Universiti Malaysia PAHANG
Engineering • Technology • Creativity

TEST 2

NAME	
STUDENT ID	CB13006
SECTION	10G
COURSE CODE	BUM2413 APPLIED STATISTICS
DATE	19 MAY 2014
DURATION	1 HOUR AND 30 MINUTES
SESSION/SEMESTER	SESSION 2013/2014 SEMESTER II

INSTRUCTIONS TO CANDIDATE:

1. Fill in the above particulars clearly.
2. Write your student ID and the question number at the top of every answer sheet.
3. Answer all questions.
4. Write your answers in the spaces provided. All calculations and assumptions must be clearly stated.

TEST REQUIREMENTS:

1. Statistical Tables and Formula
2. Scientific calculator

Question number	FOR EXAMINER USE ONLY Mark
1	9 /10
2	7 /7
3	22 /22
4	11 /11
Total marks	49 /50

DO NOT TURN THIS PAGE UNTIL YOU ARE TOLD TO DO SO

This test paper consists of **SIX (6)** printed pages including front page.

QUESTION 1

From previous record, it is found that the stalks of a crop would have grown an average of 6 cm without applying the fertiliser. A farmer decides to try out a new fertiliser on a plot that contains 10 stalks of particular crops. Before applying the fertiliser, he measures the height of each stalk. Two weeks later, he measures the stalks again and the data are shown in Table 1.

Table 1: Height of stalks before and after applying the fertiliser

Stalks	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Before	35.5	31.7	31.2	36.3	22.8	28	24.6	26.1	34.5	27.7
After	45.3	36.0	38.6	44.7	31.4	33.5	28.8	35.8	42.9	35.0

$X_D =$ -9.8 -4.3 -7.4 -8.4 -8.6 -5.5 -4.2 -9.7 -8.4 -7.3

By using a significance level of 0.05, did the fertiliser help in the growth of the crops?

$\bar{x}_D = -7.36$ $\quad S_D = 2.0533$

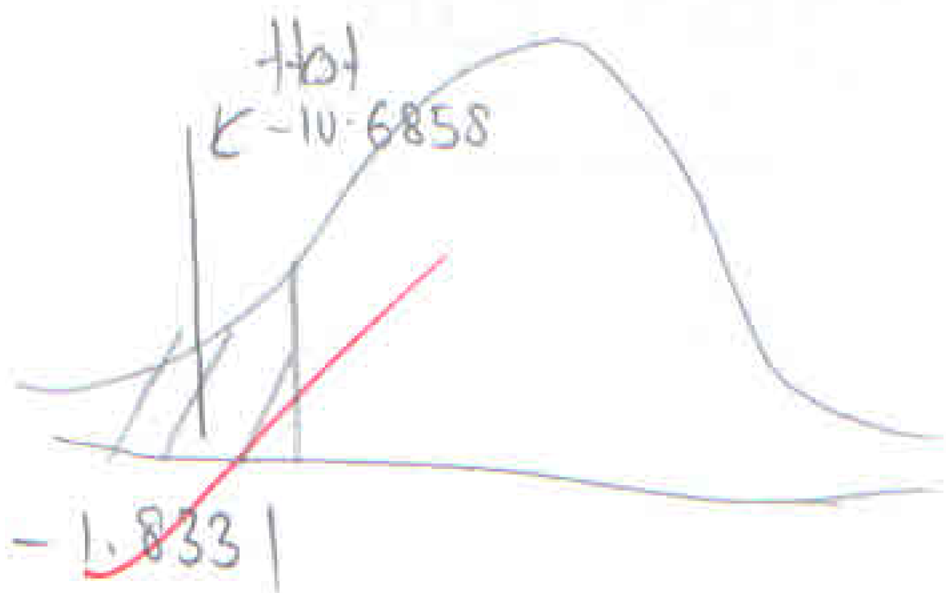
(10 Marks)

$H_0 : \mu_D \geq 0$

$H_1 : \mu_D < 0$ (claim)

$$t_{test} = \frac{-7.36 - 0}{2.0533/\sqrt{10}} = -10.6858$$

$\alpha = 0.05$, left side one tail, $t_{0.05, 9} = 1.8331$



The decision is reject H_0

Therefore, there is fertiliser help in the growth of the crops at $\alpha = 0.05$

Therefore, there is significant evidence that fertiliser help in the growth of the crops at $\alpha = 0.05$

QUESTION 2

A study was performed on patients with diabetics mellitus. The mean and standard deviation of the weights of 12 patients with diabetics mellitus were 63.1 kg and 21.4 kg, respectively. A control group of 5 patients without diabetics mellitus had a mean and standard deviation of the weights of 70 kg and 12.4 kg, respectively. A researcher claimed that the weights of the patients with diabetics mellitus are less variable than the weights of the control group. Test the researcher's claim at 0.01 significance level.

(7 Marks)

$\bar{x}_1 = 63.1 \qquad s_1 = 21.4 \qquad n = 12$

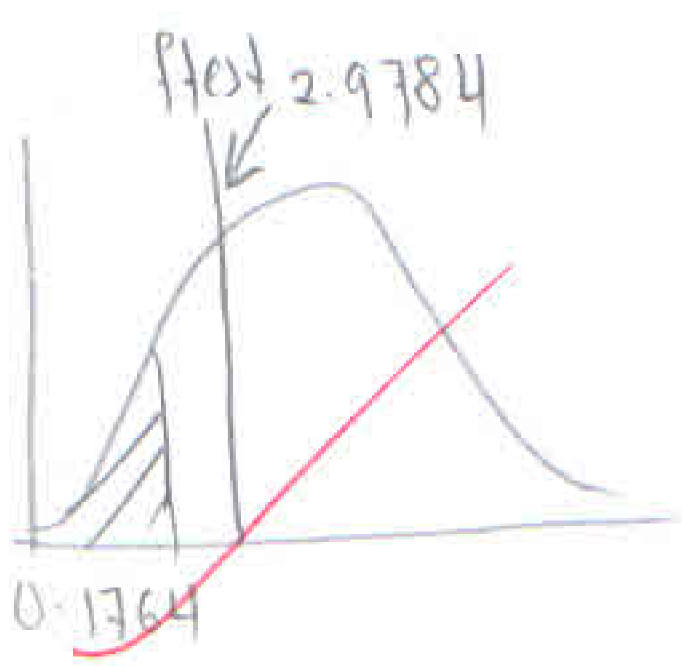
$\bar{x}_2 = 70 \qquad s_2 = 12.4 \qquad n = 5$

$H_0 : \sigma_1^2 \geq \sigma_2^2 \quad$ or $\quad \sigma_1^2 - \sigma_2^2 \geq 0$

$H_1 : \sigma_1^2 < \sigma_2^2$ (claim) $\quad \sigma_1^2 - \sigma_2^2 < 0$ (claim)

$$f_{test} = \frac{21.4^2}{12.4^2} = 2.9784$$

$\alpha = 0.01$, left side one tail, $f_{1-0.01, 11, 4} = \frac{1}{f_{0.01,4,11}} = \frac{1}{5.6683} = 0.1764$



the decision is fail to reject H_0

\# Therefore, there do not support claimed that the weights of patients with diabetics mellitus are less variable than the weights of control group at $\alpha = 0.01$

\# Therefore, there is no sufficient evidence that the weights of patients with diabetics mellitus are less variable than the weights of control group at $\alpha = 0.01$

QUESTION 3

An engineer suspects that the surface finish of metal parts is influenced by the type of metal used and the blasting time duration (minutes). He selected three blasting times duration and used two types of metal. The data is recorded as in Table 2.

Table 2: Metal Type and Blasting Time Duration

Metal Type	**Blasting Time**			
	15	**20**	**25**	
1	75 64 139	73 60 133	78 85 163	435
2	86 70 156	73 88 161	45 85 130	447
	295	294	293	882

(a) Given that the sum squares of total is $SST = 1751.000$, sum squares of interaction between metal type and blasting time is $SSAB = 528.500$. Calculate the sum squares of metal type (SSA) and blasting time (SSB). Hence, construct the ANOVA table.

(12 Marks)

$a = 2$, $b = 3$, $r = 2$

$$SSA = \frac{1}{(3)(2)} \; 435^2 + 447^2 - \frac{882^2}{(2)(3)(2)} = 12$$

$$SSB = \frac{1}{(2)(2)} \; 295^2 + 294^2 + 293^2 - \frac{882^2}{(2)(3)(2)} = 0.5$$

$$SSE = 1751.000 - 12 - 0.5 - 528.500 = 1210$$

Source of Variation	Sum Square	D o f	Mean Square	F test
A (row effect)	12	1	12	0.0595
B (column effect)	0.5	2	0.25	0.0012
AB (interaction)	528.5	2	264.25	1.3103
Error	1210	6	201.6667	
Total	1751	11		

(b) Assuming that there is no interaction effect between metal types and blasting time durations, test the marginal effects at $\alpha = 0.05$

(10 Marks)

$H_0: \mu_1 = \mu_2 = \mu_3 = \mu_4 = \mu_5 = \mu_6$

$H_1: \mu_i \neq \mu_j$ for at least one $i \neq j$ (claim)

AB interaction effect

H_0: There is no interaction effect between metal type and blasting time

H_1: There is an interaction effect between metal type and blasting time

$f_{test} = 1.3103 < f_{0.05,2,6} = 5.1433$

the decision is fail to reject H_0

Therefore, there is no interaction effect between metal types and blasting time at $\alpha = 0.05$

A row effect

H_0: There is no effect metal types

H_1: There is an effect metal types.

$f_{test} = 0.0595 < f_{0.05,1,6} = 5.9874$

the decision is fail to reject H_0

Therefore, there is no effect metal types at $\alpha = 0.05$

B column effect

H_0: There is no effect blasting time

H_1: There is an effect blasting time

$f_{test} = 0.0012 < f_{0.05,2,6} = 5.1433$

the decision is fail to reject H_0

Therefore, there is no effect blasting time at $\alpha = 0.05$

QUESTION 4

The local ice cream shop records the total sales of ice cream based on the temperature for a certain day. Table 3 shows the recorded data for the last ten days:

Table 3: Temperature (^{0}C) and ice cream sales (RM)

Temperature (^{0}C)	25	27	29	30	26	31	30	29	28	32
Ice cream sales (RM)	100	120	125	140	130	150	135	140	135	160

Given that $S_{xx} = 44.1$, $S_{yy} = 2452.5$ and $S_{xy} = 290.5$;

(a) identify the independent and dependent variables. **(1 Mark)**

independent variable (x) = temperature (°C)
dependent variable (y) = ice cream sales (RM)

(b) calculate the correlation coefficient and interpret its value. **(3 Marks)**

0.8833

$\sum x^2 = 8281, \sum x = 287, n = 10 \quad \sum y^2 = 180675 \quad \sum y = 1335 \quad \sum xy = 38605$

$S_{xy} = 38605 - \frac{(287)(1335)}{10} = 290.5$

$S_{xx} = 8281 - \frac{(287)^2}{10} = 44.1$

$S_{yy} = 180675 - \frac{(1335)^2}{10} = 2452.5$

$r = \frac{290.5}{\sqrt{(44.1)(2452.5)}} = 0.8833$

There is strong positive linear relationship between temperature and ice cream sales

(c) find the estimated regression parameters and write the equation of the regression line. **(5 Marks)**

$\hat{B}_1 = \frac{290.5}{44.1} = 6.5873$

$\bar{y} = \frac{1335}{10} = 133.5$

$\hat{B}_0 = 133.5 - (6.5873)(28.7)$
$= -55.5555$

$\bar{x} = \frac{287}{10} = 28.7$

Equation → Regression line $\hat{y} = -55.5555 + 6.5873x$

(d) predict the temperature of the day if the total sale of ice cream is RM133. **(2 Marks)**

$133 = -55.5555 + 6.5873x$
$x = 28.6241 \approx 29\ °C$

END OF QUESTION PAPER