MAT 121 Statistics I
Midterm Exam #1
09/27/2022
Time: 75 minutes

Name _____
(Please print)

Instruction: This is a closed-book exam. You can prepare a formula sheet for the exam. Examples and definitions are NOT allowed to be put on the formula sheet. You need to turn in your formula sheet with your exam.

Part I: Multiple choice questions (12 questions, each is worth 5 points: total 60 pints)

Problem 1.

The median is _____ of the sorted data set.

A). The middle point
B). The highest number
C). The average
D). Affected by extreme scores

Problem 2.

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 age of the sample?

A.   29
B.   28.2
C.   30.5
D.   28.5
E.   31

Problem 3

Choose the answer below that best completes the following statement.

A _____ is a number that describes a sample.

A) measurement
B) population
C) statistic
D) parameter

Problem 4.

The sum of the **percent frequencies** for all classes will always equal

A). one   Percent frequencies are not decimals
B). the number of classes
C). the number of items in the study
D). 100

Problem 5.

The most frequently occurring value of a data set is called the

A). range
B). mode
C). mean
D). median

Problem 6.

Which of the following is NOT a measure of variability?
A). Median
B). Variance
C). Standard deviation
D). Z-score

Note: both A and D are correct.

Problem 7
The following grouped a frequency table of the income, x, of 30 employees at a local small 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 the $28 < x \leq 30$ class is
A. $= 11$
B. ≈ 0.43 $(2 + 11) / 30 = 0.4333$
C. ≈ 0.06
D. ≈ 0.37
E. ≈ 0.7

Problem 8

Suppose that a quality manager for Lenovo Computers has collected the following data on the quality status of disk drives by the supplier. She inspected a total of 400 disk drives.

	Drive Status		
	Working	Defective	Total
Company A	147	17	164
Company B	231	5	236
Total	378	22	400

What is the probability that a randomly selected disk drive is defective and produced by Company B?

A. 17/400
B. 5/400
C. 17/164
D. 164/400
E. 22/378

Problem 9

The cholesterol content of large chicken eggs is **uniformly** distributed between 190 and 210 milligrams. The density curve has a rectangular shape.
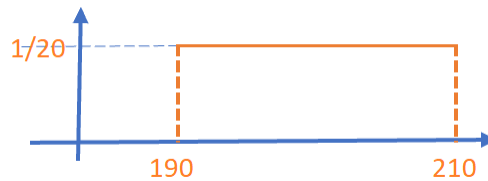
What proportion of these eggs has cholesterol content above 205 milligrams?

A. 5/20
B. 205/210
C. 190/210
D. 20/210
E. 15/210

Problem 10.
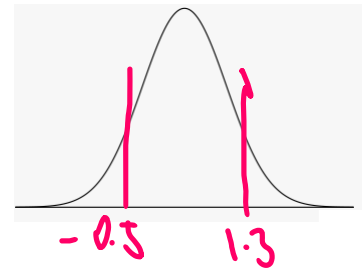
Which of the following is not a measure of central location?

A). mean
B). median
C). variance
D). mode

Problem 11

Let Z be the standard normal random variable. $P(-0.5 < Z < 1.3) = ?$
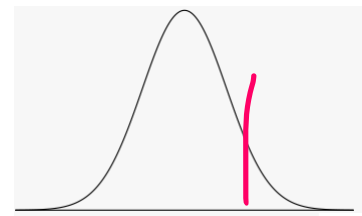
A). 0.3085
B). 0.9032
C). $1.3 - 0.5$
D). 0.5947   0.9032 - 0.3085

Problem 12

Let Z be the standard normal random variable. Given that $P(Z < Z_0) = 0.758$, what is Z_0?
A). 0.750
B). 0.700
C). 0.242
D). -0.70

Part II: Sow your work problems

Please show your work to earn credit. A Correct answer with no supporting details will earn about 25% of the credit. However, with correct details, even a wrong answer could earn up to 75% of the credit. Details are VERY important!

Problem 1 (10 points)

Following are 80 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

1. Construct a frequency table with **five** rows. [5 points]

Interval	Frequency
[16, 22]	1
(22, 28]	5
(28,34]	3
(34,40]	9
(40,46]	23

2. Convert the frequency table to a histogram and describe the shape of the distribution. [5 points]

Probability Distribution Histogram
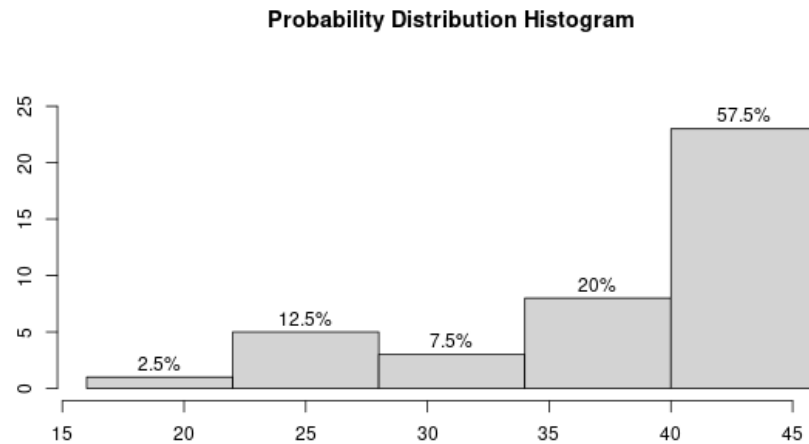
Problem 2. (15 pints, each question is worth 5 points)

Answer questions based on the following tiny <u>sample</u> data.

$$15, 30, 34, 20, 26$$

1. What is the mean of the sample data? [5 points]

$$\bar{x} = \sum_{i=1}^{n} \frac{x_i}{n} = 25 \, ,$$

2. What is the sample standard deviation? [5 points]

$$s^2 = \sum_{i=1}^{n} \frac{(x_i - \bar{x})^2}{n-1} = 58 \, , \quad s = \sqrt{s^2} = \sqrt{\sum_{i=1}^{n} \frac{(x_i - \bar{x})^2}{n-1}} = 7.6$$
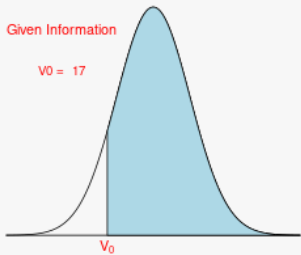
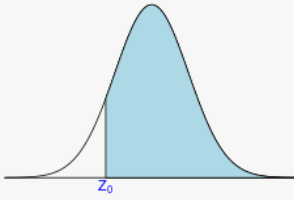3. Find the z value of 30 (based on the z-score transformation) [5 points]
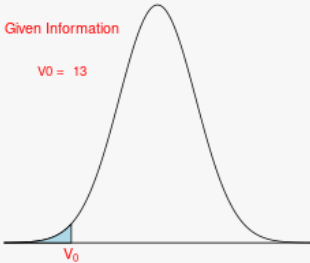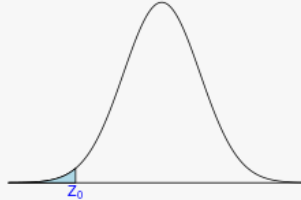
Z = (30 − 25) / 7.6 = 0.658

Problem 3. (15 points, each question is worth 5 points)

Tomkins Associates reports that the mean clear height for a Class A warehouse in the United States is 22 feet. Suppose clear heights are normally distributed and that the standard deviation is 4 feet. A Class A warehouse in the United States is randomly selected

1. What is the probability that the clear height is greater than 17 feet?

Sampling Distribution

Given Information

V0 = 17

V_0

Question:

$$P(X > 17) = ?$$

Step 4. Finding P_0:

$$P\left(\frac{X - 22}{4} > \frac{17 - 22}{4}\right)$$

$$= P(Z > Z_1)$$

$$= 1 - P(Z < -1.25)$$

$$= 1 - 0.1056 = 0.8944$$

Step 5. Answer:

$$P(X > 17) = 0.8944$$

Standard Normal Distribution

Z_0

Step 1. Z-score Transformation

$$Z = \frac{X - 22}{4}$$

Step 2. Z-scores for V

$$Z_0 = \frac{17 - 22}{4} = -1.25$$

Step 3. Finding the left-tail Probabilities

$$P(Z > -1.25) = 0.8944$$

2. What is the probability that the clear height is less than 13 feet?

Sampling Distribution

Given Information

V0 = 13

V_0

Question:

$$P(\bar{X} < 13) = ?$$

Step 4. Finding P_0:

$$P\left(\frac{\bar{X} - 22}{4} < \frac{13 - 22}{4}\right)$$

$$= P(Z < Z_0)$$

$$= P(Z < -2.25) = 0.0122$$

Step 5. Answer:

$$P(\bar{X} < 13) = 0.0122$$

Standard Normal Distribution

Z_0

Step 1. Z-score Transformation

$$Z = \frac{X - 22}{4}$$

Step 2. Z-scores for V

$$Z_0 = \frac{13 - 22}{4} = -2.25$$

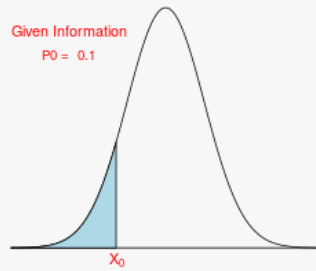Step 3. Finding the left-tail Probabilities

$$P(Z < -2.25) = 0.0122$$

3. Find the clear height such that 10% of all clear heights are less than it.

Sampling Distribution

Given Information
$P0 = 0.1$

X_0

Question: Given
$P(X < X_0) = 0.1$, what is X_0?

Step 3. Finding X_0:

$$P\left(\frac{X - 22}{4} < \frac{X_0 - 22}{4}\right) = 0.1$$

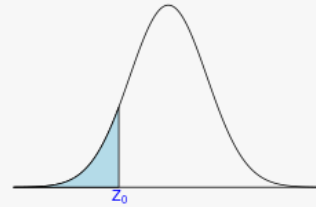or equivalently,

$$P\left(Z < \frac{X_0 - 22}{4}\right) = 0.1$$

Therefore,

$$\frac{X_0 - 22}{4} = Z_0 = -1.28.$$

Step 4. Answer:
$X_0 = 22 + (-1.28) \times 4/\sqrt{1} = 16.88$

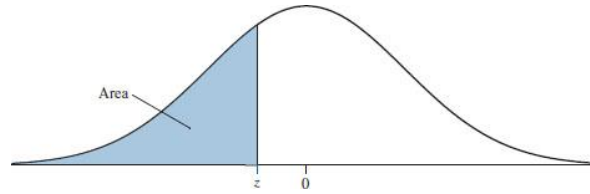**Standard Normal Distribution**

Z_0

Step 1. Z-score Transformation

$$Z = \frac{X - 22}{4}.$$

Step 2. Find the Z-score corresponding to X_0

$$P(Z < Z_0) = 0.1.$$

Therefore, $Z_0 = -1.28.$

z	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
−3.6	.0002	.0002	.0001	.0001	.0001	.0001	.0001	.0001	.0001	.0001
−3.5	.0002	.0002	.0002	.0002	.0002	.0002	.0002	.0002	.0002	.0002
−3.4	.0003	.0003	.0003	.0003	.0003	.0003	.0003	.0003	.0003	.0002
−3.3	.0005	.0005	.0005	.0004	.0004	.0004	.0004	.0004	.0004	.0003
−3.2	.0007	.0007	.0006	.0006	.0006	.0006	.0006	.0005	.0005	.0005
−3.1	.0010	.0009	.0009	.0009	.0008	.0008	.0008	.0008	.0007	.0007
−3.0	.0013	.0013	.0013	.0012	.0012	.0011	.0011	.0011	.0010	.0010
−2.9	.0019	.0018	.0018	.0017	.0016	.0016	.0015	.0015	.0014	.0014
−2.8	.0026	.0025	.0024	.0023	.0023	.0022	.0021	.0021	.0020	.0019
−2.7	.0035	.0034	.0033	.0032	.0031	.0030	.0029	.0028	.0027	.0026
−2.6	.0047	.0045	.0044	.0043	.0041	.0040	.0039	.0038	.0037	.0036
−2.5	.0062	.0060	.0059	.0057	.0055	.0054	.0052	.0051	.0049	.0048
−2.4	.0082	.0080	.0078	.0075	.0073	.0071	.0069	.0068	.0066	.0064
−2.3	.0107	.0104	.0102	.0099	.0096	.0094	.0091	.0089	.0087	.0084
−2.2	.0139	.0136	.0132	.0129	.0125	.0122	.0119	.0116	.0113	.0110
−2.1	.0179	.0174	.0170	.0166	.0162	.0158	.0154	.0150	.0146	.0143
−2.0	.0228	.0222	.0217	.0212	.0207	.0202	.0197	.0192	.0188	.0183
−1.9	.0287	.0281	.0274	.0268	.0262	.0256	.0250	.0244	.0239	.0233
−1.8	.0359	.0351	.0344	.0336	.0329	.0322	.0314	.0307	.0301	.0294
−1.7	.0446	.0436	.0427	.0418	.0409	.0401	.0392	.0384	.0375	.0367
−1.6	.0548	.0537	.0526	.0516	.0505	.0495	.0485	.0475	.0465	.0455
−1.5	.0668	.0655	.0643	.0630	.0618	.0606	.0594	.0582	.0571	.0559
−1.4	.0808	.0793	.0778	.0764	.0749	.0735	.0721	.0708	.0694	.0681
−1.3	.0968	.0951	.0934	.0918	.0901	.0885	.0869	.0853	.0838	.0823
−1.2	.1151	.1131	.1112	.1093	.1075	.1056	.1038	.1020	.1003	.0985
−1.1	.1357	.1335	.1314	.1292	.1271	.1251	.1230	.1210	.1190	.1170
−1.0	.1587	.1562	.1539	.1515	.1492	.1469	.1446	.1423	.1401	.1379
−0.9	.1841	.1814	.1788	.1762	.1736	.1711	.1685	.1660	.1635	.1611
−0.8	.2119	.2090	.2061	.2033	.2005	.1977	.1949	.1922	.1894	.1867
−0.7	.2420	.2389	.2358	.2327	.2296	.2266	.2236	.2206	.2177	.2148
−0.6	.2743	.2709	.2676	.2643	.2611	.2578	.2546	.2514	.2483	.2451
−0.5	.3085	.3050	.3015	.2981	.2946	.2912	.2877	.2843	.2810	.2776
−0.4	.3446	.3409	.3372	.3336	.3300	.3264	.3228	.3192	.3156	.3121
−0.3	.3821	.3783	.3745	.3707	.3669	.3632	.3594	.3557	.3520	.3483
−0.2	.4207	.4168	.4129	.4090	.4052	.4013	.3974	.3936	.3897	.3859
−0.1	.4602	.4562	.4522	.4483	.4443	.4404	.4364	.4325	.4286	.4247
−0.0	.5000	.4960	.4920	.4880	.4840	.4801	.4761	.4721	.4681	.4641

Area
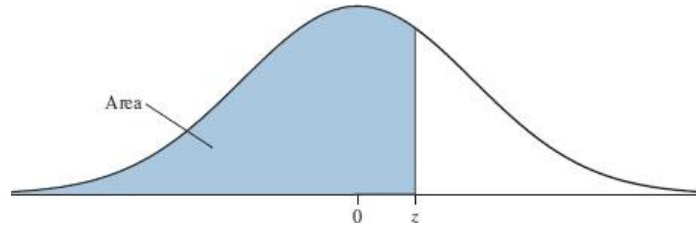
z	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	.5000	.5040	.5080	.5120	.5160	.5199	.5239	.5279	.5319	.5359
0.1	.5398	.5438	.5478	.5517	.5557	.5596	.5636	.5675	.5714	.5753
0.2	.5793	.5832	.5871	.5910	.5948	.5987	.6026	.6064	.6103	.6141
0.3	.6179	.6217	.6255	.6293	.6331	.6368	.6406	.6443	.6480	.6517
0.4	.6554	.6591	.6628	.6664	.6700	.6736	.6772	.6808	.6844	.6879
0.5	.6915	.6950	.6985	.7019	.7054	.7088	.7123	.7157	.7190	.7224
0.6	.7257	.7291	.7324	.7357	.7389	.7422	.7454	.7486	.7517	.7549
0.7	.7580	.7611	.7642	.7673	.7704	.7734	.7764	.7794	.7823	.7852
0.8	.7881	.7910	.7939	.7967	.7995	.8023	.8051	.8078	.8106	.8133
0.9	.8159	.8186	.8212	.8238	.8264	.8289	.8315	.8340	.8365	.8389
1.0	.8413	.8438	.8461	.8485	.8508	.8531	.8554	.8577	.8599	.8621
1.1	.8643	.8665	.8686	.8708	.8729	.8749	.8770	.8790	.8810	.8830
1.2	.8849	.8869	.8888	.8907	.8925	.8944	.8962	.8980	.8997	.9015
1.3	.9032	.9049	.9066	.9082	.9099	.9115	.9131	.9147	.9162	.9177
1.4	.9192	.9207	.9222	.9236	.9251	.9265	.9279	.9292	.9306	.9319
1.5	.9332	.9345	.9357	.9370	.9382	.9394	.9406	.9418	.9429	.9441
1.6	.9452	.9463	.9474	.9484	.9495	.9505	.9515	.9525	.9535	.9545
1.7	.9554	.9564	.9573	.9582	.9591	.9599	.9608	.9616	.9625	.9633
1.8	.9641	.9649	.9656	.9664	.9671	.9678	.9686	.9693	.9699	.9706
1.9	.9713	.9719	.9726	.9732	.9738	.9744	.9750	.9756	.9761	.9767
2.0	.9772	.9778	.9783	.9788	.9793	.9798	.9803	.9808	.9812	.9817
2.1	.9821	.9826	.9830	.9834	.9838	.9842	.9846	.9850	.9854	.9857
2.2	.9861	.9864	.9868	.9871	.9875	.9878	.9881	.9884	.9887	.9890
2.3	.9893	.9896	.9898	.9901	.9904	.9906	.9909	.9911	.9913	.9916
2.4	.9918	.9920	.9922	.9925	.9927	.9929	.9931	.9932	.9934	.9936
2.5	.9938	.9940	.9941	.9943	.9945	.9946	.9948	.9949	.9951	.9952
2.6	.9953	.9955	.9956	.9957	.9959	.9960	.9961	.9962	.9963	.9964
2.7	.9965	.9966	.9967	.9968	.9969	.9970	.9971	.9972	.9973	.9974
2.8	.9974	.9975	.9976	.9977	.9977	.9978	.9979	.9979	.9980	.9981
2.9	.9981	.9982	.9982	.9983	.9984	.9984	.9985	.9985	.9986	.9986
3.0	.9987	.9987	.9987	.9988	.9988	.9989	.9989	.9989	.9990	.9990
3.1	.9990	.9991	.9991	.9991	.9992	.9992	.9992	.9992	.9993	.9993
3.2	.9993	.9993	.9994	.9994	.9994	.9994	.9994	.9995	.9995	.9995
3.3	.9995	.9995	.9995	.9996	.9996	.9996	.9996	.9996	.9996	.9997
3.4	.9997	.9997	.9997	.9997	.9997	.9997	.9997	.9997	.9997	.9998
3.5	.9998	.9998	.9998	.9998	.9998	.9998	.9998	.9998	.9998	.9998
3.6	.9998	.9998	.9999	.9999	.9999	.9999	.9999	.9999	.9999	.9999