

MAT121 Statistics I

Spring 20215

Name _____
(please print)

WCUID Number _____
(please print)

Instructions

1. Formula Sheet:

- You are allowed to bring **one formula sheet** (8.5" x 11", single-sided or double-sided) with **formulas only**.
- The formula sheet must be handwritten or printed and will be collected at the end of the exam.

2. Calculators:

- (Graphing or scientific) calculators are allowed for this exam.
- Calculators with internet access, communication capabilities, or stored notes are **not allowed**.

3. Notebooks and Notes:

- **No notebooks, notes, or additional materials** are allowed during the

4. Exam Versions:

- Each student will receive a **different version** of the exam.
- Ensure you are working on your assigned version only.

5. Grading for Word Problems:

- For word problems, you must provide **detailed steps and justification** for your solution.
- Correct answers with **no or incorrect justification** will receive **ZERO credit**.
- Partial credit may be awarded for correct steps even if the final answer is incorrect.

6. Multiple Choice Problems:

- For multiple-choice questions, **manually calculate** your answer and select the option that is **closest to your calculated result**.
- If your calculated answer does not match any option exactly, choose the **closest value**.

7. General Rules:

- No communication or collaboration with other students is allowed during the exam.
- All electronic devices (e.g., phones, smartwatches) must be turned off and stored away.

Part I: Multiple-choice Questions [4 points each, total 48 points]: Please circle the correct answer.

For each question, only one choice is correct. If your calculated answer does not match any option exactly, choose the **closest value**.

1. The following frequency table of the income, denoted by X , of 30 employees at a local business (in \$1000s)

Income	[26, 28]	(28, 30]	(30, 32]	(32, 34]	(34, 36]
Frequency	2	11	8	5	4

The relative cumulative frequency of class $28 < X \leq 30$ class is

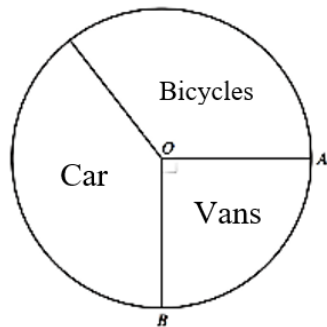
- A. 11 B. 0.43 C. 0.06 **D. 0.37** E. 0.7
2. Find the mean, median, and mode for the following data set.
4 7 9 11 11 11 13 17 22 26
- A. mode = 11, mean = 12, median = 11
B. mode = 11, mean = 11, median = 11
C. mode = 12, mean = 13, median = 11.5
D. mode = 11, mean = 13, median = 11
E. mode = 11.5, mean = 12, median = 11
3. A Study of 1106 college students asked about their preference for online resources. The following relative frequency distribution was determined based on the survey.



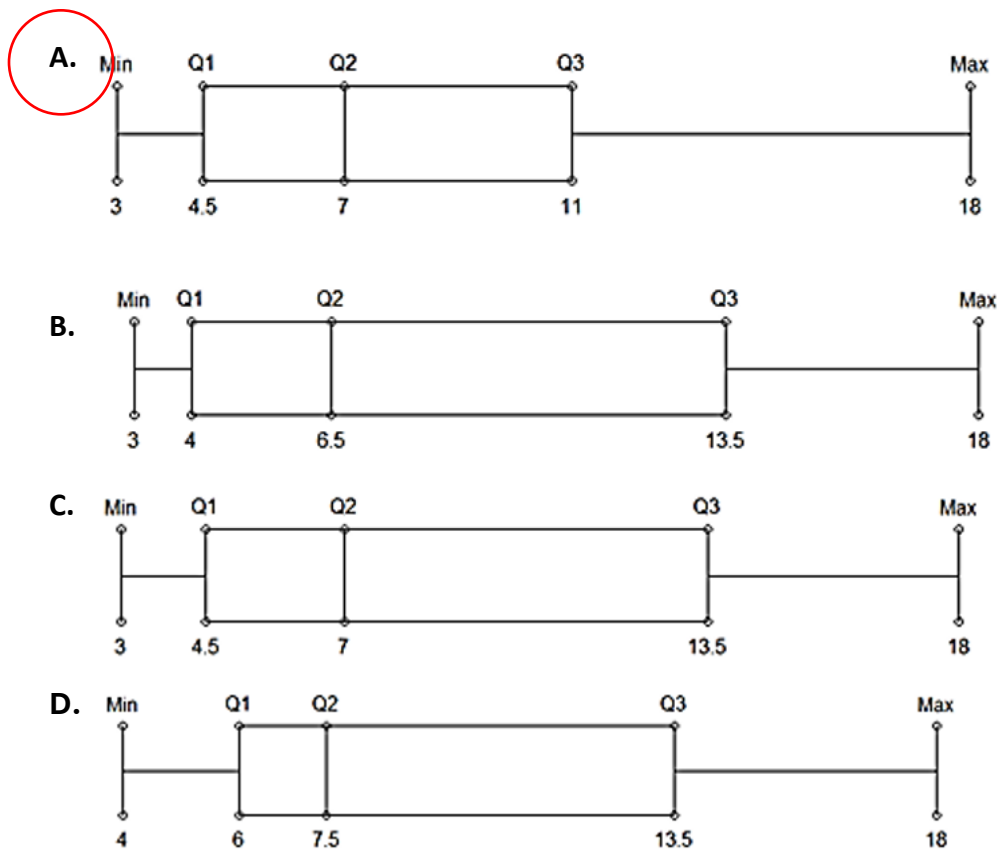
Resource	Relative Frequency
Google or Google Scholar	0.736
Library database or website	0.136
Wikipedia or online encyclopedia	0.094
Other	0.034

- A. 34 B. 292 C. 736 D. 814 E. 921

4. The pie chart above, not drawn to scale, shows the number of vehicles parked outside a supermarket. Angle AOB is the right angle. Given that there were 60 vehicles, how many vans were there?



- A. 4 B. 6 C. 12 **D. 15** E. 20
5. The mean temperature in Glens Falls for the month of February is 23 degrees with a standard deviation of 4.2 degrees. What is the z-score for a temperature of 17 degrees (keeping 3 decimal places)
- A. 9.523 **B. -1.429** C. 1.429 D. -2.928 E. -0.340
6. A scientist obtained a normally distributed population of scores with a mean of 70 and a standard deviation of 10. What proportion of scores do you expect to find the interval between 60 and 80?
- A. 1.0 B. 0.50 C. 0.34 **D. 0.68** E. cannot be determined
7. The following is a sample of ages (in months) of 18 children at a daycare.
- 18, 19, 22, 22, 24, 24, 25, 26, 28, 29, 29, 30, 31, 32, **35**, 36, 36, 42
- What is the median of the above data set?
- A. 29 B. 28.2 C. 30.5 **D. 28.5** E. 31
8. Construct a boxplot of data set: {3, 4, 4, 5, 5, 6, 8, 10, 10, 12, 15, 18}



9. Find the variance of the following *sample data set* taken from a population.

4 11 11 13 15 18

- A. $112/6$ **B. $112/5$** C. $72/6$ D. $72/5$ E. $976/5$

10. A national achievement test is administered annually to 3rd graders. The test score is a continuous random variable that has a mean score of 100 and a standard deviation of 15. What is the probability that a randomly selected student scored 95 on the test? [Hint: please draw density curves and label the given information and derived information on the curves in the following box.]

- A. $95/100$ B. $(100-95)/15$ **C. 0** D. $15/95$ E. cannot be determined

11. The scoring of modern IQ is such that intelligence Quotients (IQs) have a normal distribution of $\mu = 100$ and $\sigma = 15$. Mensa International is a non-profit organization that accepts only people with IQ scores in the top 2%. What level of IQ qualifies one to be a member of Mensa? [Hint: top 2% means 98th percentile]

SKIP

- A. 115 B. 130.8 C. 145 D. 120 E. cannot be determined
12. The following are 40 measurements of the iron-solution index of tin-plate specimens, designed to measure the corrosion resistance of tin-plated steel. The original data set has been sorted in ascending order as:

16, 26, 28, 28, 28, 28, 30, 32, 34, 35, 36, 36, 37, 37, 40, 40, 40, 41, 41, 41, 42, 42, 42, 43, 43, 43, 44, 44, 44, 44, 45, 45, 45, 45, 45, 45, 46, 46, 46, 46,

We want to Construct a frequency table with five rows. Which of the following histogram is correct?

A)

[15,31]	7
(31,42]	16
(42,53]	17
(53,64]	0
(64,75]	0

B)

[15,25]	1
(25,35]	9
(35,40]	7
(40,45]	19
(45,50]	4

C)

[15,23]	1
(23,31]	6
(31,39]	7
(39,46]	26
(46,53]	0

D)

[15,22]	1
(22,29]	5
(29,36]	6
(36,43]	14
(43,50]	14

Part II World problems [Total 52 points]: Show your detailed work to earn full credit. Partial credits will be assigned for correct details. Correct answers without appropriate justification will not earn any credit.

Problem 1.

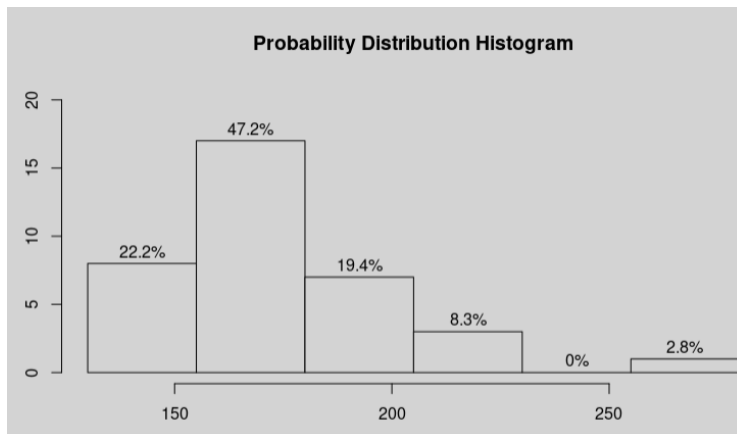
Weights of 18- to 24- Year- Old Males. The U. S. National Center for Health Statistics publishes data on weights and heights by age and sex in the document Vital and Health Statistics. The weights shown in the following, given to the nearest tenth of a pound, were obtained from a sample of 18- to 24- year- old males. Use the cut-point grouping to organize these data into frequency and relative- frequency distributions.

132.1, 136.7, 142.8, 145.6, 146.4, 149.9, 150.7, 151.3, 155.2, 158.5, 158.6, 161.0, 161.7, 165.0, 165.8, 167.3, 170.0, 170.1, 172.5, 173.6, 173.7, 175.4, 175.6, 178.2, 178.7, 182.0, 182.5, 185.3, 187.0, 187.5, 188.7, 191.1, 209.1, 214.6, 218.1, 278.8

1. Construct a frequency table with **six (6)** classes. [6 points]

cut.data.freq	Freq	midpts	rel.freq	cum.freq	rel.cum.freq
[1.3e+02,1.6e+02]	8	142.50	0.22	8	0.22
(1.6e+02,1.8e+02]	17	167.50	0.47	25	0.69
(1.8e+02,2e+02]	7	192.50	0.19	32	0.89
(2e+02,2.3e+02]	3	217.50	0.08	35	0.97
(2.3e+02,2.6e+02]	0	242.50	0.00	35	0.97
(2.6e+02,2.8e+02]	1	267.50	0.03	36	1.00

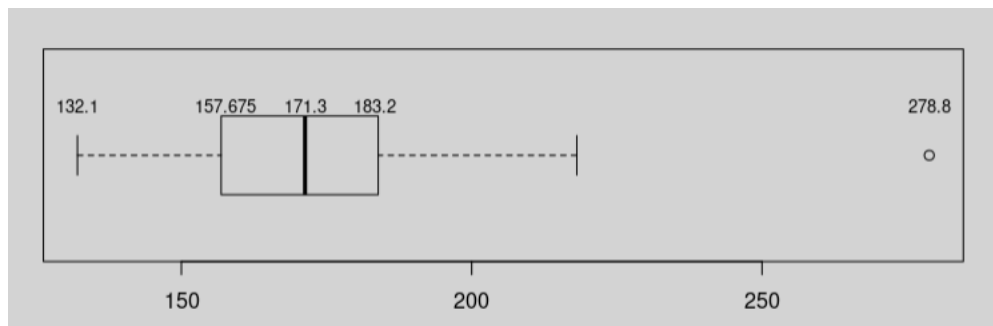
2. Convert the above frequency table to a histogram. [6 points]



3. Find the five-number summary. [Hint: need to find 1st, 2nd, 3rd quartiles] [6 points]

stats	value
Min.	132.10
1st Qu.	157.68
Median	171.30
3rd Qu.	183.20
Max.	278.80

4. Construct a boxplot to represent the distribution of the above data set. [Hint: make sure the quartiles are at the correct scale] [6 points]



Problem 2.

The Precision Scientific Instrument Company manufactures thermometers that are supposed to give readings of 0°C at the freezing point of water. Tests on a large sample of these instruments reveal that the freezing point of water is around zero (some thermometers give positive degrees, some thermometers give negative degrees), Assume that the mean reading is 0°C and the standard deviation of the readings is 1.00°C. Assume further that the readings are normally distributed. [Hint: density curves are always helpful]

1. Randomly select a thermometer, what is the probability the reading of this thermometer in the ice water is bigger than 0.5? [7 points]

The left-tail Probability based on the above z-score is

$$P(Z < 0.5) = 0.6915.$$

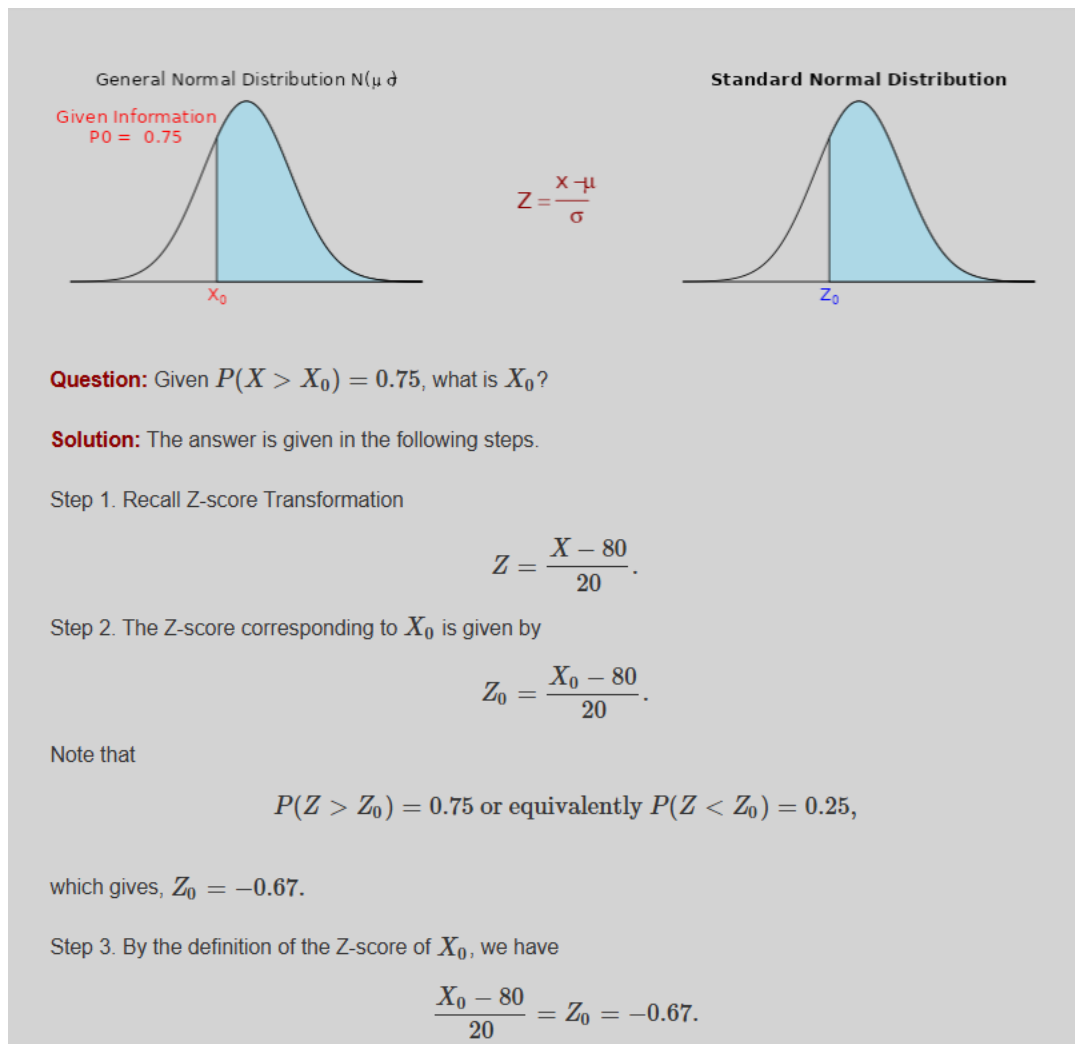
Note that

$$P(Z > Z_1) = 1 - P(Z < 0.5) = 1 - 0.6915 = 0.3085.$$

Therefore,

$$P(X > 0.5) = 0.3085.$$

2. What is the cut-off reading that 75% of the readings of this type of thermometer in the ice water are higher than this cut-off? [7 points]



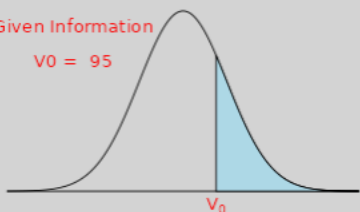
Problem 3

Blood Pressure The distribution of diastolic blood pressure for men is normally distributed with a mean of about 80 and a standard deviation of 20.

1. Randomly select a man from the population, what is the probability that his diastolic blood pressure is higher than 95. [7 points]

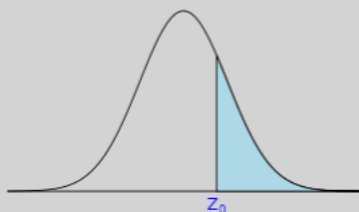
General Normal Distribution $N(\mu, \sigma)$

Given Information
 $V_0 = 95$



$$Z = \frac{X - \mu}{\sigma}$$

Standard Normal Distribution



Question: $P(X > 95) = ?$

Solution: The answer is given in the following steps.

Step 1. Recall Z-score Transformation

$$Z = \frac{X - 80}{20}.$$

Step 2. Z-scores for $V = 95$ is given by

$$Z_0 = \frac{95 - 80}{20} = 0.75.$$

Step 3. The left-tail Probability based on the above z-score is

$$P(Z < 0.75) = 0.7734.$$

Step 4. Note that

$$P(Z > Z_1) = 1 - P(Z < 0.75) = 1 - 0.7734 = 0.2266.$$

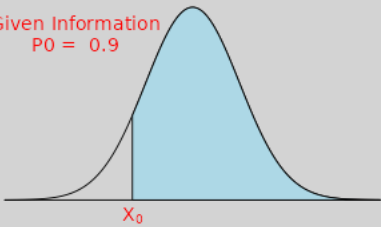
Step 5. Therefore,

$$P(X > 95) = 0.2266.$$

2. What is the cut-off diastolic blood pressure that 90% of diastolic blood pressures are higher than? [7 points]

General Normal Distribution $N(\mu, \sigma)$

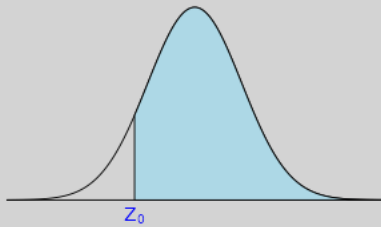
Given Information
 $P_0 = 0.9$



X_0

$$Z = \frac{X - \mu}{\sigma}$$

Standard Normal Distribution



Z_0

Question: Given $P(X > X_0) = 0.9$, what is X_0 ?

Solution: The answer is given in the following steps.

Step 1. Recall Z-score Transformation

$$Z = \frac{X - 80}{20}.$$

Step 2. The Z-score corresponding to X_0 is given by

$$Z_0 = \frac{X_0 - 80}{20}.$$

Note that

$$P(Z > Z_0) = 0.9 \text{ or equivalently } P(Z < Z_0) = 0.1,$$

which gives, $Z_0 = -1.28$.

Step 3. By the definition of the Z-score of X_0 , we have

$$\frac{X_0 - 80}{20} = Z_0 = -1.28.$$

Step 4. Therefore, $X_0 = 80 + (-1.28) \times 20 = 54.4$.

Standard Normal Cumulative Probability Table

Cumulative probabilities for NEGATIVE z-values are shown in the following table:



z	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
-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

Standard Normal Cumulative Probability Table



Cumulative probabilities for POSITIVE z-values are shown in the following table:

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

Summary of Midterm Exam #1

1. Five Number Summary :

The five-number summary is used to describe the shape of the distribution of a given numerical data. It consists of five numbers: minimum data value, first quartile, median, the third quartile, and the maximum data value.

The five-number summary of this given data set is:

stats	value
Min.	33.00
1st Qu.	58.00
Median	76.00
3rd Qu.	94.00
Max.	100.00

2. Boxplot :

The boxplot is a geometric representation of the five-number summary. The boxplot of the given data set is given below.

