Big Future: How SAT scores play a role in college acceptance.

I. UNIT OVERVIEW & PURPOSE:

"Where do you stand?" starts by presenting students with an article about local high school's SAT scores along with a few discussions to get the students to understand the objectives and purpose of the unit. Next we quickly lead into mathematic skills necessary involved to understand statistics and analyzing data. For a few lessons and classes, we will learn how to work with data sets to get a better grasp of what normal distribution means and what it tells us about data sets when comparing two completely different sets of normally distributed data. Once the students are comfortable with skills necessary to master statistics, we will finish with an investigation on acceptable SAT scores for college entrance. Students will search for an appropriate school where acceptance based on SAT and/or ACT scores seems achievable.

II. UNIT AUTHOR:

Shauna Knarr; Massaponax High School; Spotsylvania County
Julia Schiesser; Massaponax High School; Spotsylvania County

III. COURSE:

Issues of Equity and Diversity in Mathematics Education - EDUC620 – MEPI Project

IV. CONTENT STRAND:

Data Analysis and Algebra

V. OBJECTIVES:

- SOL: AII.11: The student will identify properties of a normal distribution and apply those properties to determine probabilities associated with areas under the standard normal curve.
- The student will be able to do research to find where they belong (what college) based on their SAT score. Without doing this exercise, will students be able to succeed (get into the college that they want to)?
- NCTM Standards: Formulate questions that can be addressed with data and collect, organize, and display relevant data to answer them. Select and use appropriate measurement data, be able to display the distribution, describe its shape, and select and calculate summary statistics.

VI. MATHEMATICS PERFORMANCE EXPECTATION(s):

- MPE.22 - Analyze graphical displays of univariate data, including dotplots, stemplots, and histograms, to identify and describe patterns and departures from patterns, using central tendency, spread, clusters, gaps, and outliers. Use appropriate technology to create graphical displays.
- MPE.23 - Analyze the normal distribution. Key concepts include:
  - Characteristics of normally distributed data;
  - Percentiles;
  - Normalizing data, using z-scores;
  - Area under the standard normal curve and probability.

VII. CONTENT:

N/A

VIII. REFERENCE/RESOURCE MATERIALS:

Reference materials are available on the last page. Websites used are listed as well. All keys to lessons and assignments are provided following each document.

IX. PRIMARY ASSESSMENT STRATEGIES:

Assessments for each unit are included below. Assessments will be based on the student's work and written responses gathered from the worksheet. Additional assessment questions will be asked in some lessons. The students may also receive a participation grade based on the teacher's observations.

X. EVALUATION CRITERIA:

A key for each lesson's worksheet is included below. Appropriate weights for each response are also included.

XI. INSTRUCTIONAL TIME:

Lesson 1: 90 minutes
Lesson 2: Two 90 minute blocks
Lesson 3: 90 minutes

Lesson #1: Statistics—Normal Curve/Distribution

Through this lesson students will gain knowledge of normal distributions and standard deviation. Students will receive real world data to compare on a state and local level. Through comparison and discussion, students will better know how to accurately evaluate data and form opinions based on real life situations.

The teacher will follow this guideline throughout the lesson:

- The teacher will hand out a pre-unit survey to obtain students' opinions on SAT and ACT scores as well as GPA. (5 minutes)
- Warm-Up Lesson #1: Have the students read the article "SAT scores drop locally, but more students are taking the test." by Jeff Branscome. Students should read the article and respond to the questions individually (discussion questions are found at the end of the article). Once the students have finished, allow them to pair up and discuss their findings. Allow a couple of groups to share their findings with the rest of the class. Since the data is racially, geographically, and demographically driven, the students may have varying opinions about the results. (20 minutes)
- Pass out the handout titled Notes Lesson #1: Normal Distribution. Use guided instruction to fill in through Example 3. Student will then try example 4 on their own. (50 minutes)
- At the end of Example 4, students were asked to interpret their results in terms of student demographics. The teacher will facilitate a discussion for the remainder of the block about students' responses to this question. (15 minutes)
- Homework Lesson #1: Students will receive practice problems for homework based on today's lesson. Since the students do not have access to a graphing calculator at home, they will only work on setting up normal distributions using mean and standard deviation.

Pre-Unit Survey: Answer the following questions based on your current knowledge of the following topics.

1 - Not important, 3 – Important, 5 - Very important

How important do you think the SATs are in applying for college?
1 2 3 4 5
How important do you think your GPA is in applying for college?
1 2 3 4 5
How important do you think ACT scores are in applying for college?
1 2 3 4 5
How important do you think extracurricular activities are in applying for college?
1 2 3 4 5
List 3 colleges you would be interested in attending?
1) _____
2) _____
3) _____

Warm-Up Lesson #1:

"SAT scores drop locally, but more students are taking the test."

Jeff Branscome *Date published:* ***9/14/2011***

The state as a whole outperformed all but two of the Fredericksburg area's public high schools on the SAT college-entrance test, based on 2011 results released Wednesday.

Locally, 22 public and two private schools earned an average score of 1,463—five points less than last year's mean score and 53 points below the statewide average.

A perfect score is 2,400.

Virginia's SAT average also dropped five points from 2010. It was 1,516 for the 61,398 public, private and homeschooled seniors who took the test through June.

Still, statewide scores exceeded the national average of 1,500.

The College Board, which administers the SAT, released state and nationwide scores Wednesday.

The SAT has three sections—math, critical reading and writing. Each has a top score of 800.

Virginia's 2011 graduates were the largest and most diverse group of test-takers in the state's history, according to the state Department of Education. For instance, 40 percent of seniors who took the SAT belonged to a minority group.

Also, the Fredericksburg area had at least 4,176 students take the test. That's 425 more than last year—a significant increase when enrollments have been relatively flat.

"Students who in previous years might not have viewed themselves as college material are being encouraged to take the SAT by educators who recognize their potential," state Superintendent of Public Instruction Patricia I. Wright said.

The College Board cited the record number of test-takers and the testing pool's growing diversity as reasons for the lower average scores statewide and nationally.

"Long-term trends are more important than one-year fluctuations in achievement," state Board of Education President Eleanor B. Saslaw said in a statement.

Like last year, Colonial Forge High School in Stafford County and Fauquier High School in Warrenton had the best scores of the region's public schools.

Colonial Forge's class of 2011 posted an average score of 1,569, and Fauquier High's mean score was 1,547. Fredericksburg Academy, a private school in Spotsylvania County, fared the best in the area with an average score of 1,683. The school, whose annual tuition is $17,100 for students in grades 6 through 12, required its seniors to take the SAT.

Public high school seniors —90 percent of Virginia's test-takers—had an average score of 1,508.

Students in Virginia's religious and independent schools outperformed public schools. Students at religiously affiliated schools averaged 1,603 and independent-school seniors had a mean score of 1,674.

Jeff Branscome: 540/374-5402
jbranscome@freelancestar.com
http://fredericksburg.com/News/FLS/2012/092012/09252012/727259

AREA HIGH SCHOOL 2011 SAT TEST RESULTS

School division	High School	Test-takers	Reading mean	Math mean	Writing mean	Total
Caroline	Caroline	122	465	445	442	1,352
Colonial Beach	Colonial Beach	25	486	474	458	1,418
Culpeper	Culpeper County	119	494	496	465	1,455
Culpeper	Eastern View	147	463	457	430	1,350
DoD	Quantico	22	454	444	450	1,348
Fauquier	Fauquier	198	523	522	502	1,547
Fauquier	Liberty	140	488	492	463	1,443
Fredericksburg	James Monroe	154	509	483	483	1,475
King George	King George	167	510	503	489	1,502
Louisa	Louisa County	190	473	459	459	1,391
Orange	Orange County	178	502	475	471	1,448
Spotsylvania	Chancellor	166	503	486	479	1,468
Spotsylvania	Courtland	185	499	476	487	1,462
Spotsylvania	Massaponax	289	501	484	477	1,462
Spotsylvania	Riverbend	311	509	496	496	1,501
Spotsylvania	Spotsylvania	114	474	464	443	1,381
Stafford	Brooke Point	260	504	483	474	1,461
Stafford	Colonial Forge	370	530	530	509	1,569
Stafford	Mountain View	331	511	503	480	1,494
Stafford	North Stafford	283	501	504	480	1,485
Stafford	Stafford	261	495	491	477	1,463
Westmoreland	Washington & Lee	61	478	467	462	1,407
Private	Fredericksburg Academy	22	567	544	572	1,683
Private	Fredericksburg Christian	61	526	517	508	1,551
Virginia	**All students**	**61,398**	**512**	**509**	**495**	**1,516**
National	**All students**	**1.65 mil**	**497**	**514**	**489**	**1,500**

Source: College Board

AMANDA MONTAG/THE FREE LANCE-STAR

Discuss this article using the think-pair-share technique:

Why do you think private schools tend to get higher scores on the SAT?

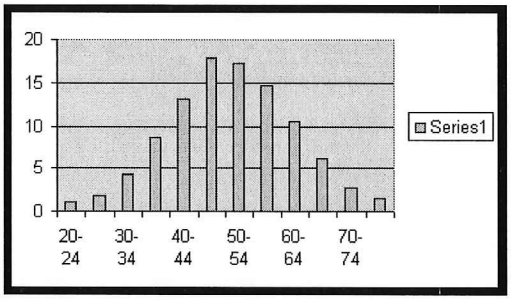
What school in our county scored the highest average on the SAT? Why do you think this happened?

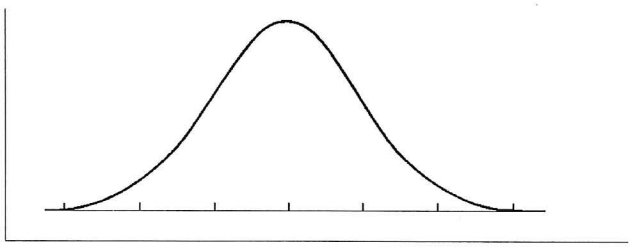
What school in our county scored the lowest average on the SAT? Why do you think this happened?

How do you think Massaponax did in comparison to other schools in the county? in the state?

Notes Lesson #1: Normal Distribution

A **normal distribution** curve is symmetrical, bell-shaped curve defined by the mean and standard deviation of a data set. Something that is unique about a Normal Curve is that the **Mean** (μ) and the **Median** are the same number (or very close). A normal distribution (N) is created using mean (μ) and standard deviation (σ). It is denoted with N (μ, σ). A normal distributed is graphed by moving 3 standard deviations from the mean in both directions.





The **Standard Deviation** (σ) is the most common measure of spread. Standard Deviation is a powerful approach to get information about how individual values compare and contrast with other data.

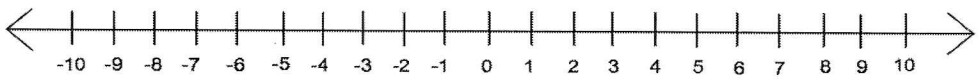
Standard Deviation: Takes into account how far EACH data point is from the mean of the data set.

- A high standard deviation shows that many of the data values are scattered far from the mean.
- A low standard deviation show that many of the data values are close to the mean.

Example 1: Sketch an N (0 , 2)

Mean μ =

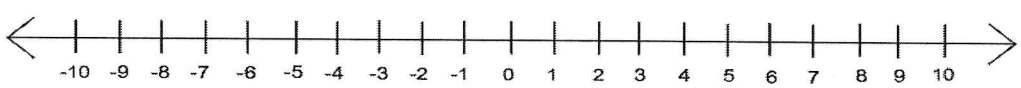
St. Deviation σ =



Example 2: Sketch a N (1 , 2.5)

Mean μ =

St. Deviation σ =



Example 3: Use the data from the warm up to fill in the chart and determine the μ and σ for each data set (use L1 to find 1 VARS STATS). Then sketch the normal curve.

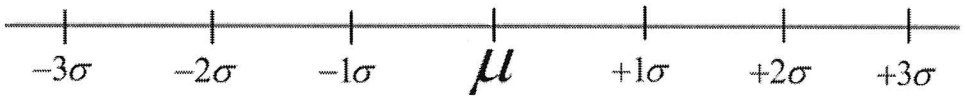
Combined SAT Scores of Fredericksburg Region High Schools

Mean μ ($\bar{x}$) = _____ Min = _____

Median= _____ Max = _____

Mode= _____ Range = _____

σ = _____



a. Under μ and each σ, label the corresponding value on the number line.

b. Draw the normal curve over the data.

c. Indicate where the Spotsylvania County high schools would fall on this line with the following letters:
- Massaponax (M)
- Riverbend (R)
- Chancellor (Ch)
- Courtland (C)
- Spotsylvania (S)

d. Answer the following questions:

I. What schools in Spotsylvania County scored above the mean?

II. About how many standard deviations from the mean does each high school fall? (use positive and negative decimals when describing your answers)

III. What does this information tell you about these schools (consider the demographics of population attending the school). Provide at least three sentences.

Try on your own!
Example 4: Now use only the **Math** SAT scores to complete the following on your own.

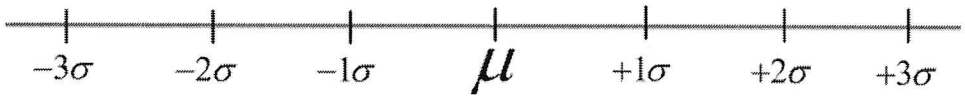
Math SAT Scores of Fredericksburg Region High Schools

Mean μ ($\bar{x}$) = _____ Min = _____

Median= _____ Max = _____

Mode= _____ Range = _____

σ = _____



a. Under μ and each σ, label the corresponding value on the number line.

b. Draw the normal curve over the data.

c. Indicate where the Spotsylvania County high schools would fall on this line with the following letters:
- Massaponax (M)
- Riverbend (R)
- Chancellor (Ch)
- Courtland (C)
- Spotsylvania (S)

d. Answer the following questions:

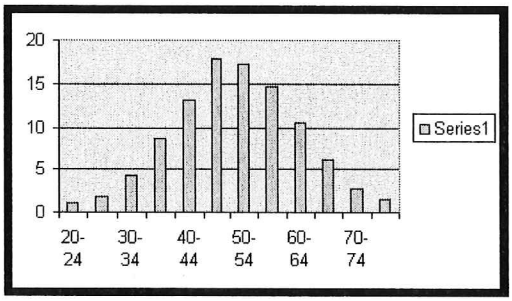
I. What schools in Spotsylvania County scored above the mean?

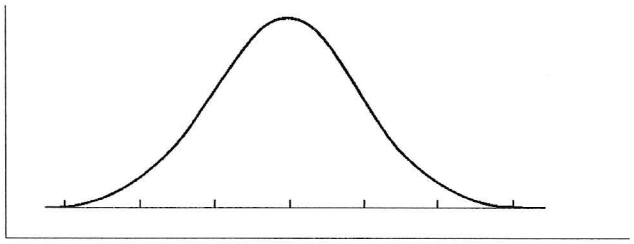
II. About how many standard deviations from the mean does each high school fall? (use positive and negative decimals when describing your answers)

III. What does this information tell you about these schools (consider the demographics of population attending the school). Provide at least three sentences.

Notes Lesson #1: Normal Distribution

A **normal distribution** curve is symmetrical, bell-shaped curve defined by the mean and standard deviation of a data set. Something that is unique about a Normal Curve is that the **Mean** (μ) and the **Median** are the same number (or very close). A normal distribution (N) is created using mean (μ) and standard deviation (σ). It is denoted with N (μ, σ). A normal distributed is graphed by moving 3 standard deviations from the mean in both directions.





The **Standard Deviation** (σ) is the most common measure of spread. Standard Deviation is a powerful approach to get information about how individual values compare and contrast with other data.

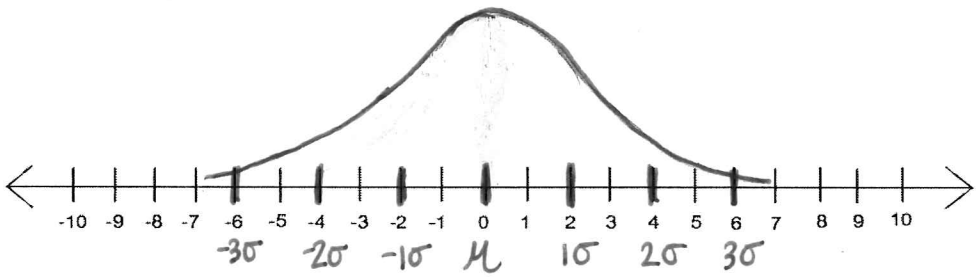
Standard Deviation: Takes into account how far EACH data point is from the mean of the data set.

- A high standard deviation shows that many of the data values are scattered far from the mean.
- A low standard deviation show that many of the data values are close to the mean.

Example 1: Sketch an N (0 , 2)

Mean μ = 0

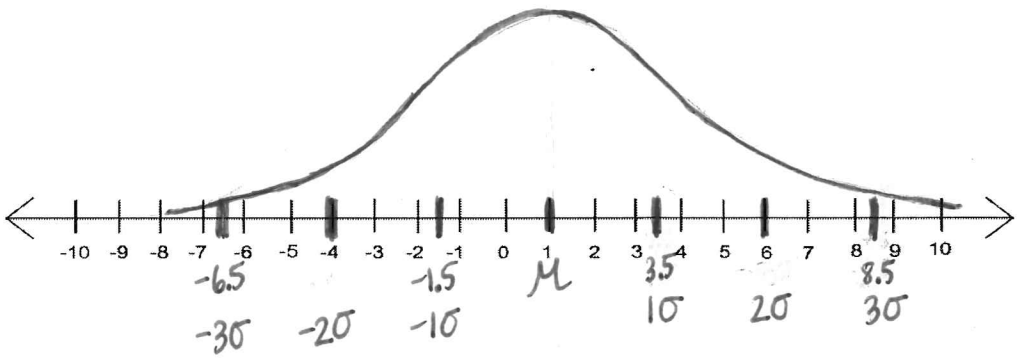
St. Deviation σ = 2



Example 2: Sketch a N (1 , 2.5)

Mean μ = 1

St. Deviation σ = 2.5



Example 3: Use the data from the warm up to fill in the chart and determine the μ and σ for each data set (use L1 to find 1 VARS STATS). Then sketch the normal curve.

Combined SAT Scores of Fredericksburg Region High Schools

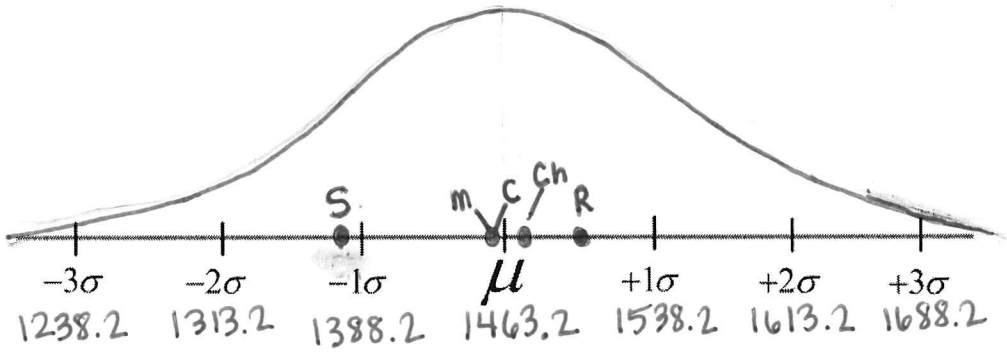
1352	1418	1455
1350	1348	1547
1443	1475	1502
1391	1448	1468
1462	1462	1501
1381	1461	1569
1494	1485	1463
1407	1683	1551

Mean μ ($\bar{x}$) = 1463.2 Min = 1348

Median= 1462 Max = 1683

Mode= 1462 Range = 221

σ = 75



a. Under μ and each σ, label the corresponding value on the number line.

b. Draw the normal curve over the data.

c. Indicate where the Spotsylvania County high schools would fall on this line with the following letters:
- Massaponax (M) ✓
- Riverbend (R) ✓
- Chancellor (Ch) ✓
- Courtland (C) ✓
- Spotsylvania (S) ✓

d. Answer the following questions:

I. What schools in Spotsylvania County scored above the mean?

Chancellor, Riverbend

II. About how many standard deviations from the mean does each high school fall? (use positive and negative decimals when describing your answers)

S ⇒ −1.2 C ⇒ −0.1 R ⇒ 0.5

M ⇒ −0.1 Ch ⇒ 0.2

III. What does this information tell you about these schools (consider the demographics of population attending the school). Provide at least three sentences.

answers may vary.

Try on your own!
Example 4: Now use only the **Math** SAT scores to complete the following on your own.

Math SAT Scores of Fredericksburg Region High Schools

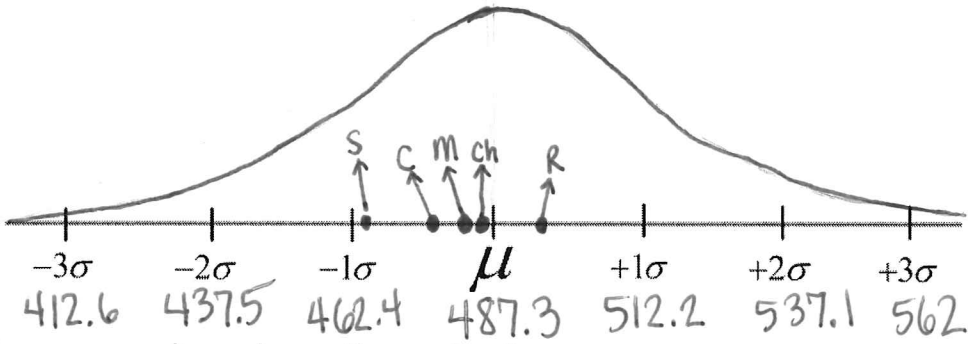
445	474	496
457	444	522
492	483	503
459	475	486
476	484	496
464	483	530
503	504	491
467	544	517

Mean μ ($\bar{x}$) = 487.3 Min = 444

Median= 485 Max = 544

Mode= 483, 496, 503 Range = 100

σ = 24.9



a. Under μ and each σ, label the corresponding value on the number line.

b. Draw the normal curve over the data.

c. Indicate where the Spotsylvania County high schools would fall on this line with the following letters:
- Massaponax (M)
- Riverbend (R)
- Chancellor (Ch)
- Courtland (C)
- Spotsylvania (S)

d. Answer the following questions:

I. What schools in Spotsylvania County scored above the mean?

Riverbend

II. About how many standard deviations from the mean does each high school fall? (use positive and negative decimals when describing your answers)

S ⇒ −0.9 m ⇒ −0.3 R ⇒ 0.3

C ⇒ −0.4 Ch ⇒ −0.1

III. What does this information tell you about these schools (consider the demographics of population attending the school). Provide at least three sentences.

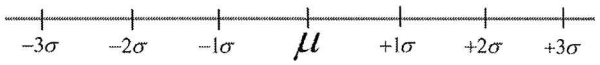
answers will vary

Homework Lesson #1 Name _____

Sketch the following normal curves. Be sure to label 3 standard deviations to the left and to the right.

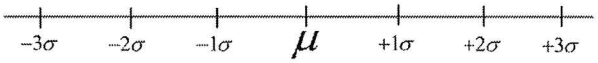
1. N (30 , 10)

2. N (56 , 12)



3. N (99.3 , 14.5)

4. N (77.25 , 32.34)



5. The distribution of weights for 6 month old baby boys is approximately normal with a mean μ = 17.25 pounds and a standard deviation σ = 2 pounds.

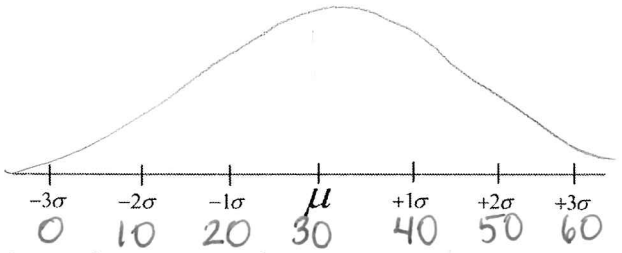
6. The distribution of weights for 1 month old baby girls is approximately normal with a mean μ = 8.75 pounds and a standard deviation σ = 1.1 pounds.

7. Packaged foods sold at supermarkets are not always the weight indicated on the package. Suppose that the weight of a "12 oz" bag of potato chips is a random variable that has an approximately normal distribution with a mean μ = 12 oz and a standard deviation σ = 0.5 oz.

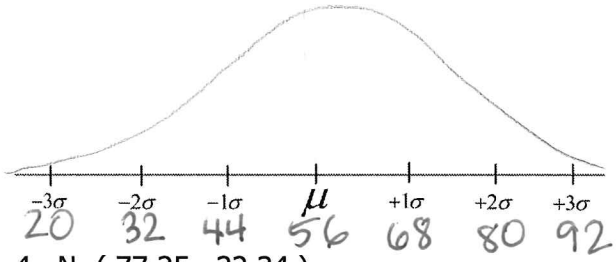
Homework Lesson #1 Name _____

Sketch the following normal curves. Be sure to label 3 standard deviations to the left and to the right.

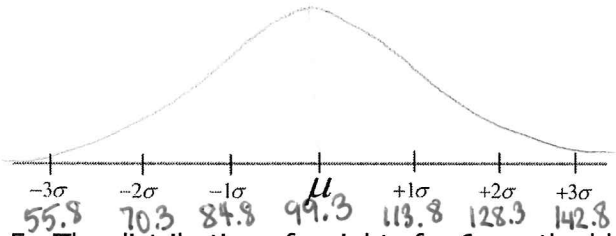
1. N (30 , 10)



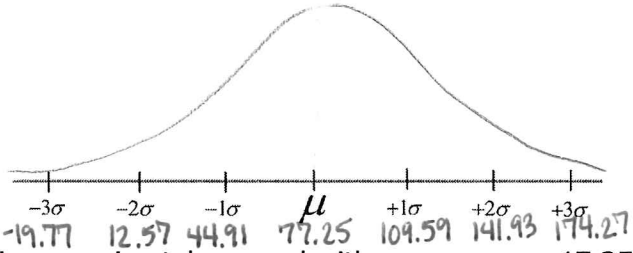
2. N (56 , 12)



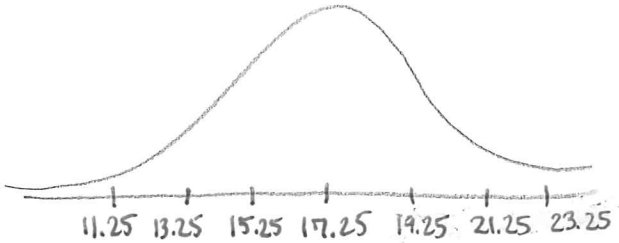
3. N (99.3 , 14.5)



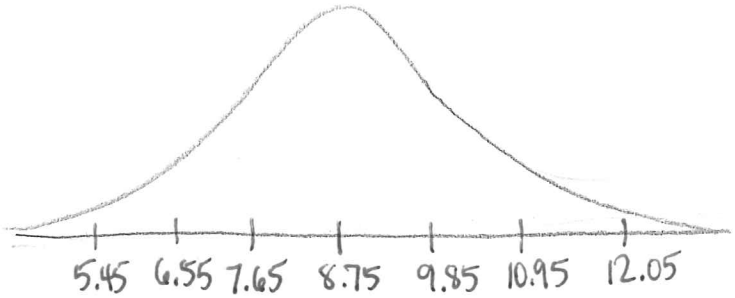
4. N (77.25 , 32.34)



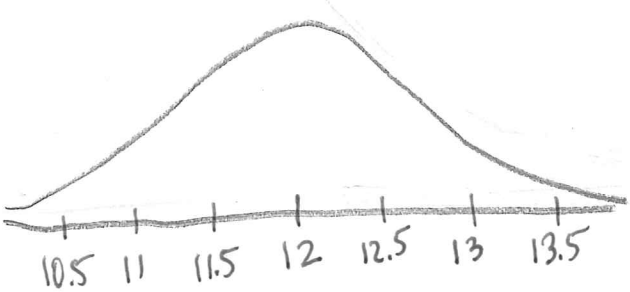
5. The distribution of weights for 6 month old baby boys is approximately normal with a mean μ = 17.25 pounds and a standard deviation σ = 2 pounds.



6. The distribution of weights for 1 month old baby girls is approximately normal with a mean μ = 8.75 pounds and a standard deviation σ = 1.1 pounds.



7. Packaged foods sold at supermarkets are not always the weight indicated on the package. Suppose that the weight of a "12 oz" bag of potato chips is a random variable that has an approximately normal distribution with a mean μ = 12 oz and a standard deviation σ = 0.5 oz.



Lesson #2: Empirical Rule & Z-Scores

Through this lesson students will gain knowledge of the empirical rule and z-scores. Through guided instruction, students will use real world data to compare z-scores. Because this topic has many difficult elements, it is important for the teacher to provide examples of the various ways this topic can be represented. Students can use these multiple representations to compare otherwise un-relatable data.

The teacher will follow this guideline throughout the lesson:
Lesson 2 will span 90 minute class periods.

Day 1

- Collect the students' homework from lesson #1. Provide feedback to the students to insure that their work is of high quality.
- Warm-Up Lesson #2: Have the students use their calculator to complete the 3 questions. The students will have access to an answer key so that they can assess their progress with normal distributions. (15 minutes)
- Pass out the handout titled Notes Lesson #2: Empirical Rule & Z-Scores and the Z-Score Table (this table will be provided the day of the SOL also). Use guided instruction to fill in through Example 2. (60 minutes)
- Give the students an exit slip titled Ticket-out Lesson #2 Day 1. The students can use this time to reflect on the lesson and express in their own words what they learned and/or are having trouble with. (10-15 minutes)

Day 2

- Go over Ticket-out Lesson #2 Day 1. (5 minutes)
- Complete Example 3 and 4 from Notes Lesson #2. (35 minutes)
- Pass out Practice Lesson #2 Day 2. Students will get into groups of two or three to complete this practice. When they are finished, they will have access to an answer key to assess their progress. (50 minutes)
- Homework Pre-Lesson #3 : Students will read the article "SAT scores show disparities by race, gender, family income" by Mary Beth Marklein, USA TODAY. They will be asked questions regarding this article as a warm-up the following day.

Warm-Up Lesson #2 Name _____

Determine the indicated values (1 VARS STATS). Then sketch the normal curve.

1. Residents of upstate New York are accustomed to large amounts of snow with snowfalls often exceeding 6 inches in one day. In one city, such snowfalls were recorded for two seasons and are as follows (in inches):

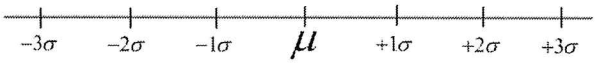
8.6 , 9.5 , 14.1 , 11.5 , 7.0 , 8.4 , 9.0 , 6.7 , 21.5 , 7.7 , 6.8 , 6.1 , 8.5 , 14.4 , 6.1 , 8.0 , 9.2 , 7.1

Mean μ ($\bar{x}$)= ____ Min = _____ Normal Curve Sketch:

Median= _____ Max = _____

Mode= _____ Range = _____

σ = _____



2. A professor at a university uses the bell curve (normal distribution) to grade his midterm exams. The students earn the following grades:

78 , 85 , 93 , 62 , 82 , 76 , 74 , 73 , 91 , 66 , 89 , 88 , 86 , 94 ,

65 , 90 , 84 , 92 , 82 , 85 , 80 , 77 , 52 , 84 , 78 , 83

Mean μ ($\bar{x}$)= ____ Min = _____ Normal Curve Sketch (with $\pm 3\sigma$):

Median= _____ Max = _____

Mode= _____ Range = _____

σ = _____

3. In 2012 data was collected from 30 high school seniors about their Math SAT scores. They scored the following:

410 , 500 , 390 , 380 , 390 , 425 , 590 , 260 , 410 , 360 , 410 , 230 , 270 , 430 , 370

520 , 400, 390 , 200 , 300 , 350 , 210 , 380 , 400 , 470 , 290 , 300 , 400 , 490 , 520

Mean μ ($\bar{x}$)= ____ Min = _____ Normal Curve Sketch (with $\pm 3\sigma$):

Median= _____ Max = _____

Mode= _____ Range = _____

σ = _____

Warm-Up Lesson #2 Name Key

Determine the indicated values (1 VARS STATS). Then sketch the normal curve.

1. Residents of upstate New York are accustomed to large amounts of snow with snowfalls often exceeding 6 inches in one day. In one city, such snowfalls were recorded for two seasons and are as follows (in inches):

8.6 , 9.5 , 14.1 , 11.5 , 7.0 , 8.4 , 9.0 , 6.7 , 21.5 , 7.7 , 6.8 , 6.1 , 8.5 , 14.4 , 6.1 , 8.0 , 9.2 , 7.1

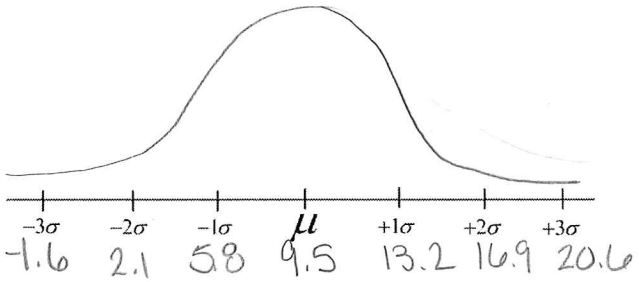
Mean μ ($\bar{x}$)= 9.5 Min = 6.1

Median= 8.45 Max = 21.5

Mode= 6.1 Range = 19.4

σ = 3.7

Normal Curve Sketch:



2. A professor at a university uses the bell curve (normal distribution) to grade his midterm exams. The students earn the following grades:

78 , 85 , 93 , 62 , 82 , 76 , 74 , 73 , 91 , 66 , 89 , 88 , 86 , 94 ,

65 , 90 , 84 , 92 , 82 , 85 , 80 , 77 , 52 , 84 , 78 , 83

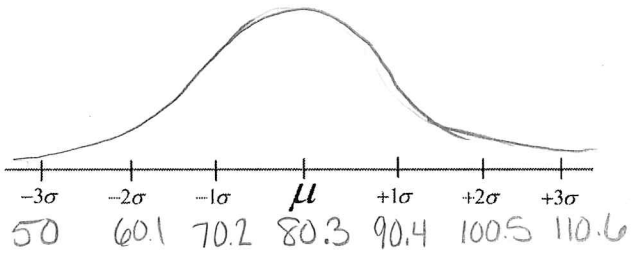
Mean μ ($\bar{x}$)= 80.3 Min = 52

Median= 82.5 (85, 84) Max = 94

Mode= 82, 78 Range = 42

σ = 10.1

Normal Curve Sketch (with $\pm 3\sigma$):



3. In 2012 data was collected from 30 high school seniors about their Math SAT scores. They scored the following:

410 , 500 , 390 , 380 , 390 , 425 , 590 , 260 , 410 , 360 , 410 , 230 , 270 , 430 , 370

520 , 400, 390 , 200 , 300 , 350 , 210 , 380 , 400 , 470 , 290 , 300 , 400 , 490 , 520

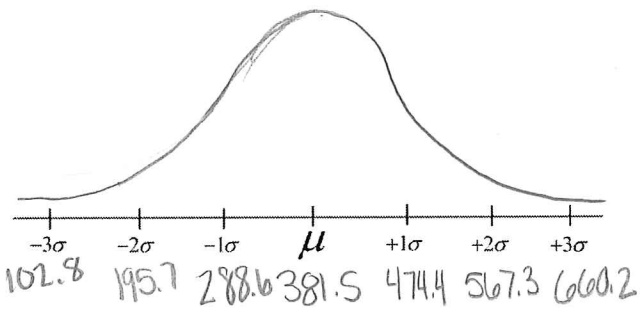
Mean μ ($\bar{x}$)= 381.5 Min = 200

Median= 390 (410) Max = 590

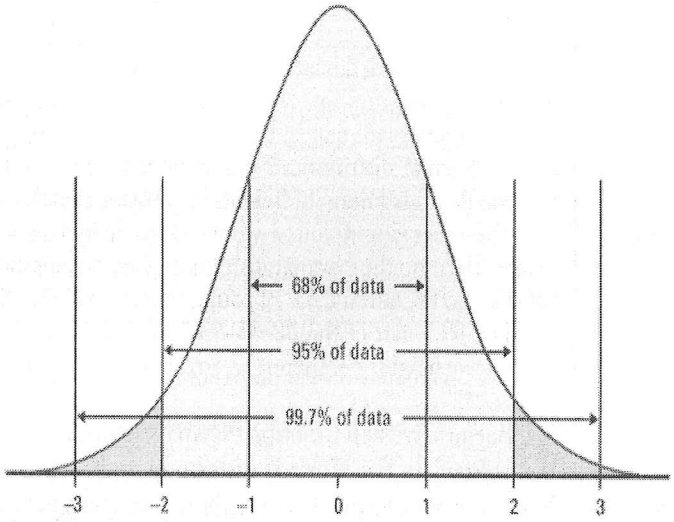
Mode= 400, 390 Range = 390

σ = 92.9

Normal Curve Sketch (with $\pm 3\sigma$):



Lesson #2: Empirical Rule & Z-Scores



EMPIRICAL RULE:

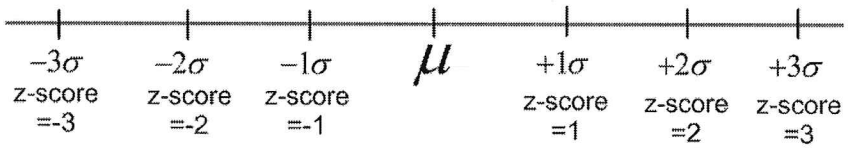
- Approximately_____of the observations fall between _____ and _____ standard deviations of the mean.
- Approximately _____of the observations fall between ____ and _____ standard deviations of the mean.
- Approximately _____of the observations fall between ____ and _____ standard deviations of the mean.
- 100% of the data falls under the curve.

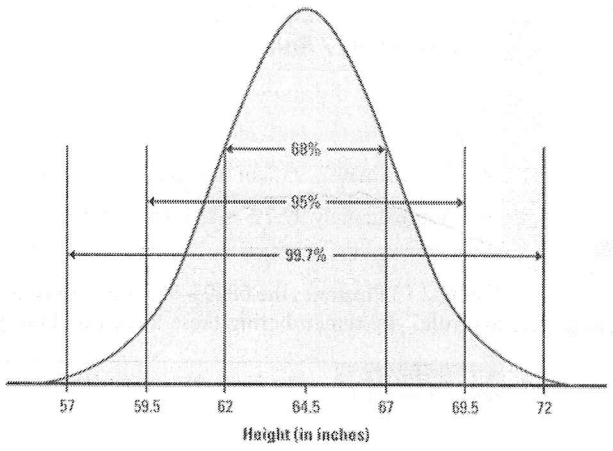
A **z-score** reflects how many standard deviations above or below the mean a data point is. The **z-score** is positive if the data value lies above the mean and negative if the data value lies below the mean.

Where x represents an element of the data set, the mean is represented by μ and standard deviation by σ

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

Z-scores coincide with the standard deviation.





Use the Empirical Rule and z-scores to answer:

1. Between what heights do 68% of women fall?

2. Between what two z-scores do 95% of women fall?

3. What percent of women are between 57 and 72 in.?

4. What z-score represents women shorter than 64.5?

5. What percent of women are taller than 69.5 inches?

6. What percent of women are shorter than 67 inches?

7. What percent of women are between 62 and 69.5 in.?

Example #1: Sketch the normal curve N (500, 50). Determine the z-scores using the formula and then place each x on the number line.

1. $X_1 = 650$ 2. $X_2 = 380$ 3. $X_3 = 565$

Z-SCORE TABLES

When using the z-score table, the number found represents the percentile below that value. For instance, a z-score of 0 (which is located at the μ) means 50% of the data is below that value

Using the z-score table, find the percentile for each data point:

$X_1 =$ $X_2 =$ $X_3 =$

Find the percent ABOVE each data point:

$X_1 =$ $X_2 =$ $X_3 =$

Example #2: Sketch a N (315.2, 23.6). There are 30 data values in this set.

Using a z-score table, answer the following questions.

1. Find the percent between 370.2 and 327.6 (find z-score of each, use table to find percentiles, then subtract).

2. Using the answer from problem 1, find the number of data points that fall between 370.2 and 327.6.

3. Find the number of data points between 319.7 and 250.4.

Example #3: Find the data point (x) given the mean and standard deviation

1. A Normal Distribution with mean = 235.7 and Standard Deviation = 41.58 . Which data point (x) has a z-score of - 3.45?

2. A Normal Distribution with a mean of = 115 and Standard Deviation of = 65. Which data point (x) has a z-score of .26?

Comparing Z-Scores: When normally distributed data has no relationship with each other, data can be compared using z-scores.

Example #4: Suppose SAT scores among high school students are normally distributed with a mean of 1650 and a standard deviation of 250. Suppose ACT sores among high school students are normally distributed with a mean of 23 and a standard deviation of 4. Sketch the normal curve for each test.

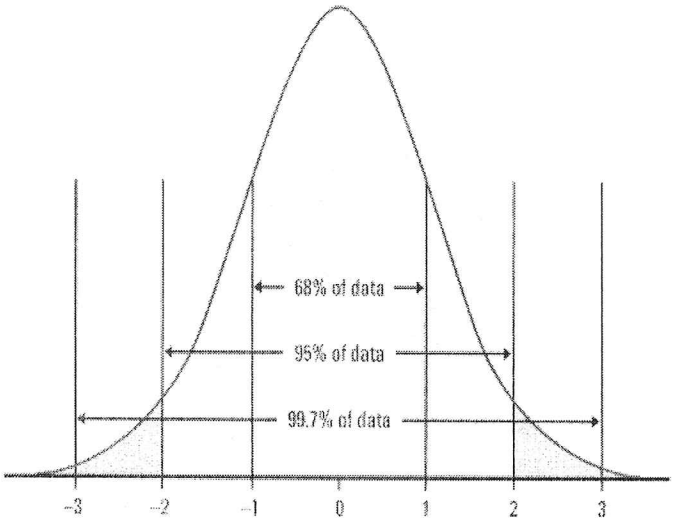
SAT

ACT

Joe took the SAT and scored a 1980. He also took the ACT and scored a 28. Which score should he send off with his college applications?

Key

Lesson #2: Empirical Rule & Z-Scores



EMPIRICAL RULE:

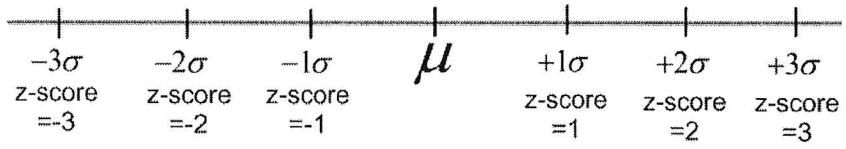
- Approximately 68% of the observations fall between -1 and 1 standard deviations of the mean.
- Approximately 95% of the observations fall between -2 and 2 standard deviations of the mean.
- Approximately 99.7% of the observations fall between -3 and 3 standard deviations of the mean.
- 100% of the data falls under the curve.

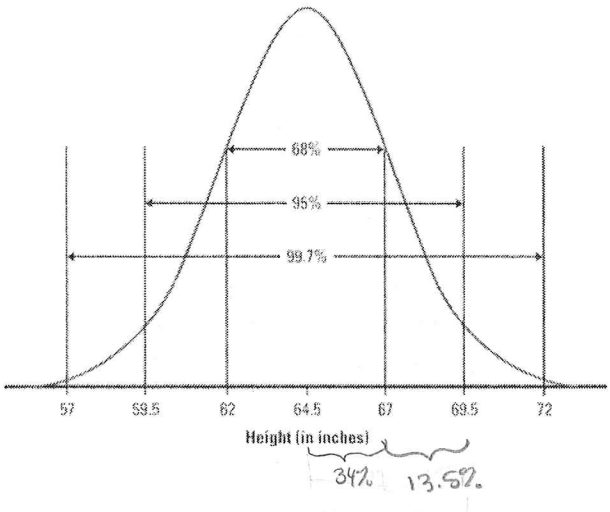
A **z-score** reflects how many standard deviations above or below the mean a data point is. The **z-score** is positive if the data value lies above the mean and negative if the data value lies below the mean.

Where x represents an element of the data set, the mean is represented by μ and standard deviation by σ

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

Z-scores coincide with the standard deviation.





Use the Empirical Rule and z-scores to answer:

1. Between what heights do 68% of women fall?

Btwn. 62 and 67 inches

2. Between what two z-scores do 95% of women fall?

Between -2σ and 2σ

3. What percent of women are between 57 and 72 in.?

99.7%

4. What z-score represents women shorter than 64.5?

0

5. What percent of women are taller than 69.5 inches?

$100-95=\frac{5}{2}=$ 2.5%

6. What percent of women are shorter than 67 inches?

$50+\frac{68}{2}=$ 84%

7. What percent of women are between 62 and 69.5 in.?

$97.5-\left(50-\frac{68}{2}\right)=$ 81.5%

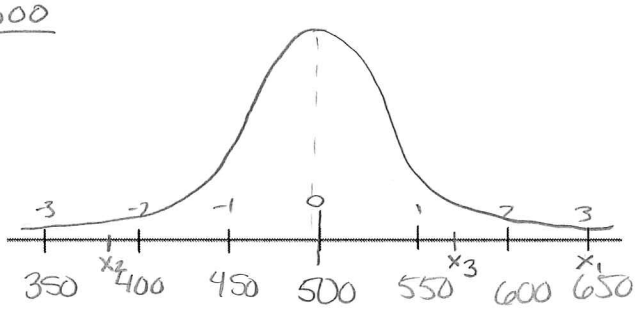
Key

Example #1: Sketch the normal curve N (500, 50). Determine the z-scores using the formula and then place each x on the number line.

1. $X_1 = 650$ 2. $X_2 = 380$ 3. $X_3 = 565$

$z = \frac{650 - 500}{50}$ $z = \frac{380 - 500}{50}$ $z = \frac{565 - 500}{50}$

$z = 3$ $z = -2.4$ $z = 1.3$



Z-SCORE TABLES

When using the z-score table, the number found represents the percentile below that value. For instance, a z-score of 0 (which is located at the μ) means 50% of the data is below that value

Using the z-score table, find the percentile for each data point:

$X_1 = .9987$ or 99.87% $X_2 = .0082$ or .82% $X_3 = .9032$ or 90.32%.

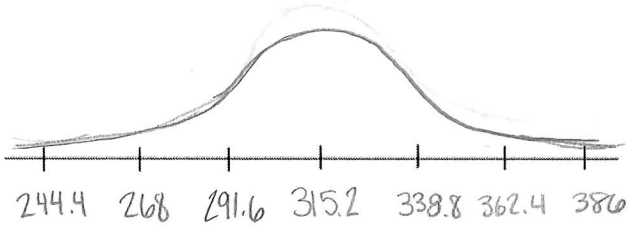
Find the percent ABOVE each data point:

$X_1 = 1 - .9987 = .0013$ or .13%

$X_2 = 1 - .0082 = .9918$ or 99.18%

$X_3 = 1 - .9032 = .0968$ or 9.68%

Example #2: Sketch a N (315.2, 23.6). There are 30 data values in this set.



Using a z-score table, answer the following questions.

1. Find the percent between 370.2 and 327.6 (find z-score of each, use table to find percentiles, then subtract).

$z = \frac{370.2 - 315.2}{23.6}$ $z = \frac{327.6 - 315.2}{23.6}$

$z = 2.33$ $= .53$

↳ .9901 ↳ .7019

.9901
-.7019
.2882

28.82% between the two pts

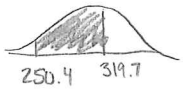
2. Using the answer from problem 1, find the number of data points that fall between 370.2 and 327.6.

$30(.2882) = 8.646$

There are about 8.646 data points between 370.2 and 327.6.

Key

3. Find the number of data points between 319.7 and 250.4.



$z = \frac{319.7 - 315.2}{23.6}$

$= .19$

↳ .5753

$z = \frac{250.4 - 315.2}{23.6}$

$= -2.75$

↳ .0030

.5753
−.0030
.5723

57.23%

30 (.5723) = 17.169

There are about 17.169 data points between 250.4 and 319.7.

Example #3: Find the data point (x) given the mean and standard deviation

1. A Normal Distribution with mean = 235.7 and Standard Deviation = 41.58 . Which data point (x) has a z-score of - 3.45? $41.58 \cdot -3.45 = \frac{x - 235.7}{41.58} \cdot 41.58$

$-143.451 = x - 235.7$

$+235.7 \quad +235.7$

$x = 92.249$

2. A Normal Distribution with a mean of = 115 and Standard Deviation of = 65. Which data point (x) has a z-score of .26? $65 \cdot .26 = \frac{x - 115}{65} \cdot 65$

$16.9 = x - 115$

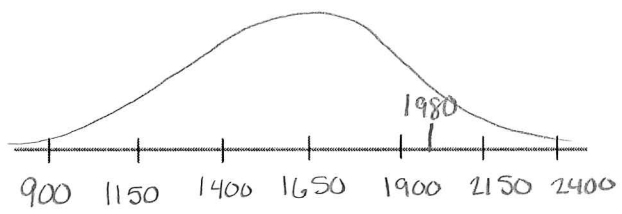
$+115 \quad +115$

$X = 131.9$

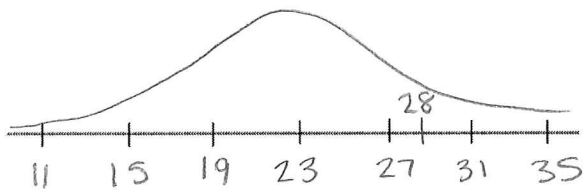
Comparing Z-Scores: When normally distributed data has no relationship with each other, data can be compared using z-scores.

Example #4: Suppose SAT scores among high school students are normally distributed with a mean of 1650 and a standard deviation of 250. Suppose ACT sores among high school students are normally distributed with a mean of 23 and a standard deviation of 4. Sketch the normal curve for each test.

SAT



ACT



Joe took the SAT and scored a 1980. He also took the ACT and scored a 28. Which score should he send off with his college applications?

SAT $z = \frac{1980 - 1650}{250}$

$= 1.32$

ACT $z = \frac{28 - 23}{4}$

$= 1.25$

Since the SAT z-score is higher, Joe did better than more people and should send that score on his college application.

Z-Score Table

Standard Normal Probabilities

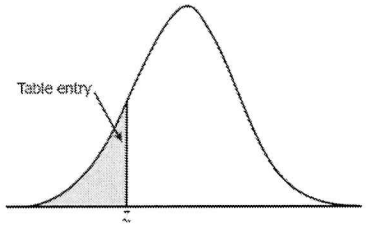


Table entry for z is the area under the standard normal curve to the left of z.

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

Standard Normal Probabilities

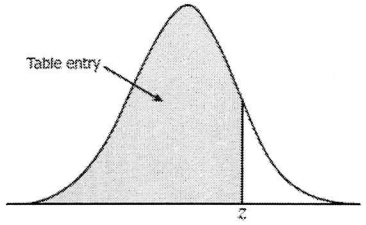


Table entry for z is the area under the standard normal curve to the left of z.

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

Ticket-out Lesson #2 Day 1

Answer the following questions to the best of your ability.

1. What are the 3 things you need to find a z-score?

2. When using the z-score table, what do you need to do to find the percent above a z-score?

3. How do you find the percent between two heights that don't lie on a standard deviation?

4. Name one new thing that you learned in class today.

5. Name one thing that you found easy, and one that you found difficult. Include why.

Key

Ticket-out Lesson #2 Day 1

Answer the following questions to the best of your ability.

1. What are the 3 things you need to find a z-score?

   mean, Standard deviation, and data point

2. When using the z-score table, what do you need to do to find the percent above a z-score?

   do 1 − value, then multiply by 100

3. How do you find the percent between two heights that don't lie on a standard deviation?

   Find the z-score of each, look it up in the table, subtract the two and multiply by 100.

4. Name one new thing that you learned in class today.

5. Name one thing that you found easy, and one that you found difficult. Include why.

Practice Lesson # 2 Day 2: Z-Score Problems Name:_____

Find the area under the curve (percentage) that corresponds with each inequality. Make sure you're considering the difference between a z-score that is "less than" versus "greater than" as well as in between! ☺

1) $z < -0.25$

2) $z < 2.75$

3) $z > -1.96$

4) $-1.18 < z < 2.15$

5) $z > 0.5$

6) $-0.52 < z < 3.45$

7) $z > -0.88$

8) $z < -3.11$

9) $0.25 < z < 0.95$

II. Answer each question below.

10) Assume that adults have IQ scores that are normally distributed with a mean of 110 and a standard deviation of 18.

a) Find the percentage of randomly selected adults who have an IQ score less than 115.

b) Find the percentage of adults with an IQ greater than 131.5.

c) Find the percentage of adults that have an IQ between 90 and 110.

11) Time to complete a standardized exam is approximately normal with a mean of 70 minutes and a standard deviation of 10 minutes.

a) What percent of students finish their exam in under 54 minutes?

b) What percent of students finish their exam between 65 and 78 minutes?

12) A Normal Distribution with mean = 23.3 and Standard Deviation = 4.7. Which data point (x) has a z-score of - 1.75?

13) A Normal Distribution with a mean of = 66 and Standard Deviation of = 12. Which data point (x) has a z-score of 2.3?

Practice Lesson # 2 Day 2: Z-Score Problems Name: Key

Find the area under the curve (percentage) that corresponds with each inequality. Make sure you're considering the difference between a z-score that is "less than" versus "greater than" as well as in between! ☺

1) $z < -0.25$

40.13%

2) $z < 2.75$

99.70%

3) $z > -1.96$

1 − .0250

97.5%

4) $-1.18 < z < 2.15$

.9842
− .1190
.8652 86.52%

5) $z > 0.5$

1 − .6915

30.85%

6) $-0.52 < z < 3.45$

.9997
− .3015
.6982 69.82%

7) $z > -0.88$

1 − .1894

81.06%

8) $z < -3.11$

.09%

9) $0.25 < z < 0.95$

.8289
− .5987
.2302 23.02%

II. Answer each question below.

10) Assume that adults have IQ scores that are normally distributed with a mean of 110 and a standard deviation of 18.

a) Find the percentage of randomly selected adults who have an IQ score less than 115.

$z = \frac{115-110}{18} = .28$

61.03%

b) Find the percentage of adults with an IQ greater than 131.5.

$z = \frac{131.5-110}{18} = 1.19$

1 − .8830 = .117

11.7%

c) Find the percentage of adults that have an IQ between 90 and 110.

$z = \frac{90-110}{18} = -1.11 \rightarrow .1335$

$z = \frac{110-110}{18} = 0 \rightarrow .5000$

.5000
− .1335
.3665

36.65%

11) Time to complete a standardized exam is approximately normal with a mean of 70 minutes and a standard deviation of 10 minutes.

a) What percent of students finish their exam in under 54 minutes?

$$z = \frac{54-70}{10} = -1.6$$

5.48%

b) What percent of students finish their exam between 65 and 78 minutes?

$$z = \frac{78-70}{10} = .8 \rightarrow .7881$$

$$z = \frac{65-70}{10} = -.5 \rightarrow .3085$$

$$.4796$$

47.96%

12) A Normal Distribution with mean = 23.3 and Standard Deviation = 4.7. Which data point (x) has a z-score of - 1.75?

$$-1.75 = \frac{X-23.3}{4.7}$$

$X = 15.075$

13) A Normal Distribution with a mean of = 66 and Standard Deviation of = 12. Which data point (x) has a z-score of 2.3?

$$2.3 = \frac{X-66}{12}$$

$X = 93.6$

Homework Pre-Lesson #3:
SAT scores show disparities by race, gender, family income

By Mary Beth Marklein, USA TODAY

Average national SAT scores for the high school class of 2009 dropped two points compared with last year, a report out today says. And while the population of test takers was the most diverse ever, average scores vary widely by race and ethnicity.

On one end, students who identified themselves as Asian, Asian-American or Pacific Islander posted a 13-point gain. On the other end, students who identified themselves as Puerto Rican posted a 9-point drop in average scores.

The SAT's owner, the nonprofit College Board, highlighted the 40% minority participation rate among test-takers this year, up from 38% last year and 29.2% in 1999. Also up from previous years: More than a third of students say they are first-generation college students whose parents never went to college, and more than a quarter said English is not their first language.

"We are tremendously encouraged by the increasing diversity," said College Board president Gaston Caperton. "More than ever, the SAT reflects the diversity of students in our nation's classrooms."

The report also noted that scores often decrease when a larger, more diverse pool of students take the test, so the relative stability is "a good sign," says Laurence Bunin, senior vice president.

But Bob Schaeffer, spokesman for the National Center for Fair & Open Testing, a critic of standardized tests, says that what stands out to him "is widening gaps of all sorts — race, gender and income — at a time when the nation is spending billions of dollars allegedly trying to close those gaps. The promise of No Child Left Behind and of many high-stakes state testing programs is that testing is going to improve educational quality. That's not what the data show."

The differences in total SAT scores by ethnicity was most extreme between Asian students (who had an average total score of 1623 out of a possible 2400) and black students (who averaged 1276, a four-point drop). Puerto Rican students averaged 1345. The national average was 1509. Top score is 800 in each of the three SAT sections.

Total scores also dropped two points for white students (who averaged 1581) and Mexican and Mexican American students (who averaged 1362). They increased two points for American Indian or Alaskan natives (average score 1448).

Disparities in scores by gender and income also widened:

•Average scores dropped 5 points for females and 2 points for males. While females represent more than half (53.5%) of test takers, their total average score (1496) is 27 points below the average score for males (1523).

•The highest average score of all (1702, up 26 points) was posted by students who said their families earned more than $200,000 a year. Students who reported family incomes of less than $20,000 a year averaged 1321, up 1 point.

The report's analysis notes that students who had completed a core curriculum, taken their school's most rigorous courses and familiarized themselves with the test were among the strongest performers.

For example, students who took an Advanced Placement or honors math course scored an average of 79 points above the national average math score. And students who had previously taken the Preliminary SAT/National Merit Scholarship Qualifying Test scored 121 points higher on average than those who did not take the test.

But Caperton stressed that not all students have access to such programs.

"As a country we must do better at providing students of every background equal access to education, equal access to the best teachers, and equal access to the best counseling," he said.

http://usatoday30.usatoday.com/news/education/2009-08-25-SAT-scores_N.htm

Lesson #3: Big Future: How SAT scores play a role in college acceptance.

Through this lesson students will gain knowledge of average SAT scores accepted by local colleges and how race, gender and family income play a role in SAT scores. Students will receive real world data to compare and will be asked compelling questions about student demographics. Students will also be assessed on their ability to use statistics to accurately answer real world questions. As a wrap up of the unit, the teacher will lead a discussion on what it takes to be successful in college and the importance of doing well in high school.

The teacher will follow this guideline throughout the lesson:

- Warm-Up Lesson #3: The students will be given the average SAT scores for students accepted to three local colleges. The students will fill in information from the reading they had for homework. The students will then answer questions about the demographics of students whose average score would gain them entrance into these colleges. The students will also read several passages about bias in the SAT and answer questions regarding their opinion of testing bias. The teacher will then facilitate a discussion of the students' answers. (20 minutes)
- Pass out the handout titled Statistics Unit Assessment. This will assess a students' ability to use statistics accurately on real world questions. This will be collected and graded upon completion. Students will be given access to a formula sheet for reference. (40 minutes)
- As students complete their assessment, give them an excerpt from the article titled "SAT I: A Faulty Instrument for Predicting College Success" from the FairTest website. After all students have had a chance to read the article and reflect, the teacher will facilitate a discussion on re-assessing the importance of SAT scores. The teacher can use the questions provided as a guide, but is advised to also use personal experiences to relate to the students. (25 minutes)
- Pass out Post-Unit Survey to see if the students have changed their viewpoints on the importance of SAT scores. (5 minutes)

Warm-Up Lesson #3 Name _____

Below are the average SAT scores accepted to 3 Virginia universities based on the website: http://www.satscores.us/. Based on the average SAT score for each category you read about in the article "SAT scores show disparities by race, gender, family income" by Mary Beth Marklein, fill in the following chart. Put an x under the university if the average student would be accepted based on their SAT score.

	Virginia Commonwealth University (VCU) 1460-1770	James Madison University (JMU) 1580-1870	Virginia Tech 1650-1940
Male			
Female			
Black			
White			
Asian			
Puerto Rican			
Mexican/Mexican American			
American Indian or Alaskan Natives			
National Average			
Family income above $200,000			
Family Income below $20,000			
Massaponax (1462)			
Riverbend (1501)			

1) Do you think there is a connection between race and SAT scores? Support your claim with evidence.

2) Do you think there is a connection between gender and SAT scores? Support your claim with evidence.

3) Do you think there is a connection between family income and SAT scores? Support your claim with evidence.

4) Do you think there is a connection between race/gender/family income and the people attending various universities?

5) Compare the population of students at Massaponax and Riverbend in regards to race and income. Do you think this has an effect on SAT scores?

6) Based on this article, what could help students increase their test scores? Support your claim with evidence.

Consider the information below about bias in the SAT and what some colleges are doing about it. Then answer the following questions.

- Passage from the blog "New Mind-Boggling Evidence Proves SAT Bias" Dr. Ibram Rogers

  Each year, when students take the SAT, one of the sections on the test is not scored. Instead, the Educational Testing Service (ETS) "pre-tests" the questions in the unscored section for potential use on a future SAT. During this pre-testing process, test developers also gather the race and gender of the test taker.

  If questions perform well, then they are used on a scored section in the future. If they perform poorly, then they are scrapped. How does the ETS judge the performance of a question?

  "Each individual SAT question ETS chooses is required to parallel the outcomes of the test overall," writes Rosner of The Princeton Review Foundation. "So, if high-scoring test-takers — who are more likely to be White (and male, and wealthy) — tend to answer the question correctly in pretesting, it's a worthy SAT question; if not, it's thrown out. Race and ethnicity are not considered explicitly, but racially disparate scores drive question selection, which in turn reproduces racially disparate test results in an internally reinforcing cycle."
  http://diverseeducation.com/article/49830/#

- Passage from the blog "SAT Racial Bias Proves Standardized Tests Are Geared Toward White Students" by Haleigh Collins

  Wealthier test takers also enjoy advantages in the form of test preparation. From tutors that cost up to hundreds of dollars an hour to private college counselors, students with means and access to additional help can often bring their scores up hundreds of points through gaming the system. For example, by my access to past tests, and my practice of taking five of them, I improved my scores by two hundred points -- just by seeing trends in the questions. My improvement was not a product of my intelligence, but rather a result of the number of questions I was exposed to and the coaching I received. Students who do not have this opportunity are at a severe disadvantage.

  If we are really a democracy and not a plutocracy, standardized tests should not be a significant factor in the college process. In fact, an increasing number of schools, most notably the University of California schools, no longer require applicants to submit SAT scores. SAT scores are not a thorough evaluation of intelligence. Socioeconomic status, culture, primary language, and test taking experience greatly affect results. However, other means of student evaluation are also biased, such as GPA and teacher recommendations. Perhaps standardized tests should still be administered, but colleges should be wary in valuing them as a major factor in a student's application.
  http://www.policymic.com/articles/8582/sat-racial-bias-proves-standardized-tests-are-geared-toward-white-students

- FairTest finds that nearly 850 four-year colleges do not use the SAT I or ACT to admit substantial numbers of bachelor degree applicants. Christopher Newport University, George Mason University, and Virginia Wesleyan College are a few Virginia four-year colleges that only consider SAT/ACT when minimum GPA and/or class rank is not met.
  http://www.fairtest.org/university/optional/state

1) Do you think the SAT is a fair assessment for colleges to use during admissions? Why or why not.

2) Do you think more colleges should exclude SAT scores during admissions?

3) Do you think the SAT is biased?

4) What about other standardized? Do you think the SOL is biased?

5) Would you like more information on this topic?

Warm-Up Lesson #3 Name Key

Below are the average SAT scores accepted to 3 Virginia universities based on the website: http://www.satscores.us/. Based on the average SAT score for each category you read about in the article "SAT scores show disparities by race, gender, family income" by Mary Beth Marklein, fill in the following chart. Put an x under the university if the average student would be accepted based on their SAT score.

	Virginia Commonwealth University (VCU) 1460-1770	James Madison University (JMU) 1580-1870	Virginia Tech 1650-1940
Male 1523	X		
Female 1496	X		
Black 1276			
White 1581	X	X	
Asian 1623	X	X	
Puerto Rican 1345			
Mexican/Mexican American 1362			
American Indian or Alaskan Natives 1448			
National Average 1501	X		
Family income above $200,000 1702	X	X	X
Family Income below $20,000 1371			
Massaponax (1462)	X		
Riverbend (1501)	X		

1) Do you think there is a connection between race and SAT scores? Support your claim with evidence.

Yes because each race varies from the national average. That would not happen if each race scored the same

2) Do you think there is a connection between gender and SAT scores? Support your claim with evidence.

Yes. There is a gap of 27 points between the female average and male average

3) Do you think there is a connection between family income and SAT scores? Support your claim with evidence.

Yes, There is a huge gap between students who have a family income of $200,000 and those who have $20,000.

4) Do you think there is a connection between race/gender/family income and the people attending various universities?

Maybe (depends on how student views the data)

5) Compare the population of students at Massaponax and Riverbend in regards to race and income. Do you think this has an effect on SAT scores?

Massaponax has lower scores, but also has more diversity and lower family income. That could have an effect on SAT scores.

6) Based on this article, what could help students increase their test scores? Support your claim with evidence.

The article gives several ways... Compute core Curriculum, take school's most rigorous courses, familiarize yourself with the test, take AP and honors math classes, and take the PSAT.

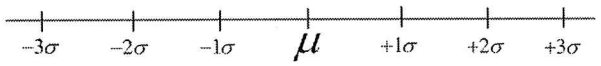
Statistics Unit Assessment Name _____

1) In 2012 data was collected from 30 high school seniors about their Math SAT scores. They scored the following:

610 , 500 , 350 , 480 , 490 , 430 , 590 , 260 , 630 , 760 , 310 , 280 , 270 , 430 , 570

520 , 470, 390 , 350 , 360 , 350 , 210 , 480 , 400 , 770 , 390 , 300 , 400 , 590 , 520

Mean μ ($\bar{x}$)= ____ σ = _____ Normal Curve Sketch (with $\pm 3\sigma$):



Determine the z-score for:

a) $X_1 = 430$ b) $X_2 = 690$ c) $X_3 = 230$ d) $X_4 = 500$

2) The writing portion of the SAT had a mean score of 488 and a standard deviation of 114.
a) Create a normal distribution curve for this data

b) Between what two scores did 68% of the students score?

c) What percent of students scored between 260 and 602?

3) You scored 550 on the reading portion of the SAT. If the mean score was 496 and the standard deviation was 114:

a) Create a normal distribution curve for this data

b) Find the z-score that corresponds to your score

c) Given that 1,664,479 people took the test, find the number of people that you scored higher than.

4) The college you are applying to only accepts Math SAT scores in the 85^{th} percentile. Given that the mean is 514 and the standard deviation is 117:

a) Create a normal distribution curve for this data

b) Find the z-score that corresponds to the 85^{th} percentile

c) Find the minimum score you need to be accepted to this school.

Statistics Unit Assessment Name Key

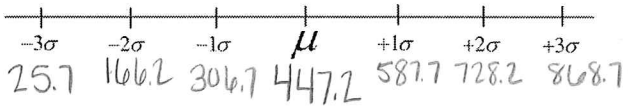
1) In 2012 data was collected from 30 high school seniors about their Math SAT scores. They scored the following:

610 , 500 , 350 , 480 , 490 , 430 , 590 , 260 , 630 , 760 , 310 , 280 , 270 , 430 , 570

520 , 470, 390 , 350 , 360 , 350 , 210 , 480 , 400 , 770 , 390 , 300 , 400 , 590 , 520

Mean μ ($\bar{x}$)= 447.2 σ = 140.5

Normal Curve Sketch (with $\pm 3\sigma$):



Determine the z-score for:

a) X_1 = 430

$z = \frac{430 - 447.2}{140.5} = -.12$

b) X_2 = 690

$z = \frac{690 - 447.2}{140.5} = 1.73$

c) X_3 = 230

$z = \frac{230 - 447.2}{140.5} = -1.55$

d) X_4 =500

$z = \frac{500 - 447.2}{140.5} = .38$

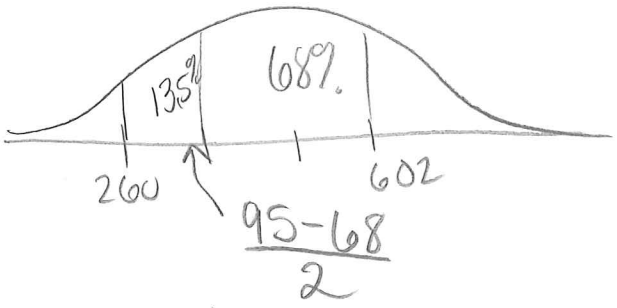
2) The writing portion of the SAT had a mean score of 488 and a standard deviation of 114.

a) Create a normal distribution curve for this data

b) Between what two scores did 68% of the students score?

374 and 602

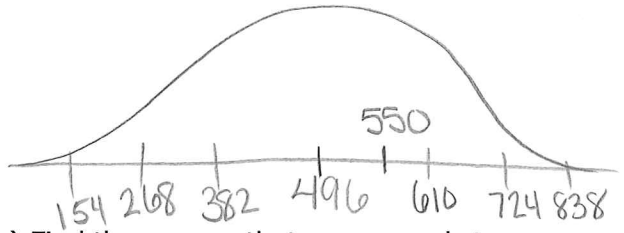
c) What percent of students scored between 260 and 602?



68% + 13.5% = 81.5%

3) You scored 550 on the reading portion of the SAT. If the mean score was 496 and the standard deviation was 114:

a) Create a normal distribution curve for this data



b) Find the z-score that corresponds to your score

$$z = \frac{550 - 496}{114}$$

$$z = .47$$

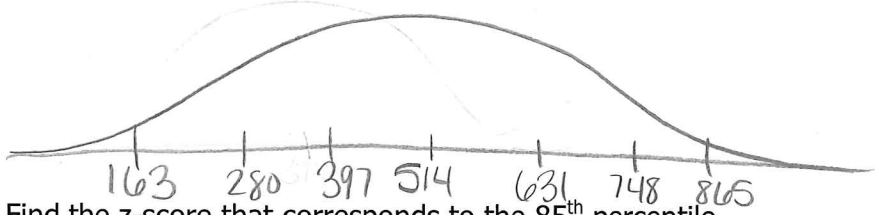
c) Given that 1,664,479 people took the test, find the number of people that you scored higher than.

$z = .47 \rightarrow .6808$ $\quad$ $1{,}664{,}479 (.6808) = 1133177$

You scored higher than 1,133,177 people

4) The college you are applying to only accepts Math SAT scores in the 85th percentile. Given that the mean is 514 and the standard deviation is 117:

a) Create a normal distribution curve for this data



b) Find the z-score that corresponds to the 85th percentile

(look up .85 in the z-score table)

$z = 1.04 \rightarrow 85\%$

c) Find the minimum score you need to be accepted to this school.

$$1.04 = \frac{x - 514}{117}$$

$x = 635.68$

You would need a score of at least 635.68 to be accepted into that college.

SAT I: A Faulty Instrument for Predicting College Success

Submitted by fairtest on August 20, 2007

Promotional claims for the SAT I frequently tout the test's important place in the "toolbox" of college admissions officers trying to distinguish between students from vastly different high schools. Yet the true utility of the SAT I is frequently lost in this rhetoric as admissions offices search for a fair and accurate way to compare one student to another. Many colleges and universities around the country, in dropping their test score requirements, have recently confirmed what the research has shown all along - the SAT I has little value in predicting future college performance.

How well does the SAT I predict success beyond the freshman year?

If one looks beyond college grades, information from The Case Against the SAT by James Crouse and Dale Trusheim actually points to the SAT I's poor utility in forecasting long-term success. Data they analyzed demonstrated that using the high school record alone to predict who would complete a bachelor's degree resulted in "correct" admissions decisions 73.4% of the time, while using the SAT I and high school GPA forecast "correct" admissions in 72.2% of the cases.

How well does the SAT I predict college achievement for females, students of color, and older students?

The poor predictive ability of the SAT I becomes particularly apparent when considering the college performance of females. Longstanding gaps in scores between males and females of all races show that females on average score 35-40 points lower than males on the SAT I, but receive better high school and college grades. In other words, the test consistently under-predicts the performance of females in college while over-predicting that of males.

Measuring the SAT I's predictive ability for students of color is more complicated since racial classifications are arbitrary. For students whose first language isn't English, test-maker research shows the SAT I frequently under-predicts their future college performance. One study at the University of Miami compared Hispanic and non-Hispanic White students. Though both groups earned equivalent college grades, the Hispanic students received on average combined SAT I scores that were 91 points lower than their non-Hispanic White peers. This gap existed despite the fact that 89% of the Hispanic students reported English as their best language.

Extensive research compiled by Derek Bok and William Bowen in The Shape of the River highlights the SAT I's questionable predictive power for African-American students. The ability of SAT I scores to predict freshman grades, undergraduate class rank, college graduation rates, and attainment of a graduate degree is weaker for African-American students than for Whites. Such discrepancies call into question the usefulness of using the SAT I to assess African-American students' potential.

The SAT I also does a poor job of forecasting the future college performance of older students. ETS acknowledges that the test's predictive power is lower for "non-traditional" students who may be out of practice taking timed, multiple-choice exams. For this reason, many colleges and universities do not require applicants who have been out of high school for five years or more, or those over age 25, to submit test scores.

What's the alternative?

The weak predictive power of the SAT I, its susceptibility to coaching, examples of test score misuse, and the negative impact test score use has on educational equity all lead to the same conclusion - test scores should be optional in college admissions. The nearly 400 colleges and universities that already admit substantial numbers of freshman applicants without regard to test scores have shown that class rank, high school grades, and rigor of classes taken are better tools for predicting college success than any standardized test. The ACT and SAT II are often viewed as alternatives to the SAT I. While they are more closely aligned with high school curricula, they are not necessarily better tests.

http://www.fairtest.org/satvalidity.html

What is one thing that interested you about this article?

Did this article have an effect on your views of the SAT? Why or why not?

Do you think you will be successful in college? Why or why not?

Post-Unit Survey: Answer the following questions based on your current knowledge of the following topics.

1 - Not important, 3 – Important, 5 - Very important

How important do you think the SATs are in applying for college?
1 2 3 4 5
How important do you think your GPA is in applying for college?
1 2 3 4 5
How important do you think ACT scores are in applying for college?
1 2 3 4 5
How important do you think extracurricular activities are in applying for college?
1 2 3 4 5
List 3 colleges you would be interested in attending?
1) _____
2) _____
3) _____