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THE OPEN UNIVERSITY OF SRI LANKA
COMMONWEALTH EXECUTIVE MASTER OF BUSINESS/ PUBLIC ADMINISTRATION
FINAL EXAMINATION 2017
MCP 1607 - QUANTITATIVE TECHNIQUES FOR MANAGERS
DURATION: THREE (03) HOURS

DATE: 20.07.2017 **TIME: 1.30pm – 4.30pm**

INSTRUCTION TO CANDIDATES.

a) **Answer any five questions only.**
b) **Each question carry 20 marks.**
c) **Write your index number on every page.**
d) **Use of non-programmable calculators are allowed.**
e) **Necessary statistical tables and formulae annexed.**
f) **Graph paper will be provided.**

(Q1) a. Lakwood is a furniture manufacturing company. They produce desks, chairs and cupboard at their three plants situated at Colombo, Kandy and Galle. The number of items produce at each plant during the month of June is explained in the table below.

Plant	Item		
	Desk	Chair	Cupboard
Colombo	20	50	12
Kandy	80	30	10
Galle	35	10	6

The unit price of desk, chair and cupboard are Rs. 4000, Rs. 2000 and Rs. 6000 respectively and revenue received from Colombo, Kandy and Galle plants during the month of June are x, y and z respectively.
Develop this relationship as a matrix equation.

b. A and B are two matrics defined as follows.

$$A = \begin{pmatrix} 2 & 3 & 7 \\ 4 & 8 & 3 \\ 6 & 5 & 9 \end{pmatrix} \quad \text{and} \quad B = \begin{pmatrix} 1 & 2 & 4 \\ 3 & 2 & 1 \\ 2 & 3 & 6 \end{pmatrix}$$

Evaluate the following.

i) A + B

ii) A - B

iii) 2 x A

iv) A x B (vector multiplication)

c. Use cramer's rule or inverse matrics method to solve the following simulation equations.

$$5x + 3y + z = 10$$
$$8x + 6y + 2z = 18$$
$$x + y + z = 4$$

(Q2) a. Find the differential coefficient of the following functions with respect to "x"

i) $2x^3+7x^2+40$

ii) $2x^2+3x+8$

iii) $(x^2+5)(x^3+3)$

iv) $\sqrt{(x)}+7x$

b. If $y = x^3+2x^2+3x$ find $\frac{d^2y}{dx^2}$

c. The marks obtained at an examination would depend on the number of the study hours spent during the last week prior to the examination. However too many study hours spent will lower the mark due to mental stress. The following equation explains the relationship between marks obtained and study hours. In this equation "y" represents marks obtained and "x" represents study hours.

$$y = 500 - 4x^2 + 600x$$

Find the optimal number of study hours that would maximize marks received.

(Q3) a. A software development company has just received 900 applications for the post of software engineer. Out of the 900 applicants 500 are females and 400 males. The company is looking for engineers with experience. Among the applicants some have no experience, some with little experience and the rest with lot experience. The distribution of the 900 applicants by gender and experience is shown in the table below.

Gender	**Experience**			**Total**
	No	**Little**	**Lot**	
Female	100	75	325	**500**
Male	75	125	200	**400**
Total	**175**	**200**	**525**	**900**

An applicant is selected at random. Find the following probabilities.

i) P (Male)

ii) P (Male ∩ Lot)

iii) P (Female ∪ No)

iv) $P\left(\frac{\text{No}}{\text{Female}}\right)$

v) $P\left(\frac{\text{Female}}{\text{No}}\right)$

b. The Met department predicts heavy rain with probability 0.6, moderate rain with probability 0.3 and no rain with probability 0.1 during the forthcoming week. The engineer in charge of the project assures that the project will be completed during the forthcoming week with probability 0.2 if heavy rain, probability 0.5 if moderate rain and probability 0.8 if no rain.

i) What is the probability that the project will be completed during the forthcoming week.

ii) Given that the project is completed during the forthcoming week what is the probability that there was no rain.

iii) Given that the project is not completed during the forthcoming week what is the probability that there was heavy rain.

(Q4) a. i) Evaluate ${}^{n}c_{r}p^{r}q^{(n-r)}$ when n = 5, r = 2 and p = 0.8

ii) Chocolate are packed in boxes each box containing 8 chocolates. The probability that a chocolate is spoilt is 0.2. What is the probability that 3 exactly out of the 8 chocolates are spoilt?

b. i) Evaluate $e^{-a}\ \frac{a^{x}}{x_{!}}$ when a = 2, x = 3, e = 2.71

ii) Police observe that on the average there are three accidents per day. What is the probability that there will be two accidents the next day?

c. The life span of a battery is normally distributed with mean 60 months and standard deviation 10 months.

i) What percentage of batteries will have a life span less than 70 months?

ii) What is the probability that the life span will be more than 80 months?

(Q5) Medical science has specified that the contents of compound "c" in a tablet should be 12 mg. To test this a sample of 49 tablets were taken and the content of compound "c" measured. It was observed that the mean content of compound "c" was 14 mg and standard deviation 6 mg.

i) Develop a 95% confidence interval estimate for the contents of compound "c".

ii) Test the hypothesis that contents of compound "c" in a tablets is 12 mg.

(Q6) To establish the relationship between age and fuel consumption of machine, a sample of five machines were taken and their fuel consumption measured. In the table below "x" represents age and "y" represents fuel consumption per run. The terms "x^2" , "y^2" and "xy" and their total values have been worked out for your convenience.

x	y	x^2	y^2	xy
7	8	49	64	56
4	3	16	9	12
5	5	25	25	25
6	4	36	16	24
8	10	64	100	80
30	30	190	214	197

Calculate the correlation coefficient.

i) Evaluate the regression equation $y = a + bx$

ii) In respect of each observations on age (x) calculate the residual.

iii) Find the mean of the residuals.

iv) Plot a graph with "x" as age and "y" as residual.

v) Comment on your results.

(Q7) Write short notes on four of the following topics

i) Sampling Concept

ii) Correlation Coefficient

iii) Residual Analysis

iv) Level of Significance

v) Unbias Estimate

Mathematical Formula

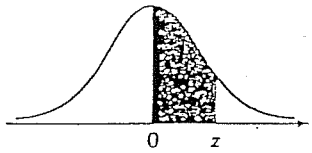
i) Correlation coefficient

$$r = \frac{\varepsilon xy - \frac{(\varepsilon x)(\varepsilon y)}{n}}{\sqrt{\left[\varepsilon x^2 - \frac{(\varepsilon x)^2}{n}\right]\left[\varepsilon y^2 - \frac{(\varepsilon y)^2}{n}\right]}}$$

ii) Line of regression $y = a + bx$

$$b = \frac{n\varepsilon xy - (\varepsilon x)(\varepsilon y)}{n\varepsilon x^2 - (\varepsilon x)^2} \qquad a = \frac{\varepsilon y}{n} - \frac{b\,\varepsilon x}{n}$$

Normal Curve Areas

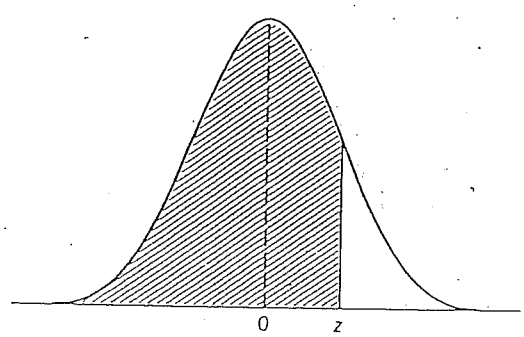


z	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
.0	.0000	.0040	.0080	.0120	.0160	.0199	.0239	.0279	.0319	.0359
.1	.0398	.0438	.0478	.0517	.0557	.0596	.0636	.0675	.0714	.0753
.2	.0793	.0832	.0871	.0910	.0948	.0987	.1026	.1064	.1103	.1141
.3	.1179	.1217	.1255	.1293	.1331	.1368	.1406	.1443	.1480	.1517
.4	.1554	.1591	.1628	.1664	.1700	.1736	.1772	.1808	.1844	.1879
.5	.1915	.1950	.1985	.2019	.2054	.2088	.2123	.2157	.2190	.2224
.6	.2257	.2291	.2324	.2357	.2389	.2422	.2454	.2486	.2517	.2549
.7	.2580	.2611	.2642	.2673	.2704	.2734	.2764	.2794	.2823	.2852
.8	.2881	.2910	.2939	.2967	.2995	.3023	.3051	.3078	.3106	.3133
.9	.3159	.3186	.3212	.3238	.3264	.3289	.3315	.3340	.3365	.3389
1.0	.3413	.3438	.3461	.3485	.3508	.3531	.3554	.3577	.3599	.3621
1.1	.3643	.3665	.3686	.3708	.3729	.3749	.3770	.3790	.3810	.3830
1.2	.3849	.3869	.3888	.3907	.3925	.3944	.3962	.3980	.3997	.4015
1.3	.4032	.4049	.4066	.4082	.4099	.4115	.4131	.4147	.4162	.4177
1.4	.4192	.4207	.4222	.4236	.4251	.4265	.4279	.4292	.4306	.4319
1.5	.4332	.4345	.4357	.4370	.4382	.4394	.4406	.4418	.4429	.4441
1.6	.4452	.4463	.4474	.4484	.4495	.4505	.4515	.4525	.4535	.4545
1.7	.4554	.4564	.4573	.4582	.4591	.4599	.4608	.4616	.4625	.4633
1.8	.4641	.4649	.4656	.4664	.4671	.4678	.4686	.4693	.4699	.4706
1.9	.4713	.4719	.4726	.4732	.4738	.4744	.4750	.4756	.4761	.4767
2.0	.4772	.4778	.4783	.4788	.4793	.4798	.4803	.4808	.4812	.4817
2.1	.4821	.4826	.4830	.4834	.4838	.4842	.4846	.4850	.4854	.4857
2.2	.4861	.4864	.4868	.4871	.4875	.4878	.4881	.4884	.4887	.4890
2.3	.4893	.4896	.4898	.4901	.4904	.4906	.4909	.4911	.4913	.4916
2.4	.4918	.4920	.4922	.4925	.4927	.4929	.4931	.4932	.4934	.4936
2.5	.4938	.4940	.4941	.4943	.4945	.4946	.4948	.4949	.4951	.4952
2.6	.4953	.4955	.4956	.4957	.4959	.4960	.4961	.4962	.4963	.4964
2.7	.4965	.4966	.4967	.4968	.4969	.4970	.4971	.4972	.4973	.4974
2.8	.4974	.4975	.4976	.4977	.4977	.4978	.4979	.4979	.4980	.4981
2.9	.4981	.4982	.4982	.4983	.4984	.4984	.4985	.4985	.4986	.4986
3.0	.4987	.4987	.4987	.4988	.4988	.4989	.4989	.4989	.4990	.4990

Source: Abridged from Table I of A. Hald, *Statistical Tables and Formulas* (New York: John Wiley & Sons, Inc.), 1952. Reproduced by permission of A. Hald and the publisher.

Table A2. Values of z, the standard normal variable, from 0·0 by steps of 0·01 to 3·9, showing the cumulative probability up to z.
(Probability correct to 4 decimal places).

z	0·00	0·01	0·02	0·03	0·04	0·05	0·06	0·07	0·08	0·09
0·0	·5000	·5040	·5080	·5120	·5160	·5199	·5239	·5279	·5319	·5359
·1	·5398	·5438	·5478	·5517	·5557	·5596	·5636	·5675	·5714	·5753
·2	·5793	·5832	·5871	·5910	·5948	·5987	·6026	·6064	·6103	·6141
·3	·6179	·6217	·6255	·6293	·6331	·6368	·6406	·6443	·6480	·6517
·4	·6554	·6591	·6628	·6664	·6700	·6736	·6772	·6808	·6844	·6879
·5	·6915	·6950	·6985	·7019	·7054	·7088	·7123	·7157	·7190	·7224
·6	·7257	·7291	·7324	·7357	·7389	·7422	·7454	·7486	·7517	·7549
·7	·7580	·7611	·7642	·7673	·7704	·7734	·7764	·7794	·7823	·7852
·8	·7881	·7910	·7939	·7967	·7995	·8023	·8051	·8078	·8106	·8133
·9	·8159	·8186	·8212	·8238	·8264	·8289	·8315	·8340	·8365	·8389
1·0	·8413	·8438	·8461	·8485	·8508	·8531	·8554	·8577	·8599	·8621
·1	·8643	·8665	·8686	·8708	·8729	·8749	·8770	·8790	·8810	·8830
·2	·8849	·8869	·8888	·8907	·8925	·8944	·8962	·8980	·8997	·9015
·3	·9032	·9049	·9066	·9082	·9099	·9115	·9131	·9147	·9162	·9177
·4	·9192	·9207	·9222	·9236	·9251	·9265	·9279	·9292	·9306	·9319
·5	·9332	·9345	·9357	·9370	·9382	·9394	·9406	·9418	·9429	·9441
·6	·9452	·9463	·9474	·9484	·9495	·9505	·9515	·9525	·9535	·9545
·7	·9554	·9564	·9573	·9582	·9591	·9599	·9608	·9616	·9625	·9633
·8	·9641	·9649	·9656	·9664	·9671	·9678	·9686	·9693	·9699	·9706
·9	·9713	·9719	·9726	·9732	·9738	·9744	·9750	·9756	·9761	·9767
2·0	·9772	·9778	·9783	·9788	·9793	·9798	·9803	·9808	·9812	·9817
·1	·9821	·9826	·9830	·9834	·9838	·9842	·9846	·9850	·9854	·9857
·2	·9861	·9864	·9868	·9871	·9875	·9878	·9881	·9884	·9887	·9890
·3	·9893	·9896	·9898	·9901	·9904	·9906	·9909	·9911	·9913	·9916
·4	·9918	·9920	·9922	·9925	·9927	·9929	·9931	·9932	·9934	·9936
·5	·9938	·9940	·9941	·9943	·9945	·9946	·9948	·9949	·9951	·9952
·6	·9953	·9955	·9956	·9957	·9959	·9960	·9961	·9962	·9963	·9964
·7	·9965	·9966	·9967	·9968	·9969	·9970	·9971	·9972	·9973	·9974
·8	·9974	·9975	·9976	·9977	·9977	·9978	·9979	·9979	·9980	·9981
·9	·9981	·9982	·9983	·9984	·9984	·9985	·9985	·9989	·9986	·9986
3·0	·9987	·9987	·9987	·9988	·9988	·9989	·9989	·9989	·9990	·9990
·1	·9990	·9991	·9991	·9991	·9992	·9992	·9992	·9992	·9993	·9993
·2	·9993	·9993	·9994	·9994	·9994	·9994	·9994	·9995	·9995	·9995
·3	·9995	·9995	·9995	·9996	·9996	·9996	·9996	·9996	·9996	·9997
·4	·9997	·9997	·9997	·9997	·9997	·9997	·9997	·9997	·9997	·9998
·5	·9998	·9998	·9998	·9998	·9998	·9998	·9998	·9998	·9998	·9998
·6	·9998	·9998	·9999	·9999	·9999	·9999	·9999	·9999	·9999	·9999
·7	·9999	·9999	·9999	·9999	·9999	·9999	·9999	·9999	·9999	·9999
·8	·9999	·9999	·9999	·9999	·9999	·9999	·9999	·9999	·9999	·9999
·9	1·0000									



The curve is $N(0, 1)$, the standard normal variable. The table entry is the shaded area $\Phi(z) = \Pr(Z < z)$. For example, when $z = 1{\cdot}96$ the shaded area is 0·9750. Critical values of the standard normal distribution will be found in the bottom row of Table A3.