Mark Scored:

KATHMANDU UNIVERSITY
End Semester Examination
August/September, 2017

Level : B. E.
Year : III
Course : COMP 304
Semester : II
Exam Roll No. :
Time: 30 min
F. M. : 20
Registration No.:
Date : SEP 0 6 2017

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. Objective of study of queueing system is to make the balance between the cost of waiting of customers in the queue and _____

2. Elements of $Z_j$ row under slack or surplus variables $s_i$ are called _____

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

4. Objective function of traveling salesman problem is _____

5. In the PERT network analysis if $t_0$ , $t_m$ , $t_p$ have their usual meaning then formula for $t_e$ = _____

6. All the floating of critical activities have their values _____

7. Actually the solution method of salesman problem is also well-known method _____

8. Probabilistic approach of simulation is called _____

9. Elements of Linear Programming problem are _____

10. In the process of optimal solution of transportation problem looping starts from the _____ cell with largest positive _____

SECTION "B"
[10Q × 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. Customers in the queuing system facing balking, reneging and jockeying are called _____

[Lower prioritized, Higher prioritized, impatient, blocking]

12. In assignment problem $x_{ij} = 1$ indicates that _____

(i) $jth$ Machine is assigned to $ith$ job (ii) $ith$ Machine is assigned to $jth$ job

(iii) $jth$ Machine is idle machine (iv) $ith$ Machine is idle

13. Which of the following method is also known as $u - v$ method _____

[North-West Corner method; Least Cost method;
Vogel's Approximation method; MODI method]

14. In M/ M/ 1 queuing system if customer arrive at the rate 4 per hour and server serves the customers at mean time 12 minutes per customer then probability that system consists of more than 5 customers is _____

[0.0014; 0.2621; 0.8000; 0.004]

15. While solving the LP problem by simplex method sometimes after the optimization criterion is met, value of $Z_j$ -row element under the non-basic variable observe to be Zero this indicates that _____

(i) Problem attains infeasible solution
(ii) Problem attains unbounded solution
(iii) Problem attains multiple solutions
(iv) Problem attains degenerate solution

[non-feasible solution, basic solution, non-basic solution]

16. Probability of 95% confidence of complete the project in expected 16 days is 0.5346 , then for $\sigma_e = 3$ the scheduled days is computed as _____

[17.6038; 60.1738; 38.1760; 17.3860]

17. The objective function of assignment problem for the assignment of ith job to j th machine is _____

[ $Minimize Z = \sum_{j=1}^{n}\sum_{i=1}^{n} c_{ij}x_{ij}$ $Minimize Z = \sum_{j=1}^{n+1}\sum_{i=1}^{n} c_{ij}x_{ij}$

$Minimize Z = \sum_{j=1}^{n+1}\sum_{i=1}^{n-1} c_{ij}x_{ij}$ $Minimize Z = \sum_{j=1}^{n}\sum_{i=1}^{n+1} c_{ij}x_{ij}$ ]

18. If for a given optimal solution of LP-problem the value of surplus comes out to be non-zero then it indicates that _____

(i) The solution is optimal
(ii) The solution is infeasible
(iii)The entire amount of resource with the constraint in which the slack variable appears has been consumed.
(iv) Shortage of resources

19. _____ is not the assumption of travelling salesman problem

(i) Traveler should know the number of cities to be visited.
(ii) Cost of travelling from one city to another.
(iii) City from which the tour to be started.
(iv) Number of travelers per route per day.

20. Kendll's notation: $a/b/c:d/e/f$ defines $f$ as _____

[System capacity, Waiting space size Queue discipline , Population size ]

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SECTION "C"
[3 Q × 7 = 21 marks]

1. Explain types of simulation. In a single channel queuing system random numbers for arrivals of customers are 91,03,16,10,11,74,13,68 and random numbers for services of customers are: 07,64,23,89,34,76,66,12, and using Monte Carlo simulation for the queuing system for 10 periods for the table given below: Find [7]
   (i) Mean queue length.
   (ii) Mean inter arrival time of a customer
   (iii) Mean service time of a customer.
   (iv) Mean idle time of server.
   (v) Mean time that a customer spends in the system
   (vi) Mean number of customers waiting in the queue.

| Inter-arrival time (min) | Probability | Service time (min) | Probability |
|---|---|---|---|
| 6 | 0.15 | 7 | 0.15 |
| 7 | 0.35 | 6 | 0.30 |
| 2 | 0.40 | 9 | 0.45 |
| 8 | 0.10 | 10 | 0.10 |

2. Using Charne's big-M method solve the following linear programming problem: [7]

Maximize $Z = x_1 + 2x_2 + 3x_3 - x_4$

Subject to

$$x_1 + 2x_2 + 3x_3 = 15$$

$$2x_1 + x_2 + 5x_3 = 20$$

$$x_1 + 2x_2 + x_3 + x_4 = 10$$

$$x_1, x_2, x_3, x_4 \geq 0$$

OR

Show that the following LP-problem has alternative optimum solution; also find the alternative solution [4+3]

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 work 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 4 weeks earlier than expected time. [1+2+2+2]

| | Predecessors | Optimistic time(Weeks) | Most likely | Most pessimistic |
|---|---|---|---|---|
| A | -- | 3 | 4 | 5 |
| B | --- | 4 | 8 | 10 |
| C | B | 5 | 6 | 8 |
| D | A,C | 9 | 15 | 10 |
| E | B | 4 | 6 | 8 |
| F | D,E | 3 | 4 | 5 |
| G | D,E | 5 | 6 | 8 |
| H | D,E | 1 | 3 | 4 |
| I | G | 2 | 4 | 5 |
| J | F,I | 7 | 8 | 10 |
| K | G | 4 | 5 | 6 |
| L | H | 8 | 9 | 13 |
| M | J,K,L | 6 | 7 | 8 |

SECTION "D"

[5 Q × 6= 30 marks]

4. Goods have to be transportated from factories $F_1, F_2, F_3$ which supply to warehouses $W_1, W_2, W_3, W_3$, Find the optimal quantities of goods to be transported so that following costs becomes minimum.

| | $W_1$ | $W_2$ | $W_3$ | $W_3$ | Supply |
|---|---|---|---|---|---|
| $F_1$ | 5 | 1 | 7 | 8 | 10 |
| $F_2$ | 6 | 4 | 6 | 6 | 80 |
| $F_3$ | 3 | 2 | 5 | 5 | 15 |
| Demand | 50 | 20 | 50 | 25 | |

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 pilots owing to domestic reasons. Find optimal allocation of pilots to flights in order to meet as many preferences as possible?

| | | Flight Numbers | | | | |
|---|---|---|---|---|---|---|
| | | P | Q | R | S | T |
| Pilots | A | 10 | 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. A manufacturer produces two different models X and Y of the same product .Model X makes a contribution of R.50 per unit and model Y Rs.30 per unit towards total profit. Raw materials M and N are required for production. At least 18 kg of M and 12 kg of N must be used daily. Also at most 34 hours of labor are to be utilized. A quantity of 2kg of M is needed for model X and 1 kg of M for model Y .For each of X and Y, 1 kg of N is required. It takes 3 hours to manufacture model X and 2 hours to manufacture model Y. Set of the problem as a linear programming problem and find by graphical method that how many units of each model should be produced in order to maximize the profit? [3+3]

7. Patients arrive at a clinic according to Poisson distribution at the rate of 30 per hour. The waiting room does not accommodate more than 14 patients. Examination time per patient is exponential with mean rate 20 per hour. [3+3]
(i) What is the probability that an arriving patient will not wait
(ii) What is the expected time spent until s/he is discharged from the clinic?

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

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

$-2x_2 + 4x_3 \leq 12$

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

$x_2, x_3, x_5 \geq 0$

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 |
| | | $C_j - Z_j$ | 0 | 0 | -12/5 | -1/5 | - 4/5 | 0 |

(i) If we wish to introduce $x_5$ into solution then what is the new objective function value

(ii) List dual prices corresponding to $s_i$

(iii) Does this problem have alternative solution? If yes/no why?

**OR**

Find the optimal solution for following linear programming problem by using the slack variable simplex method

*Maximize* $Z = 2x_1 + x_2$ Subject to $4x_1 + 3x_2 \leq 12$, $4x_1 + x_2 \leq 8$, $4x_1 - x_2 \leq 8$, $x_1, x_2 \geq 0$

## SECTION "D"

[2Q × 2= 4 marks]

9. Convert the following assignment problem into linear programming problem

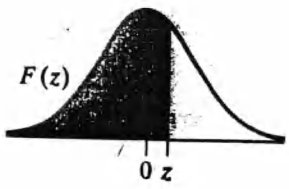
| | | |
|---|---|---|
| 4 | 6 | 8 |
| 7 | 2 | 9 |
| 3 | 5 | 1 |

10. How do maximization and minimization problems differ when applying the simplex method?

Table — COMP-304

## Standard Normal Distribution Function

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

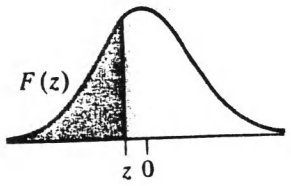



| z | 0.00 | 0.01 | 0.02 | 0.03 | 0.04 | 0.05 | 0.06 | 0.07 | 0.08 | 0.09 |
|---|---|---|---|---|---|---|---|---|---|---|
| 0.0 | 0.5000 | 0.5040 | 0.5080 | 0.5120 | 0.5160 | 0.5199 | 0.5239 | 0.5279 | 0.5319 | 0.5359 |
| 0.1 | 0.5398 | 0.5438 | 0.5478 | 0.5517 | 0.5557 | 0.5596 | 0.5636 | 0.5675 | 0.5714 | 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 | | | | | | | | | |

Table - COMP-304

## 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 |