Marks scored:

KATHMANDU UNIVERSITY
End Semester Examination [C]
July, 2017

Level : B. Sc.
Year : III
Course : COMP 317
Semester : I
Exam Roll No. :
Time: 30 mins.
F. M. : 10
Registration No. :
Date JUL: 1 1 2017

SECTION "A"
[10 Q. × 0.5 = 5 marks]

Fill in the blank space(s) by most appropriate words or symbol(s):

1. Necessary condition for transportation to start optimal solution is that its initial solution has to be _____

2. While solving LP problem we observe that number of basic variables is equal to number of _____

3. In random arrival queueing system the time between arrivals has _____ _____ distribution.

4. If d_{ij}, x_{ij} are the distance travelled per unit time and total distance from ith city to jth city respectively that travelling salesman has to travel n cities then its formula is _____

5. Maximization assignment problem is changed into minimization assignment problem by _____ _____

6. In the solution process of integer programming problem the new constraint so constructed is called _____ _____

7. If T_e , T_s and σ_e are the expected time , scheduled time and s.d of the network analysis the probability that the project is completed in scheduled time T_s is given by _____

8. In M/M/1 queueing system the formula for probability for server being idle is _____ _____

9. If objective function of minimization LP-problem is Maximize Z= 7x+8y then economic meaning of 7 is _____

10. Solution of primal LP-problem by the solution of its dual is obtained as _____ _____

SECTION "B"

[10Q × 0.5= 5 marks]

Fill in the blank spaces (Question number 11 through 20) by choosing the most appropriate answers from among the given ones. Do not tick the answers.

11. Which of the following is not concerned with Queuing model

(i) Optimization, (ii) Simulation,
(iii) Exponential distribution (iv) Expected time to complete the project

12. North-West corner rule is _____
(i) Used to find an initial feasible solution.
(ii) Used to find an optimal solution.
(iii) Based on the concept of minimizing opportunity cost.
(iv) Based on the concept of maximizing cost.

13. If the one of the solution of transportation problem is $X_{35} = 100$ then it carries meaning _____

(i) To transport the amount 100 from the origin 3 to destination 5.
(ii) Cost of transporting per unit commodity from origin 3 to destination 5 is 100.
(iii) Profit of transporting per unit commodity from origin 3 to destination 5 is 100.
(iv) Third resource used for transporting fifth product is 100.

14. The solution of transportation problem indicates $d_{ij} \leq 0$ which of the following does it imply _____
(i) feasible solution
(ii) non-feasible solution
(iii) basic solution
(iv) basic feasible optimal solution

15. Which one is not a major requirement of a linear programming problem _____

(i) An objective for the firm most exists.
(ii) Resources must be unlimited.
(iii) There must be alternative course of action among which to decide.
(iv)The problem must be of maximizing type.

16. In a departmental store customers arrive at a rate of 10 customers per hours. The average number of customers that can be handled by cashier is 24 per hour, then mean time to arrival is _____

[10 24 $\frac{1}{10}$ $\frac{12}{5}$]

17. The occurrence of degeneracy while solving a transportation problem means that_____
(i) Total supply equals total demands.
(ii) The solution so obtained is not feasible.
(iii) Nothing can be said certainly.
(iv) The few allocations become negative

18. As simulation is not an analytical model, therefore, the result of simulation must be viewed as _____
(i) Unrealistic (ii) Exact (iii) Approximation (iv) Simplified

19. Network models have advantage in terms of project_____
(i) Planning (ii) Scheduling (iii) Controlling (iv) All of the above

20. The length of time by which an activity can be delayed until preceding activities are completed at their earliest possible time and all successor activities can be delayed by latest time is determined by _____
(i) Total float (ii) Free float
(iii) Independent float (iv) Total float and Free float both

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SECTION "C"
[3Q ×7 = 21 marks]

1. Linear programming problem: Maximize $Z = 2x_1 + 4x_2 + x_3 + x_4$ Subject to the constraints $x_1 + 3x_2 + x_4 \leq 4; 2x_1 + x_2 + 3x_3 \leq 3; x_2 + 4x_3 + x_4 \leq 3; x_1, x_2, x_3, x_4 \geq 0$ has the following optimal table: [2+2+2+1]

C_j			2	4	1	1	0	0	0
C_B	B	X_B	x_1	x_2	x_3	x_4	s_1	s_2	s_3
4	x_2	1	0	1	0	2/5	2/5	−1/5	0
2	x_1	1	1	0	0	−1/5	−1/5	3/5	0
1	x_3	½	0	0	1	3/20	−1/10	1/20	1/4
Z	13/2	$Z_j - C_j$	0	0	0	7/20	11/10	9/20	1/4

(i) List the dual price and reduced cost of the problem from above table
(ii) Does the problem possess alternative solution? Give reason.
(iii) Find new objective function value when x_4 is forced into the solution
(iv) State whether the solution of LP problem is degenerate or non-degenerate

2. Differentiate between CPM and PERT with one example of each. A sociologist plans a questionnaire survey, consisting of the following tasks: [1+2+2+2]

Activity	Description	Predecessors	$t_0(days)$	$t_m\ (days)$	$t_p\ (days)$
A	Design of questionnaire	---	4	5	6
B	Sampling design	---	8	12	16
C	Testing of questionnaire and refinements	A	4	5	12
D	Recruiting for interviewers	B	1	3	5
E	Training of interviewers	D,A	2	2	2
F	Allocation of areas of interviewer	B	4	5	6
G	Conducting interviews	C,E,F	10	14	18
H	Evaluation of results	G	18	20	34

(i) Draw the network diagram of the project
(ii) Find the expected length of the project
(iii) What is the probability that the project will be completed at least 10 days earlier than expected time?

3. State two graphical approach of dealing with LP-problem. The production of a certain manufacturing firm involves a machining process that acquires raw materials and then converts them into (unassembled) parts. These parts are then sent to one of the two divisions for being assembly into the final product. Division 1 is used for product A. and Division 2 for product B. Product A requires 40 units of raw material and 10 hours of machine processing time. Product B requires 80 units of raw material and 4 hours of machine processing time. During the period, 800 units of raw material and 80 hours of machine processing time are available .The capabilities of the two assembly divisions during the period are 6 and 9 units respectively. The profit contribution per unit to profit and overhead (fixed cost) is of Rs. 200 for each unit of product A and Rs. 120 for each unit of product B. With this information, (a) Formulate this problem as linear programming model (b) Determine the optimal level of output for the two products using the graphical method. [1+3 +3]

OR

Show that feasible solution for maximization linear programming problem lies on the vertex of the polygon.

SECTION "D"

[5Q × 5 = 25 marks]

4. Kathmandu iron and steel company has three open hearth furnaces and five rolling mills. Transportation cost (Rs. Per quintal) for transportation steel from furnaces to rolling mills is shown in the table below: Find the optimal schedule.

	M_1	M_2	M_3	M_4	M_5	a_i
F_1	4	2	3	2	6	8
F_2	5	4	5	2	1	12
F_3	6	5	4	7	3	14
b_j	4	4	6	8	8	

5. An airline company has drawn up a new flight schedule involving five flights. To assist in allocating five pilots to the flights, it has asked them to state their preference scores by giving each flight a number of 10. The higher the number, the greater is the preference .Some of these flights are unsuitable to some pilots owing to domestic reasons. What would be the optimal allocation of the pilots to flights in order to meet as many preferences as possible?

	S	T	U	V	W
A	8	2	--	5	4
B	10	9	2	8	4
C	5	4	9	6	--
D	3	6	2	8	7
E	5	6	10	4	3

6. Explain what beneficial of solving LP- problem by two phase method? By using two-phase method solve the following LP-problem: [1+4]

Minimize $Z = 12x_1 + 18x_2 + 15x_3$ Subject to the constraints

$4x_1 + 8x_2 + 6x_3 \geq 64$; $3x_1 + 6x_2 + 12x_3 \geq 96$; $x_1, x_2, x_3 \geq 0$

OR

Show that dual of dual for following primal is primal itself:

$$Minimize Z = 3x_1 + 5x_2 + 6x_3 \text{ Subject to}$$

$$x_1 + x_2 + x_3 \leq 9$$
$$x_1 + 4x_2 + 6x_3 \geq 4$$
$$3x_1 + x_2 + 7x_3 = 3$$
$$x_1, x_2 \geq 0 \quad x_3 \text{ is unrestricted}$$

7. In a single channel queuing system random numbers for arrivals of customers are : 02, 14, 81, 62, 38, and random numbers for services of customers are: 71, 14, 53, 73, 88. System starts at 10:00 AM and using Monte- Carlo simulation for the queuing system. Find [5]

Inter-arrival time (min)	Probability	Service time (min)	Probability
1	0.10	3	0.15
2	0.20	5	0.15
3	0.45	4	0.40
4	0.15	7	0.20
5	0.10	2	0.10

(i) Mean queue length.
(ii) Mean service time of a customer.
(iii)Mean idle time of server.
(iv)Mean number of customers waiting in the queue.
(v) Mean time spent in the system.

8. If for a period of 2 hours in a day (A.M to 10 A.M) trains arrive at the yard every 20 minutes but the service time is 36 minutes and line capacity of the yard is limited to 4 trains only .Calculate for this period [2.5+2.5]
(a) The probability that a yard is empty
(b) The average number of trains at the yard.

SECTION "E"

[2Q × 2 = 4 marks]

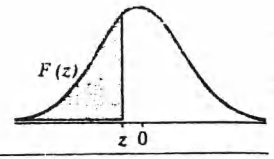
9. State five criteria for a traveling salesman problem to *exist?*

10. Change following assignment problem into linear programming problem:

	A	B	C	D
A	10	20	30	40
B	40	30	20	10
C	20	40	30	10
D	30	10	20	40

TABLE 3 Standard Normal Distribution Function

$$F(z) = \frac{1}{\sqrt{2\pi}} \int_{-\infty}^{z} e^{-t^2/2} dt$$



z	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
-5.0	0.0000003									
-4.0	0.00003									
-3.5	0.0002									
-3.4	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0002
-3.3	0.0005	0.0005	0.0005	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0003
-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	0.0007	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	0.0021	0.0021	0.0020	0.0019
-2.7	0.0035	0.0034	0.0033	0.0032	0.0031	0.0030	0.0029	0.0028	0.0027	0.0026
-2.6	0.0047	0.0045	0.0044	0.0043	0.0041	0.0040	0.0039	0.0038	0.0037	0.0036
-2.5	0.0062	0.0060	0.0059	0.0057	0.0055	0.0054	0.0052	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	0.0262	0.0256	0.0250	0.0244	0.0239	0.0233
-1.8	0.0359	0.0351	0.0344	0.0336	0.0329	0.0322	0.0314	0.0307	0.0301	0.0294
-1.7	0.0446	0.0436	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	0.1788	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	0.2266	0.2236	0.2206	0.2177	0.2148
-0.6	0.2743	0.2709	0.2676	0.2643	0.2611	0.2578	0.2546	0.2514	0.2483	0.2451
-0.5	0.3085	0.3050	0.3015	0.2981	0.2946	0.2912	0.2877	0.2843	0.2810	0.2776
-0.4	0.3446	0.3409	0.3372	0.3336	0.3300	0.3264	0.3228	0.3192	0.3156	0.3121
-0.3	0.3821	0.3783	0.3745	0.3707	0.3669	0.3632	0.3594	0.3557	0.3520	0.3483
-0.2	0.4207	0.4168	0.4129	0.4090	0.4052	0.4013	0.3974	0.3936	0.3897	0.3859
-0.1	0.4602	0.4562	0.4522	0.4483	0.4443	0.4404	0.4364	0.4325	0.4286	0.4247
-0.0	0.5000	0.4960	0.4920	0.4880	0.4840	0.4801	0.4761	0.4721	0.4681	0.4641

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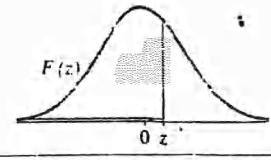

z	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	0.5000	0.5040	0.5080	0.5120	0.5160	0.5199	0.5239	0.5279	0.5319	0.5359
0.1	0.5398	0.5438	0.5478	0.5517	0.5557	0.5596	0.5636	0.5675	0.5714	0.5753
0.2	0.5793	0.5832	0.5871	0.5910	0.5948	0.5987	0.6026	0.6064	0.6103	0.6141
0.3	0.6179	0.6217	0.6255	0.6293	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
3.1	0.9990	0.9991	0.9991	0.9991	0.9992	0.9992	0.9992	0.9992	0.9993	0.9993
3.2	0.9993	0.9993	0.9994	0.9994	0.9994	0.9994	0.9994	0.9995	0.9995	0.9995
3.3	0.9995	0.9995	0.9995	0.9996	0.9996	0.9996	0.9996	0.9996	0.9996	0.9997
3.4	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9998
3.5	0.9998									
4.0	0.99997									
5.0	0.9999997									