Universiti Tun Hussein Onn Malaysia

# UNIVERSITI TUN HUSSEIN ONN MALAYSIA

## FINAL EXAMINATION
## SEMESTER II
## SESSION 2015/2016

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|---|---|---|
| COURSE NAME | : | BIOSTATISTICS |
| COURSE CODE | : | BWJ 20903 |
| PROGRAMME CODE | : | BWW |
| EXAMINATION DATE | : | JUNE / JULY 2016 |
| DURATION | : | 3 HOURS |
| INSTRUCTION | : | ANSWER **ALL** QUESTIONS |

THIS EXAMINATION PAPER CONSISTS OF **SIX (6)** PAGES

**Q1** (a) The probability density function of the random variable X is given by

$$f(x)=\begin{cases} c/\sqrt{x} & \text{for } 0<x<4 \\ 0 & \text{elsewhere} \end{cases}$$

Find

(i) the value of $c$,

(ii) $P(X<1/4)$,

(iii) $Var(2X-1)$.

(11 marks)

(b) Many samples of water, all the same size, are taken from a river suspected of having been polluted by irresponsible operators at a sewage treatment plant. The number of coliform organisms in each sample was counted. The number of organisms per sample was normally distributed with mean 15 and the standard deviation of 2.5. Find the probability that the next sample will contain:

(i) exceeds 18 organisms;

(ii) less than 16 organisms;

(iii) between 15 to 20 organisms.

(9 marks)

**Q2** Two researches put diamondback rattlesnakes (Crotalus atrox) in a "rattlebox," a box with a lid that would slide open and shut every five minutes. At first, the snake would rattle its tail each time the box opened. After a while, the snake would become habituated to the box opening and stop rattling its tail. They counted the number of box openings until a snake stopped rattling. They repeated this experiment on each snake on four successive days. The data from the 6 snakes that become habituated on each day are shown in the **Table Q2** below:

**Table Q2**: Data of six snakes habituated for four days

| Snake ID | Day 1 | Day 2 | Day 3 | Day 4 | **Total** |
|---|---|---|---|---|---|
| D1 | 85 | 58 | 15 | 57 | 215 |
| D2 | 107 | 51 | 30 | 12 | 200 |
| D3 | 61 | 60 | 68 | 36 | 225 |
| D4 | 22 | 41 | 63 | 21 | 147 |
| D5 | 40 | 45 | 28 | 10 | 123 |
| D6 | 65 | 27 | 3 | 16 | 111 |
| **Total** | 380 | 282 | 207 | 152 | **1021** |

Perform a two-way analysis of variance and test the null hypothesis at 0.05 level of significance:

(a) Difference in days has no effect on the number of box opening.
(b) Difference in snakes has no effect on the number of box opening.

(20 marks)

**Q3** Various doses of a poisonous substance were given to 7 groups which includes of 25 mice in each groups and the following results were observed in **Table Q3** below:

**Table Q3**: Doses of a poisonous substance given to 7 groups of mice

| Dose (mg) | Number of deaths |
|---|---|
| 4 | 1 |
| 6 | 3 |
| 8 | 6 |
| 10 | 8 |
| 12 | 14 |
| 14 | 16 |
| 16 | 20 |

(a) Find the equation of the regression line by using the least squares method.
(b) Estimate the number of deaths in a group of 25 mice who receive a 7-miligram dose of this poison.
(c) Compute and interpret the sample correlation coefficient.

(20 marks)

**Q4** (a) Test the null hypothesis that male and female turtles have the same variance serum cholesterol concentrations. Use 0.05 level of significance.

**Table Q4 (a)**: Serum Cholesterol (mg/100 ml)

| Male | Female |
|---|---|
| 220.1 | 223.4 |
| 218.6 | 221.5 |
| 229.6 | 223.8 |
| 228.8 | 224.3 |
| 222.0 | 230.2 |
| 224.1 | 230.8 |
| 226.5 | |

(10 marks)

(b) A species of marine arthropod lives in seawater that contains calcium in a concentration of 32 mmole/kg of water. Thirteen of the animals are collected and the calcium concentrations in mmole/kg in their coelomic fluid are found to be:

28, 27, 29, 29, 30, 30, 31, 30, 33, 27, 30, 32, 31

Test the appropriate hypothesis to conclude that the mean of this species maintain a coelomic calcium concentration less than their environment. Use 0.05 level of significance.

(10 marks)

**Q5** (a) Adult-onset diabetes is known to be highly genetically determined. A study was done comparing frequencies of a particular allele in a sample of such diabetics and a sample of nondiabetics. The data are shown in the following **Table Q5(a)** below:

**Table Q5 (a)**: Data of particular allele

| | Diabetic | Normal |
|---|---|---|
| Bb or bb | 12 | 4 |
| BB | 39 | 49 |

Are the relative frequencies of the alleles significantly different in the two groups?

(10 marks)

(b) **Figure Q5 (b) (i), (ii)** and **(iii)** below show the different combinations of time series components. What are the different combinations for each graphs? Explain your answer.

(i)

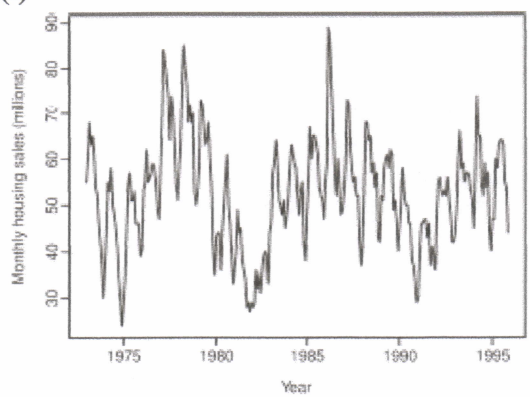


**Figure Q5 (b)(i)**: Graph of different combinations of time series components

(ii)

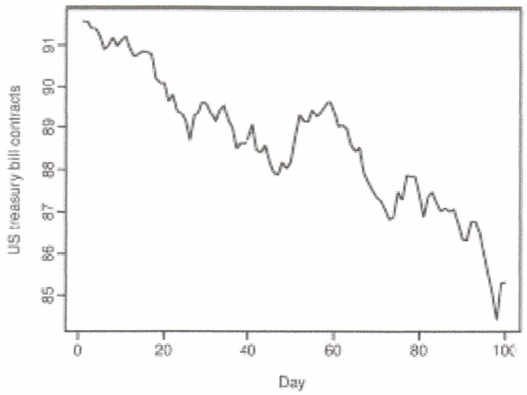


**Figure Q5 (b)(ii):** Graph of different combinations of time series components

(iii)

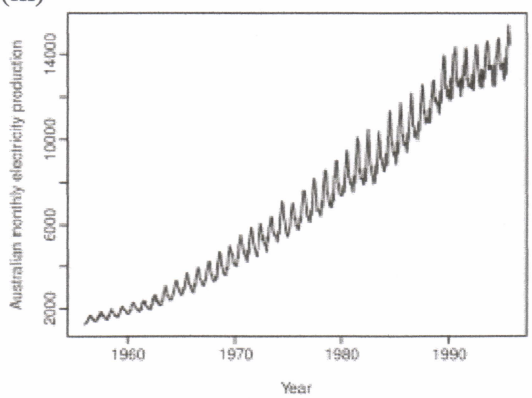


**Figure Q5 (b)(iii):** Graph of different combinations of time series components

(10 marks)

**– END OF QUESTION –**

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**FORMULAS**

$P(x=r)={}^{n}C_{r}\cdot p^{r}\cdot q^{n-r}, r=0,1,\ldots,n,\ X\sim B(n,p),$

$P(X=r)=\dfrac{e^{-\mu}\cdot\mu^{r}}{r!},\ r=0,1,\ldots,\infty,\ X\sim P_{0}(\mu),$

$Z=\dfrac{X-\mu}{\sigma},\ Z\sim N(0,1),\ X\sim N(\mu,\sigma^{2}),$

$\hat{\alpha}=\bar{y}-\hat{\beta}\bar{x}$ where $\bar{y}=\dfrac{1}{n}\sum y_{i}$ and $\bar{x}=\dfrac{1}{n}\sum x_{i}$

$\hat{\beta}=\dfrac{S_{XY}}{S_{XX}},\ S_{XX}=\sum x^{2}-\dfrac{1}{n}\left(\sum x\right)^{2},\ S_{YY}=\sum y^{2}-\dfrac{1}{n}\left(\sum y\right)^{2}$ and $S_{XY}=\sum xy-\dfrac{1}{n}\sum x\sum y$