

Q.P. Code : 830601

(3 Hours)

[Total Marks : 80

- N.B. :** (1) Attempt **any Four** questions.
(2) **All** questions carry **equal marks**.
(3) **Figures** to the **right** indicated **marks**.
(4) Assume any suitable **data** if **required**.

1. (a) The bricks supplied to a particular construction site in Mumbai come from the 5 different brick manufacturing kilns located in the vicinity. After investigation, it was observed that Kiln 1 manufactures 5000 bricks at a time, of which 10% are defective. Kiln 2 manufactures 6000 bricks of which 16% are defective. Kiln 3 & 4 manufacture 3000 bricks each of which 15% are defective. Kiln 5 manufactures 2400 bricks, of which 12% are defective. If, during random inspection, one Kiln is selected, and one brick is drawn at random from that kiln, what is the probability that the selected brick is defective? **5**
- (b) A tendered is bidding for construction works, averagely 10 nos. in a year for the past 5 years. Find the probability that : **5**
- He gets atleast 8 works
 - He gets exactly 5 works
 - He does not get any work
 - He does not get more than 2 works
 - He gets all the works
- (c) For a particular project, it was estimated that 1 lakh cement bags would be required. The ordering cost is ₹ 2000/- per order. The unit cost of cement bag was estimated ₹ 350/- Inventory carrying cost is 20% of the average annual inventory. During the project, it was found that only 95,000 bags were required. Also the cost of cement bags increased to ₹ 370/- The ordering cost increased by ₹ 500/-, whereas the inventory carrying cost remains as it is. Find out how much % increase or decrease in cost would be incurred due to variation. (Perform sensitivity analysis). **5**

TURN OVER

- (d) Based on a 360° appraisal, a project manager's performance was evaluated based on marks obtained for some parameters, on his previous projects as given in Table 1. The marks were given on a scale 1 to 10, with higher score indicating good performance. 5

Table 1 : Peer Review and Self-appraisal on previous projects

Sr. No.	Parameter	Peer Review	Self Appraisal
1	Contribution to timely completion of project	7	9
2	Cost control	6	10
3	Prevention of Rework	5	10
4	Litigation (Dispute prevention)	8	8
5	Quality	6	7

Determine Spearman's rank correlation coefficient for the above scenario.

2. (a) Explain application of Cox Model, Nunnally and Vorster-Sears models in predicting and controlling construction equipment breakdown costs with practical examples. 10
- (b) If 0.5% of doors manufactured by a factory are defective, find the probability that in a batch of 10,000 doors delivered to a mass housing site : 5
- no door is defective
 - 20 doors are defective
 - 35 doors are defective
 - 100 doors are defective
- (c) In 25 years of a truck driver's career, it has been recorded that he has encountered 40 minor and 3 major accidents. His average journey is 100 kms/day. What is the probability that, if he has embarked on a journey to deliver goods on a construction site, 50 kms from the manufacturing yard, that he will be involved in an accident. 5

3. (a) Table 2 below gives the weights of various contents in 10 concrete mixes used for construction on site : 12

Table 2 : Data pertaining to a sample of 10 concrete mixes used for construction

Sr.No.	Cement Content (X) (kg/m ³)	W/C ratio (Y)	Compressive strength (Z) (N/mm ²)
1	333	0.457	35.2
2	342	0.452	36.5
3	354	0.435	38.7
4	328	0.462	31.2
5	355	0.433	37.0
6	357	0.432	37.3
7	331	0.459	33.5
8	329	0.463	31.9
9	362	0.430	38.4
10	336	0.454	35.8

Find out the Karl-Pearsons Simple co-relation coefficient that exists between :

- Cement Content (X) and W/C Ratio (Y)
- Cement Content (X) and Compressive Strength (Z)
- W/C Ratio (Y) and Compressive Strength (Z)

Also check for probable error and find coefficient of determination. Comment on the physical significance of C.D obtained.

- (b) In the gradation process of construction contractors, adopted by Construction Industry Development Council (CIDC), based on budget and schedule achievement, contractor's organisations were rated on a scale of 1 to 5 (1 being poor, 5 being excellent), based on their performance. 8

A reputed construction firm, based on execution of 15 of its similar industrial projects, has got the following ratings (Table 3).

Table 3 : CIDC rating for project performance

Project No.	Rating for performance (maintaining Schedule)	Rating for performance (maintaining Budget)
1	4	2
2	3	4
3	4	3
4	5	5
5	1	1
6	2	1
7	2	3
8	4	1
9	2	3
10	5	2
11	5	1
12	1	2
13	3	4
14	4	3
15	3	4

Determine the mean and standard deviation values for rating S given for budget and schedule achievements. Assuming Normal distribution, determine the probability of the construction company getting grades between 3 to 5 for its future projects.

4. (a) The duration of an activity depends upon the resources allocated (ultimately the total money spent) and proper utilization of these resources (Rated on a 10 point scale with higher rating meaning proper utilization) A particular construction activity has the following historical track record. 10

Table 4 : Funds and resource utilization

Sr.No.	Activity Duration (y) (days)	Funds allocated (x_1) (₹)	Score for Resource Utilization (x_2)
1	15	25,000	9
2	20	35,000	6
3	40	63,000	4
4	22	50,000	3
5	25	45,000	8
6	37	44,000	9
7	18	44,000	5
8	24	53,000	6

For the data given in Table 4, establish the linear regression equation linking the activity duration in days with the resources consumed and its proper utilization. Comment on the accuracy of the relationship.

- (b) Decide the optimum no. of associated units for the prime mover based on the following data: 10

- (i) Mean cycle time of the prime mover = 2.5 minutes
(ii) Mean haul time of the associated unit = 10 minutes
(iii) Haul Unit capacity = 5 cu.m.
(iv) Hourly cost of prime mover, C_p = ₹ 5000/-
(v) Hourly cost of associated unit, C_A = ₹ 750/-

Based on conventional practise, for this work, 5 associated units were assigned. Using Griffi's waiting line model, decide whether the associated units assigned are optimum or adding unnecessary extra cost to the project. Justify your decision.

5. You are the materials manager of a very reputed construction company. On a prestigious construction project, your company requires 2 lakh cement bags annually. Basic Unit price of cement bags is Rs. 350/bag. The ordering cost is Rs. 2000/order. Inventory Carrying cost is 20% of average annual inventory. Based on activity scheduling, monthly requirement is as follows : 20

Table 5 : Monthly estimated requirement

Sr. No.	Month	No. of bags required (in thousand)
1	Jan	22
2	Feb	23
3	Mar	20
4	Apr	26
5	May	21
6	Jun	16
7	Jul	7
8	Aug	4.5
9	Sep	6.5
10	Oct	9.5
11	Nov	20
12	Dec	24.5

Suppliers have offered discounts on bulk purchases.

Table 6: Discounts offered

Sr. No.	No. of Bags	Discount
1	50,000 and above	10
2	30,000 to 49,999	8
3	20,000 to 29,999	6
4	10,000 to 19,999	5
5	5,000 to 9,999	2
6	Below 5,000	No discount

A research related to godown management has revealed that cement deteriorates after 3 months and hence is not suitable for the intended use. Also it is found that there have been thefts associated with over-storage. The overstocking cost for the above scenario were linked up with the period of cement remaining idle as follows :

Table 7 : Depreciation of Cement

Sr. No.	1	2	3	4
Period	3 months and less	3 to 4 months	4 to 5 months	5 months and above
Depreciation	4 % of unit price	6 % of unit price	10% of unit price	15% of unit price

Another research associated with work stoppages and production delays was carried out and understacking cost was carried out and understacking cost can be considered equivalent to 10% of the cost of total cement bags causing the understacking.

Decide the order quantity to be purchased, based on uniform ordering period, so that the total cost of cement bags is minimum.

6. (a) Trains X and Y arrive at a station at random between 10 am and 10.20 am. Train X stops for 4 minutes and Train Y stops for 5 minutes. Assuming that both trains arrive independently of each other, what is the probability that :
- Train X arrives before Train Y
 - The trains meet at the station
 - Assuming that the trains meet, Train X arrived before Train Y.

(b) Prepare a simulation model based on Monte-Carlo simulation to generate a range of random numbers, for the mean for the actual cost of 20 projects of similar nature as given below. Select suitable range for each. Run the simulation. (refer Table 8 for costs of previous projects & Table 9 for random numbers) : 14

Table 8 : Cost of previous projects similar in nature cost

Project No.	Project Cost (in Lakh ₹)	Project No.	Project Cost (in Lakh ₹)
1	11.24	11	23.50
2	13.51	12	34.16
3	12.40	13	61.27
4	19.30	14	101.48
5	23.18	15	78.91
6	38.99	16	44.01
7	44.36	17	95.81
8	10.90	18	31.22
9	61.89	19	91.23
10	29.51	20	12.58

Table 9 : Random Number Table

20	17	42	01	72	33	94	55	89	65	58	60
74	49	04	23	56	49	11	63	77	79	90	31
94	70	49	49	05	74	64	00	26	07	23	00
22	15	78	49	74	37	50	94	13	90	08	14
93	29	12	20	26	22	66	98	37	53	82	62
45	04	77	48	87	77	66	91	42	98	17	26
44	91	99	08	72	87	33	58	12	08	94	12
16	23	91	95	97	98	52	49	40	97	21	46
04	50	65	37	99	57	74	98	93	99	78	30
32	70	17	05	79	58	50	26	54	30	01	88
03	64	59	55	85	63	49	46	61	89	33	79
62	49	00	67	28	96	19	65	13	44	78	39
61	00	95	85	86	94	64	17	47	67	87	59
89	03	90	40	10	60	18	43	97	37	68	97