TEST6

2023-05-03

Questions

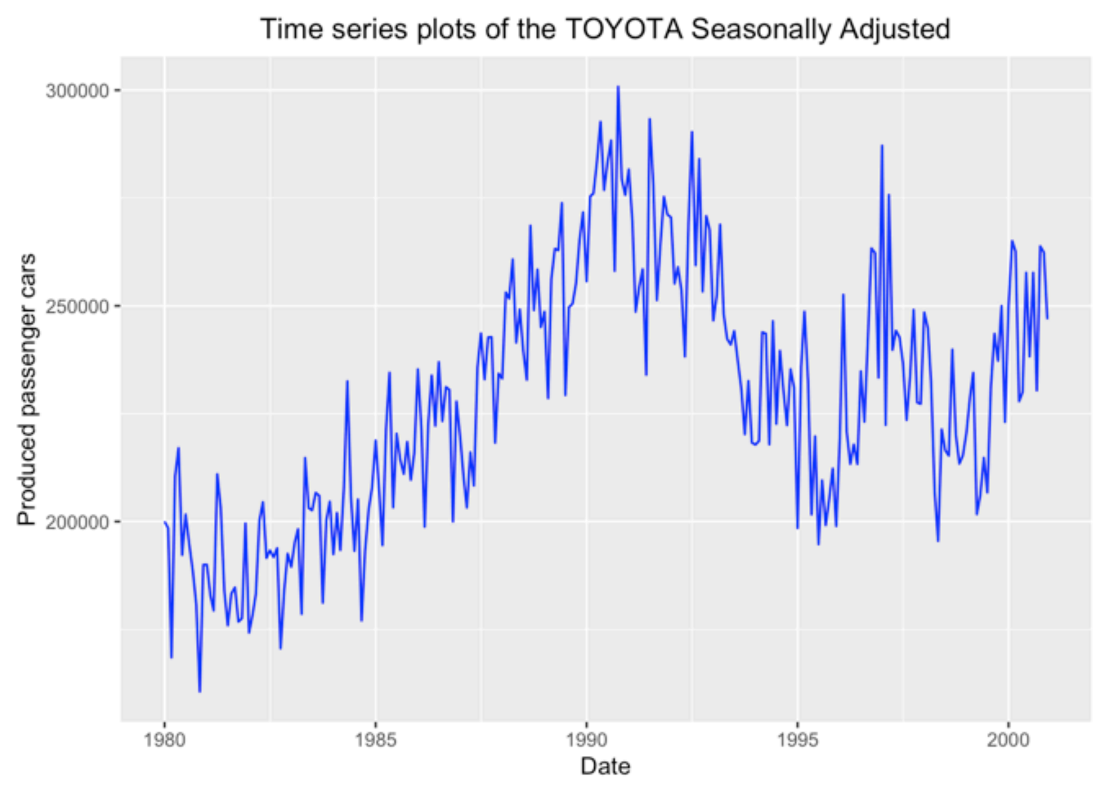
This test exercise uses DF that are available in the DF file T estExer6. T he q uestion o f i nterest i s t o model monthly production of Toyota passenger cars and to investigate whether the monthly production of all other brands of Japanese passenger cars has predictive power for the production of Toyota. Monthly production DF are available from January 1980 until December 2000. The DF for January 1980 until December 1999 are used for specification and estimation of models, and the DF for 2000 are left out for forecast evaluation purposes.

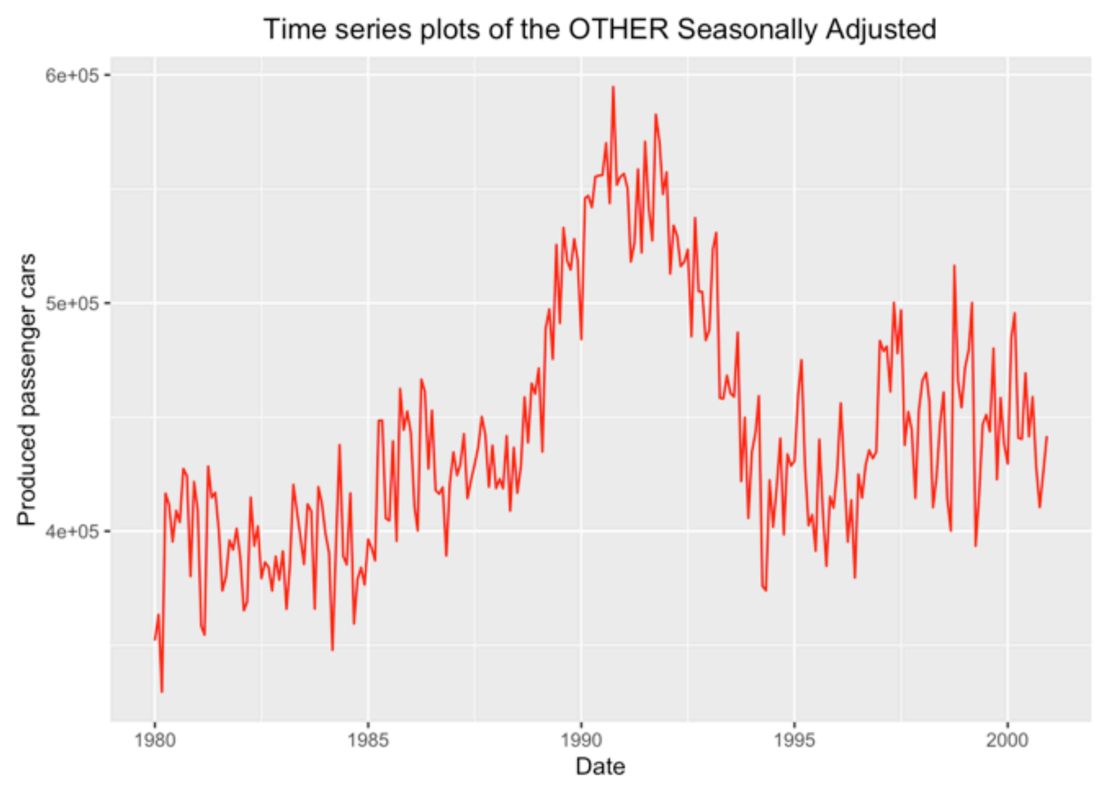
In answering the questions below, you should use the seasonally adjusted production DF denoted by 'toyota-sa' and 'other-sa'. We will denote these variables by y = toyota-sa and x = other-sa.

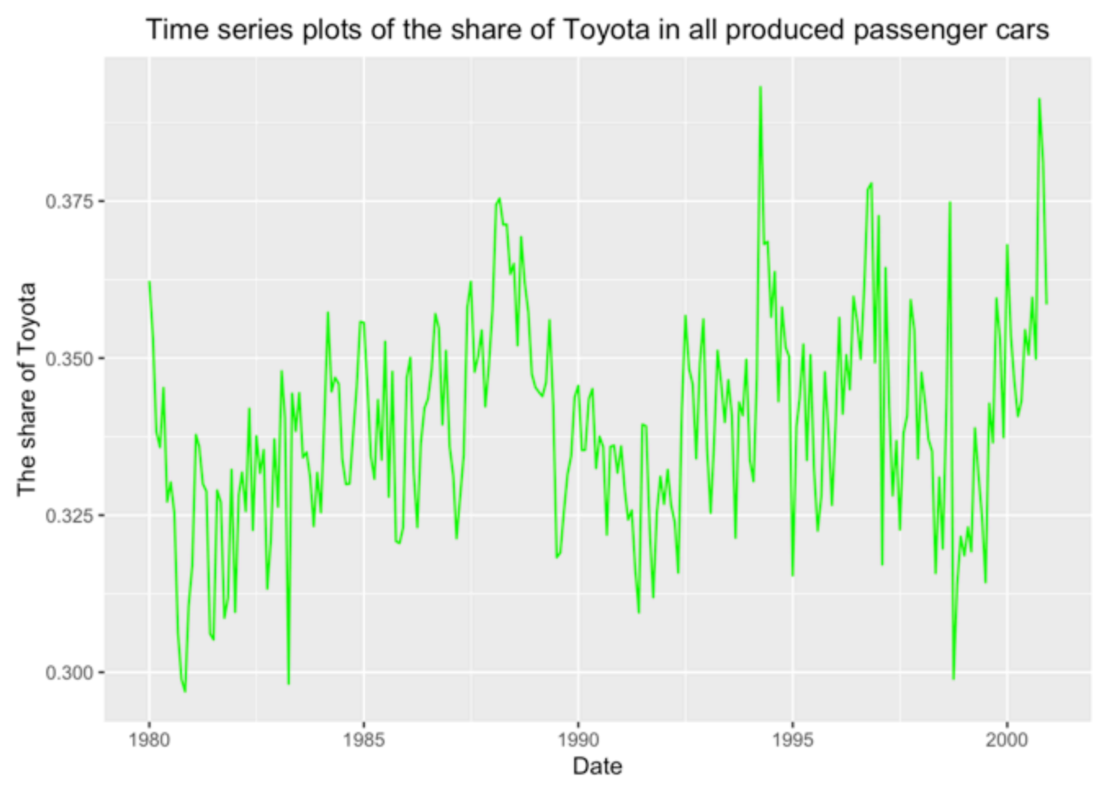
(a)

Make time series plots of the variables yt and xt, and also of the share of Toyota in all produced passenger cars, that is $y_t/(y_t + x_t)$. What conclusions do you draw from these plots?

answer (a)







Toyota's share in all produced passenger cars is between approximately 30% and 38%. This seems fairly stable and steady over a long period of time but has no trend.

(b)

(i)

Perform the Augmented Dickey-Fuller (ADF) test for y_t. In the ADF test equation, include a constant (α) and three lags of Δy_t, as well as the variable of interest, $y_t - 1$. Report the coefficient of $y_t - 1$ and its standard error and t-value, and draw your conclusion.

(ii)

Perform a similar ADF test for x_t.

answer (b)

(i)

```
##
##  Augmented Dickey-Fuller Test
##
## data:  DF$TOYOTA_SA
## Dickey-Fuller = -2.5096, Lag order = 3, p-value = 0.3612
## alternative hypothesis: stationary
```

```
                 Coef.     Std.Err.     t     P>|t|
---------------------------------------------------
const        19281.8945 8430.4101  2.2872 0.0231
y_lag1          -0.0832    0.0368 -2.2623 0.0246
```

The ADF test shows that this time series of y_t is stationary and has no trend. But t-value is bigger than critical value(-2.9). so in that point, we do not reject H_0 and it can be non-stationary.

(ii)

```
##
##  Augmented Dickey-Fuller Test
##
## data:  DF$OTHER_SA
## Dickey-Fuller = -2.0658, Lag order = 3, p-value = 0.5481
## alternative hypothesis: stationary
```

```
                 Coef.     Std.Err.     t     P>|t|
---------------------------------------------------
xlag1           -0.0696    0.0331 -2.1057 0.0363
```

same conclusion of (i).

(c)

Perform the two-step Engle-Granger test for cointegration of the time series y_t and x_t. In step 1, regress y_t on a constant and x_t. In step 2, perform a regression of the residuals e_t in the model $ Δe_t = α+ρe_{t−1} + β_1Δe_{t−1} + β_2Δe_{t−2} + β_3e_{t−3} + ω_t $. What is your conclusion?

answer (c)

Step 1,

EG : $y_t = 26706.43 + 0.45x_t + e_t$

Step 2,

```
               Coef.  Std.Err.    t    P>|t|    [0.025     0.975]
------------------------------------------------------------------
e_lag1        -0.2930   0.0680 -4.3057 0.0000    -0.4270   -0.1589
delta_e_lag1  -0.2858   0.0785 -3.6396 0.0003    -0.4406   -0.1311
delta_e_lag2  -0.1416   0.0754 -1.8794 0.0614    -0.2901    0.0068
delta_e_lag3  -0.0960   0.0657 -1.4607 0.1454    -0.2254    0.0335
const         24.9917 847.8255  0.0295 0.9765 -1645.4676 1695.4510
```

EG : $\Delta e_t = 24.9917 + 0.2930e_{t-1} + 0.2858\ \Delta\ e_{t-1} + 0.1416\ \Delta\ e_{t-2} + 0.096\ \Delta\ e_{t-3} + \omega_t$

T-value is "-4.3057", lower than critial value(-3.8). So, we can reject H_0 and conclude x_t and y_t are cointegrated.

(d)

Construct the first twelve sample autocorrelations and sample partial autocorrelations of Δy_t and use the outcomes to motivate an AR(12) model for Δy_t. Check that only the lagged terms at lags 1 to 5, 10, and 12 are significant, and estimate the following model: $\Delta y_t = \alpha + \Sigma_{j=1}^{5}\beta_j\ \Delta\ y_{t-j} + \beta_6\ \Delta\ y_{t-10} + \beta_7\ \Delta\ y_{t-12} + \varepsilon_t$ (recall that the estimation sample is Jan 1980 - Dec 1999).

answer (d)

```
NEWDF <- DF["1980-01-01" <= DF$DATE & DF$DATE <= "1999-12-01",]
```

We already know that the null hypothesis is rejected if $|r_k| > \frac{2}{\sqrt{n}}$ in 5 percent level. In this case the first order autocorrelation is significant. In this case, n = 240. So, $\frac{2}{\sqrt{240}} = 0.1291$

```
##         r_k
##  [1,] 0.4581
##  [2,] 0.3180
##  [3,] 0.0868
##  [4,] 0.1233
##  [5,] 0.1738
##  [6,] 0.0180
##  [7,] 0.2144
##  [8,] 0.0079
##  [9,] 0.2088
## [10,] 0.2317
## [11,] 0.1968
## [12,] 0.2215
```

Not 1 to 5, 10, and 12 But the lagged terms at lags of 1, 2, 5, 7, 9, 10, 11, 12 are bigger than 0.1291. so these are significant.

(e)

Extend the model of part (d) by adding the Error Correcion (EC) term $(y_t - 0.45x_t)$, that is, estimate the ECM $\Delta y_t = \alpha + \gamma(y_{t-1} - 0.45x_{t-1}) + \Sigma_{j=1}^{5}\beta_j\ \Delta\ y_{t-j} + \beta_6\ \Delta\ y_{t-10} + \beta_7\ \Delta\ y_{t-12} + \varepsilon_t$ (estimationsampleisJan1980 - Dec 1999). Check that the EC term is significant at the 5% level, but not at the 1% level.

answer (e)

```
                Coef.    Std.Err.    t    P>|t|   [0.025    0.975]
-------------------------------------------------------------------
const         4728.0072 2133.7034  2.2159 0.0277 522.6791 8933.3353
delta_lag1      -0.5223    0.0706 -7.4009 0.0000  -0.6614   -0.3832
delta_lag2      -0.1866    0.0833 -2.2403 0.0261  -0.3508   -0.0224
delta_lag3      -0.1581    0.0809 -1.9552 0.0518  -0.3175    0.0013
delta_lag4      -0.1847    0.0743 -2.4860 0.0137  -0.3311   -0.0383
delta_lag5      -0.1331    0.0611 -2.1785 0.0304  -0.2535   -0.0127
delta_lag10     -0.2737    0.0520 -5.2649 0.0000  -0.3762   -0.1712
delta_lag12      0.2516    0.0542  4.6402 0.0000   0.1448    0.3585
EC_term         -0.1503    0.0696 -2.1599 0.0319  -0.2875   -0.0132
```

So,

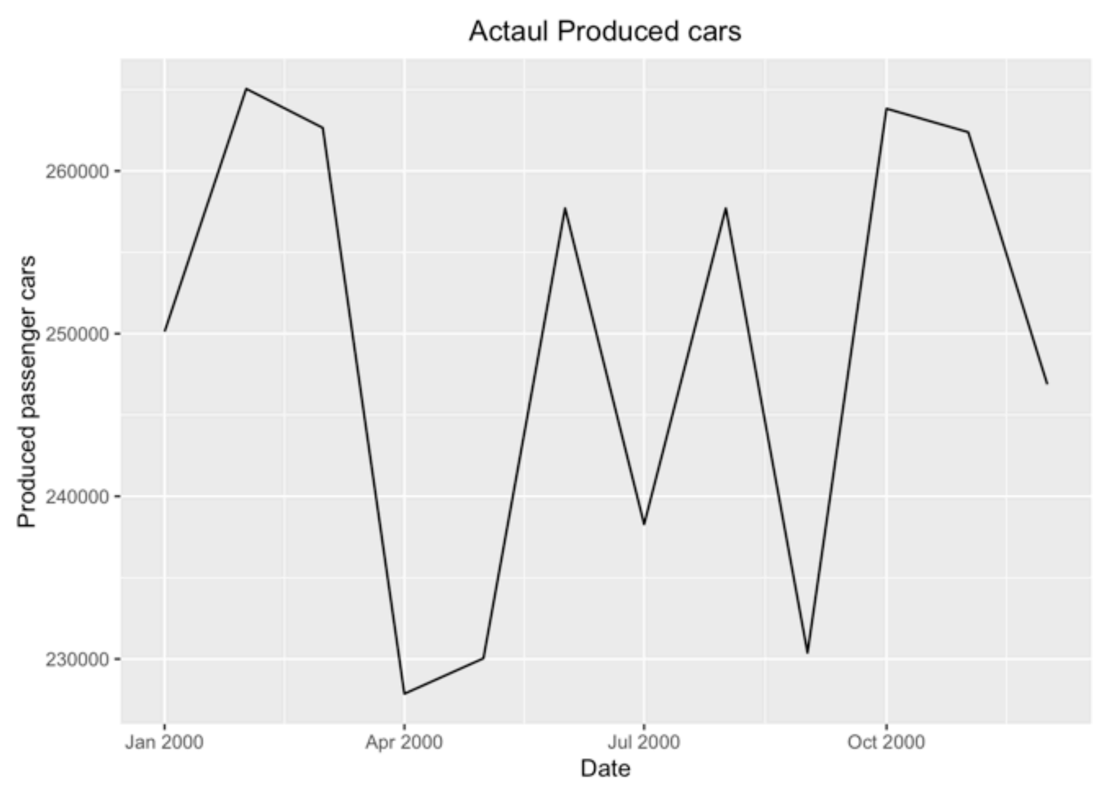
$\Delta y_t = 4728.0072 + 0.1503(y_{t-1} - 0.45x_{t-1}) + 0.5223\ \Delta\ y_{t-1} + 0.1866\ \Delta\ y_{t-2} + 0.1581\ \Delta\ y_{t-3} + 0.1847\ \Delta\ y_{t-4} + 0.1331\ \Delta\ y_{t-5} + 0.2737\ \Delta\ y_{t-10} + 0.2516\ \Delta\ y_{t-12} + \varepsilon_t$

P-value = 0.0319 is lower than 0.05. So, the EC term is significant at the 5% level, but not at the 1% level.

(f)

Use the models of parts (d) and (e) to make two series of 12 forecasts of monthly changes in production of Toyota passenger cars in 2000. At each month, you should use the DF that are then available, for example, to forecast production for September 2000 you can use the DF up to and including August 2000. However, do not re-estimate the model and use the coefficients as obtained in parts (d) and (e). For each of the two forecast series, compute the values of the root mean squared error (RMSE) and of the mean absolute error (MAE). Finally, give your interpretation of the outcomes.

answer (f)



In AR(1-5, 10, 12),

RMSE = 16992

MAE = 14703

In ECM(1-5, 10, 12),

RMSE = 18205

MAE = 15556

(RMSE : root mean squared error, MAE : mean absolute error)

It can be predicted by Both models, AR(12) model and Error correction model. But AR(12) is better predictive than Error correction model.