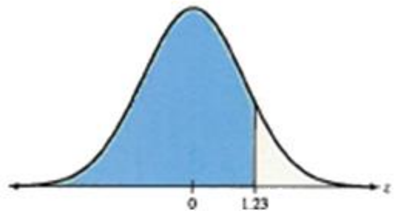
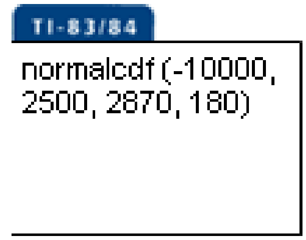
Assignments for Prob/Stat/Discrete
Unit 6 Chapter 5: Normal Probability Distributions

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





Note: You MUST draw a diagram for each problem, unless one is already given. You may use your calculator instead of Table 4, but you must record your keystrokes as part of your work.

Day	Date	**Assignment** (Due the next class meeting)
		6.1 Worksheet
		6.2 Worksheet
		6.3 Worksheet
		6.4 Worksheet
		6.5 Worksheet
		Unit 6 Practice Test Objectives Due!!!
		Unit 6 Test

NOTE: You should be prepared for daily quizzes.

HW reminders:

- If you cannot solve a problem, get help **before** the assignment is due.
- Help is available before school or during lunch
- For extra practice, visit www.interactmath.com
- Click ENTER, then scroll down to Larson, Elementary Statistics 4th edition. Pick the assignment you need extra practice with. You can get immediate feedback and hints.
- Don't forget that you can get 24-hour math help from www.smarthinking.com!

Prob/Stat/Discrete **Name______________________________**
Unit 6 Guided Notes

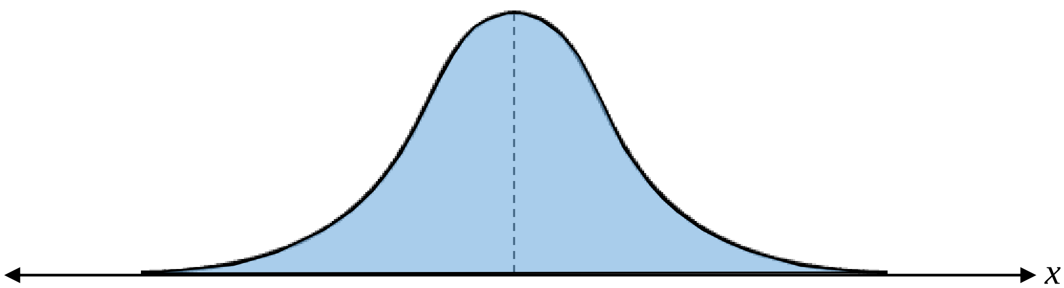
6.1: Introduction to Normal Distributions

Objectives

1. **Can you interpret graphs of normal probability distributions?**
2. **Can you create diagrams of a standard normal curve?**
3. **Can you find areas under the standard normal curve?**
4. **Can you use technology to find areas when given a *z*-score?**

What is normal? Human behavior and characteristics often follow a _______________ pattern, where a large number of people have similar behavior in the center, and a smaller number of people have _____________ behavior.

- Animals, chemicals, physical properties often demonstrate normal behavior.
- Consider the heights of adult females...



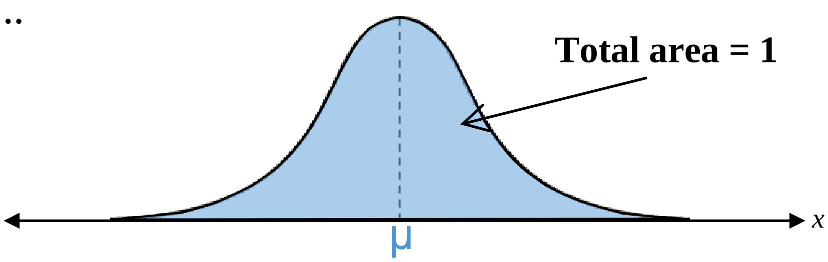
Normal Distribution

- A continuous probability distribution for a random variable, *x*.
- The most ________________ continuous probability distribution in statistics.
- The graph of a normal distribution is called the ___________________ _______________.

Properties of Normal Distribution

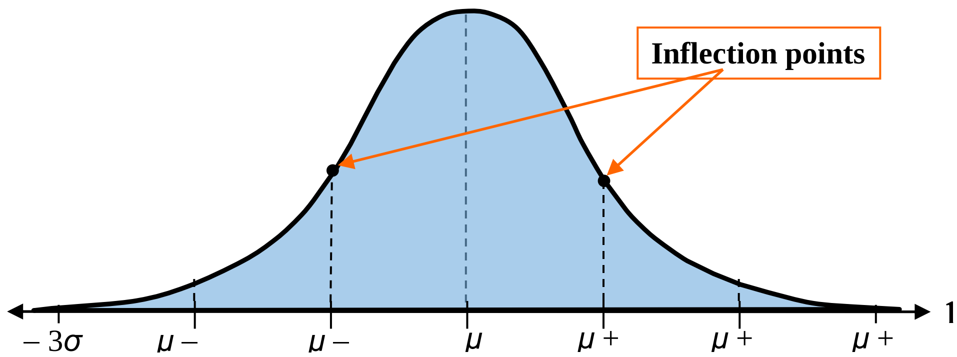
1. The mean, median, and mode are the __________ value.
2. The normal curve is bell-shaped and ______________________ about the mean (μ).
3. The total area under the curve is equal to ______.
4. The normal curve approaches but never touches the *x*-axis as it extends farther and farther away from the mean.

more on next page…



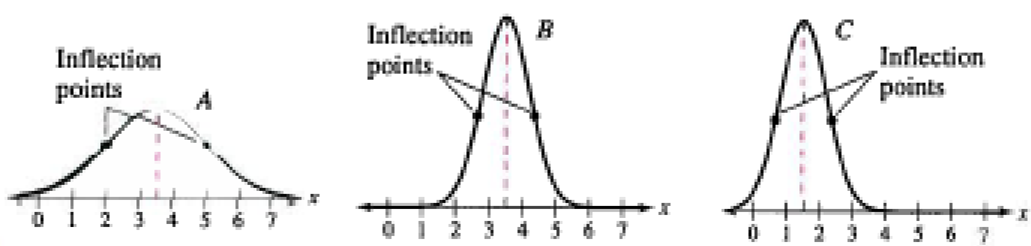
Properties of Normal Distributions, continued…

5. Between μ – σ and μ + σ (in the center of the curve), the graph curves ___________________.
   The graph then curves ________________________ to the left of μ – σ and to the right of μ + σ.
   The points at which the curve changes from curving upward to curving downward are called the _________________________________ ___________________________.



Means and Standard Deviations

- A normal distribution can have any __________ and any positive _______________________ _____________________.
- The ____________ gives the location of the line of symmetry.
- The standard deviation describes the ______________________ of the data.



μ = 3.5 σ = 1.5

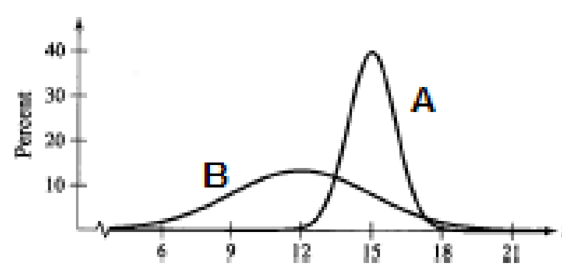
μ = 3.5 σ = 0.7

μ = 1.5 σ = 0.7

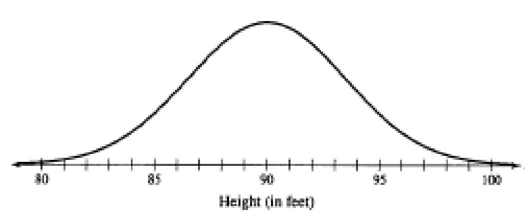
Examples:

1) Which curve has the larger mean?

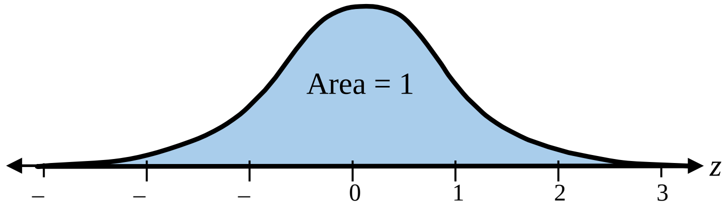
2) Which curve has the larger standard deviation?



3) The heights of fully grown white oak trees are normally distributed. The curve represents the distribution. What is the mean height of a fully grown white oak tree? Estimate the standard deviation.

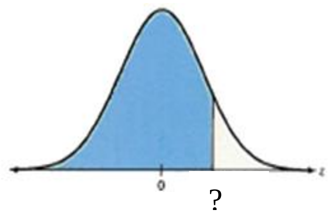


The Standard Normal Distribution: A normal distribution with a mean of _______ and a standard deviation of ________.

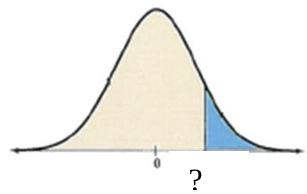


Example 4: For each normal curve, estimate the value of the *z*-score and the area of the shaded region.

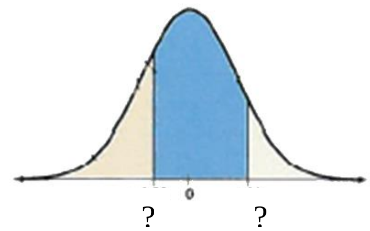
a)



b)



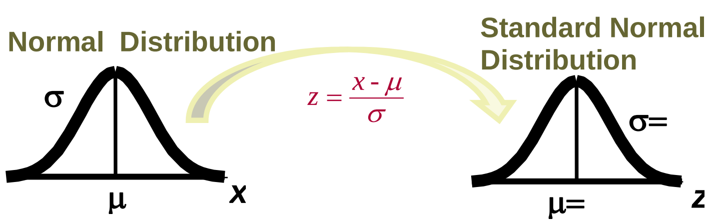
c)



Standardizing Values (*z* – scores): Any *x*-value can be transformed into a *z*-score by using the formula

$$z = \frac{\text{Value - Mean}}{\text{Standard deviation}} = \frac{x - \mu}{\sigma}$$

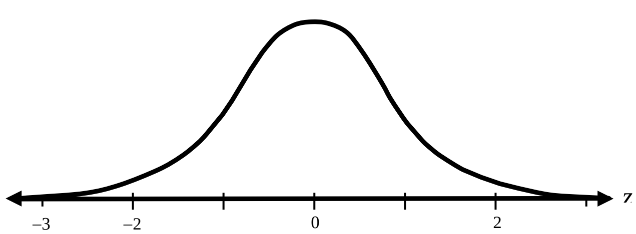
If each data value of a normally distributed random variable *x* is transformed into a *z*-score, the result will be the standard normal distribution.



We can then use the Standard Normal Table or a calculator to find the **cumulative area** (area to the _________) under the standard normal curve.

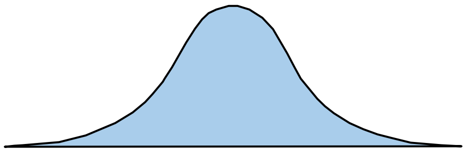
Cumulative Area

1. The cumulative area (to the ________) is close to 0 for *z*-scores close to $z = -3.49$.
2. The cumulative area increases as the *z*-scores increase.
3. The cumulative area for $z = 0$ is 0.5000.
4. The cumulative area is close to 1 for *z*-scores close to $z = 3.49$.



Example 5: Find the cumulative area that corresponds to a *z*-score of 1.15 for a normal curve.
($z < 1.15$)

Step 1: Draw a picture (**required!**)



Step 2: Use the **Standard Normal Table** (Table 4 in the foldout in your book.)

z	.00	.01	.02	.03	.04	.05	.06
0.0	.5000	.5040	.5080	.5120	.5160	.5199	.5239
0.1	.5398	.5438	.5478	.5517	.5557	.5596	.5636
0.2	.5793	.5832	.5871	.5910	.5948	.5987	.6026
0.8	.7881	.7910	.7939	.7967	.7995	.8023	.8051
0.9	.8159	.8186	.8212	.8238	.8264	.8289	.8315
1.0	.8413	.8438	.8461	.8485	.8508	.8531	.8554
1.1	.8643	.8665	.8686	.8708	.8729	.8749	.8770
1.2	.8849	.8869	.8888	.8907	.8925	[illegible]	.8962
1.3	.9032	.9049	.9066	.9082	.9099	.9115	.9131
1.4	.9192	.9207	.9222	.9236	.9251	.9265	.9279

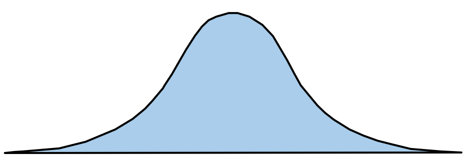
So, the cumulative area at *z* = 1.15 is ________________________.

Alternative method… on your TI-83…**You must draw a picture and record your keystrokes!**

Button	Comments
2nd, DISTR	
2: normalcdf(	*cdf* stands for Cumulative Distribution Function (gives values to the left)
-10,000,	Lower limit; use an extremely small value.
1.15)	The upper limit (the *z*-score when you are finding area to the LEFT)
ENTER	

Example 6: Find the cumulative area that corresponds to a *z*-score of -0.24. ($z < -0.24$)

Step 1: Draw a picture.



Step 2: Use the Standard Normal Table (Table 4.)

z	.09	.08	.07	.06	.05	.04	.03
−3.4	.0002	.0003	.0003	.0003	.0003	.0003	.0003
−3.3	.0003	.0004	.0004	.0004	.0004	.0004	.0004
−3.2	.0005	.0005	.0005	.0006	.0006	.0006	.0006
−0.5	.2776	.2810	.2843	.2877	.2912	.2946	.2981
−0.4	.3121	.3156	.3192	.3228	.3264	.3300	.3336
−0.3	.3483	.3520	.3557	.3594	.3632	.3669	.3707
−0.2	.3859	.3897	.3936	.3974	.4013	.4052	.4090
−0.1	.4247	.4286	.4325	.4364	.4404	.4443	.4483
−0.0	.4641	.4681	.4721	.4761	.4801	.4840	.4880

Alternative Method: Use your TI-83 **(You MUST draw a diagram and record your keystrokes for work.)**

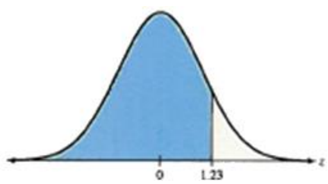
Example 7: Find the area under the standard normal curve to the **right** of $z = -0.99$. ($z > -0.99$)

Example 8: Find the area under the standard normal curve between $z = -0.99$ and $z = 2.61$.

<u>SUMMARY for finding area when the *z*-score is known:</u>

To find area to the LEFT of a *z*-score:

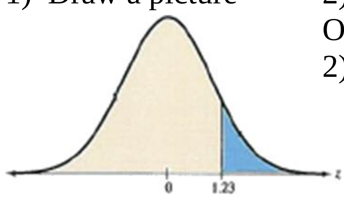
1) Draw a picture.



2) Use Table 4 (the value corresponds to the area to the left.)
OR
2) normalcdf (lower limit such as -1000, *z*-score)

To find the area to the RIGHT of a *z*-score:

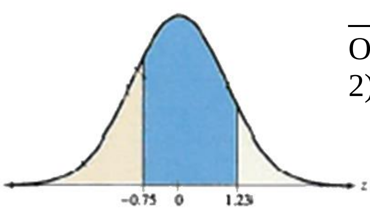
1) Draw a picture



2) Use Table 4, and subtract this value from ___________.
OR
2) normalcdf (*z*-score, up limit such as 1000)

To find the area BETWEEN two *z*-scores:

1) Draw a picture.



2) Use Table 4 to find the area to the left of each value, and ______________________ the smaller area from the larger area.
OR
2) normalcdf (smaller *z*-score, larger *z*-score)

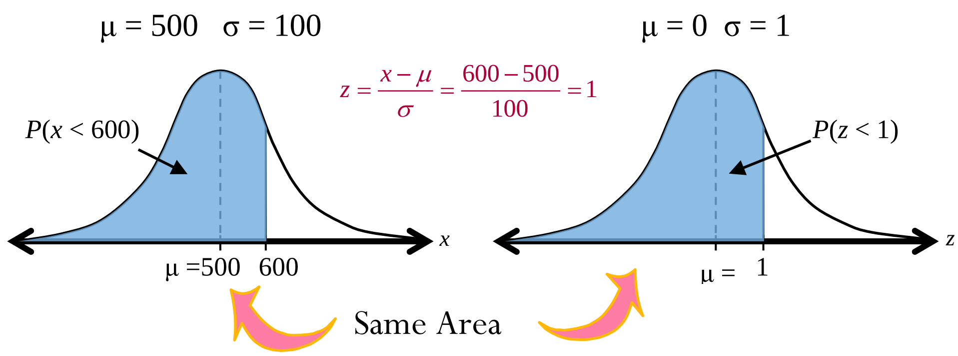
6.2 Notes: Normal Distributions: Finding Probabilities

<u>Objectives</u>:

5. Can you calculate z-scores?
6. Can you explain how area under a normal curve is related to probability?
7. Can you find probabilities for normally distributed variables?
8. Can you use technology to find probabilities?

Probability, Area, and Percent

- With a normal distribution (or any continuous distribution), the probability of getting a value greater or less than *x* is equal to the __________________ of that shaded region.
- Area and Probability are both expressed as ________________.
- Move the decimal two times to the right to change this value to a __________________.



$$P(x < 600) = P(z < 1)$$

Finding Probability with Normal Curves When Given an *x* Value:

Step 1) Draw a Diagram.

Step 2) Transform the *x* value to a *z*-score. $z = \frac{x-\mu}{\sigma}$

Step 3) Use Table 4 or the calculator to find the probability (area.)

Example 1: A survey indicates that people use their computers an average of 2.4 years before upgrading to a new machine. The standard deviation is 0.5 year. A computer owner is selected at random. Find the probability that he or she will use it for fewer than 2 years before upgrading. Assume that the variable *x* is normally distributed.

Example 2: A survey indicates that for each trip to the supermarket, a shopper spends an average of 45 minutes with a standard deviation of 12 minutes in the store. The length of time spent in the store is normally distributed and is represented by the variable x. A shopper enters the store. Find the probability that the shopper will be in the store for between 24 and 54 minutes.

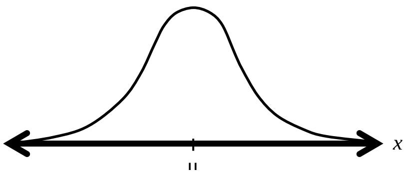
Example 3: Find the probability that the shopper will be in the store more than 39 minutes. (Recall that $\mu = 45$ minutes and $\sigma = 12$ minutes.)

Example 4: If 200 shoppers enter the store, **how many** shoppers would you expect to be in the store more than 39 minutes? (*Note: this question is NOT asking for probability!*)

Using Technology to Find Probability Without Standardizing:

Your TI-83 can automatically transform an *x*-value to a *z*-score (_____________________________), which allows you to skip this step by hand.

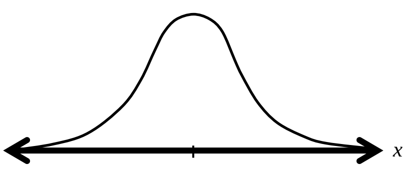
Example 5: Assume that cholesterol levels of men in the United States are normally distributed, with a mean of 215 milligrams per deciliter and a standard deviation of 25 milligrams per deciliter. You randomly select a man from the United States. What is the probability that his cholesterol level is less than 175?



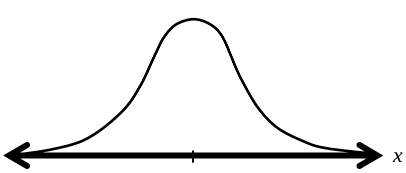
normalcdf (lower limit, upper limit, mean, standard deviation)

Button	Comments
2^{nd}, DISTR	
2: normalcdf(	*cdf* stands for Cumulative Distribution Function (gives values to the left)
0,	Lower limit (the smallest possible cholesterol); use the lowest possible value when finding area to the LEFT
175,	Upper limit (the *x*-value when we are finding are to the LEFT)
215,	The mean
25)	The standard deviation
ENTER	

Example 6: Assume that cholesterol levels of men in the United States are normally distributed, with a mean of 215 milligrams per deciliter and a standard deviation of 25 milligrams per deciliter. You randomly select a man from the United States. What is the probability that his cholesterol level is more than 230?



Example 7: Assume that cholesterol levels of men in the United States are normally distributed, with a mean of 215 milligrams per deciliter and a standard deviation of 25 milligrams per deciliter. You randomly select a man from the United States. What is the probability that his cholesterol level is between 185 and 225?



6.3 Notes: Finding *x* Values (Working BACKWARDS)

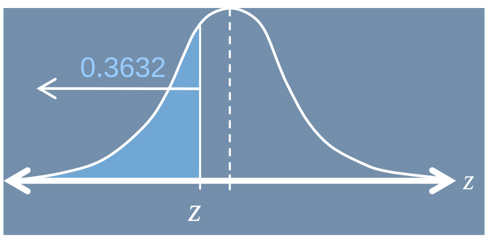
Objectives:

9. Can you find a *z*-score given the area under the normal curve?
10. Can you transform a *z*-score to an *x*-value?
11. Can you find a specific data value of a normal distribution when given the probability?

Working Backwards:

- In section 5.2 we were given a normally distributed random variable *x* and we were asked to find a probability.
- In this section, we will be given a probability or *z*-score and we will be asked to find the value of the random variable *x*.

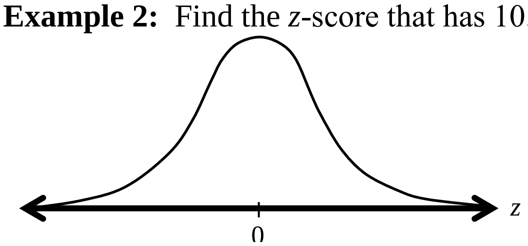
Example 1: Find the *z*-score that corresponds to a cumulative area of 0.3632.



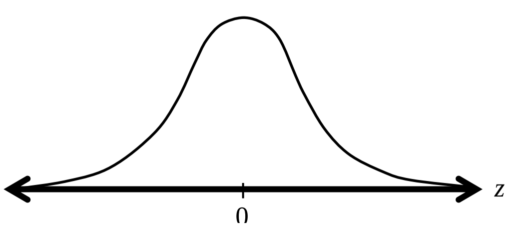
Button	Comments
2^{nd}, DISTR	
3: invNorm(	This is the inverse function of finding areas, because we are working backwards.
0.3632)	The area to the left of the *z*-score you want to find.
ENTER	

To find a z-score when given area: invNorm(area to the LEFT of the *z*-score)

Example 2: Find the *z*-score that has 10.75% of the distribution's area to its right.



Example 3: Find the *z*-score that corresponds to *P*5. *What does that mean?*

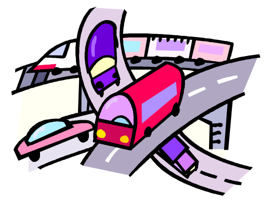


Transforming a *z*-score to an *x* value: Working BACKWARDS!

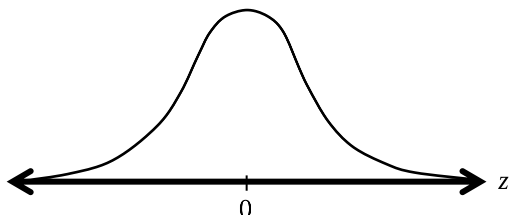
Reminder... the following formula is used to transform an *x*-value to a *z*-score:

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

Can we change this to derive a formula that isolates *x*?



Example 4: The speeds of vehicles along a stretch of highway are normally distributed, with a mean of 67 miles per hour and a standard deviation of 4 miles per hour. Find the speeds *x* corresponding to *z*-sores of 1.96, -2.33, and 0.



Given information:

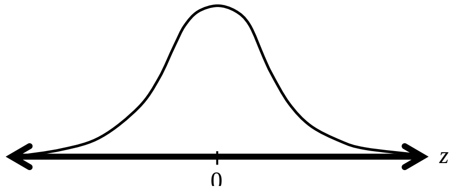
What are we trying to find?

a) $z = 1.96$

b) $z = -2.33$

c) $z = 0$

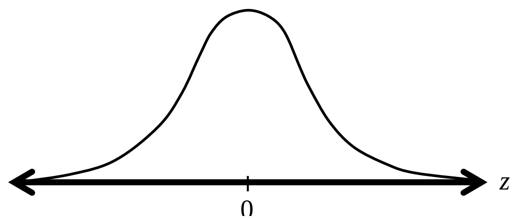
Finding a Specific *x*-value when given Area:
We can work backwards from an area in a normal distribution to find an *x*-value (previously we found *z*-scores from areas.)



***x*-value** = invNorm (area to the LEFT, mean, standard deviation)

Example 5: Scores for a civil service exam are normally distributed, with a mean of 75 and a standard deviation of 6.5. To be eligible for civil service employment, you must score in the top 5%. What is the lowest score you can earn and still be eligible for employment?

Given information:



What are we trying to find?

Button	Comments
2nd, DISTR	
3: invNorm(	This is the inverse function of finding areas, because we are working backwards.
0.95,	The area to the left of the *z*-score you want to find.
75,	The mean
6.5)	The standard deviation
ENTER	

6.4 Notes: Sampling Distributions and the Central Limit Theorem

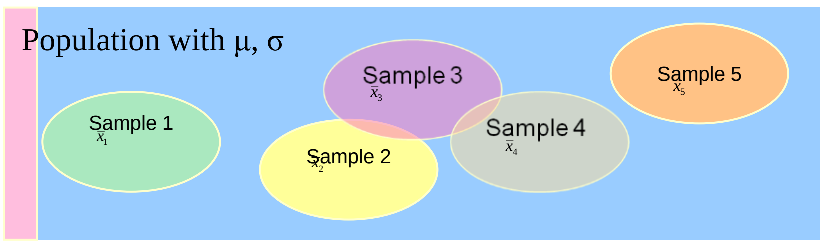
Objectives:

12. Can you find sampling distributions and verify their properties?
13. Can you find the standard error of the mean?
14. Can you interpret the Central Limit Theorem?

Sampling Distributions

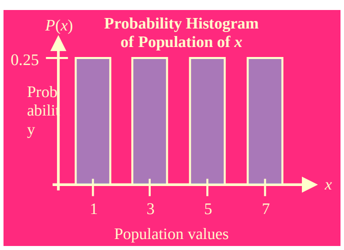
If repeated samples of a population are taken, we can take the ____________ of EACH sample. If we use each mean as an entry, we create a **sampling distribution of the ________________ means.**.

- Formed when _______________ of size *n* are ______________________ taken from a population.
- The mean is calculated from each sample, and then the means are collected to form a distribution.

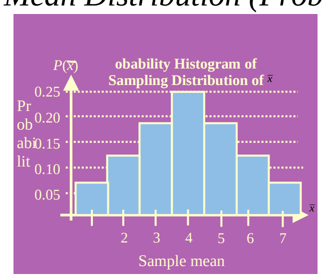


Work in groups to complete Objective #12.

Population Distribution (Probability)



Sample Mean Distribution (Probability)



Notice that the sample mean distribution is _______________.

Properties of Sampling Distributions of Sample Means

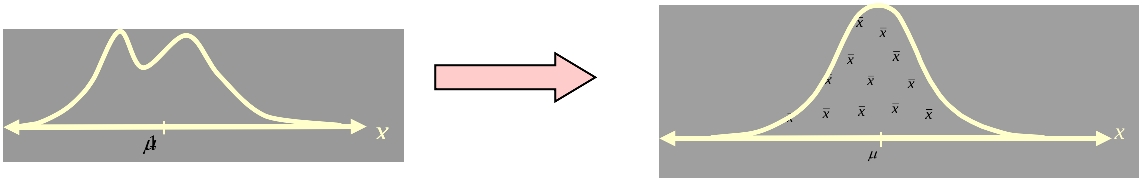
1. The mean of the sample means, _______, is EQUAL to the ___________________ mean μ.

2. The standard deviation of the sample means, _______, is equal to the population standard deviation, σ divided by the square root of the sample size, *n*.

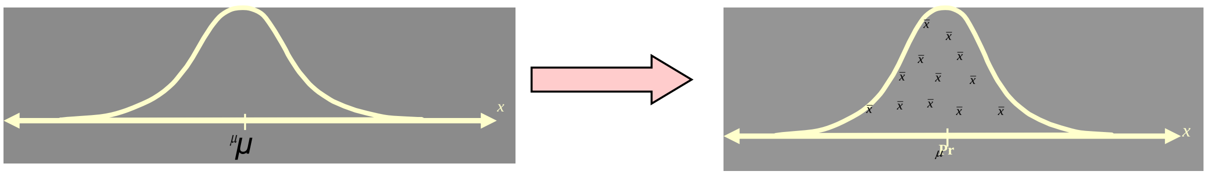
Note: Called the _______________ _____________ of the mean.

The Central Limit Theorem

1. If samples of size $n \geq$ ______ are drawn from **any** population with mean = μ and standard deviation = σ, then the sampling distribution of the sample means ___________________ a ________________ distribution. The greater the sample size, the better the approximation.

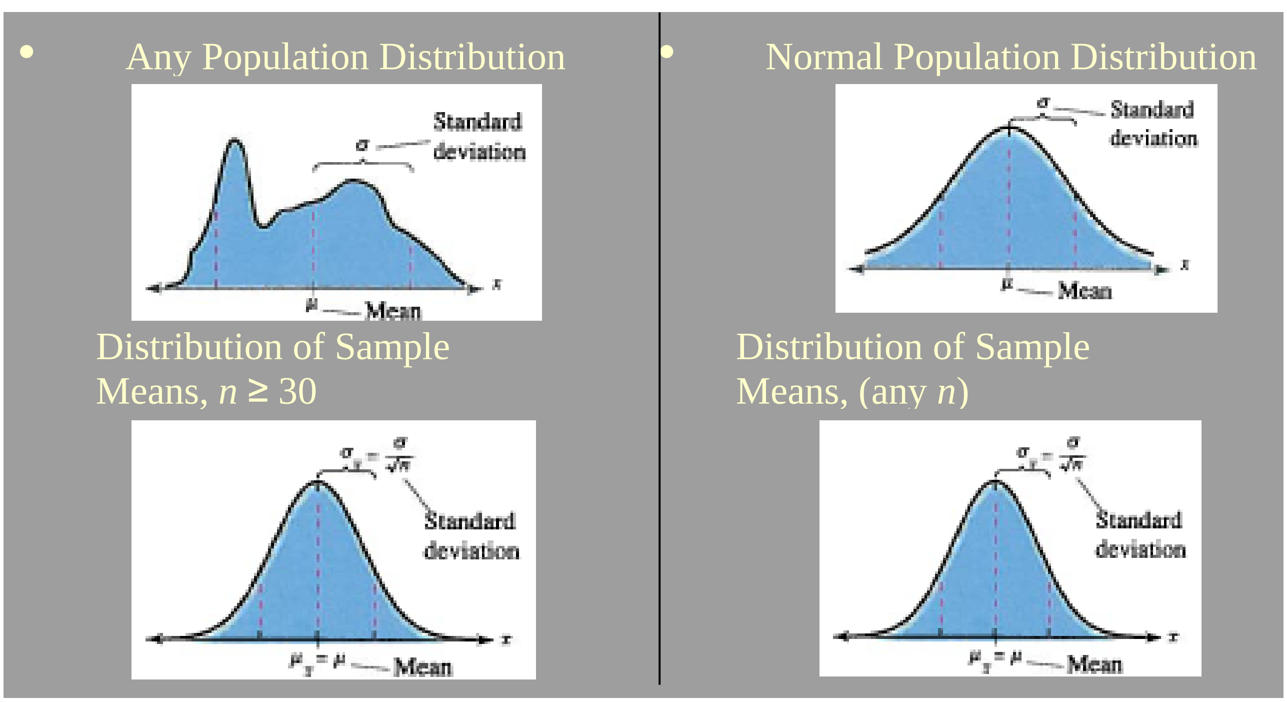


2. If the population itself is normally distributed, then the sampling distribution of the sample means is ____________ distribution for ***any*** sample size *n*.

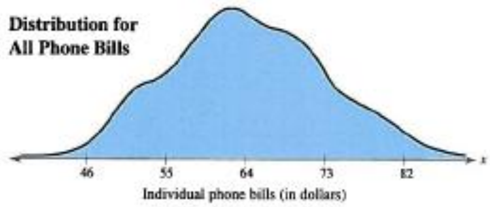


3. In either case, the sampling distribution of sample means has a mean _____________ ____ the population mean.

4. The sampling distribution of sample means has a standard deviation equal to the population standard deviation __________ by the square root of *n*. This sample standard deviation is also called the __________________ _______________ ________ _______ ___________.

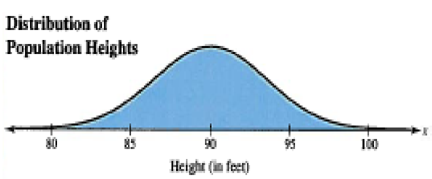


Example 1: Phone bills for residents of a city have a mean of \$64 and a standard deviation of \$9. Random samples of 36 phone bills are drawn from this population and the mean of each sample is determined. Find the mean and standard error of the mean of the sampling distribution. Then sketch a graph of the sampling distribution of sample means.



Given information:

Example 2: The heights of fully grown white oak trees are normally distributed, with a mean of 90 feet and standard deviation of 3.5 feet. Random samples of size 4 are drawn from this population, and the mean of each sample is determined. Find the mean and standard error of the mean of the sampling distribution. Then sketch a graph of the sampling distribution of sample means.



Given information:

Probability and the Central Limit Theorem

<u>Objective</u>:
15. Can you apply the Central Limit Theorem to find the probability of a sample mean?

Finding *z*-scores with sampling distributions: $z = \dfrac{\text{Value-Mean}}{\text{Standard Error}} = \dfrac{\bar{x} - \mu_{\bar{x}}}{\sigma_{\bar{x}}} = \dfrac{\bar{x} - \mu}{\sigma / \sqrt{n}}$

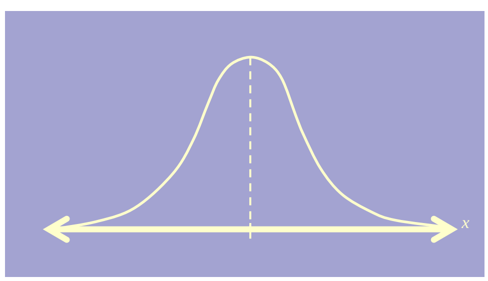
Example 1: IQ scores have a normal distribution with a mean of 90 and a standard deviation of 11.. Nine students are randomly chosen from one high school.

a) One student from the sample has an IQ of 120. What is the corresponding *z*-score?

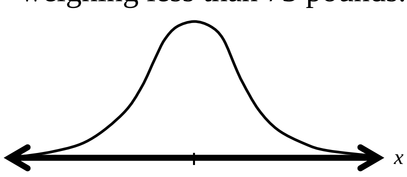
b) Another student has an IQ of 84. What is the corresponding *z*-score?

Finding probabilities with sampling distributions:
Step 1) Draw a picture.
Step 2) normalcdf (lower limit, upper limit, sample mean, standard error)

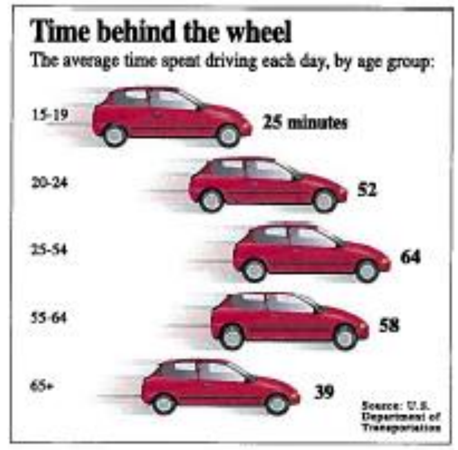
NOTE: If the population is normal, we can do this with any sample size.
If the population is NOT normal, we can only use this method for $n \geq 30$.

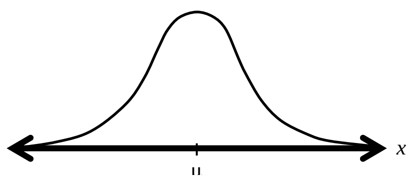


Example 2: The national mean weight for 8-year old males is 72 pounds with $\sigma = 5$ pounds. A sample is taken of 40 8-year old boys. Find the probability of one of these 8-year old boys weighing less than 73 pounds.



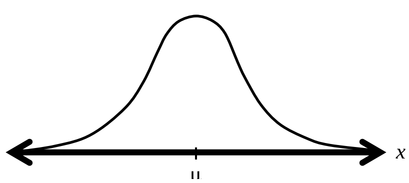
Example 3: The graph shows the length of time people spend driving each day. You randomly select 50 drivers age 15 to 19. What is the probability that the mean time they spend driving each day is between 24.7 and 25.5 minutes? Assume that $\sigma = 1.5$ minutes.





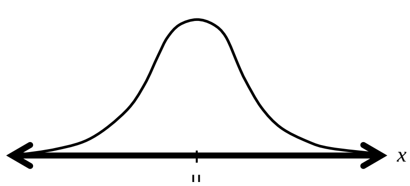
Example 4: A bank auditor claims that credit card balances are normally distributed, with a mean of \$2870 and a standard deviation of \$900. What is the probability that a randomly selected credit card holder has a credit card balance less than \$2500?

***Note**: You are asked to find the probability associated with a certain value of the POPULATION of the random variable x (<u>NOT</u> from a sample).*



Example 5: Using the same credit card balance information from Example 4, you randomly select 25 credit card holders. What is the probability that their mean credit card balance is less than \$2500?

***Note:** You are asked to find the probability associated with a sample mean.*



Section 6.5: Normal Approximations to Binomial Distributions

Section 6.5 Objectives:

Determine when the normal distribution can approximate the binomial distribution

- Find the correction for continuity
- Use the normal distribution to approximate binomial probabilities

Normal Approximation to a Binomial

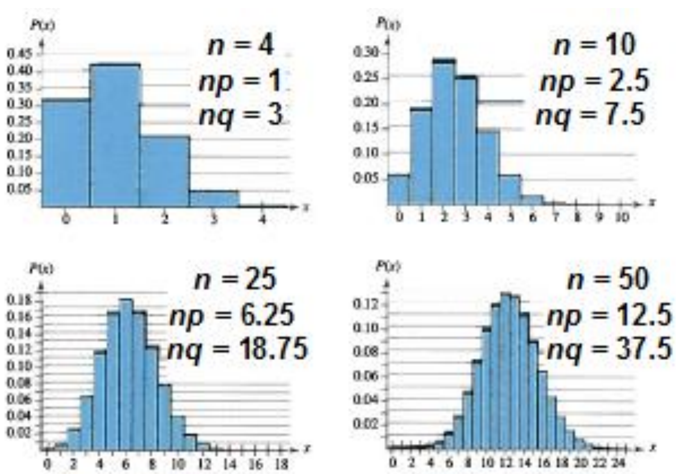
- The normal distribution is used to approximate the binomial distribution when it would be impractical to use the binomial distribution to find a probability.

Normal Approximation to a Binomial Distribution

- If $np \geq 5$ and $nq \geq 5$, then the binomial random variable x is approximately normally distributed with
  - mean $\mu = np$
  - standard deviation $\sigma = \sqrt{npq}$

Normal Approximation to a Binomial:

- Binomial distribution: $p = 0.25$



- As n increases the histogram approaches a normal curve.

Example: Approximating the Binomial:

Decide whether you can use the normal distribution to approximate x, the number of people who reply yes. If you can, find the mean and standard deviation.

1. Fifty-one percent of adults in the U.S. whose New Year's resolution was to exercise more achieved their resolution. You randomly select 65 adults in the U.S. whose resolution was to exercise more and ask each if he or she achieved that resolution.

Solution: You can use the normal approximation

$n = 65$, $p = 0.51$, $q = 0.49$

$np =$

$nq =$

- Mean: $\mu = np =$
- Standard Deviation:

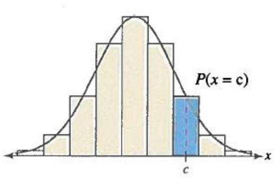
2. Fifteen percent of adults in the U.S. do not make New Year's resolutions. You randomly select 15 adults in the U.S. and ask each if he or she made a New Year's resolution.

Solution: You cannot use the normal approximation
$n = 15, \quad p = 0.15, \quad q = 0.85$
$np =$
$nq =$

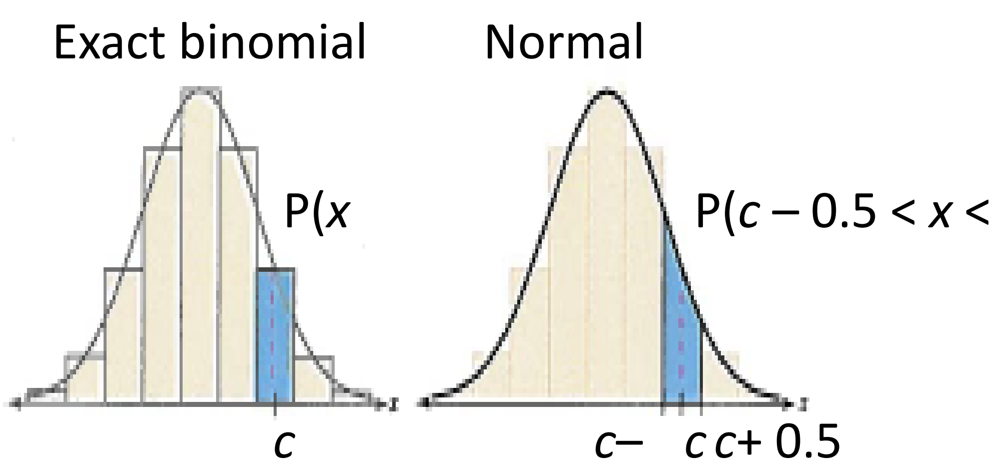
- Because np 5, you cannot use the normal distribution to approximate the distribution of x.

Correction for Continuity

- The binomial distribution is discrete and can be represented by a probability histogram.
- To calculate *exact* binomial probabilities, the binomial formula is used for each value of x and the results are added.
- Geometrically this corresponds to adding the areas of bars in the probability histogram.



- When you use a *continuous* normal distribution to approximate a binomial probability, you need to move 0.5 unit to the left and right of the midpoint to include all possible x-values in the interval (**correction for continuity**).



Example: Using a Correction for Continuity:
Use a correction for continuity to convert the binomial intervals to a normal distribution interval.

1. The probability of getting between 270 and 310 successes, inclusive.

Solution:

- The discrete midpoint values are

- The corresponding interval for the continuous normal distribution is

2. The probability of getting at least 158 successes.

   Solution:
- The discrete midpoint values are

- The corresponding interval for the continuous normal distribution is

3. The probability of getting less than 63 successes.

   Solution:
- The discrete midpoint values are

- The corresponding interval for the continuous normal distribution is

Using the Normal Distribution to Approximate Binomial Probabilities

1. Verify that the binomial distribution applies.
   Specify *n*, *p*, and *q*.

2. Determine if you can use the normal distribution to approximate x, the binomial variable.
   Is $np \geq 5$? Is $nq \geq 5$?

3. Find the mean ___ and standard deviation ___ for the distribution.
   $\mu = np \quad \sigma = \sqrt{npq}$

4. Apply the appropriate continuity correction. Shade the corresponding area under the normal curve.

   Add or subtract ______ from endpoints.

5. Find the corresponding *z*-score(s).

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

6. Find the probability.

   Use the Standard Normal Table.

Example: Approximating a Binomial Probability

Fifty-one percent of adults in the U. S. whose New Year's resolution was to exercise more achieved their resolution. You randomly select 65 adults in the U. S. whose resolution was to exercise more and ask each if he or she achieved that resolution. What is the probability that fewer than forty of them respond yes? *(Source: Opinion Research Corporation)*

Solution:

- Can use the normal approximation? (see the bottom of page 18)

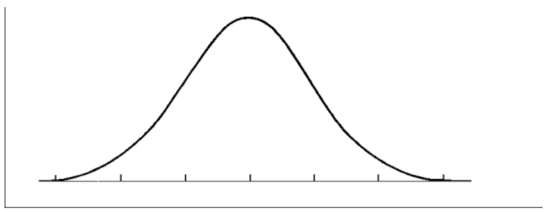
$\mu = 65 \cdot 0.51 = 33.15$ $\sigma = \sqrt{65 \cdot 0.51 \cdot 0.49} \approx 4.03$

Solution: Approximating a Binomial Probability

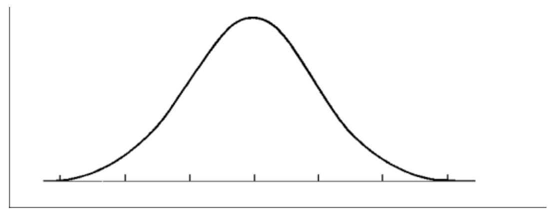
- Apply the continuity correction:

Fewer than 40 (…37, 38, 39) corresponds to the continuous normal distribution interval ______

Normal Distribution
$\mu = 33.15$ $\sigma = 4.03$



Standard Normal
$\mu = 0$ $\sigma = 1$



Example: Approximating a Binomial Probability

A survey reports that 86% of Internet users use Windows® Internet Explorer® as their browser. You randomly select 200 Internet users and ask each whether he or she uses Internet Explorer as his or her browser. What is the probability that exactly 176 will say yes? *(Source: 0neStat.com)*

Solution:

Can we use the normal approximation?

$np =$ $nq =$

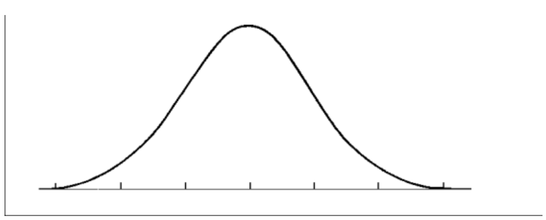
$\mu =$ $\sigma =$

Solution: Approximating a Binomial Probability

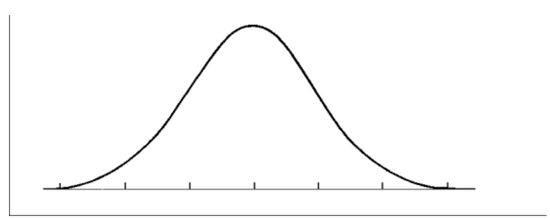
- Apply the continuity correction:

Exactly 176 corresponds to the continuous normal distribution interval ____________________

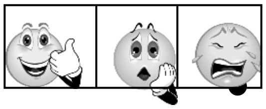
Normal Distribution
$\mu = 172$ $\sigma = 4.91$



Standard Normal
$\mu = 0$ $\sigma = 1$

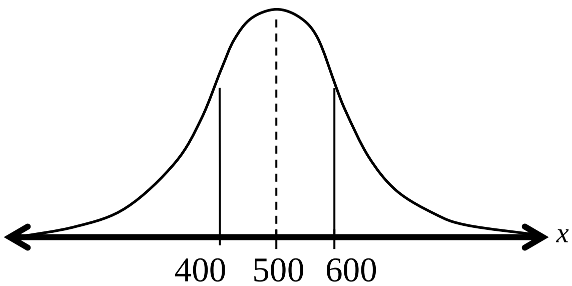


Prob/Stat/Discrete **Name**____
Unit 6 Objectives

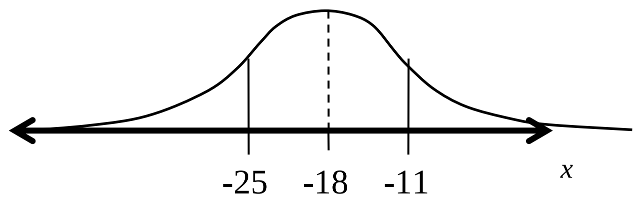


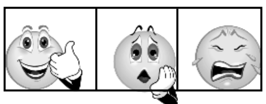
Objective #1: Can you interpret graphs of normal probability distributions?
Estimate the mean and standard deviation of each normal curve.

a) μ = ______ σ = ______



b) μ = ______ σ = ______





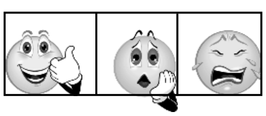
Objective #2: Can you create diagrams of a standard normal curve?

a) to the left of $z = 1.5$

b) to the right of $z = -2$

c) $z < -0.99$

d) between $z = -1.2$ and $z = 0.64$



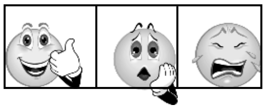
Objective #3: Can you find areas (or probabilities) under the standard normal curve? *Use the z-scores and diagrams from Objective 2 along with Table 4.*

a)

b)

c)

d)



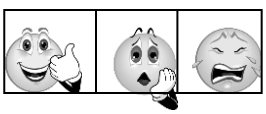
Objective #4: Can you use technology to find areas when given a *z*-score?
Use your graphing calculator to find the areas or probabilities corresponding to the following values. Also, draw a diagram for each problem!

a) To the left of $z = -2.72$

b) $z > 1.4$

c) $z = -0.52 < z < 2.09$

d) $z < 3.21$

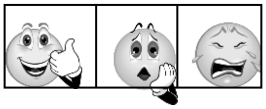


Objective #5: Can you calculate z-scores?
Find the z-score for each x-value with a normal distribution of $N(\mu, \sigma)$.

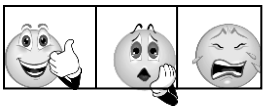
a) N (125, 30); $x = 140$

b) N (52, 9); $x = 35$

c) The mean age of college graduates is 24.8 years with a standard deviation of 1.1 years. Find the standardized value (*z*-score) of a person who graduates from college at age 26.



Objective #6: Can you explain how area under a normal curve is related to probability?



Objective #7: Can you find probabilities for normally distributed variables?
For each problem, draw a sketch, show your calculations, and use Table 4.

a) N (300, 40); P(x > 250)

b) N (14, 2.3); P(x < 19)

c) N (72, 11.3); P(50 < x < 80)

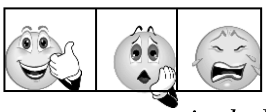
d) SAT verbal test scores follow approximately the N (505, 110). What is the probability that a person will score less than 400 points on the verbal portion of the SAT?

e) The distribution of IQ scores is normally distributed with a mean of 85 points and a standard deviation of 15 points. What is the probability of a student scoring between 105 and 120?

f) The average lifespan of human males is 77 years, with a standard deviation of 4.8 years.

i) What percent of the males would have a lifespan greater than 80 years?

ii) Also, if 200 males are randomly chosen, how many of them would you expect to have a lifespan greater than 80 years?



Objective #8: Can you use technology to find probabilities?

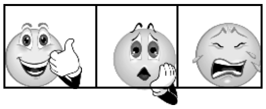
Use your graphing calculator to find the following probabilities. Draw a diagram and include your keystrokes as your work.

a) N (2.5, 0.3) P(x > 1.8)

b) N (160, 20) P(x < 203)

c) N (3170, 400) P (2400 < x < 3000)

d) A small company reports that the average employee earns $48,320 per year, with a standard deviation of $6017. What is the probability that an employee would earn more than $70,000 per year?



Objective #9: Can you find a *z*-score given the area under the normal curve?
For parts a – f, use Table 4 to find each <u>cumulative</u> area or percentile. If the area is not in the table, use the entry closest to the area. If the area is halfway between the two entries, use the z-score halfway between the corresponding z-scores. DRAW A DIAGRAM!

a) area = 0.7580

b) area = 0.2090

c) area = 0.94

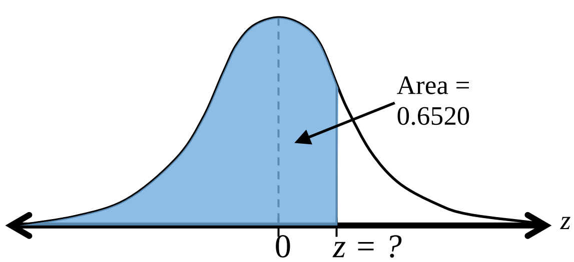
d) P_{15}

e) P_{88}

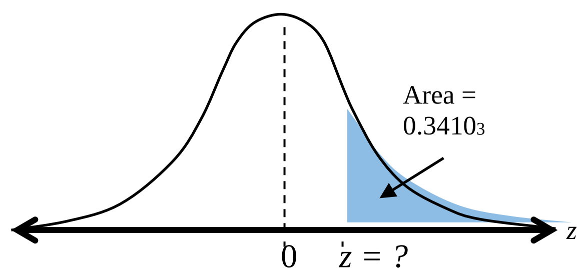
f) 0.5% of the data is to the left of *z*.

For parts g – i, find the indicated z-score(s) shown on the graph by using your calculator.

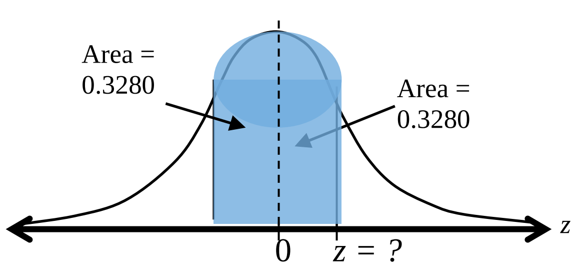
g) μ = 0 σ = 1

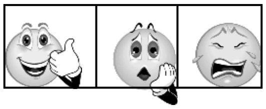


h) μ = 0 σ = 1–1



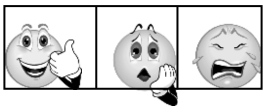
i) μ = 0 σ = 1





Objective #10: Can you transform a *z*-score to an *x*-value?
Use N(55, 4) to transform each *z*-score to an *x*-value.

a) $z = 1.83$ b) $z = 0.71$ c) $z = 2.55$



Objective #11: Can you find a specific data value of a normal distribution when given the probability or percent?

The annual per capita consumption of ice cream (in pounds) in the United States can be approximated by a normal distribution with a mean of 15.4 lb and a standard deviation of 2.5 lb. Use Table 4 to answer the questions below.

a) What is the number of pounds that has a probability of 0.15 to the left?

b) What is the number of pounds at the 40th percentile?

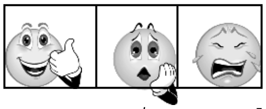
c) What is the number of pounds that is in the TOP 25% of consumption?

An automobile tire has a life expectancy that is normally distributed, with a mean life of 30,000 miles and a standard deviation of 2500 miles. Use your calculator to answer the questions below.

d) What is the life span at the 10th percentile?

e) What is the life span at the TOP 10%?

f) What is the life span at the 3rd quartile?



Objective #12: Can you find sampling distributions and verify their properties?
Four people paid the following amounts for their monthly car insurance: $120, $140, $180, and $220.

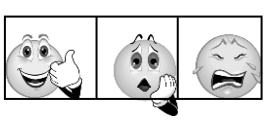
a) What is the mean and the standard deviation of this population?

b) Using a sample of size 2, list all samples (with replacement) and the sample means.

Sample	Sample Mean $\bar{x}$		Sample	Sample Mean $\bar{x}$
120, 120	120			
120, 140	130			
120, 180	150			
120, 220	170			
140, 120	130			

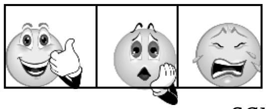
c) What is the mean and standard deviation of the sample mean $\bar{x}$?

d) How do parts a) and c) compare for the mean and standard deviation?



Objective #13: Can you find the standard error of the mean?
The females at a high school have a mean height of 66 inches with a standard deviation of 1.4 inches. Find the standard error of the mean if a sample of size *n* is taken.

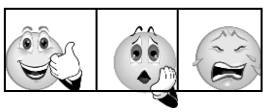
a) 25 b) 9 c) 100



Objective #14: Can you interpret the Central Limit Theorem? *For each situation, find the mean and standard error of the mean of the indicated sampling distribution.*

a) The per capita consumption of soft drinks by people in the United States in a recent year was normally distributed, with a mean of 51.5 gallons and a standard deviation of 17.1 gallons. Random samples of size 25 are drawn from this population, and the mean of each sample is determined.

b) The per capita consumption of red meat by people in the United Sates in a recent year was normally distributed, with a mean of 110 pounds and a standard deviation of 38.5 pounds. Random samples of size 20 are drawn from this population, and the mean of each sample is determined.

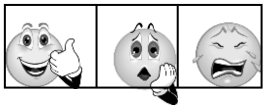


Objective #15: Can you apply the Central Limit Theorem to find the probability of a sample mean? Use Table 4 for part a), and use your calculator for parts b) and c), but record your keystrokes as your work.

a) A lumber company has bought a machine that automatically cuts lumber to a mean length of 96 inches with a standard deviation of $\sigma =$ 0.5 inches. A sample of size 25 is taken of cut lumber. What is the probability that the mean length of the sample is less than 95.95 inches?

b) A machine used to fill half-gallon sized milk containers is regulated so that the amount of milk dispensed has a mean of 64 ounces. 40 containers are randomly selected and measured. What is the probability of obtaining a mean weight for the sample containers of 64.05 ounces or greater? Assume that $\sigma = 0.51$.

c) The average math SAT score is 518 with a standard deviation of $\sigma = 115$. A sample of 50 students from a high school is taken. What is the probability that their sample mean is between 520 and 530?

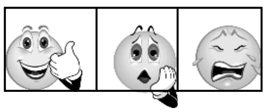


Objective #16: Can you determine when the normal distribution can approximate the binomial distribution?

Using the given sample size *n*, probability of success *p*, and probability of failure *q*, decide whether you can use the normal distribution to approximate the random variable *x*.

a) $\boldsymbol{n = 24, p = 0.85, q = 0.15}$

b) $\boldsymbol{n = 180, p = 0.90, q = 0.10}$

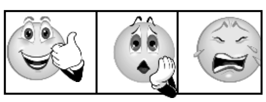


Objective #17: Can you find the correction for continuity?

Use the correction for continuity for the given binomial probability.

a) $\boldsymbol{P}(\boldsymbol{x} > 119)$

b) $\boldsymbol{P}(\boldsymbol{x} \leq \mathbf{19})$

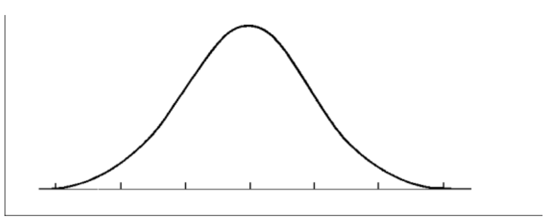


Objective #18: Can you use the normal distribution to approximate binomial probabilities?

Decide whether you can use the normal distribution to approximate the binomial distribution. If you can, use the normal distribution to approximate the indicated probabilities and sketch their graphs.

Five percent of workers in the US use public transportation to get to work. You randomly select 250 workers and ask them if they use public transportation to get to work.

a) Find the probability that exactly 16 workers will say yes.



b) Find the probability that at least 9 workers will say yes.