UTHM
Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION (ONLINE) SEMESTER I SESSION 2020/2021

COURSE NAME	:	STATISTICS FOR MANAGEMENT
COURSE CODE	:	BPA 12303
PROGRAMME CODE	:	BPA
EXAMINATION DATE	:	JANUARY / FEBRUARY 2021
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **ALL** QUESTIONS

THIS QUESTION PAPER CONSISTS OF **NINE (9)** PAGES

Q1 (a) Recent research suggests that Americans make an average of 10 phone calls per day. Let the number of calls be normally distributed with a standard deviation of 3 calls.

Compute the probability that an average American makes phone calls between 4 and 12 calls per day.

(5 marks)

(b) Suppose that an automobile parts wholesaler claims that 0.5 percent of the car batteries in a shipment are defective.

Find the probability that four car batteries in a random sample of 200 such batteries would be found to be defective by using Poisson approximation.

(3 marks)

(c) On a particular day, the probability of there being rain at Cameron Highland is p. The random variable X is the number of rainy days in one particular week (7 days) at Cameron Highlands.

(i) Find the **TWO (2)** possible values of p, if the variance of X is 1.47.

(7 marks)

(ii) Calculate the probability that during a seven day holiday at Cameron Highlands, there will be no rain. Take p in **Q1(c)(i)** to be the smaller value.

(3 marks)

(iii) Estimate the mean and variance of X, taking p to be the bigger of the two values.

(2 marks)

Q2 (a) The diameter of a brand of Ping-Pong balls is approximately normally distributed, with a mean of 1.30 inches and a standard deviation of 0.04 inch. Random sample of 16 Ping-Pong balls is selected.

Find the probability that the sample mean is less than 1.28 inches.

(4 marks)

(b) The weight of computer chairs is approximately normally distributed. There are two companies produce that kind of chair. **Table Q2(b)** shows the necessary data.

Table Q2(b): Details related to Company 1 and Company 2

	Company 1	Company 2
Sample mean	20.1	23.1
Sample standard deviation	4.6	3.1
Sample size	38	29

Find the probability that the mean weight of computer chairs produced by Company 2 is more than the weight of computer chair produced by Company 1.

(8 marks)

(c) The amount of time a bank teller spends with each customer is normally distributed with population mean of 3.10 minutes and standard deviation of 0.40 minute. If a random sample of 16 customers is selected, the probability that the sample mean less than k minutes is 0.85.

Find the value k.

(8 marks)

Q3 Mr. Annamalai believes that there is a relationship between the selling price and sales volume of milk in his company. **Table Q3** shows the data which is used to develop a simple regression model.

Table Q3: Selling price and sales volume of milk in his company

Week	Selling Price (RM)	Weekly Sales Volume (liters)
1	1.30	10
2	2.00	6
3	1.70	5
4	1.50	12
5	1.60	10
6	1.20	15
7	1.60	5
8	1.40	12
9	1.00	17
10	1.10	20

(a) Sketch a scatter plot for the data.

(4 marks)

(b) (i) Find the estimated regression line by using the least square method.

(6 marks)

(ii) Interpret the result in **Q3(b)(i)**

(2 marks)

(c) Predict the weekly sales volume when the selling price is RM2.10

(2 marks)

(d) (i) Calculate the coefficient of correlation, r and coefficient of determination, r^2.

(4 marks)

(ii) Interpret the results in **Q3(d)(i)**.

(2 marks)

Q4 (a) A paper manufacturer has a production process that operates continuously throughout an entire production shift. The paper is expected to have a mean length of 11 inches, and the standard deviation of the length is 0.02 inch. At periodic intervals, a sample is selected to determine whether the mean paper length is still equal to 11 inches or whether something has gone wrong in the production process to change the length of the paper produced. You select a random sample of 100 sheets, and the mean paper length is 10.998 inches.

(i) Construct a 95% confidence interval estimate for the population mean paper length.

(5 marks)

(i) The manager of the paper manufacturer claims that something has gone wrong in the production process.

Explain whether his claim is acceptable or not.

(2 marks)

(b) A local pizza restaurant and a local branch of a national chain are located across the street from a college campus. The local pizza restaurant advertises that it delivers to the dormitories faster than the national chain. In order to determine whether this advertisement is valid, you and some friends have decided to order 10 pizzas from the local pizza restaurant and 10 pizzas from the national chain, all at different times. Assume that the populations are normally distributed, with equal variances. **Table Q4(b)** shows the delivery times, in minutes

Table Q4(b): The delivery time (minutes)

Local	Chain
16.8	22.0
11.7	15.2
15.6	18.7
16.7	15.6
17.5	20.8
18.1	19.5
14.1	17.0
21.8	19.5
13.9	16.5
20.8	24.0

Determine whether there is enough evidence to conclude that the mean delivery time for the local pizza restaurant is less than the mean delivery time for the national pizza chain by using a level of significance of 0.05.

(13 marks)

Q5 An advertising agency has been hired by a manufacturer of pens to develop an advertising campaign for the upcoming holiday season. To prepare for this project, the research director decides to initiate a study of the effect of advertising on product perception. An experiment is designed to compare five different advertisements.

Advertisement A: greatly undersells the pen's characteristics.
Advertisement B: slightly undersells the pen's characteristics.
Advertisement C. slightly oversells the pen's characteristics.
Advertisement D: greatly oversells the pen's characteristics
Advertisement E: attempts to correctly stat the pen's characteristics.

A sample of 25 adults respondents, taken from a larger focus group, is randomly assigned to the five advertisements (so that there are five respondents to each). After reading the advertisement and developing a sense of "product expectation," all respondents unknowingly receive the same pen to evaluate. The respondents are permitted to test the pen and the plausibility of the advertising copy. The respondents are then asked to rate the pen from 1 to 7 (lowest to highest) on the product characteristic scales of appearance, durability, and writing performance. **Table Q5** shows the combined scores of three ratings (appearance, durability, and writing performance) for the 25 respondents.

Table Q5: Combined scores of three ratings

Advertisement				
A	B	C	D	E
15	16	8	5	12
18	17	7	6	19
17	21	10	13	18
19	16	15	11	12
19	19	14	9	17

(a) Determine whether there is evidence of a difference in the mean rating of the five advertisements at the 0.05 level of significance.

(18 marks)

(b) Identify the advertisement you should use and the advertisement you should avoid.

(2 marks)

-END OF QUESTIONS-

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Special Probability Distributions

Binomial:

$P(X = x) = {}^{n}C_{x} . p^{x} . q^{n-x}$ Mean, $\mu = np$ Variance, $\sigma^2 = npq$

Poisson:

$$P(X = x) = \frac{e^{-\mu} . \mu^{x}}{x!}$$

Normal:

$$P(X > k) = P\left(Z > \frac{k-\mu}{\sigma}\right)$$

Sampling Distribution

Z – value for single mean:

$$Z = \frac{\bar{x} - \mu}{\sigma / \sqrt{n}}$$

Probability related to single Mean:

$$P(\bar{x} > r) = P\left(Z > \frac{r-\mu}{\sigma / \sqrt{n}}\right)$$

Let,

$$\mu_{\bar{x}_1 - \bar{x}_2} = \mu_1 - \mu_2 \quad and \quad \sigma_{\bar{x}_1 - \bar{x}_2} = \sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}$$

Z – value for Two Mean:

$$Z = \frac{(\bar{x}_1 - \bar{x}_2) - \mu_{\bar{x}_1 - \bar{x}_2}}{\sigma_{\bar{x}_1 - \bar{x}_2}}$$

Probability related to two Mean:

$$P(\bar{x}_1 - \bar{x}_2 > r) = P\left(Z > \frac{r - \mu_{\bar{x}_1 - \bar{x}_2}}{\sigma_{\bar{x}_1 - \bar{x}_2}}\right)$$

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Estimation

Confidence interval for single mean:

Large sample: $n \geq 30 \Rightarrow \sigma$ is known: $\left(\bar{x} - z_{\alpha/2}\left(\sigma/\sqrt{n}\right) < \mu < \bar{x} + z_{\alpha/2}\left(\sigma/\sqrt{n}\right)\right)$

$\Rightarrow \sigma$ is unknown: $\left(\bar{x} - z_{\alpha/2}\left(s/\sqrt{n}\right) < \mu < \bar{x} + z_{\alpha/2}\left(s/\sqrt{n}\right)\right)$

Small sample: $n < 30 \Rightarrow \sigma$ is unknown: $\left(\bar{x} - t_{\alpha/2}\left(s/\sqrt{n}\right) < \mu < \bar{x} + t_{\alpha/2}\left(s/\sqrt{n}\right)\right)$

Hypothesis Testing

Testing of hypothesis on a difference between two means

Variances	*Samples size*	*Statistical test*
Unknown (Equal)	$n_1, n_2 < 30$	$T_{Test} = \dfrac{(\bar{x}_1 - \bar{x}_2) - (\mu_1 - \mu_2)}{S_p \sqrt{\dfrac{1}{n_1} + \dfrac{1}{n_2}}}$ $v = n_1 + n_2 - 2$ where $S_p = \sqrt{\dfrac{(n_1 - 1)s_1^2 + (n_2 - 1)s_2^2}{n_1 + n_2 - 2}}$
Unknown (Not equal)	$n_1 = n_2 < 30$	$T_{Test} = \dfrac{(\bar{x}_1 - \bar{x}_2) - (\mu_1 - \mu_2)}{\sqrt{\dfrac{1}{n}\left(s_1^2 + s_2^2\right)}}$ $v = 2(n - 1)$
Unknown (Not equal)	$n_1, n_2 < 30$	$T_{Test} = \dfrac{(\bar{x}_1 - \bar{x}_2) - (\mu_1 - \mu_2)}{\sqrt{\dfrac{s_1^2}{n_1} + \dfrac{s_2^2}{n_2}}}$ $v = \dfrac{\left(\dfrac{s_1^2}{n_1} + \dfrac{s_2^2}{n_2}\right)^2}{\dfrac{\left(\dfrac{s_1^2}{n_1}\right)^2}{n_1 - 1} + \dfrac{\left(\dfrac{s_2^2}{n_2}\right)^2}{n_2 - 1}}$

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Simple Linear Regressions

Let

$$S_{xy} = \sum_{i=1}^{n} x_i y_i - \frac{1}{n}\left(\sum_{i=1}^{n} x_i\right)\left(\sum_{i=1}^{n} y_i\right), \quad S_{xx} = \sum_{i=1}^{n} x_i^2 - \frac{1}{n}\left(\sum_{i=1}^{n} x_i\right)^2 \text{ and } S_{yy} = \sum_{i=1}^{n} y_i^2 - \frac{1}{n}\left(\sum_{i=1}^{n} y_i\right)^2$$

Simple linear regression model

$$\hat{y} = \hat{\beta}_0 + \hat{\beta}_1 x$$

where

$$\hat{\beta}_1 = \frac{S_{xy}}{S_{xx}}$$

$$\hat{\beta}_0 = \bar{y} - \hat{\beta}_1 \bar{x}$$

Coefficient of Determination

$$r^2 = \frac{(S_{xy})^2}{S_{xx} \cdot S_{yy}}$$

Coefficient of Pearson Correlation

$$r = \frac{S_{xy}}{\sqrt{S_{xx} \cdot S_{yy}}}$$

Analysis of Variance

Mean square for treatment (between)

$$MS_B = \frac{\sum n_i \left(\bar{x}_i - \bar{x}_{GM}\right)^2}{k-1}$$

Mean square for error (within)

$$MS_W = \frac{\sum (n_i - 1) s_i^2}{N - k}$$

F test value

$$F = \frac{MS_B}{MS_W}$$