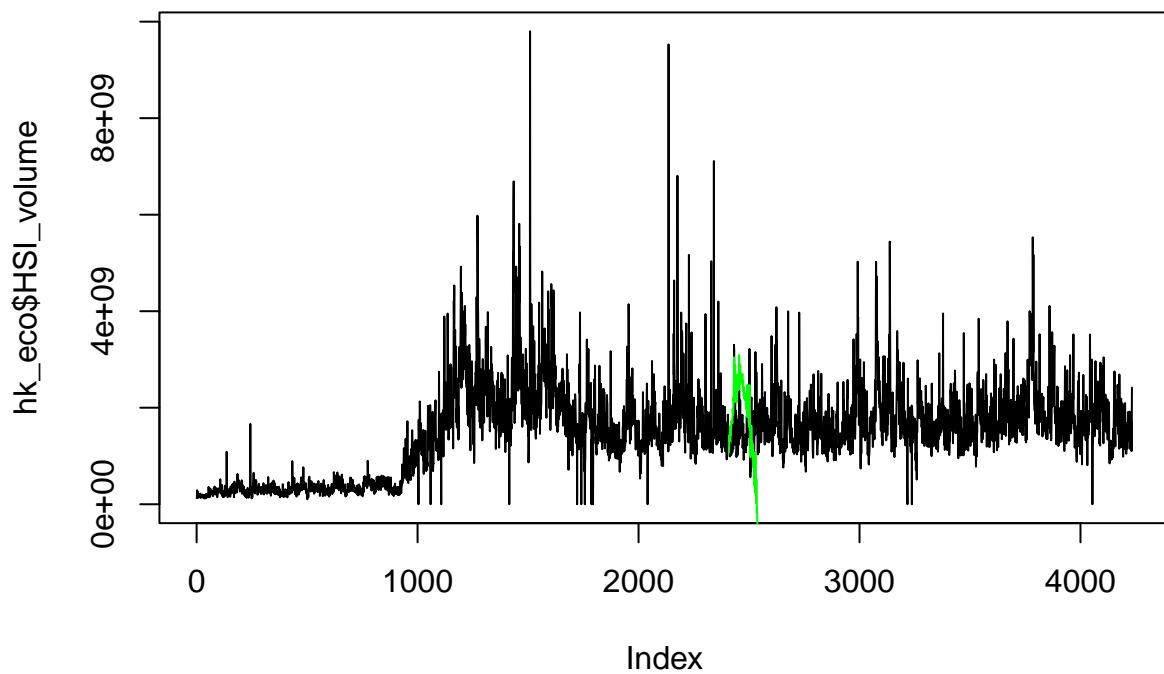


Short Term Ensemble Forecast



Ensemble models combining the MLP and VAR models to produce a new model. Long Term Ensemble model.

```
## [1] 5.665322e+22
```



Long Term Ensemble Forecast

