KATHMANDU UNIVERSITY
End Semester Examination
August, 2018

Marks scored:

Level : B.E.
Year : III

Course : COMP 304
Semester: II

Exam Roll No. :

Time: 30 mins.

F. M. : 20

Registration No.:

Date : AUG 19 2018

SECTION "A"

[10 Q × 1 = 10 marks]

Fill in the blank(s) (question number 1 through 10) by the most appropriate word(s) or symbol(s):

1. Linear programming is ....solution technique

2. If two constraints of a linear programming problem are $6x_1 + 8x_2 + 9x_3 \leq 26$ and $4x_1 + 5x_2 + 6x_3 \leq 10$ then amount of second resource spent to produce one unit of second product is ....

3. Objective function of LP-problem in Matrix notation is ....

4. Traveling salesman is the special type of ....

5. .... is the amount of time that can be delayed without delaying total completion time.

6. If third primal variable of a LP problem is stated as unrestricted then its impact on dual LP problem is that

   ....

7. If the initial solution of the transportation problem is degenerate then a small positive number ε is assigned in the .... cell which has ....

8. For $r_0 = 53, m = 100, p = 43$ the first random number r_1 =..................................

9. In a queuing system arrival is random inter-arrival time distribution follows ....

10. In transportation problem, in MODI method we compute d_{ij} which we call ....

SECTION "B"

[10 Q × 1 = 10 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. Ballistic missile is escaped being intercepted by scout missile, which one of following customers' behavior does it belong to ....
[Balking, Reneging, Jockeying, Prioritized]

12. ....gives minimum cost of transportation problem.
[North-West Corner method, Least Cost method, Vogel's Approximation method, MODI method]

13. In M/ M/ 1 queuing system if customer arrives at the rate $\lambda = 6$ per hour and server serves the customers at rate $\mu = 12$ per hour then number of customer in the system is ....
[1, 0.6, 0.5, 0.6]

14. While solving the LP problem by simplex method sometimes artificial variable still stays in the basis even after the optimization criterion is met then the problem is said to have ....
[feasible solution, infeasible solution, basic solution, non-basic solution]

15. Simulation which uses the random numbers is called ....simulation
[Analogue, Deterministic, Monte Carlo, Dynamic]

16. The objective function of assignment problem for the assignment of i^{th} job to ^{jth} machine is ....
[$MinimizeZ = \sum_{j=1}^{n}\sum_{i=1}^{n} c_{ij}x_{ij}$, $MinimizeZ = \sum_{j=1}^{n+1}\sum_{i=1}^{n} c_{ij}x_{ij}$
$MinimizeZ = \sum_{j=1}^{n+1}\sum_{i=1}^{n-1} c_{ij}x_{ij}$, $MinimizeZ = \sum_{j=1}^{n}\sum_{i=1}^{n+1} c_{ij}x_{ij}$]

17. In network construction dummy activity is used to remove....................................
[Looping, Dangling, Looping and dangling, Excess number of nodes]

18. If the customers are coming randomly into the queuing system then probability of number of arrival follows ....distribution.
[Exponential, Poisson, Binomial, Normal]

19. .... is not the assumption of travelling salesman problem.
[Traveler should know the number of cities to be visited.
Cost of travelling from one city to another.
City from which the tour to be started.
Number of travelers per route per day.]

20. Complementary slackness is the relation between ....
[Primal objective function and dual objective function,
Dual variables and primal variables,
Primal variables and dual constraints,
Primal slack variables and dual slack variables]

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Time : 2 hrs.30 mins.

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F. M. : 55

SECTION "C"
[3 Q × 7 = 21 marks]

1. A firm makes products X and Y and has total production capacity of 9 tons per day. X and Y require same production capacity .The firm has permanent contract to supply at least 2 tons of X and at least 3 tones of Y to another company. Each ton of X requires 20 machine-hours of production time and each ton of Y requires 50 machine-hours of production time. Maximum possible machine-hours per day are 360. All the firm's output can be sold and profit made is Rs.80/- per ton of X and Rs 120/- per ton of Y. (a) Set up the Mathematical model of linear programming problem (b) Find the production schedule for maximum profit by using graphical approach.

2. Using Charne's big-M method solve the following linear programming problem:
Minimize Z = $60x_1 + 80x_2$

Subject to

$x_1 \leq 400$

$x_2 \geq 200$

$x_1 + x_2 = 500$

$x, y \geq 0$

OR

Show that the following LP-problem has alternative optimum solution. Find alternative solution also

Maximize Z = $6x_1 + 3x_2$

Subject to

$2x_1 + x_2 \leq 8,$

$3x_1 + 3x_2 \leq 18$

$x_2 \leq 3$

$x_1, x_2 \geq 0$

3. What the project net analysis is about? With the help of following information (i) Draw the network diagram (ii) find the expected project length (iii) What is the probability that the project will be completed at least 3 weeks earlier than expected time. [1+2+2+2]

Activity	Predecessors	t_0 (Weeks)	t_m(Weeks)	t_p(Weeks)
A	-	1	1	7
B	-	1	4	7
C	-	2	2	8
D	A	1	1	1
E	B	2	5	14
F	C	2	5	8
G	E ,D	3	6	15

SECTION "D"

[5 Q × 6 = 30 marks]

4. State types of simulation. In a single channel queuing system random numbers for arrivals of customers are 60, 82, 99, 62, 62, 55, 14 and random numbers for services of customers are : 35, 48, 73, 10, 70, 19, 98 and using Monte Carlo simulation for the queuing system for 7 periods for the table given below: Find
   (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) Percentage of time that the server remains busy.

Inter-arrival time (min)	Probability	Service time (min)	Probability
5	0.15	7	0.10
6	0.35	15	0.30
7	0.40	9	0.45
8	0.10	10	0.15

5. What sort of problem does the transportation model solve? For the following transportation problem find the optimal solution:

	P	Q	R	Supply
A	5	1	7	10
B	6	4	6	80
C	3	2	5	15
Demand	75	20	50	

6. Dhulikhel Teaching hospital wants to purchase three different types of medical equipments and five manufactures have come forward to supply one or all the three machines. However, the hospital's policy is not to accept more than one machine from any one of the manufacturers. The data relating to the price (in thousands of rupees) quoted by the different manufacturers is given below: Find optimal assignment of manufacturers to the machines so that machines can be purchased in minimum cost.

		Machines		
		X	Y	Z
Manufacturers	A	30	31	27
	B	28	29	26
	C	29	30	28
	D	28	31	27
	E	31	29	26

7. Trains arrive at the yard at every 15 minutes and the service times are 33 minutes .If the line capacity of the yard is limited to 4 trains. Find (a) Probability that the yard is empty (b) The average number of trains in the system [3+3]

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8. Find optimal solution of following LP-problem by using appropriate Simplex method [6]

Maximize Z = $30x_1 + 23x_2 + 29x_3$

Subject to

$6x_1 + 5x_2 + 5x_3 \le 26$,

$4x_1 + 2x_2 + 5x_3 \le 7$

$x_1, x_2, x_3 \ge 0$

OR

For the linear programming problem Minimize Z = $x_2 - 3x_3 + 2x_5$ subject to

$3x_2 - x_3 + 2x_5 \le 7$

$-2x_2 + 4x_3 \le 12$

$-4x_2 + 3x_3 + 8x_5 \le 10$

$x_2, x_3, x_5 \ge 0$

Whose optimal table is?

		C_j	1	-3	2	0	0	0
C_B	Basis	$X_B = b$	x_2	x_3	x_5	s_1	s_2	s_3
1	x_2	4	1	0	4/5	2/5	1/10	0
-3	x_3	5	0	1	2/5	1/5	3/10	0
0	s_3	11	0	0	10	1	-1/2	1
		$Z_j - C_j$	0	0	-12/5	-1/5	- 4/5	0

(i) Does the LP problem possess the alternative solution? [2]

(ii) Find new objective value in the case when x_5 is forced into solution? [2]

(iii) What is new objective function value when second resource is increased by unit amount? [2]

SECTION "E"

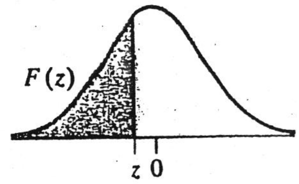
[2Q. × 2= 4 marks]

9. Explain what is queue?

10. Differentiate the Critical Path Method (CPM) from the Performance Evaluation Review Technique (PERT) method of network analysis.

 COMP 304 - Table

Standard Normal Distribution Function

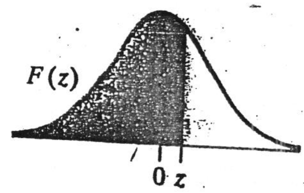


$$F(z) = \frac{1}{\sqrt{2\pi}} \int_{-\infty}^{z} e^{-t^2/2}\, dt$$

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	0.0006	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

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
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	0.5973	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									