KING FAHD UNIVERSITY OF PETROLEUM & MINERALS
DEPARTMENT OF MATHEMATICS AND STATISTICS
Term 131

STAT 213 Statistics for Actuaries

Final Exam   Saturday January 4, 2014

Name: _____ ID #: _____

☺Important Note:

➢ Show all your work including formulas, intermediate steps and final answer.
➢ In testing problems;
   • state the null and alternative hypotheses,
   • the test statistic,
   • the decision rule,
   • the decision, and
   • the conclusion

Question No	Full Marks	Marks Obtained
1	15	
2	30	
3	10	
4	25	
Total	80	

1) Below is a box plot of data from two production processes:

Boxplot of Old, New
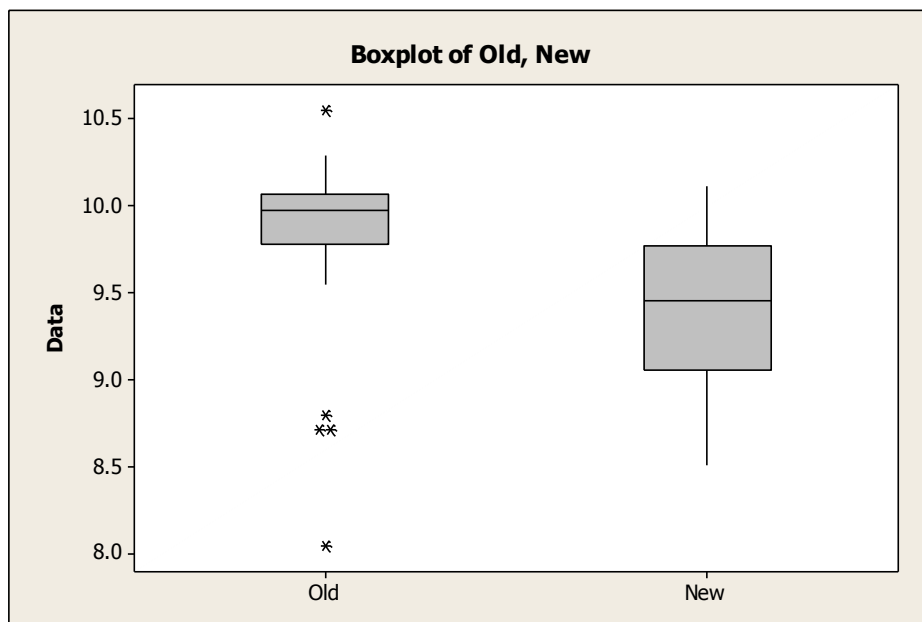
a) Explain "old" boxplot thoroughly.   *(8 pts.)*

b) Compare the two processes.   *(5 pts.)*

c) A process is considered good if the readings are at least 9.2 with larger reading being better than smaller ones, which is the better process? Explain.   *(2 pts.)*

2) You want to predict the height of a tree (y) as a function of its diameter (x). A sample of 21 trees gave the following information

Height	122.0	193.5	166.5	82.0	133.5	156.0	...	203.3	174.0	159.0	205.0	223.5	195.0	232.5	190.5	100.0
Diameter	20	36	18	10	21	29	...	52	30	22	42	45	54	39	36	8

$$\sum x = 615, \quad \sum y = 3298.8, \quad \sum x^2 = 22387, \quad \sum y^2 = 561089.3, \quad \sum xy = 108305$$

a) Find the least squares line. *(3 pts.)*

b) Interpret the slope. *(1 pt.)*

c) Interpret the intercept. Is it meaningful? *(2 pts.)*

d) Construct an ANOVA table. *(6 pts.)*

e) Estimate the variability in the height. *(2 pts.)*

f) What percentage of the variability in e) is explained by the diameter? *(1 pt.)*

g) Estimate the error when the diameter is 20. *(1 pt.)*

h) Test for the significance of the relationship. *(5 pts.)*

i) Construct a 95% confidence interval for the mean height of a tree when the diameter is 20. *(3 pts.)*

j) Interpret the interval. *(1 pt.)*

k) If you want to use location (A, B or C) as an independent variable. Write down a model containing the diameter as well the location variable. *(3 pts.)*

l) Compared to the model with only diameter as an independent variable, do you expect R^2 to increase, decrease or stay constant? Explain. *(2 pts.)*

3) Suppose we added a second variable x_2 indicating the bark (لحاء) thickness, and the resulting fitted model is

$$y = 62.14 + 2.06\, x_1 + 15.64\, x_2$$

With

	Coefficients	Standard Error	t Stat	P-value
Intercept	62.14	13.50		0.00
X_1	2.06	0.44		0.00
X_2	15.64	7.15		0.04

a) Interpret the coefficients of x_1 and x_2. *(2 pts.)*

b) Fill in the t Stat values in the table. *(3 pts.)*

c) What is the p-value for x_2 used for? What does it mean? *(2 pts.)*

d) How many degrees of freedom does each of the t-statistics above have? *(1 pt.)*

e) Compared to the model in problem 1), do you expect R^2 to increase or decrease? Explain. *(2 pts.)*

4) Consider the following data representing the mean price for three types of energy products.

Year	Electricity	Natural Gas	Fuel Oil
2000	45.2	31.7	1.2
2001	47.5	49.7	1.5
2002	47.9	36.3	1.1
2003	47.7	40.2	1.4
2004	49.2	46.0	1.5
2005	50.8	50.9	1.9
2006	57.2	66.4	2.4

a) Consider the electricity price only.

(1) Plot the time series. *(3 pts.)*

(2) Fit a 5-year moving average and plot the results on the same graph as above. *(6 pts.)*

(3) Use a smoothing coefficient of 0.2, exponentially smooth the series, and plot the results on the same graph. *(6 pts.)*

(4) Compare the 3 plots. *(3 pts.)*

b) Calculate the 2006 simple price indexes for natural gas using the year 2000 as the base year. *(1 pt.)*

c) Calculate the un-weighted aggregate price index for the group of three energy items for the year 2006 assuming the year 2000 as the base year. *(2 pts.)*

d) If the quantities consumed were as follows:

year	Electricity	Natural Gas	Fuel Oil
2000	5000	960	400
2006	6500	1040	230

Calculate the 2006 Laspeyres price index and the Paasche price index for the group of three energy items assuming that the base year is 2000. *(4 pts.)*