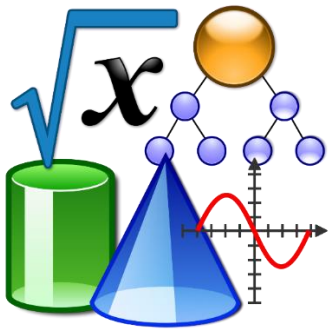
NPS Learning in Place

AFDA



Name _____ School _____ Teacher _____

May 18 – June 5

Week 1	• **Properties of Normal Distribution** • **Box-and-Whisker Plot** • **Standard Deviation** • **Interpreting Z-score**
Week 2	• **Z-Score** • **Probability Density**
Week 3	• **Sample size and Reporting**

Week 1- Day 1

Notes Mean, Median, Mode & Range

How Do You Use Mode, Median, Mean, and Range to Describe Data?

There are many ways to describe the characteristics of a set of data. The mode, median, and mean are all called **measures of central tendency**. These measures of central tendency and range are described in the table below.

Mode	The **mode** of a set of data describes which value occurs most frequently. If two or more numbers occur the same number of times and occur more often than all the other numbers in the set, those numbers are all modes for the data set. If each number in the set occurs the same number of times, the set of data has no mode.	Use the mode to show which value in a set of data occurs most often. For the set {1, 1, 2, 3, 5, 6, 10}, the mode is 1 because it occurs most frequently.
Median	The **median** of a set of data describes what value is in the middle if the set is ordered from greatest to least or from least to greatest. If there are an even number of values, the median is the average of the two middle values.	Use the median to show which number in a set of data is in the middle when the numbers are listed in order. For the set {1, 1, 2, 3, 5, 6, 10}, the median is 3 because it is in the middle when the numbers are listed in order.
Mean	The **mean** of a set of data describes their average. To find the mean, add all of the numbers and then divide by the number of items in the set.	Use the mean to show the numerical average of a set of data. For the set {1, 1, 2, 3, 5, 6, 10}, the mean is the sum, 28, divided by the number of items, 7. The mean is 28 ÷ 7 = 4.
Range	*The "range" is the difference of the largest and smallest number in a data set.*	Use the range to show how much the numbers vary. For the set {1, 1, 2, 3, 5, 6, 10}, the range is 10 – 1 = 9.

Example: Find the mean, median, mode, and range of the data set. {3, 5, 7, 10, 13, 1, 3}

Step 1: Place numbers in order from **least to greatest**: 1, 3, 3, 5, 7, 10, 13

be sure to count to make sure it's the same amount of numbers

Step 2: Mode is the number that appears most often: **3**

Step 3: Median is the number in the middle of the data set: 1, 3, 3, (5) 7, 10, 13

if it's two numbers add them and divide by 2

Step 4: Range, subtract biggest number by the smallest: **13 – 1 = 12**

Step 5: Mean(average), add all numbers up and divide by the number of entries you have:

1+3+3+5+7+10+13 = 42 ÷ 7 = 6

Day 1 Practice: Find the mean, median, mode, and range for each data set.

1) 13, 6, 24, 18, 5, 13, 9, 11, 15, 6, 13

Mean : _____ Median : _____ Mode : _____ Range : _____

2) 34, 16, 41, 20, 62, 74, 62, 12, 22,

Mean : _____ Median : _____ Mode : _____ Range : _____

3) 52, 10, 45, 23, 68, 84, 23, 52, 36, 23

Mean : _____ Median : _____ Mode : _____ Range : _____

4) 98, 64, 75, 57, 86, 60, 91, 98, 79

Mean : _____ Median : _____ Mode : _____ Range : _____

5) 25, 85, 40, 63, 29, 85, 44, 32, 15

Mean : _____ Median : _____ Mode : _____ Range : _____

6) 61, 21, 80, 46, 37, 70, 59, 65, 46

Mean : _____ Median : _____ Mode : _____ Range : _____

Day 2: Box and Whisker Notes

Vocabulary

Median(Q2) – The middle number of a set of data.

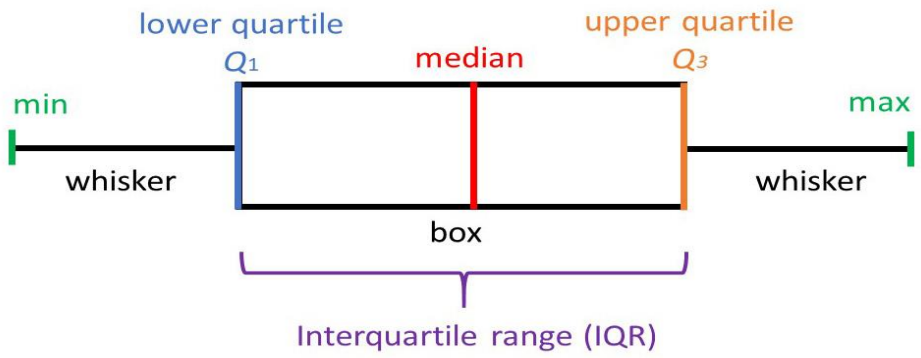
Upper Quartile(Q3) – The median of the data values that are greater than the median of the total data set.

Lower Quartile(Q1) – The median of the data values that are less than the median of the total data set.

Upper Extreme (MAX) – The highest number in a set of data.

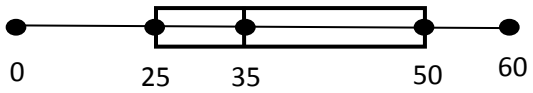
Lower Extreme (MIN) – The lowest number in a set of data.

Interquartile range(IQR) - the difference between the upper quartile and the lower quartile.



- **No matter the shape of the plot, between each piece of the plot is 25% of the data.**
  - **Each part has the same amount of data points between it.**

Use the following box-and-whisker plot to answer questions the next four questions.



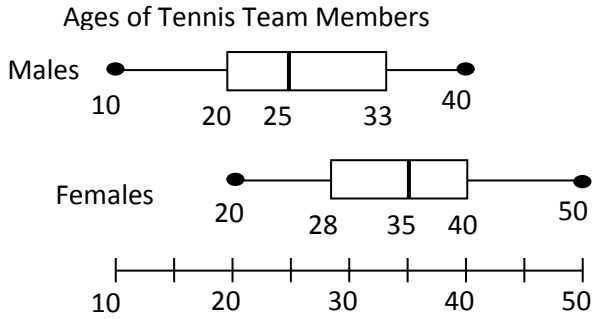
1. Write the value that represents the median.

2. Find the range of the values.

3. What is the interquartile range of this data?

4. What percent of the population is between 25 and 35?

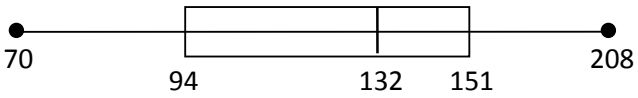
A 25% B 50% C 75% D 100%



5. Use this data display to answer the question. Which statement is true?

A The youngest male player is older than the youngest female player.
B Twenty-five percent of the males are between 10 and 25 years of age.
C There is a forty-year range in age for the female team.
D As a group, the female team has older members than the male team.

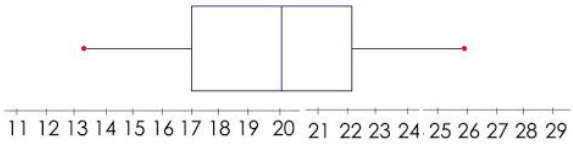
6. Which score represents the median score?



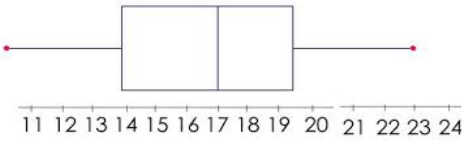
A 70 B 94 C 132 D 151

7. Place an X next to the data that has a median of 17.

_____



_____



Day 3: Standard Deviation Notes

Vocabulary

- **Standard Deviation (s or σ) –** shows the variation in the data, how spread out the data points are.
  - **The bigger the standard deviation the more spread out the data points are.**
  - **The smaller the standard deviation the closer the data points are together**
- **Variance (σ^2) –** the standard deviation squared.
- **Mean (x or μ) –** the average of the data points.

How to create a normal distribution curve using the mean and standard deviation

Step 1: Find the mean **(μ)**
Step 2: Find the standard deviation **(you may not have a calculator so we are going to give you the standard deviation)**

$$\textit{standard deviation is:}\quad \sigma = \sqrt{\frac{\Sigma(x-\bar{x})^2}{n}}$$

Step 3: Add the standard deviation to the mean **(μ)** once, twice and three times to create the right side of the normal curve.
Step 4: Subtract the standard deviation from the mean **(μ)** once, twice and three times to create the left side.

Example 1: Given the quiz scores 30, 50, 60, 70, 90. Draw a normal distribution curve.

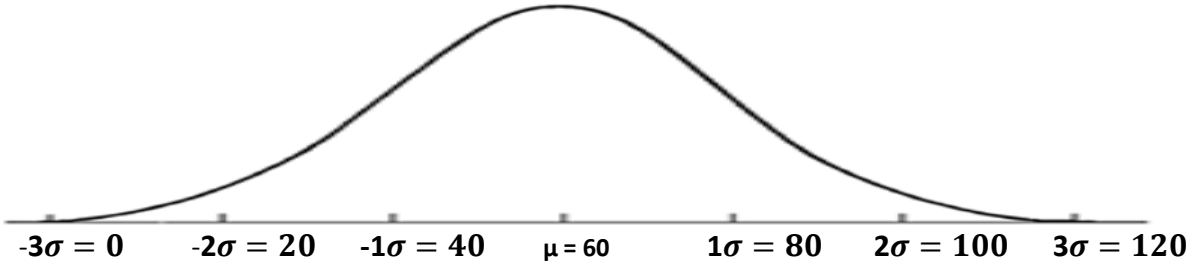
Step 1: $\frac{30+50+60+70+90}{5} = 60 = (\mu)$

Step 2: Standard deviation: σ= 20

Step 3: **60 + 20 = 80 (1 standard deviation to the right from the mean:1σ)**
80 + 20 = 100 (2 standard deviations to the right from the mean:2σ)
100 + 20 = 120 (3 standard deviations to the right from the mean:3σ)

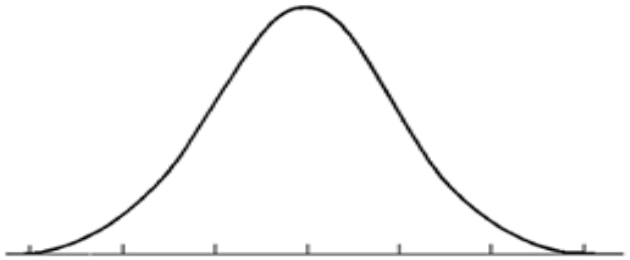
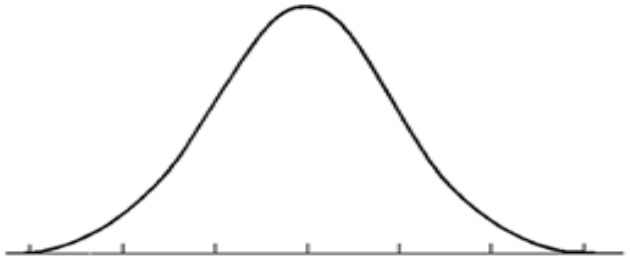
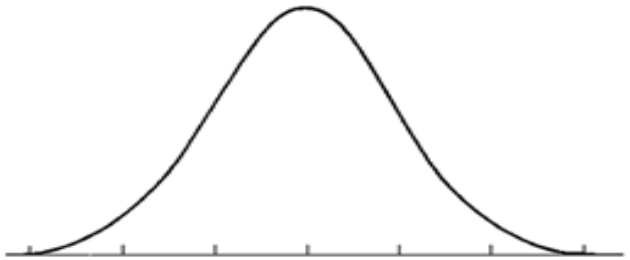
Step 4: **60 - 20 = 40 (1 standard deviation to the left from the mean: -1σ)**
40 - 20 = 20 (2 standard deviations to the right from the mean: -2σ)
20 - 20 = 0 (3 standard deviations to the right from the mean: -3σ)

Let's create the normal distribution curve



Day 3 Practice:Normal Distribution Cruve

Introducing the Bell Curve

Data	Mean	Standard Deviation	Normal Bell Curve
The prom committee kept count on how many tickets it sold each day during lunch: 12, 32, 36, 41, 22, 47, 51, 33, 37, 49.		$\sigma = 11.5$	
A rescue agency records the number of pets adopted each month: 14, 18, 12, 17, 15, 20.		$\sigma = 2.6$	
An amusement park manager wanted to keep track of how many bags of cotton candy were sold each hour: 16, 24, 15, 17, 22, 16, 18, 24, 17, 13, 25, 21.		$\sigma = 3.85$	

Day 4: Z-score Notes

Vocabulary

- **Z-score (z) –** the number of standard deviations a data point is from the mean(average) of the data.
  - **A negative z-score means below the mean.**
  - **A positive z-score means above the mean.**

Finding Z-score

1. Subtract the mean (average: μ) from **the given data point.**
2. Divide the solution from step 1 by the standard deviation.
3. The final answer is the number of standard deviations from the mean (Z-score).

Score, Mean, SD

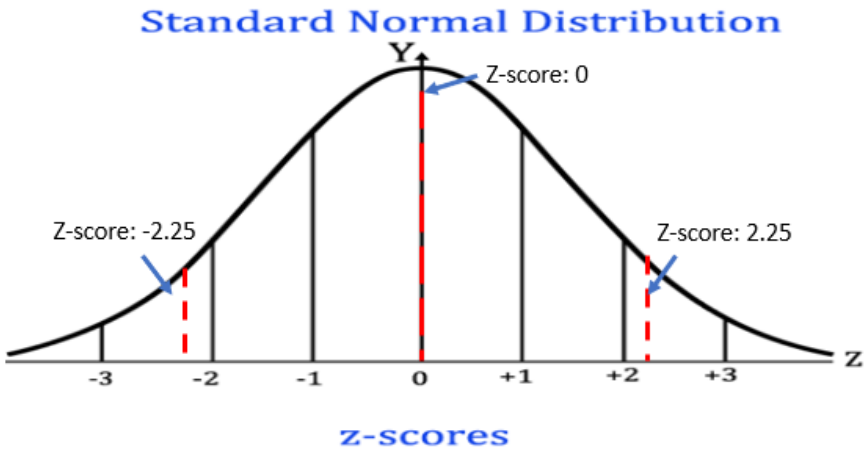
$$Z = \frac{x - \mu}{\sigma}$$

$$Z = \frac{x - \bar{x}}{s}$$

Example: Find the z-score of the test scores of 82, 91, 73, if the average score is 82 with a standard deviation of 4.

Step 1: 82 – 82 = 0	Step 1: 91 – 82 = 9	Step 1: 73 – 82 = -9
Step 2: 0 ÷ 4 = 0	Step 2: 9 ÷ 4 = 2.25	Step 2: -9 ÷ 4 = -2.25
Step 3: 0	Step 3: 2.25	Step 3: -2.25
Z-score of 82: 0	Z-score of 91: 2.25	Z-score of 73: -2.25

Let's create the normal distribution curve



Day 4: Z- Score Practice Problems

1) A population has a mean of 45 and a standard deviation of 5. Find the z-scores of the following raw scores:

   a) score = 47

   b) score = 48

   c) score = 40

   d) score = 39

2) The following table shows the scores of a person on six different scales of an aptitude test. Also shown are the means and standard deviations of these scales.

Test	Mean	Standard Deviation	Score	Z-Score
Clerical Ability	50	15	41	
Logical Reasoning	40	4	47	
Mechanical Ability	120	25	100	
Numerical Reasoning	100	10	105	
Spatial Relations	70	20	90	
Verbal Fluency	60	6	70	

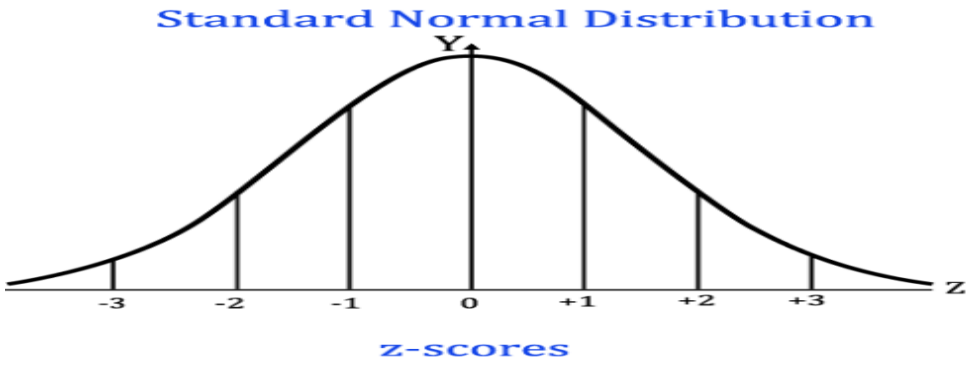
   a) Calculate the z-scores for each.

   b) How many scores are below the mean? Explain your answer

   c) How many scores are above the mean? Explain your answer

   d) On which test did subject 1 score the highest? Which did subject 1 score the lowest?

   e) Label the approximate location of each score on the normal distribution curve below.



3) Convert the following test scores to z-scores and then decide which is the student's best and worst area of performance. Label the approximate location of each score in the normal distribution curves below.

a) Best:_____ Worst:_____

Test	Score	Mean	Standard Deviation	Z-Score
MATH	87	80	5	
SCIENCE	90	92	16	
ENGLISH	75	55	18	

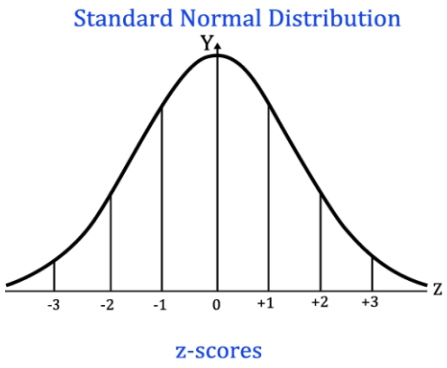
b) Best:_____ Worst:_____

Test	Score	Mean	Standard Deviation	Z-Score
BUSSINESS 205	38	50	18	
SOCIOLOGY 201	28	15	21	
ACCOUNTING 101	45	20	16	

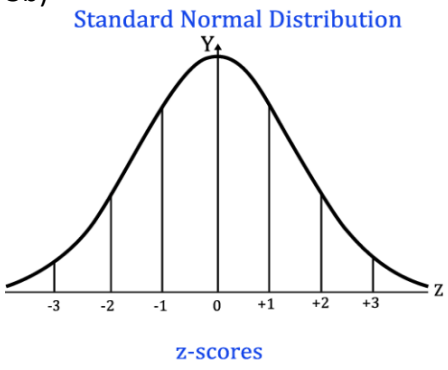
c) Best:_____ Worst:_____

Test	Score	Mean	Standard Deviation	Z-Score
HISTORY 100	48	35	20	
WRITING 100	38	22	30	
PSYCHOLOGY 100	55	19	15	

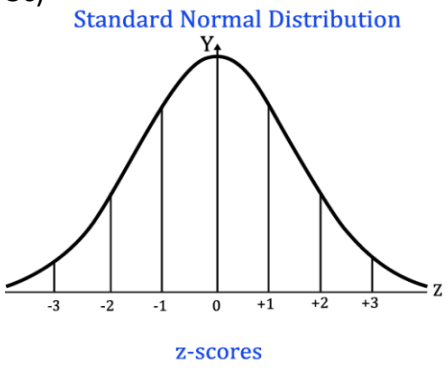
3a)



3b)



3c)



Day 5: More Z-score Practice

Name_____
Date_____

1. The mean speed of vehicles along a stretch of highway is 56 mph with a standard deviation of 4 mph. You measure the speed of three cars traveling along this stretch of highways as 62 mph, 47 mph, and 56 mph. Find the z-score that corresponds to each speed.

2. The monthly utility bills in a city have a mean of $70 and a standard deviation of $8. Find the z-scores that correspond to utility bills of $60, $71 and $92.

3. A certain brand of automobile tire has a mean life span of 35,000 miles and a standard deviation of 2250 miles. If the life spans of three randomly selected tires are 34,000 miles, 37,000 miles, and 31,000 miles. Find the z-scores that correspond with each of these mileages.

4. A highly selective university will only admit students who place at least 2-zcores above the mean on the ACT that has a mean of 18 and a standard deviation of 6. What is the minimum score that an applicant must obtain to be admitted to the university?

5. The average for the statistics exam was 75 and the standard deviation was 8. Andrey was told by the instructor that he scored 1.5 standard deviations below the mean. What was Andrey's exam score ??

Week 1 Day 1: Practice 2007 Quarterback Salary Data Table
Calculate the Z-score

Data from USA Today				
Team Name	Quarterback Salary	Mean	Standard Deviation	z- score **(round to the nearest hundredth)**
	x	μ	σ	$\frac{x-\mu}{\sigma}$
Bears	$2,039,800			-0.82
Bengals	$7,250,000			
Bills	$1,804,560			
Broncos	$8,253,020			
Browns	$1,147,000			
Buccaneers	$5,003,360			
Cardinals	$10,339,920			
Chargers	$5,005,760			
Chiefs	$3,753,600			
Colts	$11,003,840			
Cowboys	$1,506,000			
Dolphins	$6,000,000			
Eagles	$5,504,080			
Falcons	$3,503,720			
Forty-niners	$1,675,000			
Giants	$6,450,000	**$5, 286,687.50**	**$3,959,515.75**	
Jaguars	$1,105,280			
Jets	$4,000,000			
Lions	$1,500,000			
Packers	$11,000,480			
Panthers	$7,400,000			
Patriots	$6,005,160			
Raiders	$3,200,000			
Rams	$17,502,040			
Ravens	$4,001,200			
Redskins	$578,020			
Saints	$3,000,000			
Seahawks	$6,004,320			
Steelers	$1,009,840			
Texans	$8,000,000			
Titans	$13,143,000			
Vikings	$1,485,000			

Day 2

Using the 2007 Quarterback Salary Data from the previous page, answer the following questions:

1.
a) What information does the mean provide?

b) How many salaries are above the mean? _____

c) How many salaries are below the mean? _____

d) Which quarterback salaries are within one standard deviation of the mean?

e) Which quarterback salaries are *not* within two standard deviations of the mean?

2.
a) Find which team's quarterback has a salary farthest from the mean. What was the corresponding z-score?

b) Find which team's quarterback has a salary closest to the mean. What was the corresponding z-score?

c) What information does each z-score provide?

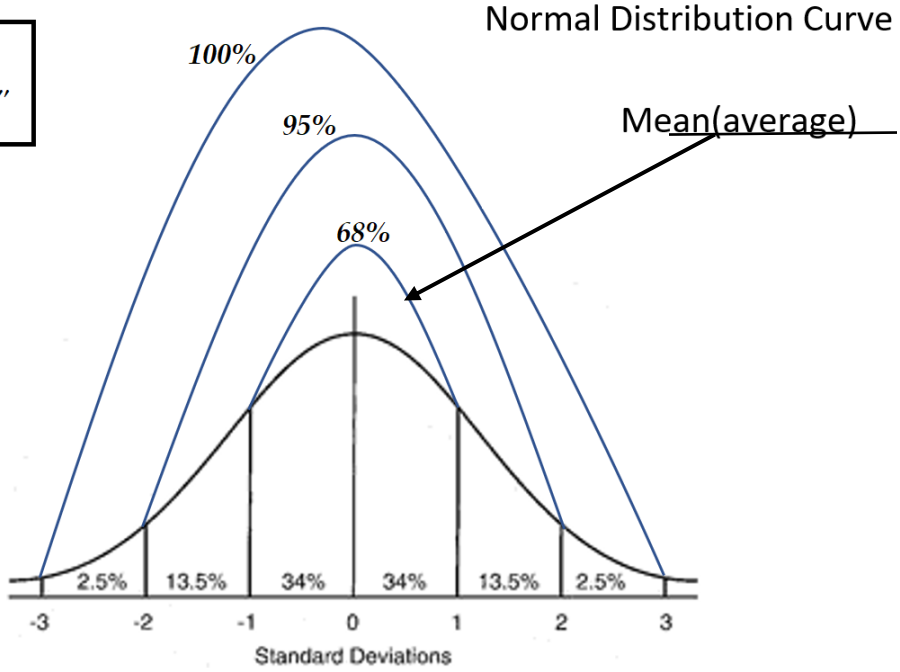
d) Determine how many of the z-scores are positive and how many are negative. Then, explain why that makes sense.

e) What is the sum of all of the z-scores? Explain why this makes sense.

Day 3 PERCENT OF DATA NOTES

All percentages are "roughly" not "exact"

Normal Distribution Curve Notes



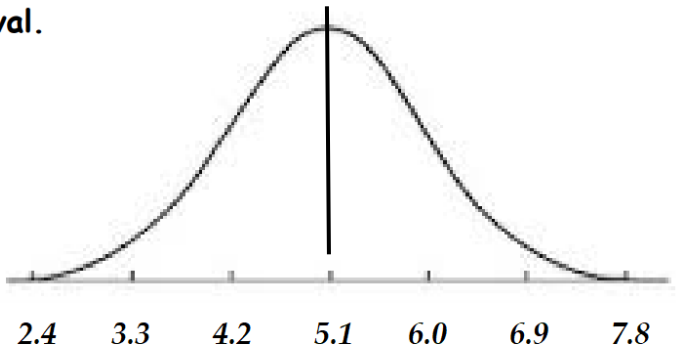
Below the mean Above the mean

To label a normal curve.

1. The mean(average) is the middle number.
2. Add standard deviation to the mean for the first line to the right.
3. Add standard deviation to the solution of step 2 for the next line on the right.
4. Add standard deviation to the solution of step 3 for the next line on the right
5. Subtract standard deviation from the mean for the first line to the left.
6. Subtract standard deviation from the solution of step 5 for the next left line.
7. Subtract standard deviation from the solution of step 6 for the next left line.

You Try It!

A set of data has a normal distribution with a mean of 5.1 and a standard deviation of 0.9. Find the percent of data within each interval.

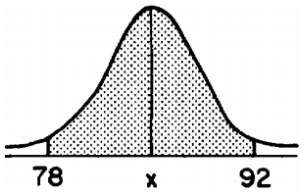


1. Sketch a normal curve for the distribution.
2. between 6.0 and 6.9
3. greater than 6.9
4. between 4.2 and 6.0
5. less than 4.2

Follow steps 1 through 7 2.) **13.5%** 3.) **2.5%** 4.) **68%** 5.) **16%**

Day 3 Practice

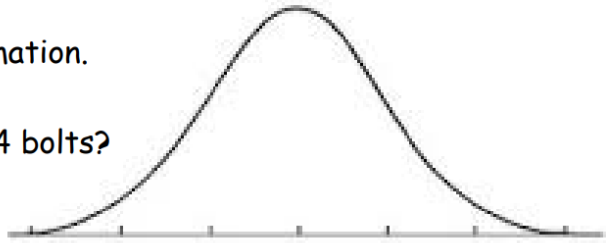
1. In the accompanying diagram, the shaded area represents approximately 95% of the scores on a standardized test. If these scores ranged from 78 to 92,



   a) What is the mean?

   b) What is the standard deviation?

2. A machine is used to put bolts into boxes. It does so such that the actual number of bolts in a box is normally distributed with a mean of 106 and a standard deviation of 2.



   a) Draw and label the Normal curve from the information.

   b) What percentage of boxes contain more than 104 bolts?

   c) What percentage of boxes contain more than 110 bolts?

   d) What percentage of boxes contain less than 108 bolts?

   e) What percentage of boxes contain less than 100 bolts?

   f) What percentage of boxes contain between 102 and 112 bolts?

   g) What percentage of boxes contain between 100 and 106 bolts?

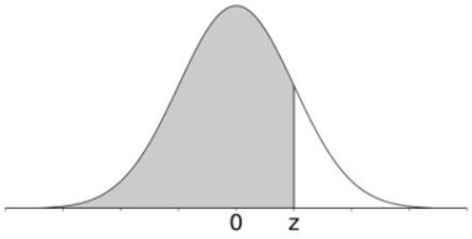
3. On a standardized test, Phyllis scored 84, exactly one standard deviation above the mean. If the standard deviation for the test is 6, what is the mean score for the test?

4. The heights of a group of girls are normally distributed with a mean of 66 inches. If 95% of the heights of these girls are between 63 and 69 inches, what is the standard deviation for this group?

5. A set of scores with a normal distribution has a mean of 50 and a standard deviation of 7. Approximately what percent of the scores fall in the range 36-64?

Day 4 Probability Density Notes
How to read the Table of Standard Nomal Probabilities

Table of Standard Normal Probabilities for Positive Z-Scores



z	.00	.01	.02	.03	.04	.05	.06	.07	.08	.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

Zoe (z-score = 1.25)

To use the z-score table, start on the left side of the table go down to 1.2. At the top of the table, go to 0.05 (this corresponds to the value of 1.2 + .05 = 1.25). The value in the table is .8944 which is the probability. Roughly 89.44% of people scored worse than her on the ACT.

Z-Table:

Measures the area to the *left* of a value. For example, z = 1.68

z	.00	.01	.02	.03	.04	.05	.06	.07	.08	.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
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

gives us a value of 0.9535, which mean 95.35% of the area under the curve is to the left of 1.68 (smaller than it). 4.65% of the area under the curve lies to the right, using the complement rule of probability (1 – P(event) = P(complement)

Table of Standard Normal Probabilities for Negative Z-Scores

z	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
–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

Table of Standard Normal Probabilities for Positive Z-Scores

z	.00	.01	.02	.03	.04	.05	.06	.07	.08	.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

Day 4 Probability Density Practice

1. **A national physical fitness test uses a mile run in its high school fitness test. The time for this event for boys is normally distributed with a mean $\mu = 450$ seconds and a standard deviation $\sigma = 50$ seconds. What is the probability that a randomly selected boy's time is under 335 seconds?**

   A) 0.0107 B) 0.5107 C) 0.4893 D) 0.9893

2. **The actual amount in a 12-oz soft drink container is normally distributed with mean $\mu = 12.23$ oz and a standard deviation $\sigma = 0.04$ oz. What is the probability that a randomly selected bottle contains between 12.13 and 12.19 ounces of soda?**

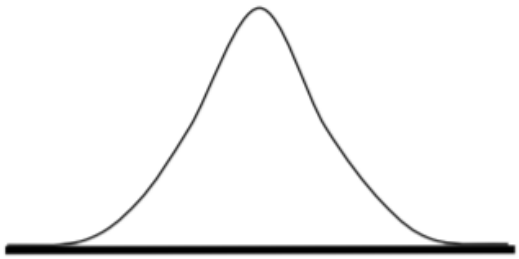
   A) 0.1525 B) 0.1649 C) 0.8351 D) 0.8475

3. **The tread life of a particular brand of tire is normally distributed with a mean $\mu = 60{,}000$ miles and a standard deviation $\sigma = 2500$ miles. What is the probability that a randomly selected tire will last longer than 57,500 miles?**

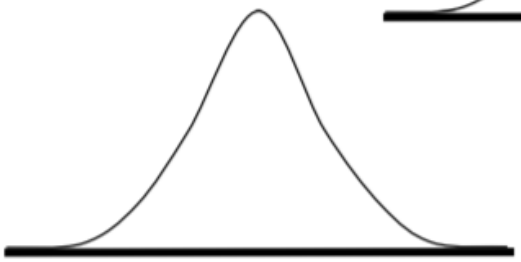
   A) 0.8413 B) 0.1587 C) 0.7266 D) 0.2266

Determine the probability of the *standard normal* random variable *Z* and for problems 4 thru 6; *label* and *shade* the area using the graphs to the right

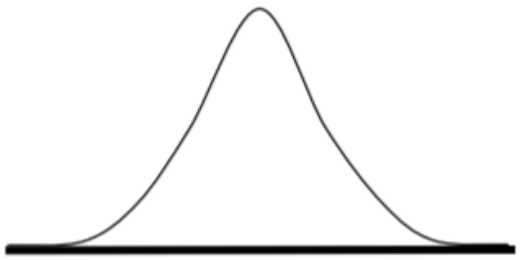
4. **P(Z < 1.93) = _____**



5. **P(Z > 0.92) = _____**



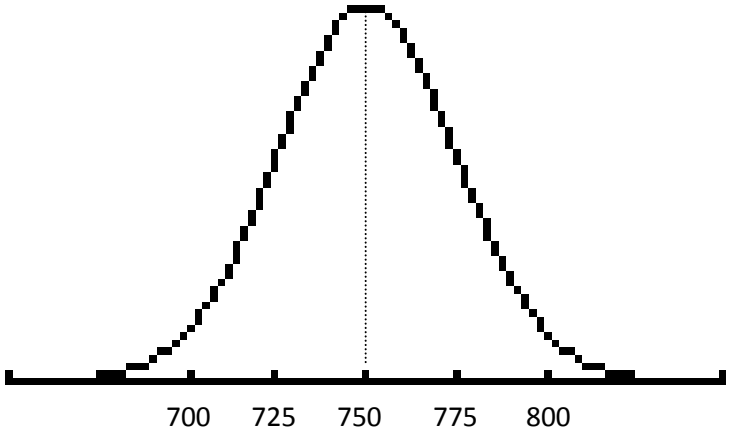
6. **P(-1.23 < Z < 1.56) = _____**



Day 5 Probability Density Additional Notes

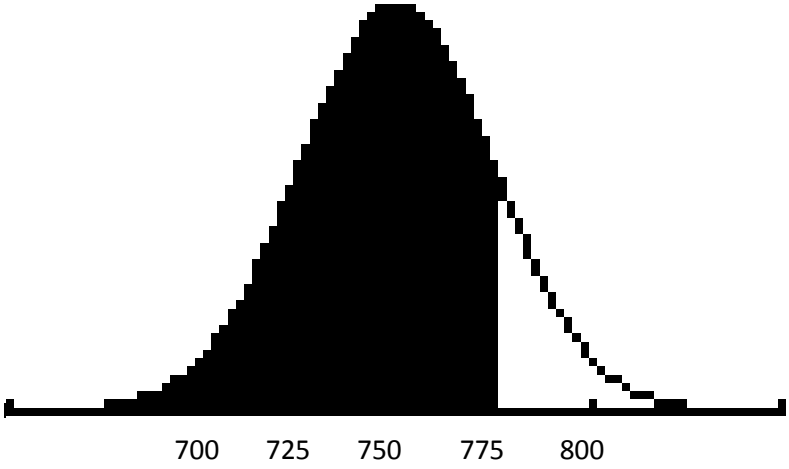
If an experiment generates outcomes that are normally distributed, the standard normal curve can be used to calculate probabilities of specific outcomes.

For example, the life span of a particular machine gasket is normally distributed, with **a mean of 750 hours** with a **standard deviation of 25 hours.**



The accumulated area up to 775 represents the **probability** that the gasket will last 775 or fewer hours.

The shaded area below represents the **probability** that the gasket will last 775 or fewer hours. The corresponding numerical probability is determined using a z-score.



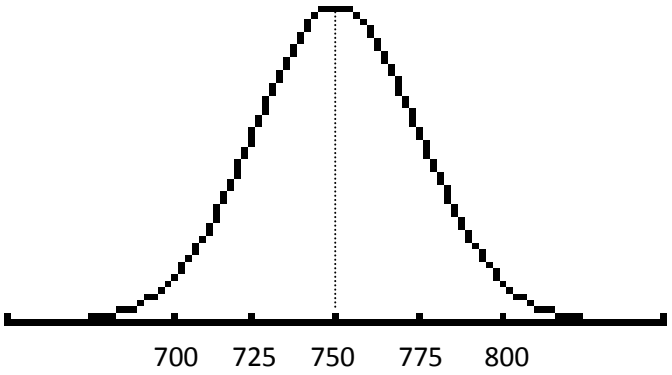
With $z = \frac{775 - 750}{25} = 1$ and using the Standard Normal Table (previous page) , we can see

$$P(x < 775) = 0.841$$

Day 5 Probability Density Practice

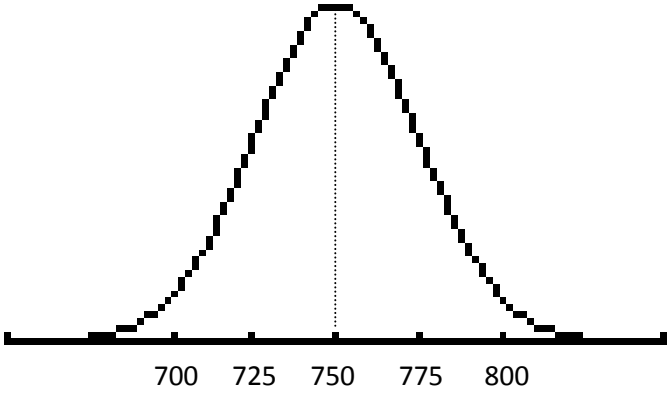
Using the same machine gasket example, shade the region representing the given probability and then determine the numerical probability using the table of Standard Normal Probabilities for Z-scores

1. The probability the gasket will last more than 730 hours.



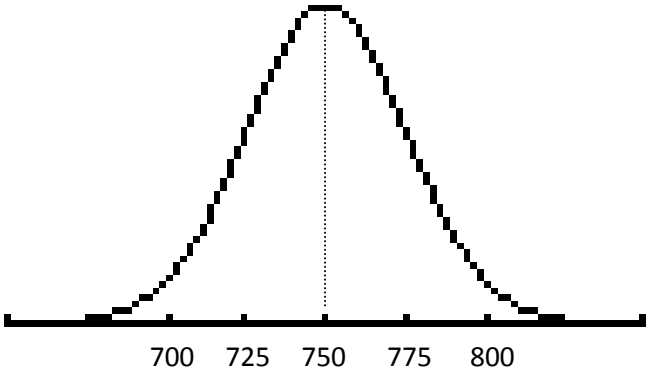
2. The probability the gasket will last more than 730 hours.

P(x > 730)



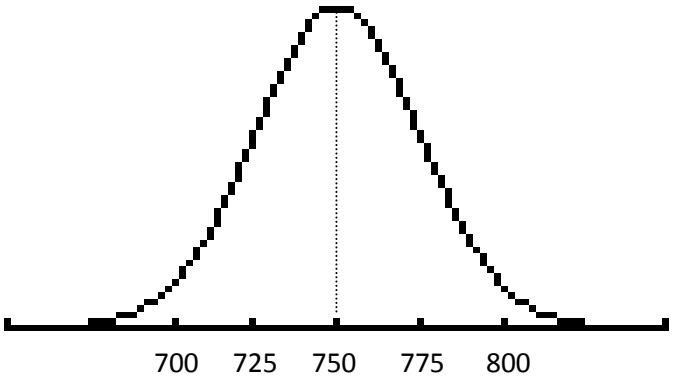
3. The probability the gasket will last less than 785 hours.

P(x < 785)



4. The probability the gasket will last between 730 and 785 hours.

P(730 < x < 785)



Day 1

Notes

Remember….. the types of Sampling:

1. Simple random sampling (SRS)
   - Everyone has an equal chance at selection
   - What statisticians strive for
2. Stratified sampling
   - Some of all
   - Divide into strata (groups), then SRS within groups
3. Cluster sampling
   - All of some
   - Divide into clusters (groups), then census within groups

YOU TRY: Read and respond using your understanding of bias and sampling.

Review

Identify the types of surveys and any problems used in the following:

1. Radio call-in survey on the state of the economy

2. Forty workers are selected randomly at the Wytheville Pepsi plant

3. All teachers in Smyth county are surveyed on a pay issue

4. Every 10^{th} customer at Food City is surveyed about food prices

5. Two English classes are random selected from each grade and every student in that class is surveyed on school uniforms

Activity: In your capacity as an administrative assistant for your county government, you need to assess the attitude of your community for a new highway proposal. Some people will favor the highway in the belief it will provide a greater mobility and promote business. Others will argue that it will bring even more congestion and will negatively impact the environment. You need to submit a preliminary report as soon as possible and someone suggests doing a sample from calling 50 random people from the phone book.

Describe how you would do it.

Do you think your method results in a simple random sample? Why or Why not?

Day 2

Writing Activity:

Suppose you county executive decides that you should survey only registered voters in your community, to determine whether the majority of county residents favor a new highway proposal. You do have a complete list of registered voters, with their party affiliation (34% are Republicans, 45% are Democrats and 21% are independent). Use complete sentences to record your design for this sample survey. You can save money by using a sample of size 100, instead of doing a census. Record a plan for this sample survey:

a) State what you need to know
b) Identify the population that is to be measured, and the sampling frame sampling?
c) Which sampling method, simple random sample or stratified sample, do you think would be best? Give a reason for your choice.
d) How would do the sampling?

Notes

Design of Experiments

Only a well-designed experiment can determine a cause and effect relationship
The three primary areas of an experimental design are

- Control
  - Overall effort to minimize variability in the way the experimental units are obtained and treated
  - Attempts to eliminate the confounding effects of extraneous variables (those not being measured or controlled in the experiment, aka lurking variables)
- Randomization
  - Rules used to assign the experimental units to the treatments
  - Uses impersonal chance to assign experimental units to treatments
  - Increases chances that there are no systematic differences between treatment groups
- Replication
  - Use enough subjects to reduce chance variation
  - Increases the sensitivity of the experiment to differences between treatments

Activity:
In an early activity, we learned to recognize a linear relationship between two variables. Recall that finding a correlation does not necessarily establish a cause-and-effect relationship between two variables. Suppose a survey of elementary school students in our county results in the following scatterplot of reading level versus shoe size.

How would you describe the association between reading level and shoe size?

Based upon your response above, would you be willing to conclude that an increase in shoe size causes a higher reading level? Why or why not?

If your answer was no, can you think of a lurking variable (one that mentioned) that might explain the correlation?

YOU TRY: (on another sheet of paper)

Example 1: A baby-food producer claims that her product is superior to that of her leading competitor, in that babies gain weight faster with her product. As an experiment, 30 healthy babies are randomly selected. For two months, 15 are fed her product and 15 are feed the competitor's product. Each baby's weight gain (in ounces) was recorded.

A) How will subjects be assigned to treatments?
B) What is the response variable (y-variable)?
C) What is the explanatory variable (x-variable)?

Example 2: Two toothpastes are being studied for effectiveness in reducing the number of cavities in children. There are 100 children available for the study.

A) How do you assign the subjects?
B) What do you measure?
C) What baseline data should you know about?
D) What factors might confound this experiment?
E) What would be the purpose of a randomization in this problem?

Day 3

Notes

Vocabulary:

Experimental unit – an individual upon which an experiment is performed; (subject is term used for human beings)
Control Group – a group that does not receive a real treatment
Treatment – a specific experimental condition applied to the experimental units
Statistically significant – a term applied to an observed effect so large that it would rarely occur by chance
Double-blind – neither the subjects nor the observers know which treatments any of the subjects had received in an experiment
Design of Experiments – DOE, a course unto itself
Placebo – a treatment that has no effect
Placebo Effect – the ability of the human mind to respond positively to perceived medicine or attention
Replication – the number of units receiving the same treatment

YOU TRY:

1. What type of an experiment is it when neither the patient nor the doctor knows what type of pill is being given?

2. List the three major components of any experimental design

3. A "sugar pill" is also known as a _____.

4. What is the only thing that can establish cause and effect?

5. What do we call a group in the experiment which treatments are measured against?

6. To help assess student learning in his literature class, an English teacher implemented pre lesson and post-lesson tests for his students. A knowledge-gained score was recorded after the lesson was taught by taking the difference of the two test scores for each student.

   a) What type of experimental design was this?
   b) What was measured (response variable) in this experiment?
   c) What treatment was applied to the subjects?

Days 4-5
Apply it!
• Plan and conduct a survey dealing with the current school closures due to COVID-19. **Be safe – use technology to get responses outside of your household.** • The experimental design should address control, randomization, and minimization of experimental error. • Write a report describing the experiment/survey and the resulting data and analysis.