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UNIVERSITI TUN HUSSEIN ONN MALAYSIA

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

COURSE NAME : STATISTICS FOR MANAGEMENT
COURSE CODE : BPA 12303
PROGRAMME CODE : BPA/BPB/BPC/BPP
EXAMINATION DATE : JUNE/JULY 2016
DURATION : 3 HOURS
INSTRUCTION : ANSWERS ALL QUESTIONS

THIS QUESTION PAPER CONSISTS OF ELEVEN (11) PAGES

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- Q1** (a) The mass of a small loaf of bread produced in a bakery may be modelled by a normal random variable with mean 303g and standard deviation 4g.

Find the probability that a randomly chosen loaf has a mass between 295g and 305g.
(5 marks)

- (b) A random variable has a Poisson distribution with positive mean and is such that $P(X = 2) = 3P(X = 4)$

Compute, correct to four decimal places, the value of $P(X = 6)$.
(6 marks)

- (c) In a Merdeka party decoration, there is a large number of color light bulbs which are continually being switched on and off. Individual lights fail at random times, and each day before Merdeka the display is inspected and any failed lights are replaced. The number of lights that failed in any one-day period has a Poisson distribution with mean 2.2.

Calculate the probability that in a period of seven days, at least four lights will need to be replaced on at least two days.
(9 marks)

- Q2** (a) The time spent using email per session is normally distributed with population mean of 8 minutes and standard deviation of 2 minutes. Random sample of 25 sessions is selected.

Find the probability that the sample mean is between 7.8 and 8.2 minutes.
(4 marks)

- (b) The usage of electricity at residential area A is normally distributed with mean of 156 kilowatt per hour and standard deviation of 43 kilowatt per hour. Meanwhile the usage of electricity at residential area B is also normally distributed with mean of 161 kilowatt per hour and its standard deviation is 48 kilowatt per hour. Two samples of size 20 and 25 residences are randomly selected from residential area A and residential area B , respectively.

Compute the probability that the mean of usage at residential area A is lower than the mean of usage at residential area B .
(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

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. (7 marks)
- (ii) Interpret the result in **Q3(b)(i)**. (1 mark)

- (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 . (5 marks)
- (ii) Interpret these results in **Q3(d)(i)**. (1 mark)

Q4 (a) The Durable Construction Company produces frames for solar panels. The frames need to withstand certain pressures. The frame is expected to support a mean weight of 40 kilos before distortion. At periodic intervals, a sample is selected and tested to determine whether the mean weight which can be supported by the frame is still 40 kilos or not. If not, then it is assumed that something has gone wrong in the production line of the frames. A random sample of 45 frames is taken from the production line. The test results from the sample of 45 frames suggest a mean weight of 39.8 kilos with a standard deviation of 6 kilos.

(i) Construct a 95% confidence interval estimate for the population mean weight which can be supported by the frame. (5 marks)

(ii) The manager of Durable Construction Company claims that something has gone wrong in the production process.

Justify whether his claim is acceptable or not. (2 marks)

(b) The manager of computer operations of a large company wants to study computer usage of two departments within the company – the accounting department and the research department. A random sample of five jobs from the accounting department in the past week and six jobs from the research department in the past week are selected. It is given that the population variances are equal. The processing time (in seconds) for each job is recorded in **Table Q4(b)**.

Table Q4(b)

Department	Processing time (in seconds)					
Accounting	9	3	8	7	12	
Research	4	13	10	9	9	6

Determine whether there is enough evidence to conclude that there is a difference between the mean processing time of the accounting department and that of the research department 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

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:

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

Poisson:

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

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,

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

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

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

Hypothesis Testing

Testing of hypothesis on a difference between two means

VariANCES	SAMPLES SIZE	STATISTICAL TEST
Unknown (Equal)	$n_1, n_2 < 30$	$T_{Test} = \frac{(\bar{x}_1 - \bar{x}_2) - (\mu_1 - \mu_2)}{S_p \cdot \sqrt{\frac{1}{n_1} + \frac{1}{n_2}}}$ $v = n_1 + n_2 - 2$ where $S_p = \sqrt{\frac{(n_1 - 1)s_1^2 + (n_2 - 1)s_2^2}{n_1 + n_2 - 2}}$
Unknown (Not equal)	$n_1 = n_2 < 30$	$T_{Test} = \frac{(\bar{x}_1 - \bar{x}_2) - (\mu_1 - \mu_2)}{\sqrt{\frac{1}{n}(s_1^2 + s_2^2)}}$ $v = 2(n - 1)$
Unknown (Not equal)	$n_1, n_2 < 30$	$T_{Test} = \frac{(\bar{x}_1 - \bar{x}_2) - (\mu_1 - \mu_2)}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}}$ $v = \frac{\left(\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}\right)^2}{\frac{\left(\frac{s_1^2}{n_1}\right)^2}{n_1 - 1} + \frac{\left(\frac{s_2^2}{n_2}\right)^2}{n_2 - 1}}$

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Simple Linear Regressions

Let

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

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)

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

Mean square for error (within)

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

F test value

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

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The unit Normal table

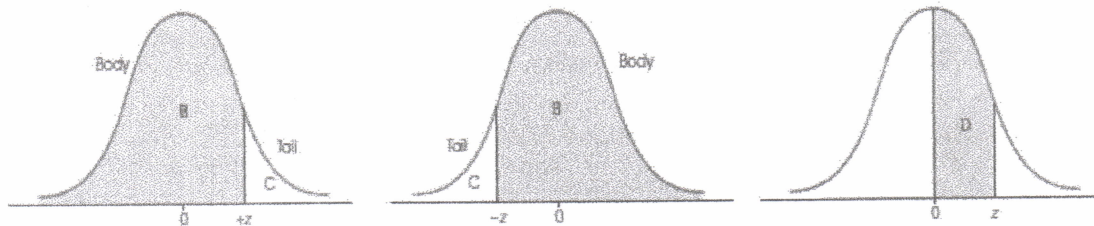
*Column A lists z-score values. A vertical line drawn through a normal distribution at a z-score location divides the distribution into two sections.

Column B identifies the proportion in the larger section, called the *body*.

Column C identifies the proportion in the smaller section, called the *tail*.

Column D identifies the proportion between the mean and the z-score.

Note: Because the normal distribution is symmetrical, the proportions for negative z-scores are the same as those for positive z-scores.



(A) z	(B) Proportion in Body	(C) Proportion in Tail	(D) Proportion Between Mean and z	(A) z	(B) Proportion in Body	(C) Proportion in Tail	(D) Proportion Between Mean and z
0.00	.5000	.5000	.0000	0.25	.5987	.4013	.0987
0.01	.5040	.4960	.0040	0.26	.6026	.3974	.1026
0.02	.5080	.4920	.0080	0.27	.6064	.3936	.1064
0.03	.5120	.4880	.0120	0.28	.6103	.3897	.1103
0.04	.5160	.4840	.0160	0.29	.6141	.3859	.1141
0.05	.5199	.4801	.0199	0.30	.6179	.3821	.1179
0.06	.5239	.4761	.0239	0.31	.6217	.3783	.1217
0.07	.5279	.4721	.0279	0.32	.6255	.3745	.1255
0.08	.5319	.4681	.0319	0.33	.6293	.3707	.1293
0.09	.5359	.4641	.0359	0.34	.6331	.3669	.1331
0.10	.5398	.4602	.0398	0.35	.6368	.3632	.1368
0.11	.5438	.4562	.0438	0.36	.6406	.3594	.1406
0.12	.5478	.4522	.0478	0.37	.6443	.3557	.1443
0.13	.5517	.4483	.0517	0.38	.6480	.3520	.1480
0.14	.5557	.4443	.0557	0.39	.6517	.3483	.1517
0.15	.5596	.4404	.0596	0.40	.6554	.3446	.1554
0.16	.5636	.4364	.0636	0.41	.6591	.3409	.1591
0.17	.5675	.4325	.0675	0.42	.6628	.3372	.1628
0.18	.5714	.4286	.0714	0.43	.6664	.3336	.1664
0.19	.5753	.4247	.0753	0.44	.6700	.3300	.1700
0.20	.5793	.4207	.0793	0.45	.6736	.3264	.1736
0.21	.5832	.4168	.0832	0.46	.6772	.3228	.1772
0.22	.5871	.4129	.0871	0.47	.6808	.3192	.1808
0.23	.5910	.4090	.0910	0.48	.6844	.3156	.1844
0.24	.5948	.4052	.0948	0.49	.6879	.3121	.1879

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(A) z	(B) Proportion in Body	(C) Proportion in Tail	(D) Proportion Between Mean and z	(A) z	(B) Proportion in Body	(C) Proportion in Tail	(D) Proportion Between Mean and z
0.50	.6915	.3085	.1915	1.00	.8413	.1587	.3413
0.51	.6950	.3050	.1950	1.01	.8438	.1562	.3438
0.52	.6985	.3015	.1985	1.02	.8461	.1539	.3461
0.53	.7019	.2981	.2019	1.03	.8485	.1515	.3485
0.54	.7054	.2946	.2054	1.04	.8508	.1492	.3508
0.55	.7088	.2912	.2088	1.05	.8531	.1469	.3531
0.56	.7123	.2877	.2123	1.06	.8554	.1446	.3554
0.57	.7157	.2843	.2157	1.07	.8577	.1423	.3577
0.58	.7190	.2810	.2190	1.08	.8599	.1401	.3599
0.59	.7224	.2776	.2224	1.09	.8621	.1379	.3621
0.60	.7257	.2743	.2257	1.10	.8643	.1357	.3643
0.61	.7291	.2709	.2291	1.11	.8665	.1335	.3665
0.62	.7324	.2676	.2324	1.12	.8686	.1314	.3686
0.63	.7357	.2643	.2357	1.13	.8708	.1292	.3708
0.64	.7389	.2611	.2389	1.14	.8729	.1271	.3729
0.65	.7422	.2578	.2422	1.15	.8749	.1251	.3749
0.66	.7454	.2546	.2454	1.16	.8770	.1230	.3770
0.67	.7486	.2514	.2486	1.17	.8790	.1210	.3790
0.68	.7517	.2483	.2517	1.18	.8810	.1190	.3810
0.69	.7549	.2451	.2549	1.19	.8830	.1170	.3830
0.70	.7580	.2420	.2580	1.20	.8849	.1151	.3849
0.71	.7611	.2389	.2611	1.21	.8869	.1131	.3869
0.72	.7642	.2358	.2642	1.22	.8888	.1112	.3888
0.73	.7673	.2327	.2673	1.23	.8907	.1093	.3907
0.74	.7704	.2296	.2704	1.24	.8925	.1075	.3925
0.75	.7734	.2266	.2734	1.25	.8944	.1056	.3944
0.76	.7764	.2236	.2764	1.26	.8962	.1038	.3962
0.77	.7794	.2206	.2794	1.27	.8980	.1020	.3980
0.78	.7823	.2177	.2823	1.28	.8997	.1003	.3997
0.79	.7852	.2148	.2852	1.29	.9015	.0985	.4015
0.80	.7881	.2119	.2881	1.30	.9032	.0968	.4032
0.81	.7910	.2090	.2910	1.31	.9049	.0951	.4049
0.82	.7939	.2061	.2939	1.32	.9066	.0934	.4066
0.83	.7967	.2033	.2967	1.33	.9082	.0918	.4082
0.84	.7995	.2005	.2995	1.34	.9099	.0901	.4099
0.85	.8023	.1977	.3023	1.35	.9115	.0885	.4115
0.86	.8051	.1949	.3051	1.36	.9131	.0869	.4131
0.87	.8078	.1922	.3078	1.37	.9147	.0853	.4147
0.88	.8106	.1894	.3106	1.38	.9162	.0838	.4162
0.89	.8133	.1867	.3133	1.39	.9177	.0823	.4177
0.90	.8159	.1841	.3159	1.40	.9192	.0808	.4192
0.91	.8186	.1814	.3186	1.41	.9207	.0793	.4207
0.92	.8212	.1788	.3212	1.42	.9222	.0778	.4222
0.93	.8238	.1762	.3238	1.43	.9236	.0764	.4236
0.94	.8264	.1736	.3264	1.44	.9251	.0749	.4251
0.95	.8289	.1711	.3289	1.45	.9265	.0735	.4265
0.96	.8315	.1685	.3315	1.46	.9279	.0721	.4279
0.97	.8340	.1660	.3340	1.47	.9292	.0708	.4292
0.98	.8365	.1635	.3365	1.48	.9306	.0694	.4306
0.99	.8389	.1611	.3389	1.49	.9319	.0681	.4319

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(A) z	(B) Proportion in Body	(C) Proportion in Tail	(D) Proportion Between Mean and z	(A) z	(B) Proportion in Body	(C) Proportion in Tail	(D) Proportion Between Mean and z
1.50	.9332	.0668	.4332	2.00	.9772	.0228	.4772
1.51	.9345	.0655	.4345	2.01	.9778	.0222	.4778
1.52	.9357	.0643	.4357	2.02	.9783	.0217	.4783
1.53	.9370	.0630	.4370	2.03	.9788	.0212	.4788
1.54	.9382	.0618	.4382	2.04	.9793	.0207	.4793
1.55	.9394	.0606	.4394	2.05	.9798	.0202	.4798
1.56	.9406	.0594	.4406	2.06	.9803	.0197	.4803
1.57	.9418	.0582	.4418	2.07	.9808	.0192	.4808
1.58	.9429	.0571	.4429	2.08	.9812	.0188	.4812
1.59	.9441	.0559	.4441	2.09	.9817	.0183	.4817
1.60	.9452	.0548	.4452	2.10	.9821	.0179	.4821
1.61	.9463	.0537	.4463	2.11	.9826	.0174	.4826
1.62	.9474	.0526	.4474	2.12	.9830	.0170	.4830
1.63	.9484	.0516	.4484	2.13	.9834	.0166	.4834
1.64	.9495	.0505	.4495	2.14	.9838	.0162	.4838
1.65	.9505	.0495	.4505	2.15	.9842	.0158	.4842
1.66	.9515	.0485	.4515	2.16	.9846	.0154	.4846
1.67	.9525	.0475	.4525	2.17	.9850	.0150	.4850
1.68	.9535	.0465	.4535	2.18	.9854	.0146	.4854
1.69	.9545	.0455	.4545	2.19	.9857	.0143	.4857
1.70	.9554	.0446	.4554	2.20	.9861	.0139	.4861
1.71	.9564	.0436	.4564	2.21	.9864	.0136	.4864
1.72	.9573	.0427	.4573	2.22	.9868	.0132	.4868
1.73	.9582	.0418	.4582	2.23	.9871	.0129	.4871
1.74	.9591	.0409	.4591	2.24	.9875	.0125	.4875
1.75	.9599	.0401	.4599	2.25	.9878	.0122	.4878
1.76	.9608	.0392	.4608	2.26	.9881	.0119	.4881
1.77	.9616	.0384	.4616	2.27	.9884	.0116	.4884
1.78	.9625	.0375	.4625	2.28	.9887	.0113	.4887
1.79	.9633	.0367	.4633	2.29	.9890	.0110	.4890
1.80	.9641	.0359	.4641	2.30	.9893	.0107	.4893
1.81	.9649	.0351	.4649	2.31	.9896	.0104	.4896
1.82	.9656	.0344	.4656	2.32	.9898	.0102	.4898
1.83	.9664	.0336	.4664	2.33	.9901	.0099	.4901
1.84	.9671	.0329	.4671	2.34	.9904	.0096	.4904
1.85	.9678	.0322	.4678	2.35	.9906	.0094	.4906
1.86	.9686	.0314	.4686	2.36	.9909	.0091	.4909
1.87	.9693	.0307	.4693	2.37	.9911	.0089	.4911
1.88	.9699	.0301	.4699	2.38	.9913	.0087	.4913
1.89	.9706	.0294	.4706	2.39	.9916	.0084	.4916
1.90	.9713	.0287	.4713	2.40	.9918	.0082	.4918
1.91	.9719	.0281	.4719	2.41	.9920	.0080	.4920
1.92	.9726	.0274	.4726	2.42	.9922	.0078	.4922
1.93	.9732	.0268	.4732	2.43	.9925	.0075	.4925
1.94	.9738	.0262	.4738	2.44	.9927	.0073	.4927
1.95	.9744	.0256	.4744	2.45	.9929	.0071	.4929
1.96	.9750	.0250	.4750	2.46	.9931	.0069	.4931
1.97	.9756	.0244	.4756	2.47	.9932	.0068	.4932
1.98	.9761	.0239	.4761	2.48	.9934	.0066	.4934
1.99	.9767	.0233	.4767	2.49	.9936	.0064	.4936