UTHM
Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2016/2017

COURSE NAME	:	STATISTICS FOR MANAGEMENT
COURSE CODE	:	BPA 12303
PROGRAMME CODE	:	BPA / BPB / BPC / BPP
EXAMINATION DATE	:	JUNE 2017
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **ALL** QUESTIONS

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THIS QUESTION PAPER CONSISTS OF **ELEVEN (11)** PAGES

Q1   A particular train is scheduled to arrive at the Sentral Station at 8.15 a.m., but the actual time of arrival are normally distributed about a mean of 8.18 a.m. with a standard deviation of 3.7 minutes.

    (a)   Find the probability that the train:

        (i)   arrives before 8.22 a.m.

(4 marks)

        (ii)   is late

(6 marks)

    (b)   Certain arrival times are classified as exceptionally late and the probability of a train being exceptionally late on a particular day is 0.015.

Calculate, to the nearest minute, the time of arrival after which a train is classified as exceptionally late.

(10 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.

Calculate 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 chairs. **Table Q2(b)** shows the necessary data.

Table Q2(b): Data of weight of computer

	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)   It has been noted by a bank that the average number of withdrawals from a particular ATM per day is 28 with a standard deviation of 6. If a random sample of 49 days is selected, there is an 80% chance that average number of withdrawals is less than k times.

Find the value k.

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(8 marks)

Q3   Dr. Ahmad has noticed many of his students have been absent from class this semester. He feels that he can explain this sluggish attendance by the distance his students live from campus. Eleven students are selected as to how many kilometres (km) they must travel to attend class and the number of classes they have missed. **Table Q3** shows the data which is used to develop a simple regression model.

Table Q3: Distance students live from campus and number of clasess missed

Student	Distance (km)	Number of classes missed
1	5	2
2	6	2
3	2	4
4	0	5
5	9	4
6	12	2
7	16	5
8	5	2
9	7	3
10	0	1
11	8	4

(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 number of class a student will misses when he or she lives 15km from campus.

(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)   A home furnishings store that sells bedroom furniture is conducting an end-of-month inventory of the beds (mattress, bed spring, and frame) in stock. An auditor for the store wants to estimate the population mean value of the beds in stock at that time. She wants to have 99% confidence that her estimate of the population mean value is correct to within ±RM100. On the basis of past experience, she estimates that the population standard deviation of the value of a bed is RM200.

(i)   Calculate the number of bed should be selected as a sample size.

(3 marks)

(ii)   Based on the sample size selected in **Q4(a)(i)**, an audit was conducted, with the following results:

$$\bar{x} = RM1654.27 \quad and \quad s = RM184.62$$

Construct a 95% confidence interval estimate for the population mean value of the beds in stock at the end of the month.

(4 marks)

(b)   A manufacturer of automobile shock absorbers was interested in comparing the durability of its shock absorbers with that of the shock absorbers produced by its biggest competitor. To make the comparison, one of the manufacturer's and one of the competitor's shock absorbers were randomly selected and installed on the rear wheels of each of six cars. After the cars had been driven 20,000 kilometres, the strength of each test shock absorbers was measured, coded, and recorded. It is given that the population variances are equal for both groups. The results of the examination are shown in the **Table Q4(b)**.

Table Q4(b): Strength of test shock absorbers

Car number	Manufacturer's shock absorbers	Competitor's shock absorbers
1	8.8	8.4
2	10.5	10.1
3	12.5	12.0
4	9.7	9.3
5	9.6	9.0
6	13.2	13.0

Determine whether there is sufficient evidence to conclude that there is a difference in the mean strength of the two types of shock absorbers after 20,000 kilometres of use by using a level of significance of 0.05.

(13 marks)

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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 avoid.

(2 marks)

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Special Probability Distributions

Binomial:

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

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:

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

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:

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

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Probability related to two Mean:

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

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Estimation

Confidence interval for single mean:

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

$\qquad\qquad\qquad \Rightarrow \sigma$ 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)	$n_1, n_2 < 30$	$T_{Test} = \dfrac{\left(\bar{x}_1 - \bar{x}_2 \right) - \left(\mu_1 - \mu_2 \right)}{S_p \cdot \sqrt{\dfrac{1}{n_1} + \dfrac{1}{n_2}}}$ $v = n_1 + n_2 - 2$ where $S_p = \sqrt{\dfrac{\left(n_1 - 1 \right) s_1^2 + \left(n_1 - 1 \right) s_2^2}{n_1 + n_2 - 2}}$
Unknown (Not equal)	$n_1 = n_2 < 30$	$T_{Test} = \dfrac{\left(\bar{x}_1 - \bar{x}_2 \right) - \left(\mu_1 - \mu_2 \right)}{\sqrt{\dfrac{1}{n} \left(s_1^2 + s_2^2 \right)}}$ $v = 2\left(n - 1 \right)$
Unknown (Not equal)	$n_1, n_2 < 30$	$T_{Test} = \dfrac{\left(\bar{x}_1 - \bar{x}_2 \right) - \left(\mu_1 - \mu_2 \right)}{\sqrt{\dfrac{s_1^2}{n_1} + \dfrac{s_2^2}{n_2}}}$ $v = \dfrac{\left(\dfrac{s_1^2}{n_1} + \dfrac{s_2^2}{n_2} \right)^2}{\dfrac{\left(\dfrac{s_1^2}{n_1} \right)^2}{n_1 - 1} + \dfrac{\left(\dfrac{s_2^2}{n_2} \right)^2}{n_2 - 1}}$

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

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

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

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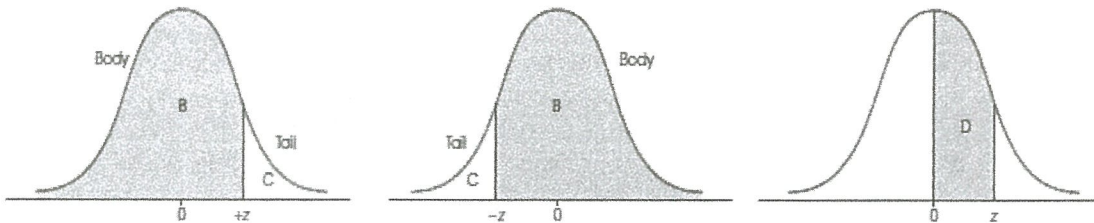| SEMESTER / SESSION	: SEM II / 2016/2017	PROGRAMME CODE: BPA / BPB / BPC / BPP
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The unit Normal table

*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