STAT349 based on log10

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AAL, 2015-03-23 to 2020-03-20

##Model 1: ARIMA(3,1,0)

```
##
## Call:
## arima(x = newdata(a), order = auto.selection(newdata(a), testdata(a), totalobs(a))[1:3])
##
## Coefficients:
##           ar1      ar2      ar3
##       -0.7394  -0.5403  -0.2815
## s.e.   0.0273   0.0316   0.0284
##
## sigma^2 estimated as 0.000138:  log likelihood = 3787.37,  aic = -7568.75
```

the last 5 days actual value, forecast value, forecast errors and mean squared forecast error

```
## [1] -0.046303430  0.009375610  0.126241528  0.053910551 -0.003781979
```

```
## Time Series:
## Start = 1254
## End = 1258
## Frequency = 1
## [1] -0.002957262  0.020636747  0.021013643  0.001243320  0.009017519
```

```
## Time Series:
## Start = 1254
## End = 1258
## Frequency = 1
## [1] -0.04334617 -0.01126114  0.10522788  0.05266723 -0.01279950
```

```
## [1] 0.003203255
```

##Model 2: ARIMA(2,1,3)

```
##
## Call:
## arima(x = newdata(c3), order = auto.selection(newdata(c3), testdata(c3), totalobs(c3))[1:3])
##
## Coefficients:
##           ar1      ar2     ma1      ma2      ma3
##       -1.1147  -0.9913  0.1043  -0.0975  -0.9967
## s.e.   0.0111   0.0093  0.0201   0.0201   0.0230
##
## sigma^2 estimated as 7.016e-05:  log likelihood = 1381.19,  aic = -2752.39
```

I split the data in to 5 subsets, which are

```
## [1] "2015-03-24" "2016-01-04"
```

```
## [1] "2016-01-04" "2016-07-01"
```

```
## [1] "2016-01-04" "2018-03-01"
```

```
## [1] "2018-03-01" "2019-01-02"
```

```
## [1] "2019-01-02" "2020-03-20"
```

and I use the third 2016-01-04 to 2018-03-01 to build the model.

the last 5 days actual value, forecast value, forecast errors and mean squared forecast error

```
## [1] -0.003348012 -0.012902774  0.005882908  0.000080100  0.006208326
```

```
## Time Series:
## Start = 414
## End = 418
## Frequency = 1
## [1] -0.0012135155 -0.0006818861  0.0002062442 -0.0013107154 -0.0005001823
```

```
## Time Series:
## Start = 414
## End = 418
## Frequency = 1
## [1] -0.002134496 -0.012220888  0.005676664  0.001390815  0.006708508
```

```
## [1] 4.661383e-05
```

##Model 3 ARIMA(3,1,0) I split the data in to 5 subsets, which are

```
## [1] "2015-03-24" "2015-06-09"
```

```
## [1] "2015-06-09" "2016-04-21"
```

```
## [1] "2016-04-21" "2016-07-11"
```

```
## [1] "2016-07-11" "2018-03-19"
```

```
## [1] "2018-03-19" "2020-03-20"
```

the transformations are obtain by Box-Cox and the last 5 days actual value, forecast value, forecast errors and mean squared forecast error are

```
## [1] "x^2"    "x^3"    "log(x)" "x"      "x"
```

```
##
## Call:
## arima(x = newdata(c.new), order = auto.selection(newdata(c.new), testdata(c.new),
##     totalobs(c.new))[1:3])
##
## Coefficients:
##           ar1      ar2      ar3
##       -0.7391  -0.5405  -0.2814
## s.e.   0.0273   0.0316   0.0284
##
## sigma^2 estimated as 0.000138:  log likelihood = 3787.19,  aic = -7568.38
```

```
## [1] -0.046303430  0.009375610  0.126241528  0.053910551 -0.003781979
```

```
## Time Series:
## Start = 1254
## End = 1258
## Frequency = 1
## [1] -0.002995491  0.020659255  0.021005294  0.001233819  0.009004292
```

```
## Time Series:
## Start = 1254
## End = 1258
## Frequency = 1
## [1] -0.04330794 -0.01128365  0.10523623  0.05267673 -0.01278627
```

```
## [1] 0.003203178
```

BBY, 1999-06-29 to 2020-03-20

##Model 1: ARIMA(3,1,0)

```
##
## Call:
## arima(x = newdata(a), order = auto.selection(newdata(a), testdata(a), totalobs(a))[1:3])
##
## Coefficients:
##           ar1      ar2      ar3
##       -0.7889  -0.5597  -0.2481
## s.e.   0.0136   0.0158   0.0138
##
## sigma^2 estimated as 0.0001304:  log likelihood = 15905.28,  aic = -31804.56
```

the last 5 days actual value, forecast value, forecast errors and mean squared forecast error

```
## [1]  0.08155932  0.05931400  0.13566260 -0.03151705 -0.07918125
```

```
## Time Series:
## Start = 5211
## End = 5215
## Frequency = 1
## [1] 0.025122843 0.050570114 0.034932953 0.009474805 0.031996874
```

```
## Time Series:
## Start = 5211
## End = 5215
## Frequency = 1
## [1]  0.056436476  0.008743887  0.100729649 -0.040991856 -0.111178120
```

```
## [1] 0.00548978
```

##Model 2: ARIMA(3,1,3)

```
##
## Call:
## arima(x = newdata(c2), order = auto.selection(newdata(c2), testdata(c2), totalobs(c2))[1:3])
##
## Coefficients:
##           ar1      ar2     ar3      ma1     ma2      ma3
##       -0.2695  -0.9305  0.0527  -0.6824  0.6547  -0.9685
## s.e.   0.0417   0.0550  0.0324   0.0280  0.0357   0.0439
##
## sigma^2 estimated as 3.36e-05:  log likelihood = 3706.22,  aic = -7400.45
```

I split the data in to 4 subsets, which are

```
## [1] "1999-06-29" "2003-06-23"
```

```
## [1] "2003-06-23" "2007-06-13"
```

```
## [1] "2007-06-13" "2012-03-16"
```

```
## [1] "2012-03-16" "2020-03-20"
```

and I use the second 2003-06-23 to 2007-06-13 to build the model.

the last 5 days actual value, forecast value, forecast errors and mean squared forecast error

```
## [1]  0.010955468 -0.000620708  0.000709607 -0.006869880 -0.001570279
```

```
## Time Series:
## Start = 996
## End = 1000
## Frequency = 1
## [1]  3.390063e-04  1.047497e-05 -2.281281e-04 -3.272679e-04 -9.584453e-05
```

```
## Time Series:
## Start = 996
## End = 1000
## Frequency = 1
## [1]  0.0106164617 -0.0006311830  0.0009377351 -0.0065426121 -0.0014744345
```

```
## [1] 3.179335e-05
```

##Model 3 ARIMA(3,1,0) I split the data in to 2 subsets, which are

```
## [1] "1999-06-29" "2008-08-19"
```

```
## [1] "2008-08-19" "2020-03-20"
```

the transformations are obtain by Box-Cox and the last 5 days actual value, forecast value, forecast errors and mean squared forecast error are

```
## [1] "x" "x"
```

```
##
## Call:
## arima(x = newdata(c.new), order = auto.selection(newdata(c.new), testdata(c.new),
##     totalobs(c.new))[1:3])
##
## Coefficients:
##           ar1      ar2      ar3
##       -0.7874  -0.5589  -0.2475
## s.e.   0.0136   0.0158   0.0139
##
## sigma^2 estimated as 0.0001309:  log likelihood = 15895.64,  aic = -31785.27
```

```
## [1]  0.08155932  0.05931400  0.13566260 -0.03151705 -0.07918125
```

```
## Time Series:
## Start = 5211
## End = 5215
## Frequency = 1
## [1] 0.024939211 0.050529212 0.034874557 0.009448575 0.031882979
```

```
## Time Series:
## Start = 5211
## End = 5215
## Frequency = 1
## [1]  0.056620108  0.008784789  0.100788045 -0.040965627 -0.111064225
```

```
## [1] 0.005490937
```

BIIB, 2003-11-13 to 2020-03-20

##Model 1: ARIMA(1,1,0)

```
##
## Call:
## arima(x = newdata(a), order = auto.selection(newdata(a), testdata(a), totalobs(a))[1:3])
##
## Coefficients:
##           ar1
##       -0.5416
## s.e.   0.0135
##
## sigma^2 estimated as 0.0001658:  log likelihood = 12049.77,  aic = -24097.55
```

the last 5 days actual value, forecast value, forecast errors and mean squared forecast error

```
## [1]  0.02118389 -0.03272020  0.09284443 -0.01311470  0.01902892
```

```
## Time Series:
## Start = 4110
## End = 4114
## Frequency = 1
## [1]  0.031653263 -0.023658991  0.006296675 -0.009926528 -0.001140466
```

```
## Time Series:
## Start = 4110
## End = 4114
## Frequency = 1
## [1] -0.010469376 -0.009061209  0.086547751 -0.003188169  0.020169387
```

```
## [1] 0.001619839
```

##Model 2: ARIMA(0,1,0)

```
##
## Call:
## arima(x = newdata(c1), order = auto.selection(newdata(c1), testdata(c1), totalobs(c1))[1:3])
##
## Coefficients:
##           ma1
##       -1.0000
## s.e.   0.0028
##
## sigma^2 estimated as 0.0001002:  log likelihood = 3799.84,  aic = -7597.68
```

I split the data in to 5 subsets, which are

```
## [1] "2003-11-13" "2008-08-21"
```

```
## [1] "2008-08-21" "2009-06-09"
```

```
## [1] "2009-06-09" "2011-06-02"
```

```
## [1] "2011-06-02" "2011-10-24"
```

```
## [1] "2011-10-24" "2020-03-20"
```

and I use the first 2003-11-13 to 2008-08-21 to build the model.

the last 5 days actual value, forecast value, forecast errors and mean squared forecast error

```
## [1] -0.009731986  0.007056097  0.006992058  0.004176639  0.004033217
```

```
## Time Series:
## Start = 1196
## End = 1200
## Frequency = 1
## [1] -0.0002580046 -0.0002580046 -0.0002580046 -0.0002580046 -0.0002580046
```

```
## Time Series:
## Start = 1196
## End = 1200
## Frequency = 1
## [1] -0.009473981  0.007314102  0.007250063  0.004434644  0.004291222
```

```
## [1] 4.677929e-05
```

##Model 3 ARIMA(1,1,0) I split the data in to 5 subsets, which are

```
## [1] "2003-11-13" "2005-01-25"
```

```
## [1] "2005-01-25" "2007-11-05"
```

```
## [1] "2007-11-05" "2009-03-27"
```

```
## [1] "2009-03-27" "2016-03-10"
```

```
## [1] "2016-03-10" "2020-03-20"
```

the transformations are obtain by Box-Cox and the last 5 days actual value, forecast value, forecast errors and mean squared forecast error are

```
## [1] "x"      "log(x)" "x"      "x"      "x"
```

```
##
## Call:
## arima(x = newdata(c.new), order = auto.selection(newdata(c.new), testdata(c.new),
##     totalobs(c.new))[1:3])
##
## Coefficients:
##           ar1
##       -0.6321
## s.e.   0.0133
##
## sigma^2 estimated as 0.001024:  log likelihood = 6896.18,  aic = -13790.36
```

```
## [1]  0.02118389 -0.03272020  0.09284443 -0.01311470  0.01902892
```

```
## Time Series:
## Start = 3411
## End = 3415
## Frequency = 1
## [1]  0.048718282 -0.026622120  0.020997821 -0.009101020  0.009923368
```

```
## Time Series:
## Start = 3411
## End = 3415
## Frequency = 1
## [1] -0.027534395 -0.006098080  0.071846604 -0.004013677  0.009105553
```

```
## [1] 0.001211257
```

BSX, 1995-02-24 to 2020-03-20

##Model 1: ARIMA(1,1,0)

```
##
## Call:
## arima(x = newdata(a), order = auto.selection(newdata(a), testdata(a), totalobs(a))[1:3])
##
## Coefficients:
##           ar1
##       -0.4924
## s.e.   0.0110
##
## sigma^2 estimated as 0.0001797:  log likelihood = 18241.48,  aic = -36480.96
```

the last 5 days actual value, forecast value, forecast errors and mean squared forecast error

```
## [1]  0.06948414 -0.01912009  0.02403458 -0.01611871  0.01611871
```

```
## Time Series:
## Start = 6307
## End = 6311
## Frequency = 1
## [1]  0.0096131189 -0.0041049409  0.0026504206 -0.0006762094  0.0009619660
```

```
## Time Series:
## Start = 6307
## End = 6311
## Frequency = 1
## [1]  0.05987103 -0.01501515  0.02138416 -0.01544250  0.01515674
```

```
## [1] 0.0009470948
```

##Model 2: ARIMA(2,1,3)

```
##
## Call:
## arima(x = newdata(c4), order = auto.selection(newdata(c4), testdata(c4), totalobs(c4))[1:3])
##
## Coefficients:
##           ar1      ar2      ma1     ma2      ma3
##       -0.7041  -0.9791  -0.3130  0.2761  -0.9631
## s.e.   0.0248   0.0209   0.0345  0.0311   0.0265
##
## sigma^2 estimated as 0.0001726:  log likelihood = 2746.6,  aic = -5483.2
```

I split the data in to 5 subsets, which are

```
## [1] "1995-02-24" "1997-02-14"
```

```
## [1] "1997-02-14" "2002-09-11"
```

```
## [1] "2002-09-11" "2008-06-16"
```

```
## [1] "2008-06-16" "2012-03-22"
```

```
## [1] "2012-03-22" "2020-03-20"
```

and I use the fourth 2008-06-16 to 2012-03-22 to build the model.

the last 5 days actual value, forecast value, forecast errors and mean squared forecast error

```
## [1] -0.008600172  0.005714484  0.000719626  0.000000000  0.002166062
```

```
## Time Series:
## Start = 946
## End = 950
## Frequency = 1
## [1] -0.0002469519  0.0007407962  0.0007330711 -0.0002286262  0.0004560532
```

```
## Time Series:
## Start = 946
## End = 950
## Frequency = 1
## [1] -0.0083532201  0.0049736878 -0.0000134451  0.0002286262  0.0017100088
```

```
## [1] 1.949809e-05
```

##Model 3 ARIMA(1,1,0) I split the data in to 5 subsets, which are

```
## [1] "1995-02-24" "1999-02-10"
```

```
## [1] "1999-02-10" "2000-11-20"
```

```
## [1] "2000-11-20" "2004-04-14"
```

```
## [1] "2004-04-14" "2012-08-14"
```

```
## [1] "2012-08-14" "2020-03-20"
```

the transformations are obtain by Box-Cox and the last 5 days actual value, forecast value, forecast errors and mean squared forecast error are

```
## [1] "x"      "log(x)" "x"      "x"      "x"
```

```
##
## Call:
## arima(x = newdata(c.new), order = auto.selection(newdata(c.new), testdata(c.new),
##     totalobs(c.new))[1:3])
##
## Coefficients:
##           ar1
##       -0.6023
## s.e.   0.0104
##
## sigma^2 estimated as 0.0003566:  log likelihood = 14935.21,  aic = -29868.41
```

```
## [1]  0.06948414 -0.01912009  0.02403458 -0.01611871  0.01611871
```

```
## Time Series:
## Start = 5858
## End = 5862
## Frequency = 1
## [1]  0.0158268527 -0.0046935595  0.0076655926  0.0002218512  0.0047051107
```

```
## Time Series:
## Start = 5858
## End = 5862
## Frequency = 1
## [1]  0.05365729 -0.01442653  0.01636898 -0.01634056  0.01141359
```

```
## [1] 0.0007504915
```

BXP, 2006-04-03 to 2020-03-20

##Model 1: ARIMA(2,1,0)

```
##
## Call:
## arima(x = newdata(a), order = auto.selection(newdata(a), testdata(a), totalobs(a))[1:3])
##
## Coefficients:
##           ar1      ar2
##       -0.7938  -0.3772
## s.e.   0.0157   0.0157
##
## sigma^2 estimated as 0.0001275:  log likelihood = 10753.44,  aic = -21502.87
```

the last 5 days actual value, forecast value, forecast errors and mean squared forecast error

```
## [1]  0.08195031 -0.03819163  0.07913202  0.01319627  0.01850771
```

```
## Time Series:
## Start = 3511
## End = 3515
## Frequency = 1
## [1] 0.022250053 0.009631768 0.003854704 0.013200426 0.007961105
```

```
## Time Series:
## Start = 3511
## End = 3515
## Frequency = 1
## [1]  5.970025e-02 -4.782340e-02  7.527731e-02 -4.159822e-06  1.054660e-02
```

```
## [1] 0.002325821
```

##Model 2: ARIMA(2,0,3)

```
##
## Call:
## arima(x = newdata(c1), order = auto.selection(newdata(c1), testdata(c1), totalobs(c1))[1:3])
##
## Coefficients:
##          ar1      ar2      ma1     ma2      ma3  intercept
##       1.4941  -0.7542  -1.4555  0.7121  -0.0260     -2e-04
## s.e.  0.2508   0.2632   0.2555  0.2601   0.0639      3e-04
##
## sigma^2 estimated as 4.293e-05:  log likelihood = 1425.54,  aic = -2839.07
```

I split the data in to 3 subsets, which are

```
## [1] "2006-04-03" "2007-11-02"
```

```
## [1] "2007-11-02" "2011-10-21"
```

```
## [1] "2011-10-21" "2020-03-20"
```

and I use the first 2006-04-03 to 2007-11-02 to build the model.

the last 5 days actual value, forecast value, forecast errors and mean squared forecast error

```
## [1]  0.000608073  0.002196473 -0.007439159  0.012731888  0.008882582
```

```
## Time Series:
## Start = 396
## End = 400
## Frequency = 1
## [1] 0.0001769618 0.0007735013 0.0011734125 0.0011141849 0.0007240786
```

```
## Time Series:
## Start = 396
## End = 400
## Frequency = 1
## [1]  0.0004311112  0.0014229717 -0.0086125715  0.0116177031  0.0081585034
```

```
## [1] 5.558386e-05
```

##Model 3 ARIMA(0,1,0) I split the data in to 4 subsets, which are

```
## [1] "2006-04-03" "2008-03-31"
```

```
## [1] "2008-03-31" "2009-03-05"
```

```
## [1] "2009-03-05" "2011-10-21"
```

```
## [1] "2011-10-21" "2020-03-20"
```

the transformations are obtain by Box-Cox and the last 5 days actual value, forecast value, forecast errors and mean squared forecast error are

```
## [1] "x"   "x"   "x"   "x^2"
```

```
##
## Call:
## arima(x = newdata(c.new), order = auto.selection(newdata(c.new), testdata(c.new),
##     totalobs(c.new))[1:3])
##
##
## sigma^2 estimated as 0.0004735:  log likelihood = 3357.81,  aic = -6715.63
```

```
## [1]  0.008453447 -0.009862137  0.012218379 -0.003744759 -1.988946634
```

```
## Time Series:
## Start = 1396
## End = 1400
## Frequency = 1
## [1] -0.01163015 -0.01163015 -0.01163015 -0.01163015 -0.01163015
```

```
## Time Series:
## Start = 1396
## End = 1400
## Frequency = 1
## [1]  0.020083597  0.001768013  0.023848529  0.007885391 -1.977316484
```

```
## [1] 0.7821636
```

COG, 2008-06-23 to 2020-03-20

##Model 1: ARIMA(3,1,0)

```
##
## Call:
## arima(x = newdata(a), order = auto.selection(newdata(a), testdata(a), totalobs(a))[1:3])
##
## Coefficients:
##           ar1      ar2      ar3
##       -0.8067  -0.5914  -0.2691
## s.e.   0.0181   0.0213   0.0188
##
## sigma^2 estimated as 0.000125:  log likelihood = 9069.83,  aic = -18133.66
```

the last 5 days actual value, forecast value, forecast errors and mean squared forecast error

```
## [1]  0.08155932  0.05931400  0.13566260 -0.03151705 -0.07918125
```

```
## Time Series:
## Start = 2952
## End = 2956
## Frequency = 1
## [1] 0.023673884 0.053437146 0.036597433 0.007422808 0.032906763
```

```
## Time Series:
## Start = 2952
## End = 2956
## Frequency = 1
## [1]  0.057885435  0.005876855  0.099065169 -0.038939859 -0.112088009
```

```
## [1] 0.005455841
```

##Model 2: ARIMA(1,1,0)

```
##
## Call:
## arima(x = newdata(c2), order = auto.selection(newdata(c2), testdata(c2), totalobs(c2))[1:3])
##
## Coefficients:
##          ar1      ar2     ar3      ma1     ma2  intercept
##       0.9481  -0.0796  0.0211  -1.0318  0.1135     -1e-04
## s.e.  0.7675   0.6104  0.0509   0.7673  0.6729      3e-04
##
## sigma^2 estimated as 9.298e-05:  log likelihood = 2449.17,  aic = -4886.35
```

I split the data in to 3 subsets, which are

```
## [1] "2008-06-23" "2009-05-29"
```

```
## [1] "2009-05-29" "2012-06-11"
```

```
## [1] "2012-06-11" "2020-03-20"
```

and I use the second 2009-05-29 to 2012-06-110 to build the model.

the last 5 days actual value, forecast value, forecast errors and mean squared forecast error

```
## [1] -0.000839203 -0.010219110 -0.004480894 -0.011727468  0.004095164
```

```
## Time Series:
## Start = 761
## End = 765
## Frequency = 1
## [1] -0.0008974133 -0.0004100617 -0.0003161052 -0.0003023782 -0.0002865842
```

```
## Time Series:
## Start = 761
## End = 765
## Frequency = 1
## [1]  5.821031e-05 -9.809048e-03 -4.164789e-03 -1.142509e-02  4.381748e-03
```

```
## [1] 5.265974e-05
```

##Model 3 ARIMA(1,1,0) I split the data in to 4 subsets, which are

```
## [1] "2008-06-23" "2010-09-27"
```

```
## [1] "2010-09-27" "2016-06-02"
```

```
## [1] "2016-06-02" "2017-10-20"
```

```
## [1] "2017-10-20" "2020-03-20"
```

the transformations are obtain by Box-Cox and the last 5 days actual value, forecast value, forecast errors and mean squared forecast error are

```
## [1] "x"      "log(x)" "x"      "x"
```

```
##
## Call:
## arima(x = newdata(c.new), order = auto.selection(newdata(c.new), testdata(c.new),
##     totalobs(c.new))[1:3])
##
## Coefficients:
##           ar1
##       -0.6617
## s.e.   0.0193
##
## sigma^2 estimated as 0.002732:  log likelihood = 2330.4,  aic = -4658.8
```

```
## [1]  0.08155932  0.05931400  0.13566260 -0.03151705 -0.07918125
```

```
## Time Series:
## Start = 1523
## End = 1527
## Frequency = 1
## [1]  0.083749421 -0.017858408  0.049379539  0.004885511  0.034328982
```

```
## Time Series:
## Start = 1523
## End = 1527
## Frequency = 1
## [1] -0.002190102  0.077172409  0.086283063 -0.036402563 -0.113510228
```

```
## [1] 0.005522973
```

GS, 2002-07-22 to 2020-03-20

##Model 1: ARIMA(3,1,0)

```
##
## Call:
## arima(x = newdata(a), order = auto.selection(newdata(a), testdata(a), totalobs(a))[1:3])
##
## Coefficients:
##           ar1      ar2      ar3
##       -0.7980  -0.5663  -0.2543
## s.e.   0.0148   0.0173   0.0152
##
## sigma^2 estimated as 0.0001072:  log likelihood = 13995.21,  aic = -27984.42
```

the last 5 days actual value, forecast value, forecast errors and mean squared forecast error

```
## [1]  0.08155932  0.05931400  0.13566260 -0.03151705 -0.07918125
```

```
## Time Series:
## Start = 4443
## End = 4447
## Frequency = 1
## [1] 0.025918073 0.050660504 0.035708130 0.009290783 0.032547511
```

```
## Time Series:
## Start = 4443
## End = 4447
## Frequency = 1
## [1]  0.055641246  0.008653497  0.099954472 -0.040807834 -0.111728757
```

```
## [1] 0.005462064
```

##Model 2: ARIMA(1,0,2)

```
##
## Call:
## arima(x = newdata(c2), order = auto.selection(newdata(c2), testdata(c2), totalobs(c2))[1:3])
##
## Coefficients:
##          ar1      ar2      ma1     ma2  intercept
##       1.1268  -0.4686  -1.0725  0.4088     -2e-04
## s.e.  0.3630   0.3558   0.3740  0.3657      2e-04
##
## sigma^2 estimated as 3.8e-05:  log likelihood = 4385.68,  aic = -8761.35
```

I split the data in to 4 subsets, which are

```
## [1] "2002-07-22" "2003-05-07"
```

```
## [1] "2003-05-07" "2008-02-12"
```

```
## [1] "2008-02-12" "2011-12-22"
```

```
## [1] "2011-12-22" "2020-03-20"
```

and I use the second 2003-05-07 to 2008-02-12 to build the model.

the last 5 days actual value, forecast value, forecast errors and mean squared forecast error

```
## [1]  0.001281855 -0.002772433  0.000531811 -0.005919091 -0.010270333
```

```
## Time Series:
## Start = 1196
## End = 1200
## Frequency = 1
## [1]  0.0011501573 -0.0002972733 -0.0009276863 -0.0009598562 -0.0007007227
```

```
## Time Series:
## Start = 1196
## End = 1200
## Frequency = 1
## [1]  0.0001316977 -0.0024751597  0.0014594973 -0.0049592348 -0.0095696103
```

```
## [1] 2.488907e-05
```

##Model 3 ARIMA(3,1,0) I split the data in to 4 subsets, which are

```
## [1] "2002-07-22" "2004-12-07"
```

```
## [1] "2004-12-07" "2008-11-25"
```

```
## [1] "2008-11-25" "2017-11-02"
```

```
## [1] "2017-11-02" "2020-03-20"
```

the transformations are obtain by Box-Cox and the last 5 days actual value, forecast value, forecast errors and mean squared forecast error are

```
## [1] "x" "x" "x" "x"
```

```
##
## Call:
## arima(x = newdata(c.new), order = auto.selection(newdata(c.new), testdata(c.new),
##     totalobs(c.new))[1:3])
##
## Coefficients:
##           ar1      ar2      ar3
##       -0.7963  -0.5650  -0.2536
## s.e.   0.0148   0.0173   0.0152
##
## sigma^2 estimated as 0.0001077:  log likelihood = 13984.42,  aic = -27962.84
```

```
## [1]  0.08155932  0.05931400  0.13566260 -0.03151705 -0.07918125
```

```
## Time Series:
## Start = 4443
## End = 4447
## Frequency = 1
## [1] 0.02573819 0.05056980 0.03565115 0.00927605 0.03241051
```

```
## Time Series:
## Start = 4443
## End = 4447
## Frequency = 1
## [1]  0.055821131  0.008744198  0.100011452 -0.040793101 -0.111591758
```

```
## [1] 0.00546231
```

INTC, 1986-08-28 to 2020-03-20

##Model 1: ARIMA(1,1,0)

```
##
## Call:
## arima(x = newdata(a), order = auto.selection(newdata(a), testdata(a), totalobs(a))[1:3])
##
## Coefficients:
##           ar1
##       -0.4756
## s.e.   0.0096
##
## sigma^2 estimated as 0.0002223:  log likelihood = 23554.11,  aic = -47106.21
```

the last 5 days actual value, forecast value, forecast errors and mean squared forecast error

```
## [1]  0.013578679 -0.075429400  0.040299072 -0.035278274  0.002122872
```

```
## Time Series:
## Start = 8454
## End = 8458
## Frequency = 1
## [1] -0.007118724 -0.016388074 -0.011979353 -0.014076244 -0.013078913
```

```
## Time Series:
## Start = 8454
## End = 8458
## Frequency = 1
## [1]  0.02069740 -0.05904133  0.05227842 -0.02120203  0.01520179
```

```
## [1] 0.001465583
```

##Model 2: ARIMA(3,1,3)

```
##
## Call:
## arima(x = newdata(c4), order = auto.selection(newdata(c4), testdata(c4), totalobs(c4))[1:3])
##
## Coefficients:
##          ar1     ar2      ar3      ma1     ma2     ma3
##       0.9099  -0.665  -0.0029  -1.9154  1.6164  -0.701
## s.e.     NaN     NaN   0.0290      NaN     NaN     NaN
##
## sigma^2 estimated as 9.313e-05:  log likelihood = 3843.33,  aic = -7674.66
```

I split the data in to 6 subsets, which are

```
## [1] "1986-08-28" "1989-01-12"
```

```
## [1] "1989-01-12" "1997-09-24"
```

```
## [1] "1997-09-24" "2002-07-05"
```

```
## [1] "2002-07-05" "2007-04-12"
```

```
## [1] "2007-04-12" "2011-11-01"
```

```
## [1] "2011-11-01" "2020-03-20"
```

and I use the fourth 2002-07-05 to 2007-04-12 to build the model.

the last 5 days actual value, forecast value, forecast errors and mean squared forecast error

```
## [1]  0.000947108  0.002282025  0.001623542  0.003072473 -0.006503511
```

```
## Time Series:
## Start = 1196
## End = 1200
## Frequency = 1
## [1] -9.326684e-05 -1.499534e-04 -4.794399e-04 -7.423593e-04 -7.623136e-04
```

```
## Time Series:
## Start = 1196
## End = 1200
## Frequency = 1
## [1]  0.001040375  0.002431978  0.002102982  0.003814832 -0.005741197
```

```
## [1] 1.178674e-05
```

##Model 3 ARIMA(1,1,0) I split the data in to 4 subsets, which are

```
## [1] "1986-08-28" "2002-07-05"
```

```
## [1] "2002-07-05" "2010-06-15"
```

```
## [1] "2010-06-15" "2016-10-20"
```

```
## [1] "2016-10-20" "2020-03-20"
```

the transformations are obtain by Box-Cox and the last 5 days actual value, forecast value, forecast errors and mean squared forecast error are

```
## [1] "log(x)" "log(x)" "x"      "x"
```

```
##
## Call:
## arima(x = newdata(c.new), order = auto.selection(newdata(c.new), testdata(c.new),
##     totalobs(c.new))[1:3])
##
## Coefficients:
##           ar1
##       -0.5414
## s.e.   0.0398
##
## sigma^2 estimated as 0.0007082:  log likelihood = 5414.74,  aic = -10827.47
```

```
## [1]  0.013578683 -0.075429410  0.040299052 -0.035278267  0.002122879
```

```
## Time Series:
## Start = 2456
## End = 2460
## Frequency = 1
## [1] -0.004422225 -0.016434032 -0.009930468 -0.013451699 -0.011545195
```

```
## Time Series:
## Start = 2456
## End = 2460
## Frequency = 1
## [1]  0.01800091 -0.05899538  0.05022952 -0.02182657  0.01366807
```

```
## [1] 0.001398141
```

NEE, 1980-01-02 to 2020-03-20

##Model 1: ARIMA(1,1,0)

```
##
## Call:
## arima(x = newdata(a), order = auto.selection(newdata(a), testdata(a), totalobs(a))[1:3])
##
## Coefficients:
##           ar1
##       -0.4972
## s.e.   0.0087
##
## sigma^2 estimated as 4.591e-05:  log likelihood = 36237.8,  aic = -72473.61
```

the last 5 days actual value, forecast value, forecast errors and mean squared forecast error

```
## [1]  0.041496593 -0.041888444  0.022342359  0.007360733  0.033444739
```

```
## Time Series:
## Start = 10137
## End = 10141
## Frequency = 1
## [1]  0.018249000 -0.003539060  0.007293670  0.001907783  0.004585574
```

```
## Time Series:
## Start = 10137
## End = 10141
## Frequency = 1
## [1]  0.02324759 -0.03834938  0.01504869  0.00545295  0.02885917
```

```
## [1] 0.000620035
```

##Model 2: ARIMA(0,1,2)

```
##
## Call:
## arima(x = newdata(c1), order = auto.selection(newdata(c1), testdata(c1), totalobs(c1))[1:3])
##
## Coefficients:
##           ma1      ma2
##       -0.9810  -0.0190
## s.e.   0.0142   0.0142
##
## sigma^2 estimated as 2.161e-05:  log likelihood = 18548.01,  aic = -37092.01
```

I split the data in to 3 subsets, which are

```
## [1] "1980-01-02" "1998-08-06"
```

```
## [1] "1998-08-06" "2011-09-15"
```

```
## [1] "2011-09-15" "2020-03-20"
```

and I use the first 1980-01-02 to 1998-08-06 to build the model.

the last 5 days actual value, forecast value, forecast errors and mean squared forecast error

```
## [1] -0.000873110  0.010146653 -0.007522544  0.007076486  0.000892575
```

```
## Time Series:
## Start = 4696
## End = 4700
## Frequency = 1
## [1] -0.0003302053 -0.0003106816 -0.0003106816 -0.0003106816 -0.0003106816
```

```
## Time Series:
## Start = 4696
## End = 4700
## Frequency = 1
## [1] -0.0005429047  0.0104573346 -0.0072118624  0.0073871676  0.0012032566
```

```
## [1] 4.353592e-05
```

##Model 3 ARIMA(1,1,0) I split the data in to 3 subsets, which are

```
## [1] "1980-01-02" "2006-02-24"
```

```
## [1] "2006-02-24" "2008-12-04"
```

```
## [1] "2008-12-04" "2020-03-20"
```

the transformations are obtain by Box-Cox and the last 5 days actual value, forecast value, forecast errors and mean squared forecast error are

```
## [1] "x" "x" "x"
```

```
##
## Call:
## arima(x = newdata(c.new), order = auto.selection(newdata(c.new), testdata(c.new),
##     totalobs(c.new))[1:3])
##
## Coefficients:
##           ar1
##       -0.4972
## s.e.   0.0087
##
## sigma^2 estimated as 4.639e-05:  log likelihood = 36184.37,  aic = -72366.73
```

```
## [1]  0.041496593 -0.041888444  0.022342359  0.007360733  0.033444739
```

```
## Time Series:
## Start = 10137
## End = 10141
## Frequency = 1
## [1]  0.018249417 -0.003539057  0.007293982  0.001907889  0.004585808
```

```
## Time Series:
## Start = 10137
## End = 10141
## Frequency = 1
## [1]  0.023247177 -0.038349387  0.015048377  0.005452843  0.028858931
```

```
## [1] 0.0006200263
```

TXN, 1980-01-02 to 2020-03-20

##Model 1: ARIMA(1,1,0)

```
##
## Call:
## arima(x = newdata(a), order = auto.selection(newdata(a), testdata(a), totalobs(a))[1:3])
##
## Coefficients:
##           ar1
##       -0.4657
## s.e.   0.0088
##
## sigma^2 estimated as 0.0001769:  log likelihood = 29401.69,  aic = -58801.37
```

the last 5 days actual value, forecast value, forecast errors and mean squared forecast error

```
## [1]  0.054658112 -0.055108396  0.025920007 -0.006765452  0.017315644
```

```
## Time Series:
## Start = 10137
## End = 10141
## Frequency = 1
## [1] -0.001619286 -0.017783644 -0.010256424 -0.013761608 -0.012129357
```

```
## Time Series:
## Start = 10137
## End = 10141
## Frequency = 1
## [1]  0.056277398 -0.037324752  0.036176431  0.006996156  0.029445001
```

```
## [1] 0.001356994
```

##Model 2: ARIMA(1,1,0)

```
##
## Call:
## arima(x = newdata(c1), order = auto.selection(newdata(c1), testdata(c1), totalobs(c1))[1:3])
##
##
## sigma^2 estimated as 0.00018:  log likelihood = 11552.23,  aic = -23104.47
```

I split the data in to 3 subsets, which are

```
## [1] "1980-01-02" "1995-10-26"
```

```
## [1] "1995-10-26" "2008-12-04"
```

```
## [1] "2008-12-04" "2020-03-20"
```

and I use the first 1980-01-02 to 1995-10-26 to build the model.

the last 5 days actual value, forecast value, forecast errors and mean squared forecast error

```
## [1]  0.021263205 -0.009240774  0.006912277  0.017373996  0.004047767
```

```
## Time Series:
## Start = 3996
## End = 4000
## Frequency = 1
## [1] 0.009529315 0.009529315 0.009529315 0.009529315 0.009529315
```

```
## Time Series:
## Start = 3996
## End = 4000
## Frequency = 1
## [1]  0.011733890 -0.018770089 -0.002617038  0.007844681 -0.005481548
```

```
## [1] 0.0001176871
```

##Model 3 ARIMA(0,0,0) I split the data in to 4 subsets, which are

```
## [1] "1980-01-02" "1995-10-26"
```

```
## [1] "1995-10-26" "2000-05-17"
```

```
## [1] "2000-05-17" "2003-03-05"
```

```
## [1] "2003-03-05" "2020-03-20"
```

the transformations are obtain by Box-Cox and the last 5 days actual value, forecast value, forecast errors and mean squared forecast error are

```
## [1] "x"      "log(x)" "log(x)" "x"
```

```
##
## Call:
## arima(x = newdata(c.new), order = auto.selection(newdata(c.new), testdata(c.new),
##     totalobs(c.new))[1:3])
##
## Coefficients:
##       intercept
##          -2e-04
## s.e.       1e-04
##
## sigma^2 estimated as 0.000177:  log likelihood = 24040.59,  aic = -48079.19
```

```
## [1]  0.054658112 -0.055108396  0.025920007 -0.006765452  0.017315644
```

```
## Time Series:
## Start = 8289
## End = 8293
## Frequency = 1
## [1] -0.0002150617 -0.0002150617 -0.0002150617 -0.0002150617 -0.0002150617
```

```
## Time Series:
## Start = 8289
## End = 8293
## Frequency = 1
## [1]  0.054873174 -0.054893334  0.026135068 -0.006550391  0.017530705
```

```
## [1] 0.001411524
```