

**UNIVERSITY OF COLOMBO, SRI LANKA**

**FACULTY OF GRADUATE STUDIES**

Postgraduate Diploma in Business Management (Semester 1) Examination –

September 2020

**PGDBM-5103 Quantitative Techniques**

**Three (03) Hours**

**Answer any FIVE (05) questions.**

**This paper consists of 06 questions printed on 09 pages including Formula sheet and Normal distribution Table.**

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1. i. What is correlation coefficient? Explain the following with diagrams.

- a. Positive correlation
- b. No correlation
- c. Strong negative correlation

(06 Marks)

ii. A department store gives in-service training to its salesmen followed by a test to consider whether it should terminate the services of any of the salesmen who does not qualify in the test. The following sample data give the test scores and sales made by nine salesmen during a certain period.

Test score:	14	19	24	21	28	22	15	20	19
Sales (000 Rs.)	31	36	48	37	50	45	33	41	39

- a. Develop an estimating equation that best describes these data.
- b. If the firm wants a minimum sales volume of Rs.30, 000, what is the minimum test score that will ensure continuation of the service?
- c. Compute the coefficient of determination.
- d. Interpret your results in (a), (b), and (c).

(14 marks)

**(Total 20 marks)**

2. i. A dressmaker makes three types of dresses-morning wear, evening gowns, and party wear. The inputs for the dresses are fabric, labour and fastenings. The following table gives the units of input required per dress for each type:

Inputs	Morning wear	Evening gowns	Party wear
Fabric	5	6	8
Labour	20	25	30
Fastenings	15	20	22

The dressmaker makes a combination of the three dress types which uses exactly 270 units of fabric, 1050 units of labour and 790 units of fastenings. Using the inverse matrix method or Cramer's rule, determine the numbers of each type of dress made by the dress maker.

(12 marks)

- ii. A furniture firm produces chairs, tables, and cupboards, each requiring three types of raw materials- timber, nails, and varnish. Given below are the requirements of different raw materials for producing one unit of each product.

Product	Timber (cft)	Nails (g)	Varnish (litres)
Chair	0.8	20	1
Table	1	40	1.5
Cupboard	3	60	2

if the firm produces 300 chairs, 100 tables, and 75 cupboards, find the quantity of each raw material using matrix algebra.

(08 marks)

**(Total: 20 Marks)**

3. i. A computer manufacturing firm's cost function and demand function are given as:

$$TC = 3Q^2 + 2Q + 20$$

$$P = 50 - Q$$

Where Q is the quantity produced and P is the selling Price.

- a. What output leads to the highest level of revenue from sales?
- b. Find the number of units that should be produced to maximize the profit.
- c. Determine the maximum profit.
- d. An excise tax is imposed at Rs 4 per unit output of the firm. What is the new profit maximizing output and price?
- e. What is the conclusion you will make from the answers above?

(15 marks)

ii. Given the following total cost function, find the average and marginal cost function.

$$TC = 0.0003Q^2 + 6.75Q^2 - 10485$$

(05 marks)

(Total: 20 Marks)

4. The following frequency distribution shows the number of days absent by 100 employees at a company during the year 2019.

Days Absent	Number of Employees
00-05	05
05-10	22
10-15	36
15-20	24
20-25	11
25-30	02

- a. Calculate the mean number of days absent by an employee. (04 Marks)
- b. In order to improve the attendance the company authorities proposed an incentive allowance for those 20 percent of the employees who record the least number of days absent during the year. Determine in term of days absent who will benefit from this allowance. (04 Marks)
- c. Determine the standard deviation of this distribution. (05 Marks)
- d. Because the distribution is roughly bell-shaped, between what values would you expect to find 95% of the observations? (04 Marks)
- e. If an employee is selected at random find the probability that the employee is absent for more than 20 days. (03 Marks)
- (Total: 20 Marks)**

5. i. Consider the following probability distribution for the random variable  $x$ :

$x$	0.1	0.2	0.3	0.4	0.5
$P(x)$	0.05	0.30	0.35	0.20	0.10

Find expected value and variance for the above distribution?

(05 Marks)

- ii. The speed with which utility companies can resolve problems is very important. ABC Telephone Company reports that they can resolve customer problems in the same day they are reported in 70 percent of the cases. Suppose the 15 cases reported today are representative of all complaints. Use the binomial model to answer the following questions:
- a. How many of the problems would you expect to be resolved today? What is the standard deviation?

b. What is the probability 10 of the problems can be resolved today?

(05 marks)

iii. A cola-dispensing machine is set to dispense on average 7.00 ounces of cola per cup. The standard deviation is 0.10 ounces. The distribution amounts dispensed follows a normal distribution.

a. What is the probability that the machine will dispense between 7.10 and 7.25 ounces of cola?

b. What is the probability that the machine will dispense 7.25 ounces of cola or more?

c. What is the probability that the machine will dispense between 6.80 and 7.25 ounces of cola?

(10 marks)

**(Total 20 Marks)**

6. i. Explain briefly the following with the help of examples where possible:

- a. Descriptive statistics and Inferential statistics
- b. Stratified random sampling and Simple random sampling.
- c. Covariance and Coefficient of correlation

(09 marks)

ii. Consider the following data about the means and the standard deviations in relation to the production of the workers of 3 sub-groups, A,B , and C.

<u>Sub-group</u>	<u>No. of workers(N)</u>	<u>Mean</u>	<u>Standard Deviation (SD)</u>
A	60	50	7
B	75	70	8
C	130	80	10

a. Which sub-group generates the largest production? (02 marks)

b. In which sub-group, there is greater variability in production? (03 marks)

c. Calculate the combined mean and the standard deviation of the production of the sub-groups, A,B , and C.

(06 marks)

**(Total: 20 Marks)**

**Statistical Formula sheet:**

$$\bar{X} = \frac{\sum_{i=1}^n fX_i}{n}$$

$$S = \sqrt{\frac{\sum f(X - \bar{X})^2}{n-1}}$$

$$\text{Mode} = \frac{l + \frac{d_1}{d_1 + d_2} \times c}{2}$$

$$E(X) = \sum_{i=1}^N X_i P(X_i)$$

$$\sigma = \sqrt{\sum_{i=1}^N [X_i - E(X)]^2 P(X_i)}$$

$$C.V = \frac{\sigma}{\bar{x}} \times 100$$

$$P(X) = \frac{n!}{X!(n-X)!} p^X (1-p)^{n-X}$$

$$\sigma_{123} = \sqrt{\frac{N_1\sigma_1^2 + N_2\sigma_2^2 + N_3\sigma_3^2 + N_1d_1^2 + N_2d_2^2 + N_3d_3^2}{N_1 + N_2 + N_3}}$$

$$Z = \frac{X - \mu}{\sigma}$$

$$\bar{X}_{23} = \frac{N_1\bar{X}_1 + N_2\bar{X}_2 + N_3\bar{X}_3}{N_1 + N_2 + N_3}$$

$$Y_i = \beta_0 + \beta_1 X_i + \epsilon_i$$

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

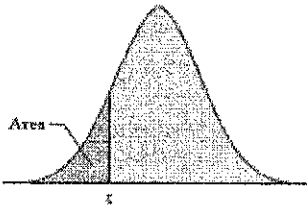
$$r = \frac{\sum(X - \bar{X})(Y - \bar{Y})}{\sqrt{\sum(X - \bar{X})^2 \sum(Y - \bar{Y})^2}}$$

$$\beta_1 = \frac{n\sum xy - \sum x \sum y}{[n\sum x^2 - (\sum x)^2]}$$

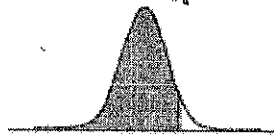
$$\hat{\beta}_1 = \frac{\sum(x_i - \bar{x})(y_i - \bar{y})}{\sum(x_i - \bar{x})^2} \text{ and } \hat{\beta}_0 = \bar{y} - \hat{\beta}_1 \bar{x}$$

$$\beta_0 = \frac{\sum y}{n} - b \frac{\sum x}{n}$$

$$r^2 = \frac{SSR}{SST} = \frac{\text{regression sum of squares}}{\text{total sum of squares}}$$



Standard Normal Distribution										
z	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
-3.4	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003
-3.3	0.0005	0.0005	0.0005	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004
-3.2	0.0007	0.0007	0.0006	0.0006	0.0006	0.0006	0.0006	0.0005	0.0005	0.0005
-3.1	0.0010	0.0009	0.0009	0.0009	0.0008	0.0008	0.0008	0.0008	0.0008	0.0007
-3.0	0.0013	0.0013	0.0013	0.0012	0.0012	0.0011	0.0011	0.0011	0.0010	0.0010
-2.9	0.0019	0.0018	0.0018	0.0017	0.0016	0.0016	0.0015	0.0015	0.0014	0.0014
-2.8	0.0026	0.0025	0.0024	0.0023	0.0023	0.0022	0.0022	0.0021	0.0020	0.0019
-2.7	0.0035	0.0034	0.0033	0.0032	0.0031	0.0030	0.0030	0.0029	0.0027	0.0026
-2.6	0.0047	0.0045	0.0044	0.0043	0.0041	0.0040	0.0040	0.0038	0.0037	0.0036
-2.5	0.0062	0.0060	0.0059	0.0057	0.0055	0.0054	0.0053	0.0051	0.0049	0.0048
-2.4	0.0082	0.0080	0.0078	0.0075	0.0073	0.0071	0.0069	0.0068	0.0066	0.0064
-2.3	0.0107	0.0104	0.0102	0.0099	0.0096	0.0094	0.0091	0.0089	0.0087	0.0084
-2.2	0.0139	0.0136	0.0132	0.0129	0.0125	0.0122	0.0119	0.0116	0.0113	0.0110
-2.1	0.0179	0.0174	0.0170	0.0166	0.0162	0.0158	0.0154	0.0150	0.0146	0.0143
-2.0	0.0228	0.0222	0.0217	0.0212	0.0207	0.0202	0.0197	0.0192	0.0188	0.0183
-1.9	0.0287	0.0281	0.0274	0.0268	0.0263	0.0256	0.0250	0.0244	0.0238	0.0233
-1.8	0.0359	0.0353	0.0344	0.0336	0.0329	0.0322	0.0314	0.0307	0.0301	0.0294
-1.7	0.0446	0.0438	0.0427	0.0418	0.0409	0.0401	0.0392	0.0384	0.0375	0.0367
-1.6	0.0548	0.0537	0.0526	0.0516	0.0505	0.0495	0.0485	0.0475	0.0465	0.0455
-1.5	0.0668	0.0655	0.0643	0.0630	0.0618	0.0606	0.0594	0.0582	0.0571	0.0559
-1.4	0.0808	0.0793	0.0778	0.0764	0.0749	0.0735	0.0721	0.0708	0.0694	0.0681
-1.3	0.0968	0.0951	0.0934	0.0918	0.0901	0.0885	0.0869	0.0853	0.0838	0.0823
-1.2	0.1151	0.1131	0.1112	0.1093	0.1075	0.1056	0.1038	0.1020	0.1003	0.0985
-1.1	0.1357	0.1335	0.1314	0.1292	0.1271	0.1251	0.1230	0.1210	0.1190	0.1170
-1.0	0.1587	0.1562	0.1539	0.1515	0.1492	0.1469	0.1446	0.1423	0.1401	0.1379
-0.9	0.1841	0.1814	0.1789	0.1762	0.1736	0.1711	0.1685	0.1660	0.1635	0.1611
-0.8	0.2119	0.2090	0.2061	0.2033	0.2005	0.1977	0.1949	0.1922	0.1894	0.1867
-0.7	0.2420	0.2389	0.2358	0.2327	0.2296	0.2264	0.2233	0.2202	0.2171	0.2140
-0.6	0.2743	0.2700	0.2657	0.2613	0.2570	0.2527	0.2484	0.2441	0.2400	0.2357
-0.5	0.3085	0.3030	0.2975	0.2919	0.2864	0.2812	0.2757	0.2703	0.2650	0.2596
-0.4	0.3446	0.3389	0.3332	0.3276	0.3219	0.3164	0.3108	0.3053	0.2997	0.2941
-0.3	0.3821	0.3763	0.3705	0.3647	0.3589	0.3532	0.3475	0.3418	0.3361	0.3303
-0.2	0.4207	0.4148	0.4089	0.4030	0.3971	0.3913	0.3854	0.3796	0.3737	0.3678
-0.1	0.4602	0.4542	0.4482	0.4423	0.4363	0.4304	0.4245	0.4186	0.4126	0.4067
0.0	0.5000	0.4960	0.4920	0.4880	0.4840	0.4801	0.4761	0.4721	0.4681	0.4641



$z$	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	0.5000	0.5040	0.5080	0.5120	0.5160	0.5199	0.5239	0.5279	0.5319	0.5359
0.1	0.5398	0.5438	0.5478	0.5517	0.5557	0.5596	0.5636	0.5675	0.5714	0.5753
0.2	0.5793	0.5832	0.5871	0.5910	0.5948	0.5987	0.6026	0.6064	0.6103	0.6141
0.3	0.6179	0.6217	0.6255	0.6293	0.6331	0.6368	0.6406	0.6443	0.6480	0.6517
0.4	0.6554	0.6591	0.6628	0.6664	0.6700	0.6736	0.6772	0.6808	0.6844	0.6879
0.5	0.6915	0.6950	0.6985	0.7019	0.7054	0.7088	0.7123	0.7157	0.7190	0.7224
0.6	0.7257	0.7291	0.7324	0.7357	0.7389	0.7422	0.7454	0.7486	0.7517	0.7549
0.7	0.7580	0.7611	0.7642	0.7673	0.7704	0.7734	0.7764	0.7794	0.7823	0.7852
0.8	0.7881	0.7910	0.7939	0.7967	0.7995	0.8023	0.8051	0.8078	0.8106	0.8133
0.9	0.8159	0.8186	0.8212	0.8238	0.8264	0.8289	0.8315	0.8340	0.8365	0.8389
1.0	0.8413	0.8438	0.8461	0.8485	0.8508	0.8531	0.8554	0.8577	0.8599	0.8621
1.1	0.8643	0.8665	0.8686	0.8708	0.8729	0.8749	0.8770	0.8790	0.8810	0.8830
1.2	0.8849	0.8869	0.8888	0.8907	0.8925	0.8944	0.8962	0.8980	0.8997	0.9015
1.3	0.9032	0.9049	0.9066	0.9082	0.9099	0.9115	0.9131	0.9147	0.9162	0.9177
1.4	0.9192	0.9207	0.9222	0.9236	0.9251	0.9265	0.9279	0.9292	0.9306	0.9319
1.5	0.9332	0.9345	0.9357	0.9370	0.9382	0.9394	0.9406	0.9418	0.9429	0.9441
1.6	0.9452	0.9463	0.9474	0.9484	0.9495	0.9505	0.9515	0.9525	0.9535	0.9545
1.7	0.9554	0.9564	0.9573	0.9582	0.9591	0.9599	0.9608	0.9616	0.9625	0.9633
1.8	0.9641	0.9649	0.9656	0.9664	0.9671	0.9678	0.9686	0.9693	0.9699	0.9706
1.9	0.9713	0.9719	0.9726	0.9732	0.9738	0.9744	0.9750	0.9756	0.9761	0.9767
2.0	0.9772	0.9778	0.9783	0.9788	0.9793	0.9798	0.9803	0.9808	0.9812	0.9817
2.1	0.9821	0.9826	0.9830	0.9834	0.9838	0.9842	0.9846	0.9850	0.9854	0.9857
2.2	0.9861	0.9864	0.9868	0.9871	0.9875	0.9878	0.9881	0.9884	0.9887	0.9890
2.3	0.9893	0.9896	0.9898	0.9901	0.9904	0.9906	0.9909	0.9911	0.9913	0.9916
2.4	0.9918	0.9920	0.9922	0.9925	0.9927	0.9929	0.9931	0.9932	0.9934	0.9936
2.5	0.9938	0.9940	0.9941	0.9943	0.9945	0.9946	0.9948	0.9949	0.9951	0.9952
2.6	0.9953	0.9955	0.9956	0.9957	0.9959	0.9960	0.9961	0.9962	0.9963	0.9964
2.7	0.9965	0.9966	0.9967	0.9968	0.9969	0.9970	0.9971	0.9972	0.9973	0.9974
2.8	0.9974	0.9975	0.9976	0.9977	0.9977	0.9978	0.9979	0.9979	0.9980	0.9981
2.9	0.9981	0.9982	0.9982	0.9983	0.9984	0.9984	0.9985	0.9985	0.9986	0.9986
3.0	0.9987	0.9987	0.9987	0.9988	0.9988	0.9989	0.9989	0.9989	0.9990	0.9990