Key to Assignment 4

1. For the following forecasting model, Yt is quarterly sales for 36 quarters,

$$\text{Log}(Yt) = 0.8 + 0.2T + 0.3S1t - 0.5S2t + 0.1S4t + ut$$
$$(0.1) \quad (0.1) \quad (0.4) \quad (0.2) \quad (0.08)$$

where T is time trend and T=1, 2, …, 36, S1, S2, S4 are seasonal dummy for quarter 1, 2, and 4, respectively. The sum of squared residuals of the regression is 2263.

a. Interpret the coefficient of T and show why.

b. How would you test whether the seasonality for quarter 1 and 2 is the same as that for quarter 3 in the data? Give details.

c. What is the expected increase of sales between the first quarter of year 10 and the forth quarter of year 9? How much of that is caused by seasonality?

d. Forecast the sales for T=38. Construct 70% confidence interval for the true sales at T=38.

e. Give Eviews code for the following functions:

1. Generate time trend

2. Generate seasonal dummies

3. Estimate the above model

-------Answer to 1------

a. The coefficient of T means the growth rate of sales.

Because the model can be written as

$$Log(Y_t) = \beta_0 + \beta_1 S_{1t} + \beta_2 S_{2t} + \beta_3 T + \beta_4 S_{4t} + \mu_t$$

Having the derivative for both side with respect to T, then

$$\frac{1}{Y_t}\frac{\partial Y_t}{\partial T} = \frac{1}{Y_t}\frac{\Delta Y_t}{\Delta T} = \beta_3$$

When $\Delta T=1$, $\frac{\Delta Y_t}{Y_t} = \beta_3$, which is the growth of sales, i.e., without seasonality, the sales are expected to growth at 20% per quarter.

b. To test whether $\beta_1 = \beta_2 = 0$

H_0: $\beta_1 = \beta_2 = 0$ H_1: Not H_0

As we know the seasonality for quarter 1 is $\beta_0 + \beta_1$, the seasonality for quarter 2 is $\beta_0 + \beta_2$, and the seasonality for quarter 3 is β_0, so what we should do is to test whether $\beta_1 = \beta_2 = 0$

We can construct a new restricted model,

$$Log(Y_t) = \beta_0 + \beta_3 T + \beta_4 S_{4t} + \mu_t$$

Then get the value of restricted R-square R_r^2

We can also get the value of unrestricted R-square R_{ur}^2

$$F = \frac{(R_{ur}^2 - R_r^2)/q}{(1-R_{ur}^2)/(n-k-1)} = \frac{(R_{ur}^2 - R_r^2)/2}{(1-R_{ur}^2)/31}$$

At a given significant level a, the critical value is F_α

Compare F with F_α, and then we can determine whether to reject or accept the null hypothesis.

c. The expected log (sales) of the first quarter of year 10 (T=37) is

$$0.8 + 0.2 * 37 + 0.3 = 8.5$$

The expected log (sales) of the fourth quarter of year 9 (T=36) is

$$0.8 + 0.2 * 36 + 0.1 = 8.1$$

So the increase of sales between these two periods is

$$e^{8.5} - e^{8.1} = 1620.30076\ 5$$

The seasonality component in the first quarter of year 10 is 0.3,

The seasonality component in the fourth quarter of year 9 is 0.1,

So the factor caused by seasonality is $e^{0.3} - e^{0.1} = 0.24468789$

d. T=38 corresponds the second quarter of year 10. Substitute T=38, S_{2t}=1 into the regression model, we can get

$$\hat{Log}(Y_{38}) = 0.8 + 0.2 * 38 - 0.5 = 7.9$$

So the estimated sales for T=38 is $\hat{Y}_{38} = e^{7.9} = 2697.282328$

$$Z = \frac{\hat{e}_{38}}{\sigma} = \frac{Log(Y_{38}) - \hat{Log}(Y_{38})}{\sigma} \sim N(0,1)$$

Then

$$P(-1.0364 \le \frac{Log(Y_{38}) - 7.9}{\sigma} \le 1.0364) = 70\%$$

We can use $\hat{\sigma} = \sqrt{SSR/n-k-1}$ as the estimator of □, SSR refers to squared residual of regression, which is 2263, n=36, k=4. So we can obtain $\hat{\sigma}$=8.544

Then

$$P(-0.9550016 \le Log(Y_{38}) \le 16.7550016) = 70\%$$

$$P(0.384811529 \le Y_{38} \le 18906221.39) = 70\%$$

e.

1. genr T=@trend (0)

2. genr d1=@seas(1)

genr d2=@seas(2)

genr d4=@seas(4)

3. Genr logy=log(y)

Ls logy T d1 d2 d4 c

2. Diebold's book, page 87, replicate the application--forecasting retail sales.

3. Diebold's book, page 104, replicate the application--forecasting housing starts.

4. (Testing for seasonality) Using the housing starts data:

a. As in the chapter, construct and estimate a model with a full set of seasonal dummies.

b. Test the hypothesis of no seasonal variation. Discuss your results.

c. Test for the equality of the coefficients on March and November and the coefficients on all the months in between and construct a model that uses three dummy variables, one for December, January, and February, one for March and November, and one for the remaining months.

5. (Seasonal regressions with an intercept and s-1 seasonal dummies) Reestimate the housing starts model using an intercept and eleven seasonal dummies, rather than the full set of seasonal dummies as
in the text. Compare and contrast your results with those reported
in the text. What is the interpretation of the intercept? What are the interpretations of the coefficients on the eleven included seasonal dummies? Does it matter which month's dummy you drop?