King Saud University
College of Business Administration
Quantitative Analysis Department (QUA)

Business Forecasting

DSC 542

MIDTERM EXAM **Duration: 90 min.**

Name:

Student ID:

Q#	1	2	3	4	5	6	7
Answer							
Q#	8	9	10	11	12	13	14
Answer							

Note:

- THE EXAM CONSISTS OF 17 QUESTIONS (14 multiple choices) AND 8 PAGES.
- ANSWER ALL THE QUESTIONS AND PLACE THEM IN THE TABLE ABOVE.
- CIRCLE ONE ANSWER FOR EACH QUESTION.
- USE THE EXAM PAGES TO SOLVE THE QUESTIONS.
- YOU CAN'T BORROW ANYTHING FROM ANY STUDENT.

1. Which measure of forecast accuracy is analogous to standard deviation?

   A) Mean Absolute Error.
   B) Mean Absolute Percentage Error.
   C) Mean Squared Error.
   D) Root Mean Squared Error.

2. Autocorrelation refers to the correlation between a variable and:

   A) itself.
   B) another very similar variable.
   C) itself when lagged one or more periods.
   D) another variable when the analysis is done on a computer.
   E) None of the above.

3. Which of the following is not consistent with the presence of a trend in a time series?

   A) The autocorrelation function declines quickly to zero as the lag increases.
   B) The autocorrelation function of the first-differences declines quickly to zero as the lag increases.
   C) The autocorrelation function declines slowly towards zero as the lag increases.
   D) The autocorrelation function of the first-differences quickly declines to zero.

4. Simple-exponential smoothing models are useful for data, which have

   A) a downward trend.
   B) an upward trend.
   C) neither an upward or downward trend.
   D) pronounced seasonality.

5. Winter's model differs from simple exponential smoothing in that it includes a term for:
   A) seasonality
   B) trend
   C) residuals
   D) cyclical fluctuations

6. When a time series contains no trend, it is said to be

   A) nonstationary.
   B) seasonal.
   C) nonseasonal.
   D) stationary.

7. Forecasters at Siegfried Corporation are using simple exponential smoothing to forecast the sales of its major product. They are trying to decide what smoothing constant will give the best results. They have tried a number of smoothing constants with the following results: Which smoothing constant appears best from these results?

	Smoothing Constant	**RMSE**
A	0.10	125
B	0.15	97
C	0.20	136
D	0.25	141

<u>Note</u>: The next three questions relate to the following data:

Time Period	Actual Series	Forecast Series	Forecast Error
1	100	100	0
2	110	--	--
3	115	--	--

8. If a smoothing constant of 0.3 is used, what is the exponentially smoothed forecast for period4?

   A) 106.6
   B) 103.0
   C) 115.0
   D) 112.6

9. What is the forecast error for period 3?

   A) -3
   B) -12
   C) -10
   D) +7

10. If a three-month moving-average model is used, what is the forecast for period 4?

   A) 104.4
   B) 106.6
   C) 107.1
   D) 108.3

11. In choosing the “best-fitting” line through a set of points in linear regression, we choose the one with the:

A) smallest sum of squared residuals
B) largest sum of squared residuals
C) smallest number of outliers
D) largest number of points on the line

12. The following are the values of a time series for the first four time periods:

t	1	2	3	4
y_t	24	25	26	27

Using a three-period moving average, the forecasted value for time period 5 is:

E) 20.4
F) 25.5
G) 26
H) none of the above

13. Suppose that a simple exponential smoothing model is used (with α = 0.40) to forecast monthly sandwich sales at a local sandwich shop. The forecasted demand for September was 1560 and the actual demand was 1480 sandwiches. Given this information, what would be the forecast for October in number of sandwiches?

A) 1480
B) 1528
C) 1560
D) 1592

14. The forecast error is:

A) the difference between this period’s value and the next period’s value
B) the difference between the average value and the expected value of the response variable
C) the difference between the explanatory variable value and the response variable value
D) the difference between the actual value and the forecast

Below you will find a regression model that compares the relationship between the average utility bill (*Y*, in $) for homes of a particular size and the average monthly temperature (*X*, in Fahrenheit). The data represents monthly values for the past year. Also, a residual plot is shown below.

Summary measures

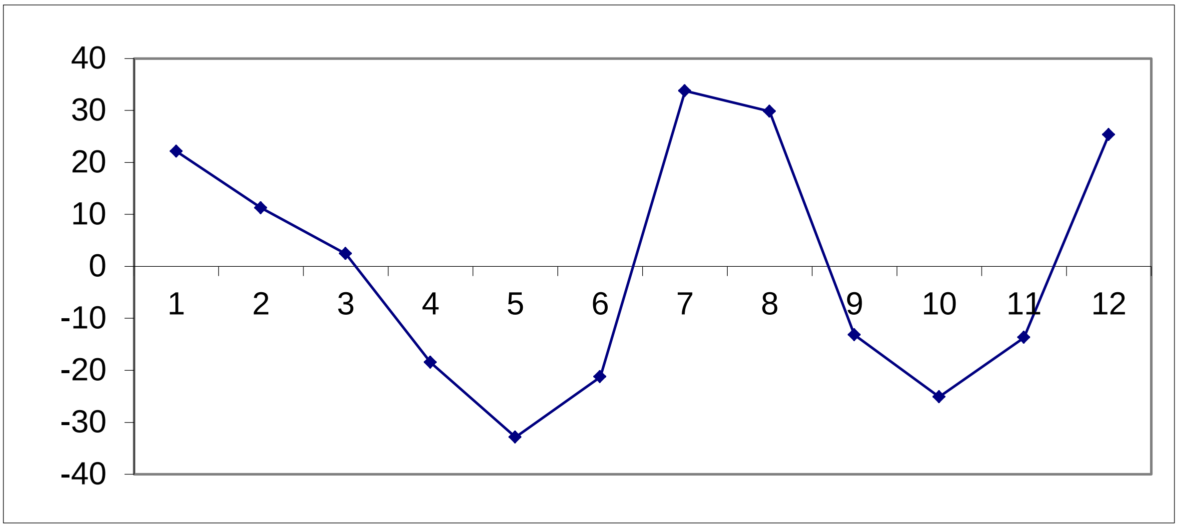
Multiple R	0.0295
R-Square	0.0009
StErr of Estimate	24.8184

ANOVA table

Source	*df*	*SS*	*MS*	*F*	*p-value*
Regression	1	5.3575	5.3575	0.0087	0.9275
Error	10	6159.5125	615.9512		

Regression coefficients

	Coefficient	*Std Err*	*t-value*	*p-value*
Constant	112.547	28.815	3.9059	0.0029
Average Monthly Temp	0.0403	0.4316	0.0933	0.9275



15. Estimate the regression model. How well does this model fit the given data?

16. Is there a linear relationship between X and Y? Explain how you arrived at your answer (state the null and the alternative hypothesis, test statistic, p-value and your conclusion).

17. In looking at the graph of the residuals, do you see any evidence of any violations of the assumptions regarding the errors of the regression model?

Formulas

Moving average

$$\hat{y}_{t+1} = \frac{(y_t + y_{t-1} + y_{t-2} + \cdots + y_{t-k+1})}{K}$$

Exponential Smoothing

$$\hat{y}_{t+1} = \alpha\, y_t + (1-\alpha)\hat{y}_t \qquad \hat{y}_{t+1} = \hat{y}_t + \alpha(y_t - \hat{y}_t)$$

Holt's method

$$L_t = \alpha\, y_t + (1-\alpha)(L_{t-1} + T_{t-1}) \qquad T_t = \beta(L_t - L_{t-1}) + (1-\beta)T_{t-1} \qquad \hat{y}_{t+p} = L_t + pT_t$$

Winter's method

$$L_t = \alpha \frac{y_t}{S_{t-p}} + (1-\alpha)(L_{t-1} + T_{t-1}) \qquad T_t = \beta(L_t - L_{t-1}) + (1-\beta)T_{t-1} \qquad S_t = \gamma \frac{y_t}{L_t} + (1-\gamma)S_{t-p}$$

$$\hat{y}_{t+m} = (L_t + mT_t)S_{t+m-p}$$

Mean Absolute Error

$$\text{MAE} = \frac{1}{n}\sum_{t=1}^{n} \left| y_t - \hat{y}_t \right|$$

Mean Squared Error

$$\text{MSE} = \frac{1}{n}\sum_{t=1}^{n} (y_t - \hat{y}_t)^2$$

Mean absolute percentage Error

$$\text{MAPE} = \frac{1}{\text{n}}\sum_{t=1}^{n} \frac{\left| y_t - \hat{y}_t \right|}{y_t}$$

Mean percentage Error

$$\text{MPE} = \frac{1}{n}\sum_{t=1}^{n} \frac{(y_t - \hat{y}_t)}{y_t}$$

Root mean square error

$$\text{RMSE} = \sqrt{\frac{\sum_{t=1}^{n} (y_t - \hat{y}_t)^2}{n}}$$

Simple Regression

$$\hat{y} = b_0 + b_1 x$$

$$R^2 = r^2 = \frac{SST - SSE}{SST} = \frac{SSR}{SST} = 1 - \frac{SSE}{SST}$$

$$\hat{y} \pm t_{(\frac{\alpha}{2};n-2)}(S_f)$$

$$S_f = S_{y.x}\sqrt{1 + \frac{1}{n} + \frac{(x-\bar{x})^2}{\sum(x-\bar{x})^2}}$$

$$b_1 = \frac{n\sum xy - \sum x \sum y}{n\sum x^2 - (\sum x)^2}$$

$$b_1 = \frac{\sum_{i=1}^{n}(x-\bar{x})(y-\bar{y})}{\sum_{i=1}^{n}(x-\bar{x})^2}$$

$$b_0 = \bar{y} - b_1\bar{x}$$

$$r = \frac{\sum(x-\bar{x})(y-\bar{y})}{\sqrt{(x-\bar{x})^2}\sqrt{(y-\bar{y})^2}}$$

$$r = \frac{n\sum xy - \sum x \sum y}{\sqrt{n\sum x^2 - (\sum x)^2}\sqrt{n\sum y^2 - (\sum y)^2}}$$

$$MSR = \frac{SSR}{df}$$

$$MSE = \frac{SSE}{df}$$

df = Degrees of freedom

$$S_{Y.X}^2 = s^2 = \frac{1}{n-2}\sum e_i^2 = \frac{1}{n-2}\sum(y_i - \hat{y}_i)^2$$

$$t = \frac{b_1}{S(b_1)}$$

$$e_i = y_i - \hat{y}_i$$

$$b_1 \pm t_{(\frac{\alpha}{2};n-2)}(S(b_1))$$

$$S(b_1) = \frac{S_{y.x}}{\sqrt{\sum(x-\bar{x})^2}}$$

$$t = \frac{r\sqrt{n-2}}{\sqrt{1-r^2}}$$