Economic Forecasting
Exercise Sheet 2 Solutions

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1. (a) Figure 1 shows the variable NYSE. It displays a very obvious non-linear trend.

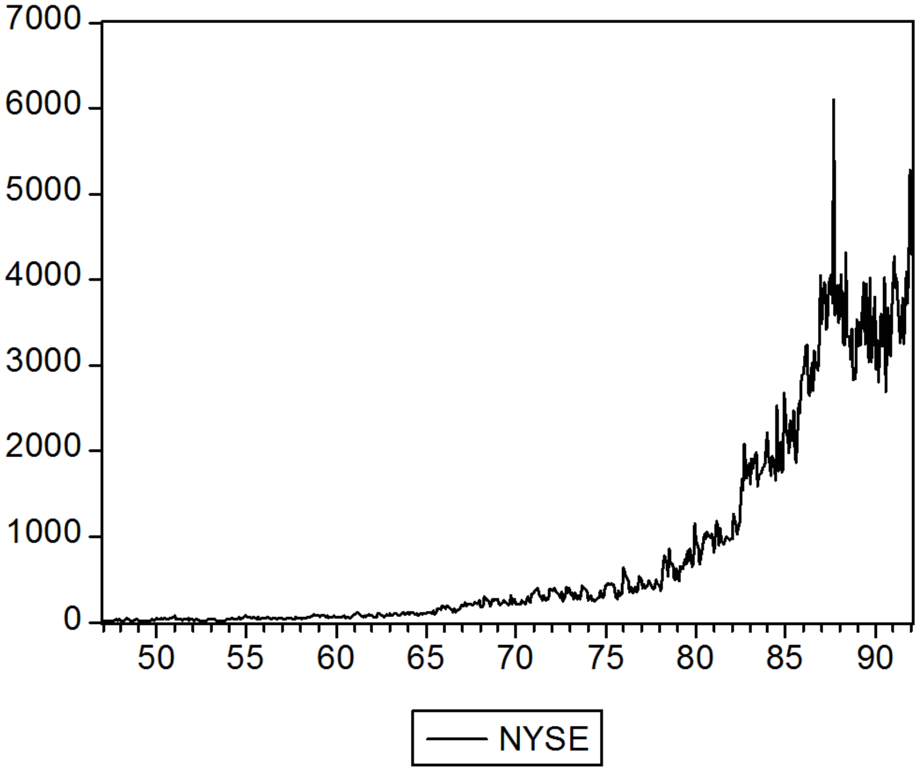

Figure 1: New York Stock Exchange: Volume 1947:01–1992:02

(b) The estimates for the quadratic trend model are:

```
Dependent Variable: NYSE
Method: Least Squares
Date: 02/06/13   Time: 15:31
Sample: 1947M01 1992M02
Included observations: 542
===============================================================
Variable    Coefficient     Std. Error    t-Statistic  Prob.
===============================================================
C             536.4267      50.32188       10.65991    0.0000
@TREND       -9.204234      0.429674      -21.42143    0.0000
@TREND*@TREND 0.028411      0.000769       36.94912    0.0000
===============================================================
R-squared             0.896102    Mean dependent var    820.9982
Adjusted R-squared    0.895716    S.D. dependent var    1213.746
S.E. of regression    391.9546    Akaike info criterion 14.78569
Sum squared resid     82805727    Schwarz criterion     14.80946
Log likelihood       -4003.922    Hannan-Quinn criter.  14.79499
F-statistic           2324.389    Durbin-Watson stat    0.487013
Prob(F-statistic)     0.000000
===============================================================
```

Note that all three coefficients are statistically significant (the final column gives *P-values* which are all less than 0.05 showing that all coefficients are significantly different from zero at the 5% level. The positive quadratic term means that the equation forecast will have a U-shape with a minimum at the point

$$-9.204234 + 2 * 0.028411 * t = 0 \text{ or } t = 161.98.$$

Observation 162 corresponds to period 1960m7.

(c) The estimates for the cubic trend model are:

```
Dependent Variable: NYSE
Method: Least Squares
Date: 02/06/13   Time: 16:16
Sample: 1947M01 1992M02
Included observations: 542
===============================================================
Variable         Coefficient    Std. Error   t-Statistic   Prob.
===============================================================
C                  -89.25834      52.95417   -1.685577   0.0925
@TREND              4.738587      0.848466    5.584886   0.0000
```

```
@TREND*@TREND       -0.036080     0.003646   -9.894747   0.0000
@TREND*@TREND*@TREND 7.95E-05     4.43E-06    17.93810   0.0000
===============================================================
R-squared            0.934986     Mean dependent var    820.9982
Adjusted R-squared   0.934624     S.D. dependent var     213.746
S.E. of regression   310.3399     Akaike info criterion 14.32057
Sum squared resid    51815255     Schwarz criterion     14.35227
Log likelihood      -3876.873     Hannan-Quinn criter.  14.33296
F-statistic          2579.061     Durbin-Watson stat    0.778127
Prob(F-statistic)    0.000000
===============================================================
```

Note that the extra cubic parameter, though very small, is highly significant and that both the *Akaike* and *Schwartz* information criteria are lower than in the quadratic equation showing that this model is preferred. The cubic trend has two turning points defined by the equation

$$4.738587 - 2 * 0.036080 * t + 3 * 0.0000795 * t^2 = 0$$

which has solutions at $t \simeq 96$ and $t \simeq 206$ or 1955m1 and 1964m3, the first being a maximum and the second a minimum.

(d) The estimates for the exponential trend model are:

```
Dependent Variable: LOG(NYSE)
Method: Least Squares
Date: 02/07/13   Time: 13:33
Sample: 1947M01 1992M02
Included observations: 542
===============================================================
Variable         Coefficient    Std. Error   t-Statistic  Prob.
===============================================================
C                   2.719730      0.024832    109.5253   0.0000
@TREND              0.010327      7.95E-05    129.9519   0.0000
===============================================================
R-squared          0.969014     Mean dependent var     5.513070
Adjusted R-squared 0.968957     S.D. dependent var     1.642859
S.E. of regression 0.289455     Akaike info criterion  0.362052
Sum squared resid  45.24357     Schwarz criterion      0.377901
Log likelihood    -96.11603     Hannan-Quinn criter.   0.368250
F-statistic        16887.49     Durbin-Watson stat     0.445528
Prob(F-statistic)  0.000000
===============================================================
```

Both intercept and trend are positive and significant. Note that it is not possible to compare the information criteria for this equation (*Akaike* and *Schwartz*) directly with those of the quadratic and cubic equations. This is because the dependent variable in this equation is the logarithm of NYSE whereas in the previous equations it was NYSE. To get information criteria that we can compare, we would have needed to estimate this equation in non-linear form as

$$\text{NYSE}_t = e^{\beta_0+\beta_1 t}$$

which in *EViews* can be done by specifying a non-linear regression equation:

```
NYSE = EXP(C(1) + C(2) * @TREND)
```

The resulting *Akaike* and *Schwartz* criteria are 14.50 and 14.51 respectively, which lie between those for the quadratic and the cubic equation.

(e) The estimates for the log random walk model with drift are:

```
Dependent Variable: DLOG(NYSE)
Method: Least Squares
Date: 02/07/13   Time: 13:48
Sample (adjusted): 1947M02 1992M02
Included observations: 541 after adjustments
==============================================================
Variable         Coefficient    Std. Error   t-Statistic  Prob.
==============================================================
C                   0.009587      0.008306      1.154133 0.2490
==============================================================
R-squared           0.000000     Mean dependent var     0.009587
Adjusted R-squared 0.000000     S.D. dependent var     0.193204
S.E. of regression 0.193204     Akaike info criterion -0.448294
Sum squared resid  20.15699     Schwarz criterion     -0.440358
Log likelihood     122.2636     Hannan-Quinn criter.  -0.445191
Durbin-Watson stat 2.674632
==============================================================
```

Note that the drift parameter is positive though not significantly different from zero (P-value 0.249).

(f) Perform an *Augmented Dickey-Fuller* (*ADF*) test of the null hypothesis that NYSE is