QUEENS COLLEGE
DEPARTMENT OF MATHEMATICS
FINAL EXAMINATION
$2\frac{1}{2}$ HOURS

Mathematics 110   **Spring 2024**

Instructions: Answer all questions. Show all work. Box final answers. All answers should be rounded to the nearest hundredth. Good Luck!!

1.   The town horticultural society is deciding on which flowers to plant at the town veteran's memorial. Their preference rankings are listed below:

Flower	Group of 12	Group of 6	Group of 15	Group of 2	Group of 6	Group of 9
Hyacinths	1√	1√	3	2	3	2√
Tulips	2	3	1√	1√	2√	3
Daffodils	3	2√	2√	3	1√	1√

   a)   Which flower would be selected using the plurality method?
   b)   Which flower would be selected using plurality with runoff?
   c)   Which flower would be selected using Borda's method?
   d)   Which flower would win the approval vote?
   e)   Which flower would be the Condorcet winner, if any?

2.   a)   If 2,345 votes are cast in an election that is to be decided by plurality, what is the smallest number of votes a candidate can win with in a six-candidate race if no ties are allowed?

   b)   Suppose we are voting on our favorite snack using a plurality vote. There are 200 votes to be cast in an election among four top candidates – Cheetos, Doritos, Nachos, and Popcorn. After the first 180 votes are counted, the tallies are as follows: Cheetos received 45 votes, Doritos received 25 votes, Nachos received 58 votes, and Popcorn received 52 votes. What is the minimal number of remaining votes Cheetos needs to be assured of a win?

3.   A generous tree doctor has donated 250 hours of tree care service to his neighbors based on the number of trees in their yard.

Name	#trees								
Adam	19								
Bella	22								
Carlos	12								
Diego	5								

   Apportion the 250 hours based on the number of trees in each yard using:
   a)   Hamilton's method
   b)   Lowndes' method
   c)   Webster's method

(continued on the back)

4.	A random sample of the grades on an exam are listed:

| 55 | 76 | 21 | 84 | 99 | 99 | 86 | 63 | 91 | 85 |
| 97 | 81 | 99 | 79 | 67 | 59 | 85 | 85 | 96 | 93 |

a)	Construct a frequency table and histogram using the first exam interval of 20-29.
b)	Find the sample mean and the sample standard deviation.
c)	Find the five-number summary and construct a box-and-whisker plot.

5.	Eight books are sitting on your shelf.
a)	How many distinct ways can you choose 4 books to take with you on vacation to Aruba?
b)	Once you arrive in Aruba and unpack, how many distinct ways are there to place those books on the shelf?

6.	An experiment has outcomes 2, 3, 5, 7, and 9 with probabilities as shown

$p(x)$	.3	.35	.2	?	.1
x	2	3	5	7	9

a)	Find the missing $p(x)$.
b)	Calculate the mean and standard deviation.
c)	Calculate the probability of having an outcome of at least 7.
d)	Construct the probability histogram.

7.	In a standard 52-card deck (2, 3, 4, 5, 6, 7, 8, 9, 10, J, Q, K, A with four suits (clubs, diamonds, hearts, and spades)), find the probability that
a)	One card is picked and it is a 7.
b)	A 7 is picked and then without replacement, a face card (J, Q, K) is picked.
c)	A 7 is picked, replaced and then a face card is picked.
d)	An odd card (3,5,7,9) is picked and then, without replacement, another odd card is picked.
e)	An odd card is picked, replaced, and then another odd card is picked.

8.	The student loans of employees at a certain company have an approximately normal distribution with $\mu = \$150,000$ and $\sigma = \$40,000$.
a)	Find the percentage of employees with loans greater than $150,000.
b)	Find the percentage of employees with loans between $190,000 and $230,000.
c)	Below what amount is 88.30% of the employees' loans at the company?
d)	If there are 20,000 employees at the company, how many employees have loans above $190,000?

Statistical Tables

Table A   Normal Curve (z) Table

The normal curve table gives only the percentage of data starting from the middle $(z = 0)$, out to whatever z score you look up. For instance, if you look up $z = 1.28$, you get .3997. This means .3997 or 39.97% of the data in the normal curve is found between $z = 0$ and $z = 1.28$.
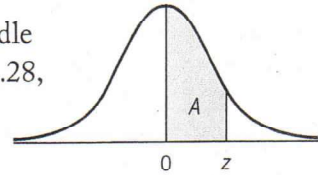
z	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	.0000	.0040	.0080	.0120	.0160	.0199	.0239	.0279	.0319	.0359
0.1	.0398	.0438	.0478	.0517	.0557	.0596	.0636	.0675	.0714	.0753
0.2	.0793	.0832	.0871	.0910	.0948	.0987	.1026	.1064	.1103	.1141
0.3	.1179	.1217	.1255	.1293	.1331	.1368	.1406	.1443	.1480	.1517
0.4	.1554	.1591	.1628	.1664	.1700	.1736	.1772	.1808	.1844	.1879
0.5	.1915	.1950	.1985	.2019	.2054	.2088	.2123	.2157	.2190	.2224
0.6	.2257	.2291	.2324	.2357	.2389	.2422	.2454	.2486	.2517	.2549
0.7	.2580	.2611	.2642	.2673	.2704	.2734	.2764	.2794	.2823	.2852
0.8	.2881	.2910	.2939	.2967	.2995	.3023	.3051	.3078	.3106	.3133
0.9	.3159	.3186	.3212	.3238	.3264	.3289	.3315	.3340	.3365	.3389
1.0	.3413	.3438	.3461	.3485	.3508	.3531	.3554	.3577	.3599	.3621
1.1	.3643	.3665	.3686	.3708	.3729	.3749	.3770	.3790	.3810	.3830
1.2	.3849	.3869	.3888	.3907	.3925	.3944	.3962	.3980	.3997	.4015
1.3	.4032	.4049	.4066	.4082	.4099	.4115	.4131	.4147	.4162	.4177
1.4	.4192	.4207	.4222	.4236	.4251	.4265	.4279	.4292	.4306	.4319
1.5	.4332	.4345	.4357	.4370	.4382	.4394	.4406	.4418	.4429	.4441
1.6	.4452	.4463	.4474	.4484	.4495	.4505	.4515	.4525	.4535	.4545
1.7	.4554	.4564	.4573	.4582	.4591	.4599	.4608	.4616	.4625	.4633
1.8	.4641	.4649	.4656	.4664	.4671	.4678	.4686	.4693	.4699	.4706
1.9	.4713	.4719	.4726	.4732	.4738	.4744	.4750	.4756	.4761	.4767
2.0	.4772	.4778	.4783	.4788	.4793	.4798	.4803	.4808	.4812	.4817
2.1	.4821	.4826	.4830	.4834	.4838	.4842	.4846	.4850	.4854	.4857
2.2	.4861	.4864	.4868	.4871	.4875	.4878	.4881	.4884	.4887	.4890
2.3	.4893	.4896	.4898	.4901	.4904	.4906	.4909	.4911	.4913	.4916
2.4	.4918	.4920	.4922	.4925	.4927	.4929	.4931	.4932	.4934	.4936
2.5	.4938	.4940	.4941	.4943	.4945	.4946	.4948	.4949	.4951	.4952
2.6	.4953	.4955	.4956	.4957	.4959	.4960	.4961	.4962	.4963	.4964
2.7	.4965	.4966	.4967	.4968	.4969	.4970	.4971	.4972	.4973	.4974
2.8	.4974	.4975	.4976	.4977	.4977	.4978	.4979	.4979	.4980	.4981
2.9	.4981	.4982	.4982	.4983	.4984	.4984	.4985	.4985	.4986	.4986
3.0	.4987	.4987	.4987	.4988	.4988	.4989	.4989	.4989	.4990	.4990
3.1	.4990	.4991	.4991	.4991	.4992	.4992	.4992	.4992	.4993	.4993
3.2	.4993	.4993	.4994	.4994	.4994	.4994	.4994	.4995	.4995	.4995
3.3	.4995	.4995	.4996	.4996	.4996	.4996	.4996	.4996	.4996	.4997
3.4	.4997	.4997	.4997	.4997	.4997	.4997	.4997	.4997	.4998	.4998
3.5	.4998	.4998	.4998	.4998	.4998	.4998	.4998	.4998	.4998	.4998