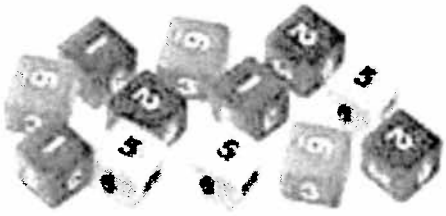
Probability & Statistics
More Geometry & Measurement...



University of Houston – Central Campus

EatMath Workshop

March 27, 2010

Probability & Statistics

Make a list of topics and ideas that come to mind when you think of "probability". These should include everyday uses of probability as well as mathematical or school uses.

1.	Weather
2.	Lottery
3.	Counting Outcomes
4.	Chances of an Event
5.	Pregnancy (genetic disorder, sex, etc)
6.	Vehicle Purchase (Repairs, surviving a crash)
7.	
8.	
9.	
10.	

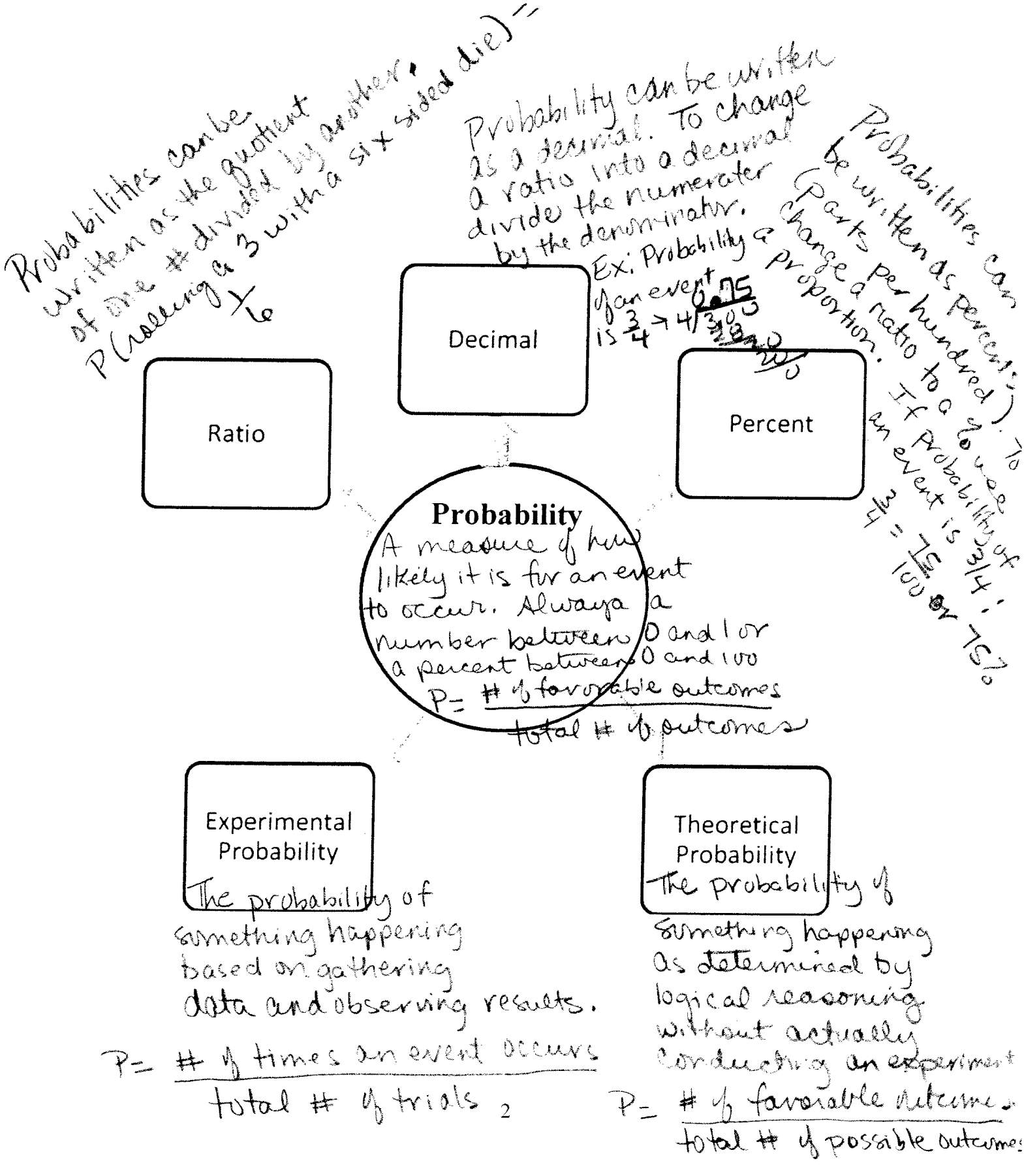
Answers will vary

What does "probability" have to do with "statistics"? (Think of ways that statistics may use probability and ways that probability may use statistics)

Answers will vary...

Probability is used as data set and statistics is used to analyze the data. The two are interrelated ideas.

Probability Concept Map



From the list below select your most favorite category of music. Write your selection on a slip of paper.

Music Category	Number of Responses
Country	
Hip Hop	Responses vary with size of class.
Pop	
Rap	
Rock	
Tejano	

If one slip of paper is randomly selected from all the slips, what is the theoretical probability the slip will say Rap? Write your answer as a fraction, decimal, and percent.

Answers will be based on actual data collected from the slips of paper

How could you conduct an experiment to determine the experimental probability of selecting a Rap Slip from the class set of slips?

Discussion should lead to drawing the slips of paper from the container.

Theoretical & Experimental Probability Problem Situations

Problem 1

Suppose you toss a fair coin three times, and the coin comes up as heads all three times. What is the probability that the fourth toss will be tails? Justify your answer $P(T) = \frac{1}{2}$

There are two possible outcomes for tossing a coin either Heads or Tails.

Problem 2

Toss a coin twice and record the two outcomes in order (for example, "HT" would mean that the first toss came up heads, and the second toss came up tails).

Answers will vary

Toss 1	Toss 2
H	T

a. List all the possible outcomes for tossing a coin twice. HT, HH, TH, TT

1. How many are there? 4
2. What is the probability that each occurs? $\frac{1}{4}$

b. List all the possible outcomes for tossing a coin three times.

HHH, HHT, HTT, TTT, TTH, THH, THT, HTH

1. How many are there? 8
2. What is the probability that each occurs? $\frac{1}{8}$

Problem 3: Fair or Unfair?

Here is a game of chance for two players using two number cubes of different colors. Each of the two players rolls a number cube, and the winner is determined by the sum of the faces:

- Player A wins when the sum is 2, 3, 4, 10, 11, or 12.
- Player B wins when the sum is 5, 6, 7, 8, or 9.

Let's Play: Roll the number cube 20 times and record the results using the table below.

Sum	Tally	Frequency	Probability (Fraction)	Probability (Decimal)	Probability (Percent)
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					

Responses will be based on data collected from experiment

Who won the most often? what was the % of wins for each player?

Fair or Unfair Combined Results

Sum	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	Average
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							

Fair or Unfair?: Finding the Winner

Let's take a look at the sums of the possible outcomes for the two number cubes.

		Number Cube 1					
	+	1	2	3	4	5	6
Number Cube 2	1	(2)	(3)	(4)	5	6	7
	2	(3)	(4)	5	6	7	8
	3	(4)	5	6	7	8	9
	4	5	6	7	8	9	(10)
	5	6	7	8	9	(10)	(11)
	6	7	8	9	(10)	(11)	(12)

Remember the rules of the game:

- Player A wins when the sum is 2, 3, 4, 10, 11, or 12.
- Player B wins when the sum is 5, 6, 7, 8, or 9.

a. For how many of the 36 outcomes will Player A win? 12/36 or 33%

b. For how many of the 36 outcomes will Player B win? 24/36 or 67%

c. Who is more likely to win this game? Player B will win this game 2/3 of the time

Ans. will vary

Extension: Change the rules of the game in some way that makes it equally likely for Player A or Player B to win. One potential change is to change the sums that each player wins with. Here's one possible solution:

- Player A wins when the sum is 2, 3, 4, 7, 10, 11 or 12
- Player B wins when the sum is 5, 6, 8, or 9

With this change each player will win one-half ($\frac{18}{36}$) of the time.

Complete the Probability Table below using the sum of the possible outcomes from Fair or Unfair?

Sum	Frequency	Probability
2	1	1/36
3	2	2/36
4	3	3/36
5	4	4/36
6	5	5/36
7	6	6/36
8	5	5/36
9	4	4/36
10	3	3/36
11	2	2/36
12	1	1/36

1. Using the probability table above, determine the probability that Player A will win the game. Recall that Player A wins if the sum is 2, 3, 4, 10, 11, or 12.

$1/36 + 2/36 + 3/36 + 3/36 + 2/36 + 1/36 = 12/36$

2. If you know the probability that Player A wins, how could you use it to determine the probability that Player B wins without adding the remaining values in the table?

Subtract the probability that Player A wins ($12/36$) from 1:

$$1 - \frac{12}{36} = \frac{36}{36} - \frac{12}{36} = \frac{24}{36} \text{ or } \frac{2}{3}$$

To Toss or To Simulate?

① not collected out in the real world
② amt of data is typically larger than the amt you could observe in real life

Problem 1 – Tossing a coin

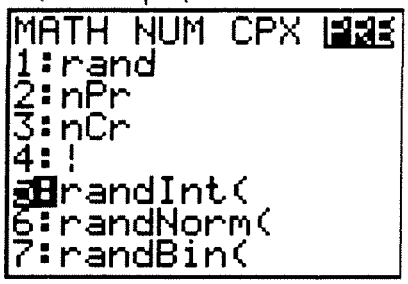
When you toss a coin, there are two possible outcomes. The sample space, or set of all possible outcomes, is heads or tails, {H, T}.

In this activity, we will use the calculator to simulate the tossing of a coin many times. The command **randInt()** that randomly generates integers.

You can choose any two integers. We will use randInt(0,1), letting 0 represent a tail and 1 represent a head.

On the Home screen, "toss a coin" 5 times by entering **randint(0,1)** and then pressing enter 5 times.

math → PRB



Note: **randInt** can be entering by pressing MATH, arrow to the PRB menu and select command #5.

- How many heads did you get?

3

Ans: will vary

- Now, enter **randInt(0,1,5)**. What happens? What would you need to type to toss the coin 10 times?

① All five results appear at once.

② randint(0, 1, 10)

On the Home screen, simulate the tossing of a coin and find the number of heads by entering **sum(randint(0,1,# of trials))**.

2nd 0 (catalog)

Repeat this for each number of tosses listed in the second column. Press 2nd **Enter** to recall the last entry.

Record your results in the table.

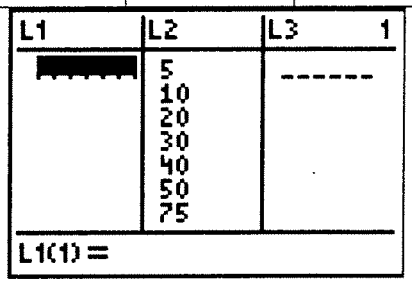
Ans. will vary

```
sum(randInt(0,1,
10))
```

Heads	Tosses	Percent (=L1/L2)
5	5	100%
4	10	40%
11	20	55%
13	30	43.3%
17	40	42.5%
19	50	38%
	75	
	100	
	200	
	300	
	400	
	500	
	900	

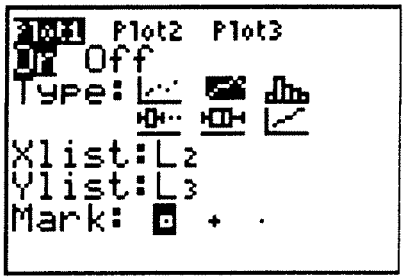
Press **STAT EDIT**. Enter the number of heads in list L1 and the number of tosses in list L2.

To calculate the percent of heads for each trial, move to the top of list L3 and enter **L1/L2**.

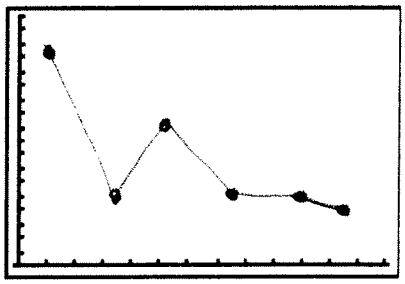


Now create a connected scatter plot of **percent heads (L3)** versus **tosses (L2)**. Press 2nd Y= **(STAT PLOT)** and select **Plot1**. Match the settings to those shown at the right.

Press **Zoom** and select **ZoomStat** to view the plot.



- Sketch your connected scatter plot of percent heads versus tosses.



For students to see that the experimental probability approaches the theoretical probability, have them add a horizontal line at 0.5 $Y_1 = 0.5$

- What do you notice about the shape of the graph? Why do you think this happens?

  levels off to the theoretical probability b/c of the increased # of data collected.

- What can you conclude about the percent of getting heads as the number of trials increases?

  should be close to the theoretical probability %

Problem 2 – Rolling a die

You will now use the **randInt()** function to simulate the rolling of a six-sided die.

- How many possible outcomes are there? What is the sample space?

Can't use sum command because some of the integers will be greater than 1.

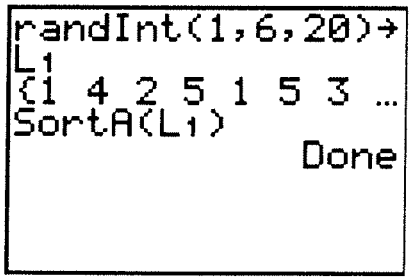
On the Home screen, simulate the rolling of a die by entering **randint(1,6,# of trials)→L1**. Then sort list L1 in ascending order by entering **SortA(L1)**.

Note: Press **STAT** and select the command to sort.

Press **STAT EDIT** and arrow up twice. To determine the number of 6s in the list, subtract the row number of the first 6 from row number of the last 6 and then add 1. For example, if the first 6 is at L1(16) and the last 6 is at L1(20), it is 20 – 16 + 1 = 5.

Repeat these steps for each number of rolls listed in the second column. Press **2nd Enter 2nd Enter** to recall the second previous entry on the Home Screen.

Record your results in the table.

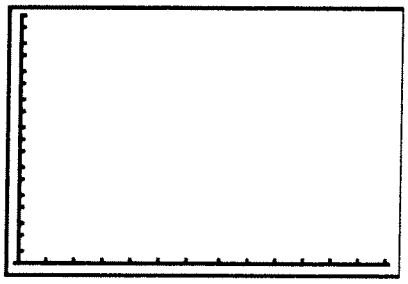


6's	Rolls	Percent (=L1/L2)
	5	
	10	
	20	
	30	
	40	
	50	
	75	
	100	
	200	
	300	
	400	
	500	
	900	

Clear list L1 (arrow to the top of L1 and press **Clear Edit**) and enter the data in the table into lists L1 and L2. Calculate the percent of 6s in list L3.

Then create a scatter plot of the percent of 6s versus rolls.

- Sketch your connected scatter plot.

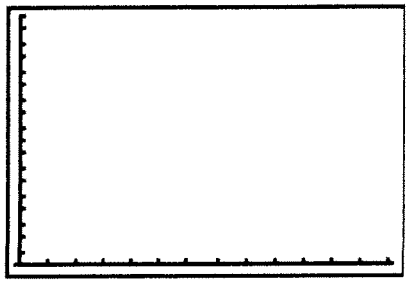


- What can you conclude about the percent of rolling a 6 as the number of trials increases?

Extension – Rolling Two Dice

Use what you have learned in the previous problems to simulate rolling two dice and finding the sum. Record the number of sums that are 7.

- Sketch your connected scatter plot.



- What can you conclude about the percent of rolling a sum of 7 as the number of trials increases?

Sum of 7	Rolls	Percent (=L1/L2)
	5	
	10	
	20	
	30	
	40	
	50	
	75	
	100	
	200	
	300	
	400	
	500	
	900	

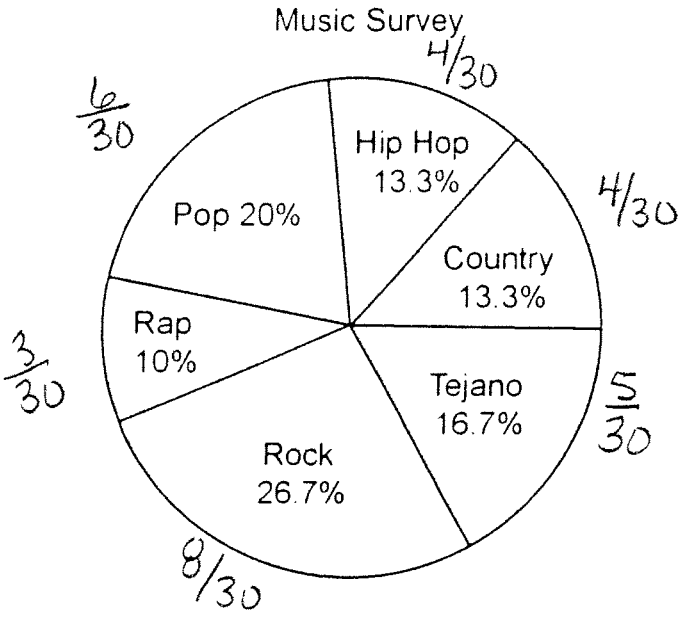
Students will be tempted to use integers from 2-12. However, this does not take into consideration that each sum does not have an equal probability of being chosen

use (randint(1,6, #trials) + randint(1,6, #trials)) → L1 to generate the sum of the rolls

Activity: More Data

1. Mrs. Richardson's communications class collected data for a music survey. Thirty students responded to the survey. The data is displayed in the circle graph below. Note: The percents have been rounded to the nearest tenth of a percent.

Multiply each % by 30 to get the # of students out of 30.



a. Rock had approximately the same percent as Rap and Tejano combined.

b. Six students preferred Pop.

c. About 8 students preferred Rock.

d. Hip Hop, Rap, and Rock accounted for exactly 50% of the responses.

2. Tanisha recorded her quiz grades for a class. 60, 75, 75, 80, 84, 88, 90, 96

75, 84, 96, 90, 88, 75, 80, 60

a. Which measure of central tendency (mean, median, or mode) will give Tanisha the highest grade? mean = 81 (median = 82) mode = 75

b. If her next quiz is an 81, which measure of central tendency is affected the most?

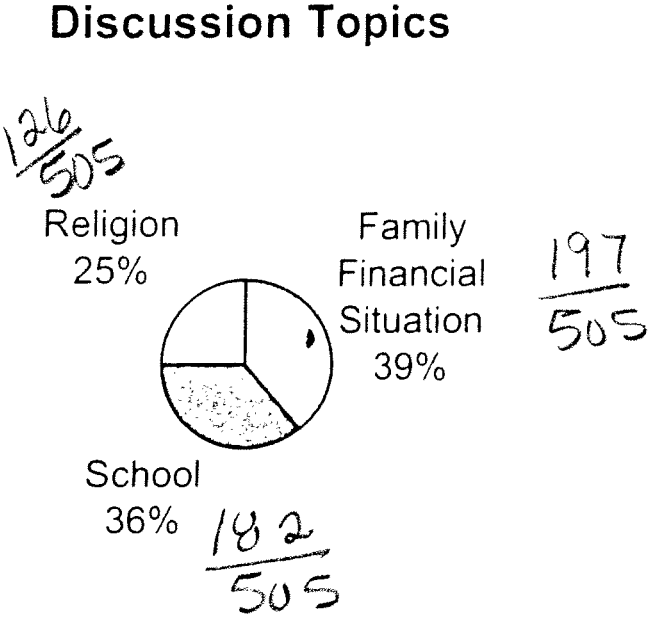
mean = 81 (median = 81) mode = 75

60, 75, 75, 80, 81, 84, 88, 90, 96

Youth Poll

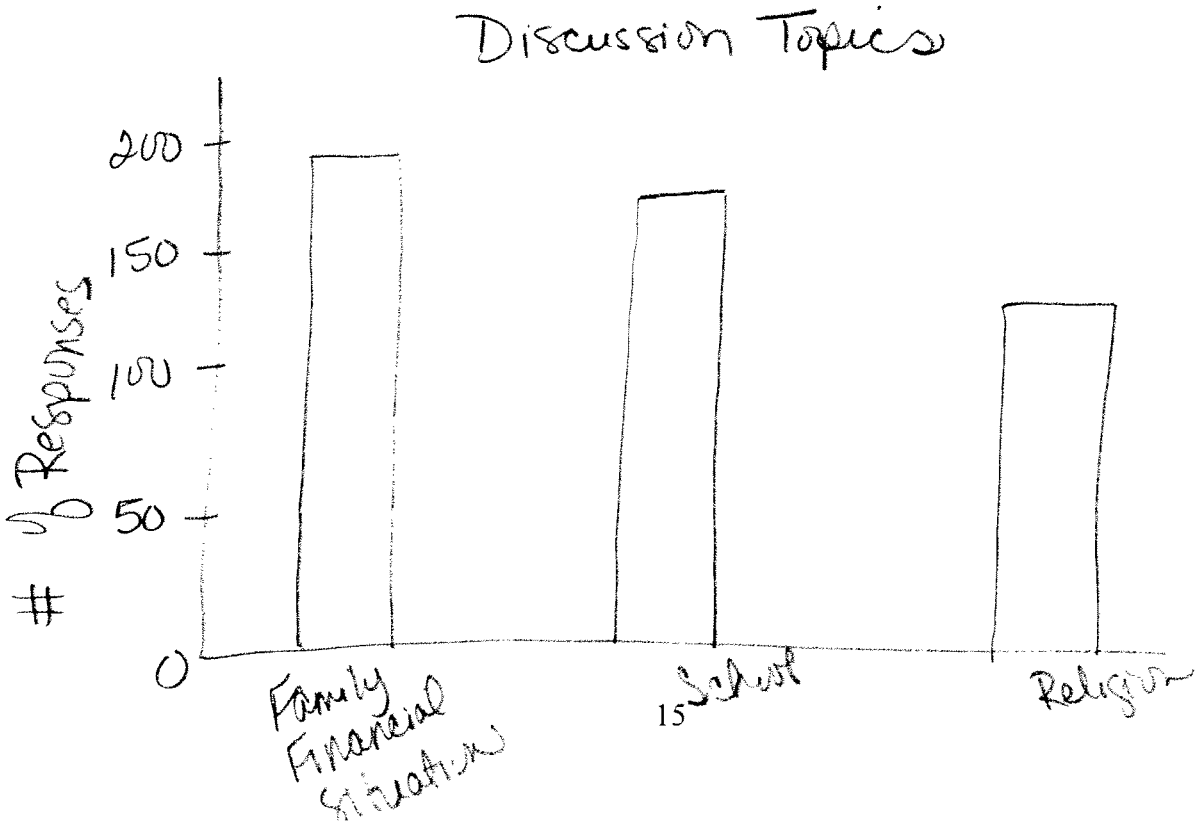
A poll was conducted to determine the topics teenagers most want to discuss with their parents. The poll was based on a national sample of 505 teenagers selected at random. The results are shown in the graph below.

Multiply each % by 505 to determine the actual # for each category.



Create a different graph to display the same set of data. Justify your choice of graph.

Ans will vary



1 Ms. Ugalde has an 80-acre farm.

≈ 48% • 38 acres are used for planting corn.

≈ 23% • 18 acres are used for planting soybeans.

≈ 13% • 10 acres are used for planting wheat.

66 acres total

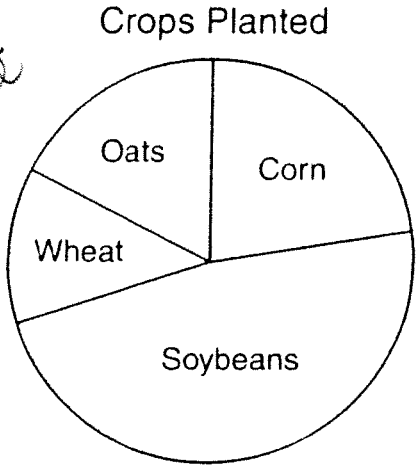
14 acres oats

≈ 18%

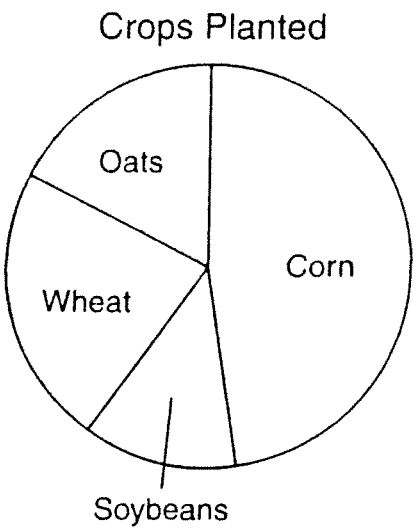
The remaining acres are used for planting oats. Which of the following graphs best represents these data?

eliminate

A

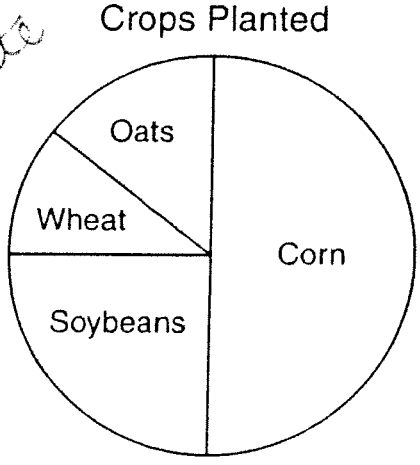


C

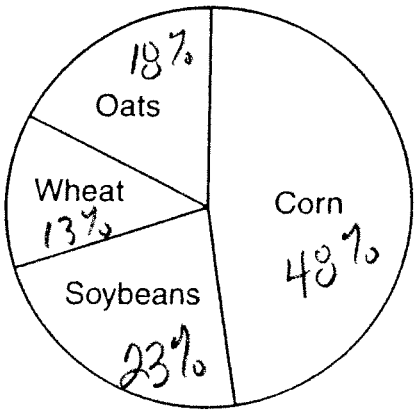


eliminate

B

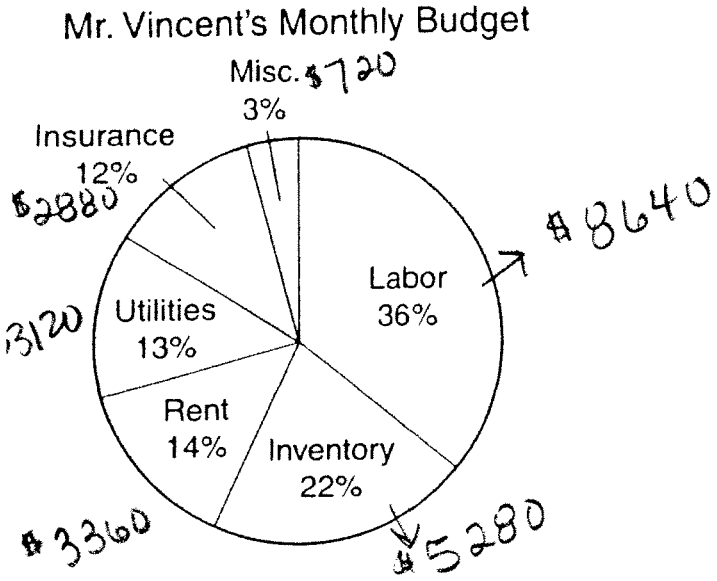


D



2

Mr. Vincent owns a store that sells auto parts. He budgeted $24,000 for the store's expenses last month. The graph below shows the percentage of the budget he reserved for each type of expense.



Multiply each % by $24000 to get the actual amount spent for that category

Which statement is best supported by the data in the graph?

F Mr. Vincent budgeted $15,500 for labor, utilities, and rent. $15120

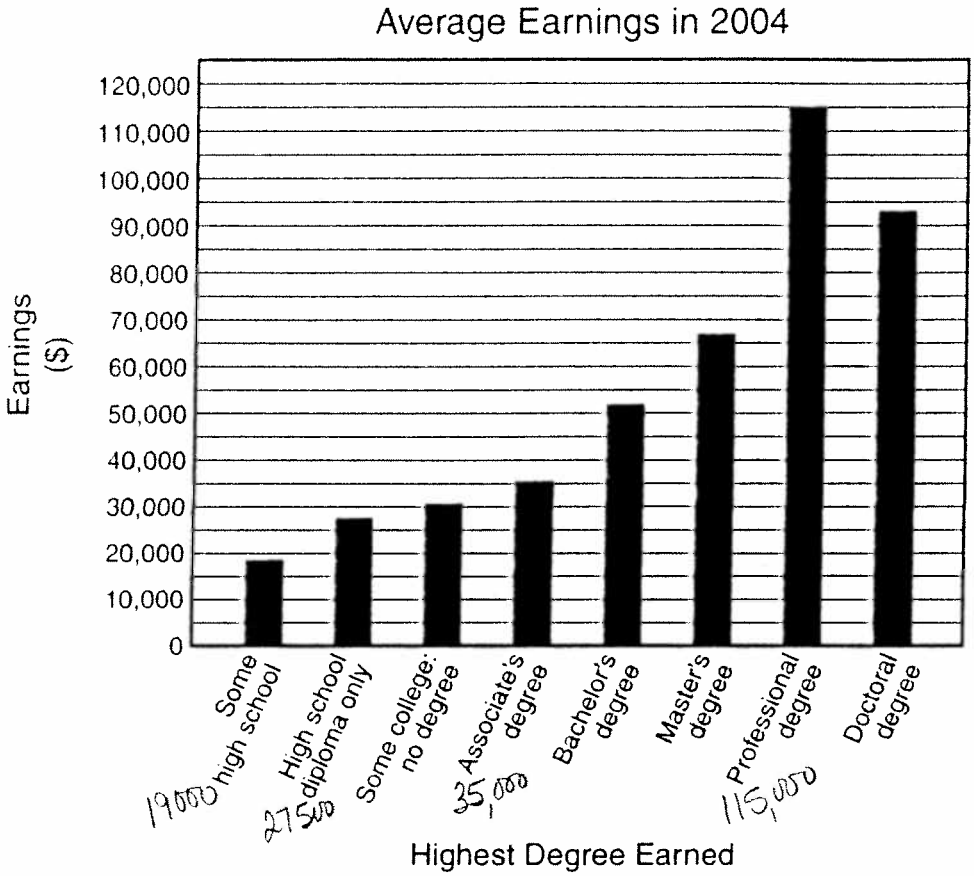
G More than 50% of Mr. Vincent's budget was reserved for rent and utilities. 27%

(H) Mr. Vincent budgeted $16,800 for labor, insurance, and inventory. $16800

J Less than 50% of Mr. Vincent's budget was reserved for labor and inventory. 58%

3

The graph below shows the 2004 average yearly earnings of people at least 18 years old according to the highest degree they have earned.



According to the graph, which of the following statements is true?

F In 2004 a person with an associate's degree earned more than twice as much as a person with a high school diploma.

G In 2004 a person with a high school diploma earned about $9,000 more than a person with only some high school.

H In 2004 a person with a doctoral degree earned less than 3 times as much as a person with a high school diploma.

J In 2004 a person with a high school diploma earned $100,000 less than a person with a professional degree.

4

Elise practiced gymnastics for 50 minutes. The time she spent on each activity is recorded in the table below.

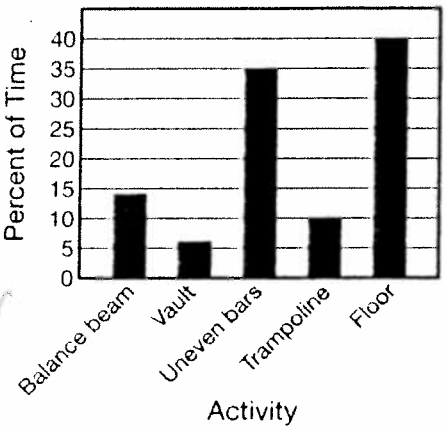
Elise's Gymnastics Practice

Activity	Time Spent (minutes)	
Balance beam	7	14%
Vault	3	6%
Uneven bars	15	30%
Trampoline	5	10%
Floor	20	40%

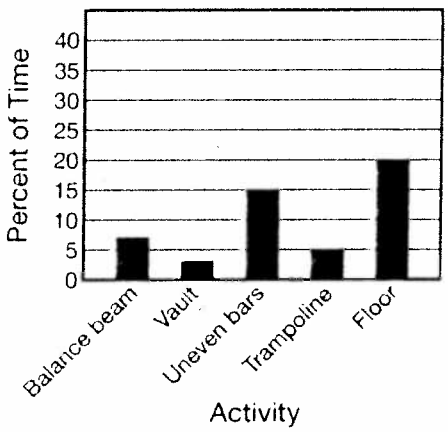
Which of the following graphs best represents the percent of time Elise spent on each activity during her gymnastics practice?

Bar graphs are best to use when comparing things between different groups or to track changes over time

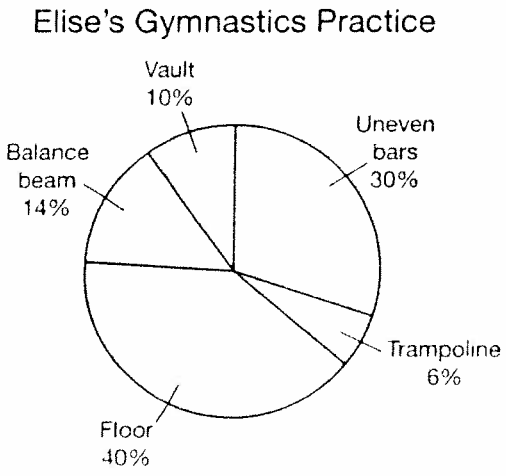
A



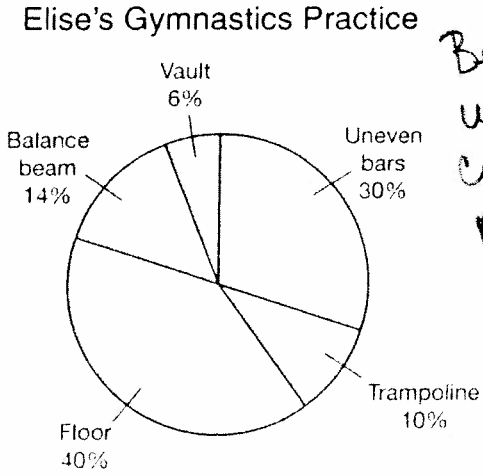
C



B



D



Best to use when comparing parts to a whole

5

Francis, Leon, and Shelby are running for president of their school's student council. A random survey of 60 students was taken to determine whom they planned to vote for in the election. The results are shown in the table below.

Survey Results

Candidate	Number of Students
Francis	29
Leon	22
Shelby	9

Based on the data in the table, which of the following is the best prediction of the number of students who will vote for Leon if 2500 students vote?

A 1208
B 292
C 916
D 550

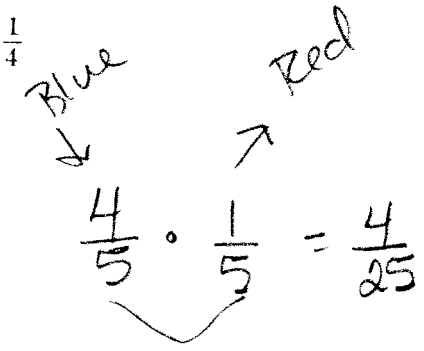
$\frac{22}{60} \rightarrow \frac{x}{2500}$

$x = 916$

6

Sabrina has a bag of 5 marbles that are identical in size. The bag contains 4 blue marbles and 1 red marble. If Sabrina randomly draws a marble from the bag, replaces it, and then draws another marble, what is the probability that she will first draw a blue marble and then a red marble?

A $\frac{4}{25}$
B $\frac{1}{5}$
C $\frac{4}{5}$
D $\frac{1}{4}$



With Replacement

More Geometry & Measurement...

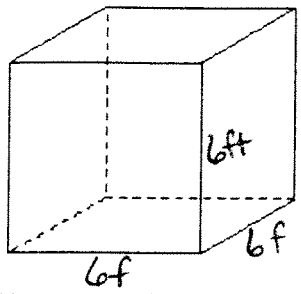
Problem Situation

Design the largest possible closed container out of 1 sheet of paper.

What elements might you consider when designing the largest possible closed container using 1 sheet of paper?

Name: _____ Date: _____

A 72-foot piece of wire was cut into equal segments, which were then soldered at the ends to form the edges of a cube.



1. How many edges does a cube have? 12 (1 pt)

2. What is the length of each edge of the cube formed as described above? 6 ft (1pts)

3. Write the formula for the volume of a cube. $V = s^3$ (1 pt)

4. Calculate the volume of the cube formed. $V = 6^3 = 216\,ft^3$ (2 pts)

5. Draw and label the dimensions of the net of the cube. (3 pts)

Ans. will vary

6. Suppose you wanted to wrap the entire cube with plastic that cost \$0.15 per square inch. Determine the following.

a. The amount of plastic needed in square feet. (5pts)

$S = Ph + 2B$
$S = 24(6) + 2(36)$
$S = 144 + 72$
$S = 216 ft^2$

b. The amount of plastic needed in square inches. (2pts)

There are 144 sq inches in a sq ft $\therefore$ $216(144)$
$= 31104 in^2$

c. The cost of the plastic needed. (1pt)

$31104(0.15) = \$4665.6$

7. If a similar cube was made using a piece of wire 216 feet long. What would be the volume and surface area of the cube formed? (4 pts)

$V = s^3$
$V = 18^3$
$V = 5832 ft^3$

SF
or $3^3 = 27$
times original volume
$27(216)$
$5832 ft^3$

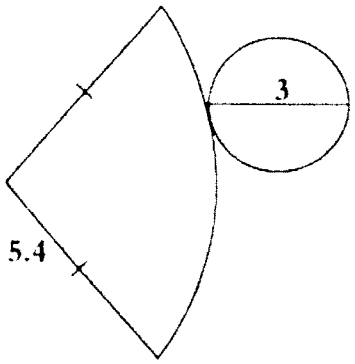
22

$S = Ph + 2B$
$S = 72(18) + 2(324)$ or SF $3^2 = 9$
$S = 1296 + 648$
$S = 1944 ft^2$

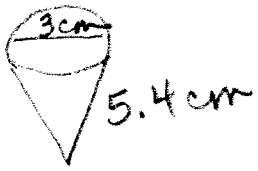
times original surface area
$216(9) = 1944$

Name: _____ Date: _____

All units are in cm



Draw and label the dimensions the solid figure. (2 pts)



1. Name the solid figure that produces the NET above Cone (1 pt)

2. Using your formula chart, write the formula for the following:

Total Surface Area $\pi r l + \pi r^2$ Lateral Surface Area $\pi r l$ Volume $\frac{1}{2} Bh$ (3pts)

3. What is the difference between **h** and ***l*** in the formula given h = height of cone, l = slant height (2pts)

4.
Shape of base circle

Diameter = 3cm

Radius = 1.5cm

Slant height (*l*) = 5.2cm

(2 pts)

5. Calculate the Lateral Surface Area (3 pts)

$S = \pi r l$

$S = 3.14(1.5)(5.2)$

$S = 24.49 cm^2$

6. Calculate the Total Surface Area (3 pts)

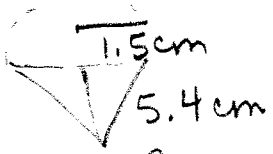
$S = \pi r l + \pi r^2$

$24.49 + 3.14(1.5)^2$

$24.49 + 7.065$

$S = 31.56 cm^2$

7. Use Pythagorean Theorem to calculate the height (h) (3pts)



$a^2 + b^2 = c^2$

$(1.5)^2 + (b)^2 = (5.4)^2$

$2.25 + b^2 = 29.16$

$\sqrt{b^2} = \sqrt{26.91}$

$b = 5.2 cm$

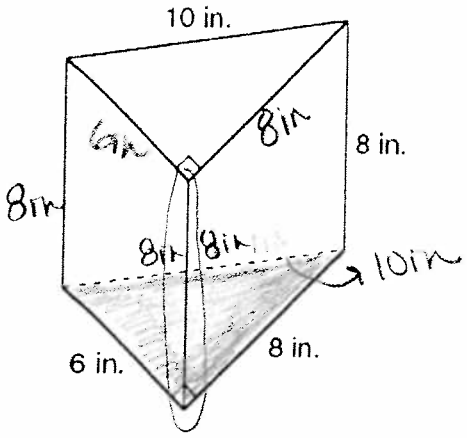
8. Calculate the volume (3pts)

$V = \frac{1}{3} Bh$ ($B = \pi r^2$)

$V = \frac{1}{3}(7.065)(5.2)$

$V = 12.25 cm^3$

Name: _____ Date: _____



Draw and label the dimensions of the net for the solid shown. Use the composite figure created to calculate the surface area. (5pts)

1. Name the solid shown above. rt triangular prism (faces are rectangles) (1pt)

2. Write the formula for the volume of the solid. $V = Bh$ (1pt)

3. Shade the base (B) and circle the height (h) of the solid. (2 pts)

4. Give the precise name and then draw and label the dimensions of the figure of the base. (2 pts)

5. Write the formula for the area of the base (B). $A = \frac{1}{2}bh$ (1pt)

6. Calculate B. $A = \frac{1}{2}(6)(8) = 24 in^2$ (2pts)

7. Calculate the volume of the solid. $V = Bh$ $V = (24)(8) = 192 in^3$ (1pt)

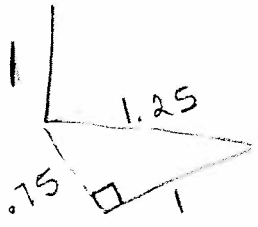
8. Determine the perimeter of the Base (B). $P = 24 in$ (1pt)

9. Calculate the surface area of the solid. $S = Ph + 2B \rightarrow 24(8) + 2(24) = 240 in^2$ (3 pts)

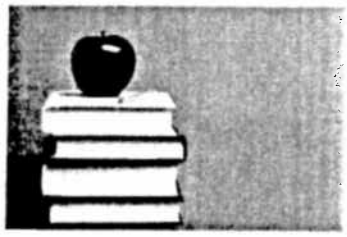
10. Calculate the lateral surface area of the solid. $S = Ph \rightarrow 24(8) = 192 in^2$ (1pt)

11. A similar solid has a volume of 24 in^2. What is the scale factor of the larger to the smaller solid? 8 to 1 (2pts)

12. Draw and label the dimensions of the smaller solid. (3pts)



Resources Used



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"TAKS Mathematics Preparation" Grade 9. Region IV Education Service Center (2004).

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