PROBABILITY AND STATISTICS

Grade Level: Middle School, Science and Math
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Length of Unit: Four Lessons, plus a Culminating Activity

I. ABSTRACT

In this unit, students will be exposed to the information in the probability and statistics section of the 7th grade Math section of the 1999 version of the *Core Knowledge Sequence*. Additional material related to probability and statistics is also included to help meet Colorado State and St. Vrain Valley District Standards. The cumulating activity is a hands-on investigation dealing with M&Ms. It is highly recommended that this activity is included in your study of probability and statistics.

II. OVERVIEW

A. Concept Objectives
   1. Students use data collection and analysis, statistics, and probability in problem-solving situations and communicate the reasoning and processes used in solving these problems *(Colorado Mathematics State Standard 3).*

B. Content from the *Core Knowledge Sequence*
   1. Probability and Statistics
      a. Show the relationship between two variables using a scatter-plot and describe the apparent relationship informally.
      b. Find the upper and lower quartiles for a data set.
      c. Understand that if *p* is the probability of an event occurring 1- *p* is the probability of the event not occurring.
      d. Understand the difference between independent and dependent events.

C. Skill Objectives
   1. Students will be able to find the mean, median, mode, and range of a data set.
   2. Students will be able to find the probability of an event not occurring.
   3. Students will be able to create and properly label a scatter plot, bar graph, and a pie chart from a given data set.
   4. Students will understand the difference between independent and dependent events.
   5. Students will understand how to find the upper and lower quartile of a data set.
   6. Students will be able to collect a requested set of data.
   7. Students will be able to calculate the probability of an event occurring.
   8. Students will be able to interpret and draw conclusions based on comparison of actual and experimental data.

III. BACKGROUND KNOWLEDGE

A. For Teachers
   1. Basic knowledge of probability. Probability is the likelihood of an event occurring or not occurring. Probability doesn't tell you how often an

event will happen, just the likelihood of the event taking place. Probabilities can be expressed as a ratio (fraction) or a percent.

2. If the probability of an event taking place is 1, the event will always occur. If the probability is 0, the event will never happen.

B. For Students

None

IV. RESOURCES

A. www.baking.m-m2.com/factory/history/faq1.html

B. http://www.ci.longmont.co.us/Planning/profile/pdfs/histor_pg24.pdf

C. Kaplan, Andrew. *Math on Call*. © 1998 Great Source Education Group, Inc. ISBN# 0-669-45770-1

V. LESSONS

Lesson One: Mean, Median, Mode, and Range

A. *Daily Objectives*

1. Concept Objective(s)
   a. Students use data collection and analysis, statistics, and probability in problem-solving situations and communicate the reasoning and processes used in solving these problems.
2. Lesson Content
   a. Teacher guided examples of how to find mean, median, mode, and range of a data set.
   b. Student practice finding mean, median, mode, and range.
3. Skill Objective(s)
   a. Students will be able to find the mean, median, mode, and range of a data set.

B. *Materials*

1. Appendices A and B

C. *Key Vocabulary*

1. Mean: the average of data set
2. Median: the middle number of a data set
3. Mode: the most common number in a data set
4. Range: the difference between the largest and smallest number in a data set

D. *Procedures/Activities*

1. Have one copy of Appendix A, *Mean, Median, Mode, and Range Problems*, for each student.
2. Complete the following example with the students.
   a. The scores for the last Math test were as follows: 100, 97, 87, 79, 85, 69, 70, 80, 91, 94, 88, 88, 91, 92, and 91. Find the mean, median, mode, and range of the scores. Express your answer in complete sentences.
3. The **mean** of the data set is the average of the data set. To find this, add all the numbers and divide by the number of scores.

Mean = $\frac{\text{sum of scores}}{\text{Number of scores}}$

Mean = $\frac{100+97+87+79+85+69+70+80+91+94+88+88+91+92+91}{15}$

Mean = $\frac{1302}{15}$

Mean = 86.8

The mean can only be written to one or zero decimal points. This is because when reporting result, you can only reliably report to one more place than the data.

Answer: *The mean of the scores on the last math test is 86.8* .

4. The **median** of the scores is the middle number when the scores or arranged in increasing or decreasing order.
   100, 97, 94, 92, 91, 91, 91, 88, 88, 87, 85, 80, 79, 70, 69
   To find the median, you can cross of numbers, one at each end, one at a time. The last number remaining is the median.
   ~~100~~, ~~97~~, ~~94~~, ~~92~~, ~~91~~, 91, ~~91~~, ~~88~~, ~~88~~, ~~87~~, ~~85~~, ~~80~~, ~~79~~, ~~70~~, ~~69~~
   Answer: *The median score on the last math test was 88.*
5. The **mode** is the most common number of a data set. We want to look for scores that appear more than once. 3 students received a 91 on their test while 2 students received a score of 88.
   Answer: *The mode of the scores on the last math test is 88.*
6. To find the range of a data set, subtract the largest value from the smallest value.
   Range = largest value – smallest value
   Range = 100 – 69
   Range = 31
   Answer: *The scores on the math test had a range of 31.*
7. Appendix A contains more problems where the students are asked to find the mean, median, mode, and range of a given set of data.
8. Appendix A is due tomorrow.

E. *Assessment/Evaluation*

1. Appendix B contains an answer key for the problems in Appendix A.

Lesson Two: Probability of an Event Not Occurring

A. *Daily Objectives*

1. Concept Objective(s)
   a. Students use data collection and analysis, statistics, and probability in problem-solving situations and communicate the reasoning and processes used in solving these problems.
2. Lesson Content
   a. Explanation of how to find negative probability
   b. Student negative probability practice problems.
3. Skill Objective(s)
   a. Students will be able to find the probability of an event not occurring.

B. *Materials*
   1. Appendices C and D
C. *Key Vocabulary*
   1. Negative probability: the probability of an event not occurring
D. *Procedures/Activities*
   1. Have one copy of Appendix C, *Probability Problems,* for each person in the class.
   2. Collect yesterday's homework – Appendix A, *Mean, Median, Mode, and Range Problems*.
   3. We have been talking about the probability of an event occurring. Today we are going to discuss the probability of an event ***not*** occurring.
   4. If ***p*** is the probability of an event occurring, ***1 – p*** is the probability of the event ***not*** occurring, negative probability = 1 – positive probability.
   5. Let look at some examples of this.
      a. Let's say that the probability that your teacher will give you all the answers for your next test is 25%. In our equation 25% = *p*. The probability of this not happening = 1- *p* or 1 – 25%. This equation cannot be completed as written. We must do one of two things: (a) convert 25% to a decimal by dividing by 100%; or (b) change 1 into a percent. We would like to have our answer in percent form so that it can be easily compare with the probability of the teacher giving you the test answers. Therefore, change 1 into a percent by multiplying by 100%. This leaves us with 75% probability that the teacher will not give you the answers for the next test.
   6. Pass out Appendix C *Probability Problems*. Appendix C contains problems in which the students are asked to find probabilities of events occurring and not occurring.
   7. Problems are due tomorrow.
E. *Assessment/Evaluation*
   1. Appendix D is a key for the problems in Appendix C.

Lesson Three: Graphs

A. *Daily Objectives*
   1. Concept Objective(s)
      a. Students use data collection and analysis, statistics, and probability in problem-solving situations and communicate the reasoning and processes used in solving these problems.
   2. Lesson Content
      a. Teacher guided examples of how to make a scatter plot, bar graph and pie chart.
      a. Student graph making practice.
   3. Skill Objective(s)
      a. Students will be able to create and properly label a scatter plot, bar graph, and a pie chart from a given data set.
B. *Materials*
   1. Appendix E: lesson examples

2. Appendix F, *Graph Problems*
3. Appendix G: Homework Key

C. *Key Vocabulary*
1. Axes: reference lines on a graph, most often are a horizontal line and a vertical line that cross where one or both of the axes are zero
2. Scale: numbers running along the side of the graph
3. Interval: the difference between numbers from one grid to another on the graph

D. *Procedures/Activities*
1. Collect Appendix C, *Probability Problems*.
2. When data is collected for statistical analysis, it is often convenient to put the gathered information in a form that is easy to read and interpret. One of the most common ways to do this is to form graphs using the data.
3. Appendix E contains a sample data table and scatter plot similar to the one discussed in this example. Using a sample set of data, here we will plot the frequency of hair colors in you class, to show the students how to make a scatter plot.
4. Survey the class to determine the number of students with red, brown, blond, and black hair. Record this information in a table.
5. The first kind of graph we will be making is a scatter plot. Explain to the class that the axes on a graph are the reference lines. The axes are usually the bottom and left-hand borders of the graph.
6. When you make a graph, the axes must be labeled. How you label your axes depends on the data you have, and what you wish to show on your graph. Ask the students what they think would be good labels for the graph axes. One possibility would be to have the horizontal axis labeled with possible hair colors and the vertical axis labeled with the number of students displaying each hair color.
7. Next we need to choose a scale for the graph. The scale tells what units each axis is broken up into. To find the scale for the vertical axis, examine the range of the numbers. The sample data numbers range from 2 – 10. Based on this information, we should use an interval of 1 on the vertical axis. On the horizontal axis we will list the hair colors.
8. The next step is to plot the points on the graph. Once all the points are plotted, they can be connected.
9. The last thing that needs to be done it to come up with a title for our graph. The title should describe the graph, but should give more information than the labels on the axes.
10. Next we are going to create a bar graph for the information we collected.
11. Like a scatter plot, a bar graph consists of axes that are used as reference lines to help us plot our data. We can use the same labeling scheme that we used for the scatter plot of hair colors on the bar graph of hair colors. The horizontal axis will be labeled with possible hair colors and the vertical axis labeled with the number of students displaying each hair color.

12. We also need to choose a scale for the graph. We can use the same scale that was used in the scatter plot. We will use an interval of 1 on the vertical axis.
13. Bar graphs are different from scatter plots in the way that data shows on the graph. On a scatter plot, information appears as a point, on a bar graph information appears as a bar. Appendix E shows a sample bar graph based on the same information contained in the scatter plot.
14. The next kind of graph we are going to create is a pie graph. With a pie graph we are able to compare collected data with each other. Each piece of data is represented as a section of a circle. Each piece can be thought of as a percentage of the whole.
15. To create a pie graph we need to find out the percent each piece of data is of the whole. For example, there were a total of 24 students. To find the percent of each hair color, divide the number of students showing the hair color by the total number of students in the class. Then multiply this number by 100%. There were 2 students in our sample with red hair, 2/24 x 100% = 8.3%, 8.3% of our students have red hair. The table in Appendix E contains the percent of each hair color represented.
16. Once the percentages are calculated, draw a circle. Divide the circle into pieces to represent the percent of each color of hair in the class.
17. When using pie graphs, be sure to include a key that shows what each section represents.
18. Pass out homework, Appendix F, *Graph Problems*.

E. *Assessment/Evaluation*
1. Using Appendix G, grade Appendix F, *Graph Problems*.

Lesson Four: Independent and Dependent Events/Upper and Lower Quartiles

A. *Daily Objectives*
1. Concept Objective(s)
   a. Students use data collection and analysis, statistics, and probability in problem-solving situations and communicate the reasoning and processes used in solving these problems.
2. Lesson Content
   a. Teacher lecture on independent and dependent events.
   b. Teacher lecture on finding the upper and lower quartile of a data set.
3. Skill Objective(s)
   a. Students will understand the difference between independent and dependent events.
   b. Students will understand how to find the upper and lower quartile of a data set.

B. *Materials*
None

C. *Key Vocabulary*
1. Independent Events: events which proceeding outcomes have no bearing on current outcomes

2. Dependent Events: events where the outcome of prior events makes a difference on the outcome

D. *Procedures/Activities*

1. In today's lesson, we are going to go over the difference between independent and dependent events and how to find the upper and lower quartile for a data set.
2. When analyzing an independent event, the result of previous test has no bearing on the current outcome. An example of this would be flipping a fair coin. You may flip a fair coin 100 times in a row and always get heads, *but* the probability of getting a heads on one flip is always ½. This is always the case. Previous outcomes have no bearing on the current outcome.
3. A dependent event is the opposite of an independent event. In this case prior outcomes do affect the probability of the next outcome. This can be demonstrated in picking a specific card out of a whole deck. For example, let's say we are trying to pick the ace of spades, at random, out of a full deck of cards. With each try, the probability of picking the ace of spades is higher because we are decreasing the total number of cards there are to pick from. We are still looking for only one card, but there are fewer choices.
4. Ask the students for examples of situations that could be classified as independent or dependent events. Be sure that they can justify their answers.
5. When finding the upper and lower quartile for a data set, it is helpful to talk about a bell curve. A bell curve is a perfect curve that is divided in such a way that the top and bottom 10% cover the same area, and are the smallest sections. The next 20% of the top and bottom of the curve also cover an equal area larger than that of the bottom and top 10%. The middle 40% is the largest area and covers the remainder of the curve. A classic example of how this may be used is when discussing grading on a bell curve. This means that only 10% of the class will earn an A, 20% will get a B, 40% will receive a C, 20% will get a D, and 10% of the class will fail. These percentages have no bearing on how well the class actually does. All that matters is that the top 10% receive an A, the next 20% a B, and so an and so forth with the bottom 10% always receiving a failing grade.
6. Let's figure out how many of each letter grade would be given out if your teacher used this kind of system to grade a class of 24 students. To find out how many would receive A's, find what 10% of 24 is. 10% x 24 = 2.4. Let's say the teacher is really mean and doesn't like to round up so, only two students will receive an A. This also means that two students will always fail. The same number of students that receive B's will also receive D's. We find this number the same way, but we multiply 24 by 20% instead of 10%. 24 x 20% = 4.8. This time your teacher rounds up, so five students receive B's and five receive D's. So far we have assigned two A's, five B's, five D's, and two F's. There are 10 grades left to

assign. These should all be C's. Let's check. 40% of the grades should be C's. 40% x 24 = 9.6. This number your teacher also rounds up to give 10 C's.

E. *Assessment/Evaluation*
   1. Ask the students to take out a sheet of paper and answer the two following questions based on today's lesson.
      a. What is the difference between independent and dependent events? Give an example of each.
      b. Which kind of grading system would you rather have in place at your school, one that uses a straight curve (where you have to have 90% to get and A and so on), or one that utilizes the bell curve to assign grades? Justify your answer.

VI. CULMINATING ACTIVITY

The following is a 3-part investigation to close this unit. The activity involves analysis of the colors of M&Ms found in a package. You may want to provide M&Ms for your class or ask them to bring in the same kind ahead of time to use in the activity.

Part One: Data Collection

A. *Daily Objectives*
   1. Concept Objective(s)
      a. Students use data collection and analysis, statistics, and probability in problem-solving situations and communicate the reasoning and processes used in solving these problems.
   2. Lesson Content
      a. Students will collect data to be analysis over the next few days.
   3. Skill Objective(s)
      a. Students will be able to collect a requested set of data.
      b. Students will be able to calculate the probability of an event occurring.

B. *Materials*
   1. One package of M&M's for each student
   2. Appendix H

C. *Key Vocabulary*
   1. Probability: a number used to describe the likelihood of an event occurring
   2. Probability = $\frac{\text{number of favorable outcomes}}{\text{number of possible outcomes}}$

D. *Procedures/Activities*
   1. Prior to class, ask each student to bring in a package of M&M candies to use in a study of statistical analysis and probability. The students may use any kind of M&M's expect special holiday packages.
   2. Pass out a data collection sheet to each student (Appendix H).
   3. Ask the students to open their package of M&Ms, but not to eat any! Have the students fill out the Data Table with the number of each color of M&Ms in their package. Be sure that the students record the total number of M&Ms in their package.

4. Once they students have collected all their data, they may eat their M&Ms.
5. Instruct the students how to fill in the Probability and Percent columns of the table. To find the probability of finding one color of M&Ms, we need to create a ratio that is similar to the one shown with Probability in the *Key Terms* section. Write the number of favorable outcomes (the number of a specific color of M&Ms over the total number of M&Ms contained in the package. To calculate the percent of each color of M&M the package, divide the number of each color by the total number of M&Ms in the package (the probability), and multiply by 100%. Be sure to have the students show and label their work for their calculations. The students will also be asked to find the mean, median, mode, and range of the colors represented.
6. Remind the students to bring their completed data sheets to class tomorrow.

E. *Assessment/Evaluation*
1. Be sure the students are calculating their probabilities and percentages correctly.
2. Tomorrow check Data Sheet for completion.

Part Two: Graphing M&M data

A. *Daily Objectives*
1. Concept Objective(s)
   a. Students use data collection and analysis, statistics, and probability in problem-solving situations and communicate the reasoning and processes used in solving these problems.
2. Lesson Content
   a. Graphing experimental data.
3. Skill Objective(s)
   a. Students will be able to create and properly label a scatter plot, bar graph, and a pie chart from a given data set.

B. *Materials*
1. Appendix I
2. Data sheet, Appendix H
3. Graph paper

C. *Key Vocabulary*

No new vocabulary

D. *Procedures/Activities*
1. Pass out one sheet of graph paper to each student.
2. Have the students make a bar graph, scatter plot, and a pie graph that represents the color of M&Ms in their sample.

E. *Assessment/Evaluation*
1. Collect the graphs. On the graphs, make sure the axes are labeled correctly, that there is an appropriate interval used for the data collected, and that there is a title on the graph.
2. Appendix I contains a rubric to assist in grading each graph.

Part Three: Class Analysis

A. *Daily Objectives*
   1. Concept Objective(s)
      a. Students use data collection and analysis, statistics, and probability in problem-solving situations and communicate the reasoning and processes used in solving these problems.
   2. Lesson Content
      a. Comparison of individual and class results.
   3. Skill Objective(s)
      a. Interpret and draw conclusions based on comparison of actual and experimental data.

B. *Materials*
   1. Large piece of butcher paper
   2. Appendices J and K
   3. Calculators are helpful but not necessary

C. *Key Vocabulary*
   1. Theoretical probability: when you use a formula to find the probability of an event
   2. Experimental probability: when you use the results of an experiment to find the probability of an event occurring

D. *Procedures/Activities*
   1. Tell the students that the company that makes M&Ms manufactures specific ratios of each color of M&Ms. With the data they have collected, the students will able to compare how closely the percentage of each color contained in their bag matched the percentage of colors made by the company. The M&M web site, www.baking.m-m2.com/factory/history/faq1.html, shows the percentages of each color of M&Ms made by the company. Go to this web site and print off a copy of the percentages to share with your class.
   2. Hand out a copy of Appendices J and K to each student. Appendix J will ask the students to create a table that compares the percentages of the colors contained in their sample to the actual percentage of each color of M&M made. Appendix J also asks the students to make some suggestions about why the actual percent they found may be different from the actual percent made.
   3. Discuss the results of comparing the actual percentages found in the students' samples with the percentages of M&Ms made. Lead the class in a discussion as to why these values may be different. See if the class can come up with a way to get results similar to the actual percent of M&Ms made. The easiest way to do this is to pool a lot of data from many different packages (of the same kind of M&Ms) together, and then analyze that information.
   4. As a class, decide what kinds of M&Ms were analyzed the most. Pool data from these samples together on a piece of butcher paper in a chart similar to the one used for M&Ms data collections (Appendix H).

5. Appendix K has provided each student space to make a copy of the class data and to perform and record calculations using the data.
6. Each student is to find the total number, probability, and percent for each color of M&Ms in the class sample. This can be done following the same formulas as used to calculate this information on each student's sample.
7. Appendix K also asks the students to find the mean, median, and mode for at least three colors of M&Ms. You may want to assign each student the colors they are to find these values for.
8. Allow to the students to work together on this so they may compare their result to insure they have correct answers.
9. Compare the percent of each color in the newly pooled class data to the actual percentages of M&Ms made for the type being analyzed. These results should be much closer to the actual values.

E. *Assessment/Evaluation*

1. Students check each other in the calculating the new percentages.
2. Collect Appendices J and K. Check for accuracy, completeness, and appropriateness.

VII. HANDOUTS/WORKSHEETS

A. Appendix A: Mean, Median, Mode, and Range Problems
B. Appendix B: Mean, Median, Mode, and Range Problems Answer Key (two pages)
C. Appendix C: Probability Problems
D. Appendix D: Probability Problems Answer Key (two pages)
E. Appendix E: Lesson Examples
F. Appendix F: Graph Problems
G. Appendix G: Graph Problems Answer Key (two pages)
H. Appendix H: M&M Data Sheet
I. Appendix I: M&M Data Analysis Graph Rubrics
J. Appendix J: M&M Question Sheet
K. Appendix K: M&M Question Sheet

VIII. BIBLIOGRAPHY

A. www.baking.m-m2.com/factory/history/faq1.html
B. http://www.ci.longmont.co.us/Planning/profile/pdfs/histor_pg24.pdf
C. Kaplan, Andrew. *Math on Call*. © 1998 Great Source Education Group, Inc. ISBN# 0-669-45770-1

Appendix A-Probability and Statistics
Mean, Median, Mode, and Range Problems

Name: _____
Please show ***all*** your work on a separate sheet of paper.
Put your answers in complete sentences in order to receive full credit.

1. For your latest science experiment involving speed, you have to find an accurate measure of your desk. The instructions ask you to measure the length of your desk 3 times and find the mean length to use in other calculations. You measure your desk 3 times and come up with the following lengths 1.02m, 0.98m, and 0.99m. Find the mean length of your desk.

2. Anna works as a waitress. Her math assignment one evening was to find the mean, median, mode, and range of her tips. She collected the following amounts in tips from her tables: $2, $5, $3.75, $4.41, $ 1.50, $ 6.25, $7, $5, and $10. Find the (a) mean, (b) median, (c) mode, and (d) range of Anna's tips for the evening.

3. Scores on the last Science test were as follows: 95, 80, 93, 93, 89, 86, 88, 95, 94, 92, and 93. Find the (a) mean, (b) median, (c) mode, and (d) range of the test scores.

BONUS
Miss Edwins and her roommates are trying to find their mean height. Miss Edwins is 5'04", Robin is 5'02", Misty and Sherry are both 5'10", Heather is 5'06", Tiffany is 5'07", Raye Lynn is 5'7", Jackie is 5'5", and Erin is 5'10". Find the (a) mean, (b) median, (c) mode, and (d) range of their heights.

Key: Mean, Median, Mode, & Range Problems

1. mean = $\frac{\text{sum of possibilities}}{\text{\# of possibilities}}$

$$\text{mean} = \frac{1.02m + 0.98m + 0.99m}{3}$$

$$\text{mean} = \frac{2.99m}{3}$$

mean = 1.00m

Answer: *The mean length of the desk is 1.00m.*

2. (a) Mean – average tip value

$$\text{mean} = \frac{\text{sum of possibilities}}{\text{\# of possibilities}}$$

$$\text{mean} = \frac{\$2+\$5+\$3.75+\$4.41+\$1.50+\$6.25+\$7+\$5+\$10}{9}$$

$$\text{mean} = \frac{\$44.91}{9}$$

mean = $4.99

Answer: *The mean of Anna's tips is $4.99.*

(b) median – middle number

Arrange tips in numerical order: $10 $7 $6.25 $5 $5 $4.41 $3.75 $2 $1.50

Cross off one number from each side until only one number is left.

~~$10~~ ~~$7~~ ~~$6.25~~ ~~$5~~ $5 ~~$4.41~~ ~~$3.75~~ ~~$2~~ ~~$1.50~~

Answer: *The median of Anna's tips is $5.*

(c) mode – most common tip value

Anna received $5 twice as a tip.

Answer: *The mode of Anna's tips is $5.*

(d) Range

Range = largest value – smallest value

Range = $10 - $1.50

Range = $8.50

Answer: *The range of Anna's tips is $8.50.*

3. (a) mean – average test score

$$\text{mean} = \frac{\text{sum of possibilities}}{\text{\# of possibilities}}$$

$$\text{mean} = \frac{95 + 80 + 93 + 93 + 89 + 86 + 88 + 95 + 94 + 92 + 93}{11}$$

$$\text{mean} = \frac{998}{11}$$

mean = 90.7

Answer: *The mean test score is 90.7.*

(b) median – middle score

~~95~~ ~~95~~ ~~94~~ ~~93~~ ~~93~~ 93 ~~92~~ ~~89~~ ~~88~~ ~~86~~ ~~80~~

Answer: *The median score is 93.*

(c) mode – most common score

Answer: *A score of 93 was received by 3 students making it the most common answer – the mode.*

(d) range

range = highest score – lowest score

range = 95 – 80

range = 15
Answer: *The range of the test scores is 15.*

BONUS
The height of each roommate is given in feet *and* inches. In order to do this problem, the height of each roommate must first be converted to inches or to feet. This answer will show the height converted to inches.

Roommate	**Height**	**Conversion** (feet x 12in/1ft)	**Total Height**
Miss Edwins	5'04"	5ft x 12in/1ft = 60in	60in + 4in = 64in
Robin	5'02"	5ft x 12in/1ft = 60in	60in + 2in= 62in
Misty	5'10"	5ft x 12in/1ft = 60in	60in + 10in = 70in
Sherry	5'10"	5ft x 12in/1ft = 60in	60in + 10in = 70in
Heather	5'06"	5ft x 12in/1ft = 60in	60in + 6in = 66in
Tiffany	5'07"	5ft x 12in/1ft = 60in	60in + 7in = 67in
Raye Lynn	5'07"	5ft x 12in/1ft = 60in	60in + 7in = 67in
Jackie	5'5"	5ft x 12in/1ft = 60in	60in + 5in = 65in
Erin	6'0"	6ft x 12in/1ft = 671in	72in + 0in = 72in

(a) mean height
mean = $\frac{\text{sum of heights}}{\text{\# of heights}}$
mean = $\frac{64in + 62in + 70in + 70in + 66in + 67in + 67in + 65in + 72in}{9}$
mean = $\frac{603in}{9}$
mean = 67in
67in = 5'7"
Answer: *The average height of Miss Edwins and her roommates is 67in or 5'7".*

(b) median height
72in 70in 70in 66in 67in 67in 65in 64in 62in
Answer: *The median height of Miss Edwins' household is 67 inches or 5'7".*

(c) mode
Answer: *Misty and Sherry both are 5'10" tall, and Tiffany and Raye Lynn are both 5'7" tall. The are 2 modes for this data set 5'10" and 5'7".*

(d) range of heights
range = tallest height – shortest height
range = 6'0" – 5'2"
range = 5'12" –5'2"
range = 10"
Answer: *The range of the heights of Miss Edwins' roommates is 10 inches.*

Appendix C-Probability and Statistics

Probability Problems

Name: _____
Put your answers in complete sentences in order to receive full credit.

1. You have noticed that the cafeteria only serves Salisbury steak, tacos, corn dog, chicken fired steak on bun, hot dog on bun, and pizza. The only item you find palatable is pizza. When everything else is being served, you bring a sack lunch from home. (a) Find the probability that pizza will be served tomorrow. (b) What is the probability that pizza will not be served tomorrow? (c) Should you pack a lunch? Why or why not?

2. For music class you have to bring a red pen. Your class before music runs late and you don't have time to search for your pen so you grab your whole pencil pouch. Your pouch contains 3 mechanical pencils, 2 red pans, 2 black pens, a pink purple and a green pen. (a) What is the probability that the 1st writing utensil you pull out of the bag will be a red pen? (b) What is the probability that it is not a red pen? (c) Are you more likely to get a red pen or a pen of a different color on the first try?

3. You love green skittles. You are trying to find the probability of pulling a green skittle at random from a package. In order to find this kind of information, you decided to survey all the skittles in your package. You fin 8 purple, 5 green, 6 yellow, 7 orange, and 10 red. (a) Find the probability that the first skittle you pull out is green. (b) What's the probability of the first skittle being green, yellow, or orange? (c) Probability that the first skittle is not green?

Appendix D, page 1-Probability and Statistics

Answers to Appendix C: Probability Problems

1. (a) Find the probability that pizza will be served

$P = \frac{\text{favorable outcomes}}{\text{possible outcomes}}$

Probability Pizza = P_p

$P_p = \frac{\text{\# time pizza served}}{\text{total items served}}$

$P_p = \frac{1}{6}$

Answer: *There is 1/6 probability that pizza will be served tomorrow.*

(b) What is the probability that pizza will not be serve tomorrow?

Negative probability = 1 – positive probability

Probability of no pizza (P_{np}) = 1 - P_p

$P_{np} = 1 – 1/6$

$P_{np} = 6/6 – 1/6$

$P_{np} = 5/6$

Answer: *The odds are 5/6 that pizza will not be served tomorrow.*

(c) Should you pack a lunch? Why or why not?

Answer: *Accept all reasonable answers.*

2. (a) What is the probability of the first writing utensil you pull out of the bag being a red pen?

$P_r = \frac{\text{favorable outcomes}}{\text{possible outcomes}}$

Probability of getting a red pen = P_r

$P_r = \frac{\text{\# red pens}}{\text{total \# of pens}}$

$P_r = \frac{2}{9}$

Answer: *The probability of getting a red pen the first time is 2/9.*

(b) What is the probability that the pen is *not* red?

Negative probability (probability of no red pen, P_{nr}) = 1 – positive probability

$P_{nr} = 1 - P_r$

$P_{nr} = 1 – 2/9$

$P_{nr} = 9/9 – 2/9$

$P_{nr} = 7/9$

Answer: *The probability of not getting a red pen on the first try is 7/9.*

(c) Are you more likely to get a red pen or a pen of a different color on the first try?

Answer: *Because 7/9 > 2/9 the chances are better of getting a non-red pen on the first try.*

3. (a) Find the probability that the first skittle you pull out is green.

$P = \frac{\text{favorable outcomes}}{\text{possible outcomes}}$

Probability of getting a green skittle = P_g

$P_g = \frac{\text{\# of green skittles}}{\text{total \# of skittles}}$

$P_g = \frac{5}{36}$

Answer: *The probability of getting a green skittle is 5/36.*

(b) What's the probability of the first skittle being green, yellow, or orange?

$P = \frac{\text{favorable outcomes}}{\text{possible outcomes}}$

Probability of getting a green, orange, or yellow skittle = P_{goy}

$P_{goy} = \frac{\text{\# green + \# orange + \# yellow}}{\text{total \# of skittles}}$

$P_{goy} = \frac{5 + 6 + 7}{36}$

$P_{goy} = \frac{18}{36}$

$P_{goy} = \frac{1}{2}$

Answer: *The probability that the first skittle will be green, orange, or yellow is ½.*

(c) Probability that the first skittle is not green?

Negative probability (probability of not green, P_{ng}) = 1 – positive probability

$P_{ng} = 1 - P_g$

$P_{ng} = 1 - P_g$

$P_{ng} = 1 - 5/36$

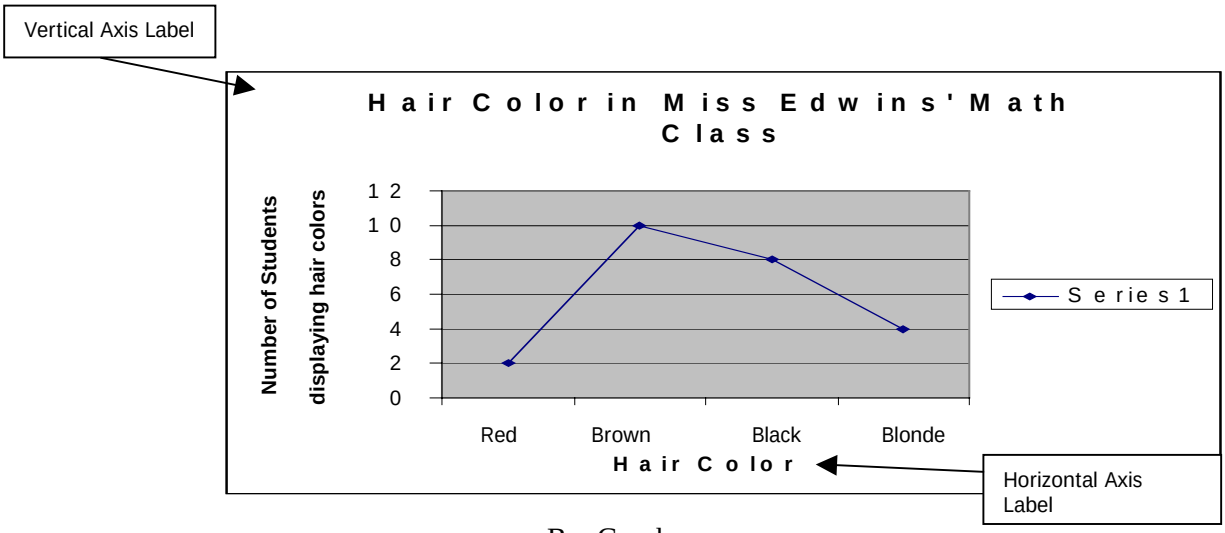
$P_{ng} = 36/36 - 5/36$

$P_{ng} = 31/36$

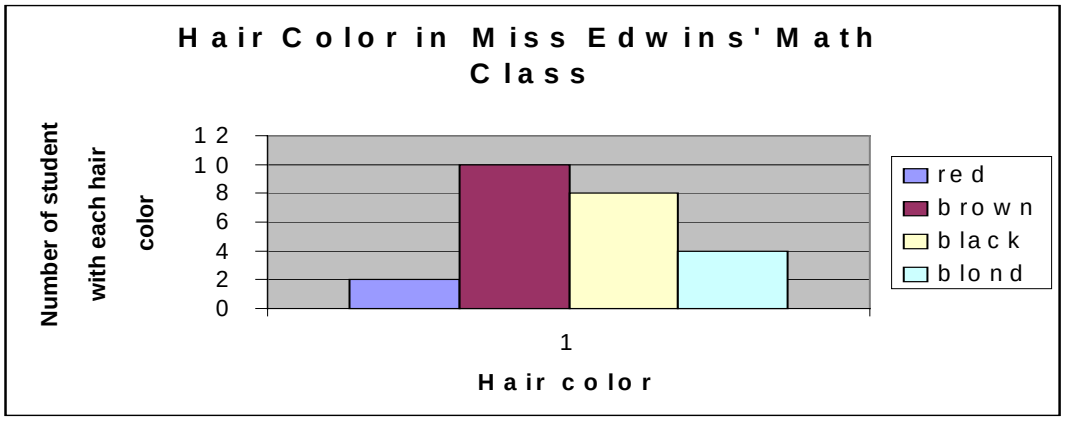
Answer: *There is a 31/36 chance that the first skittle will not be green.*

Appendix E-Probability and Statistics

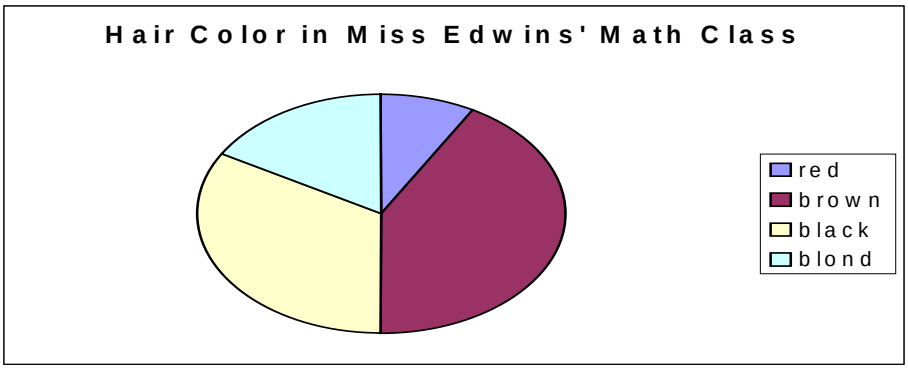
Hair Color	Number of students with Hair Color	Percent of students with Hair Color
Red	2	8.3%
Brown	10	41.7%
Black	8	33.3%
Blonde	4	16.7%



Bar Graph



Pie Graph



Appendix F-Probability and Statistics

Graph Problems

Name: _____

1. The following table contains population statistics for Longmont's growth since 1880.

Year	Population	Year	Population
1880	773	1940	7406
1890	1543	1950	8099
1900	2201	1960	11489
1910	4256	1970	23209
1920	5843	1980	42942
1930	6029	1990	51555

   Make (a) a scatter plot and (b) a bar graph to display this data.

2. Joe and Stan decided to survey 111 of their friends to find out what their favorite dinner choice was.

Dinner Choice	Votes Received
Pizza	24
Hamburger	12
Tacos	8
Spaghetti	18
Lasagna	5
Steak	17
Meatloaf	2
BBQ chicken	10
Lobster	3
BLT	12
Total	**111**

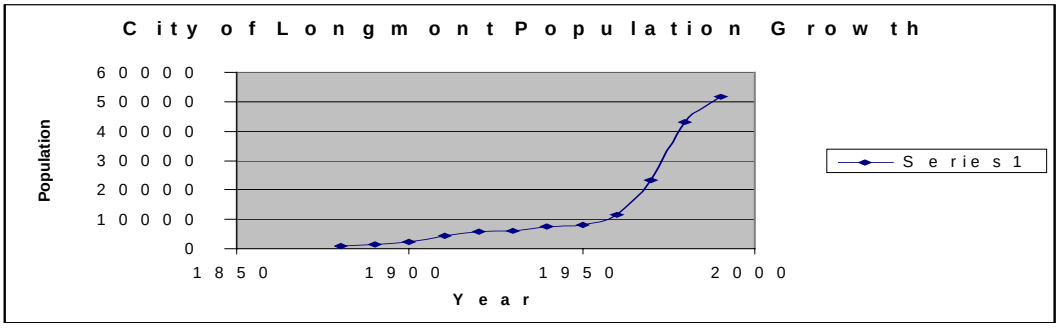
   Using their data create (a) a scatter plot, (b) a bar graph, and (c) a pie graph.

3. Sue and Jane decided to survey the same 111 friends surveyed by Joe and Stan. They were interested in the favorite color of their friends. Sue and Jane's results are recorded in the data table below. After examining the data, create (a) a scatter plot, (b) a bar graph, and (c) a pie graph to display Sue and Jane's

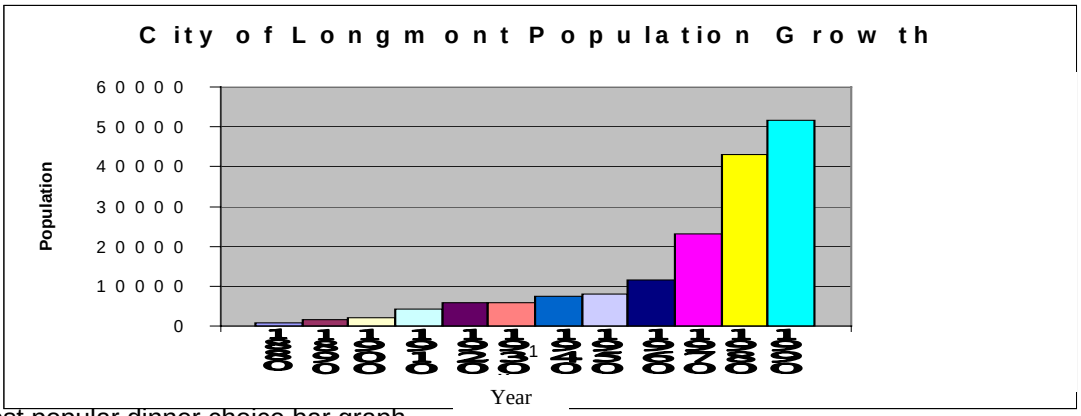
Appendix G, page 1-Probability and Statistics

Graph Problems Key

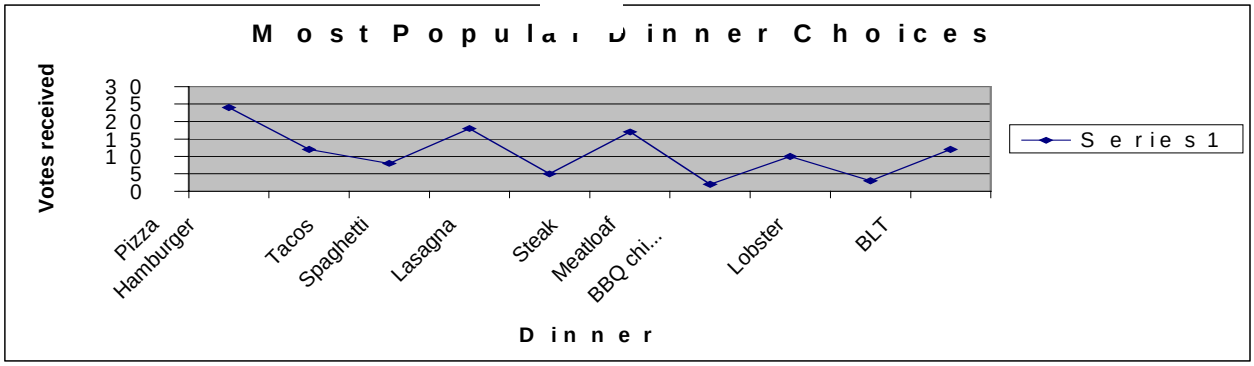
1. (a) Longmont population scatter plot.



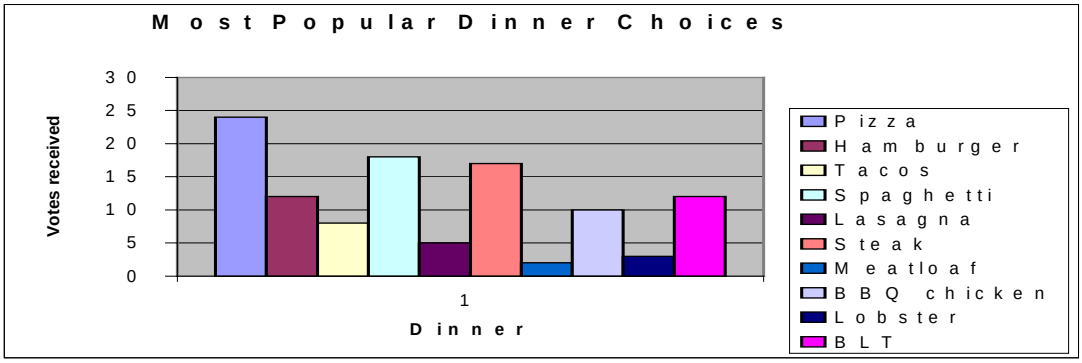
(b) Longmont population bar graph



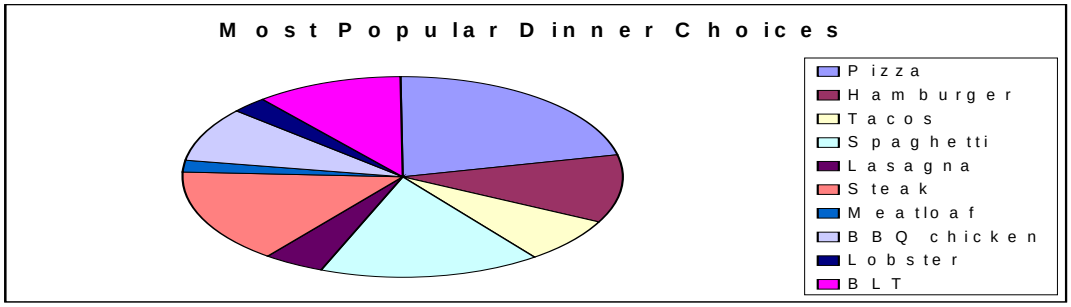
2. (a) Most popular dinner choice bar graph.



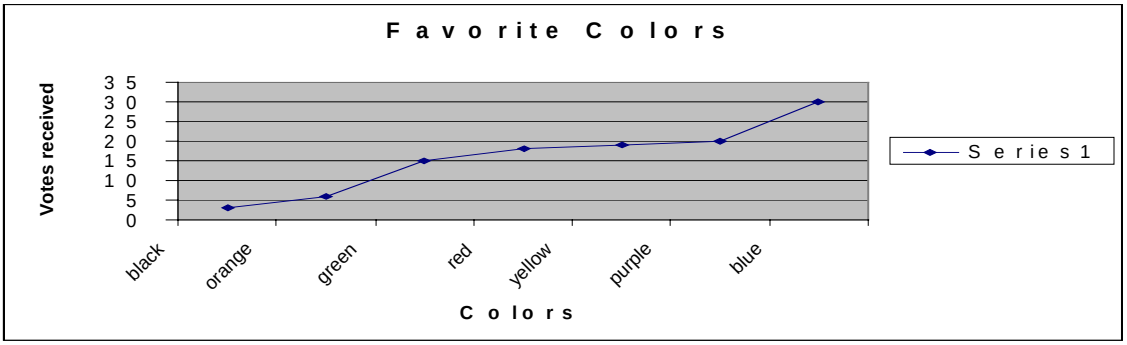
(b) Most popular dinner choices bar graph.



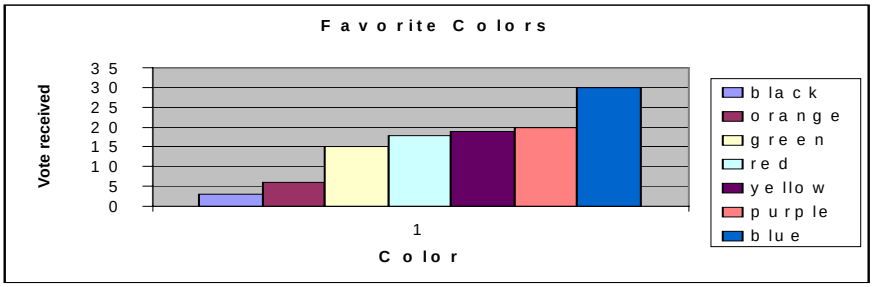
(c) Most popular dinner choice pie graph.



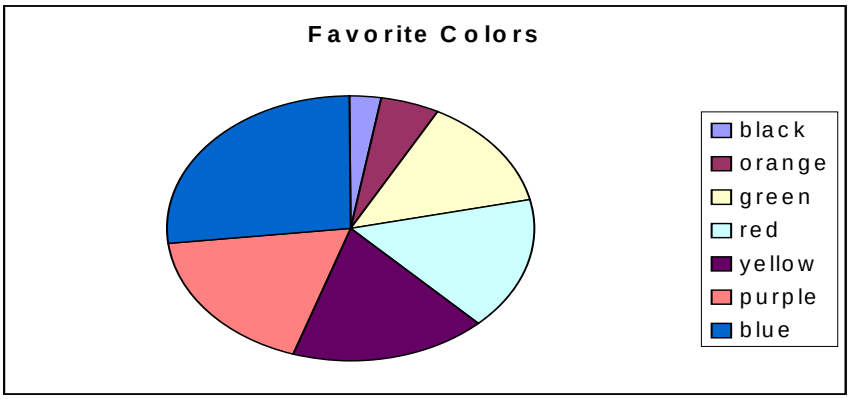
3. (a) Favorite color scatter plot.



(b) Favorite color bar graph.



(c) Favorite color pie graph.



Appendix H-Probability and Statistics

M&M DATA SHEET

Name:_____

Type of M&M's used: _____

M&M COLOR	NUMBER	PROBABILITY	PERCENT
Blue			
Brown			
Green			
Orange			
Pink			
Red			
Yellow			
Total			

Use the space below and the back of this sheet to show your percent calculations. Be sure to **CLEARLY** label **ALL** calculations.

To calculate the percent of each color in relation to the total number of M&M's in the package, divide the number of each color by the total number of M&M's in your package. Then multiply this number by 100%.

$$\frac{\text{Number of a certain color}}{\text{Total M\&M's in the package}} \times 100\% = \%\text{ of the color}$$

M&M Data Analysis Graph Rubrics

Scatter Plot	**Possible Points**	**Points Received**
Horizontal Axis Labeled	2	
Vertical Axis Labeled	2	
Horizontal Scale Labeled	2	
Vertical Scale Labeled	2	
Appropriate Scale	5	
Appropriate Graph Title	2	
Total	**15**	

Bar Graph	**Possible Points**	**Points Received**
Horizontal Axis Labeled	2	
Vertical Axis Labeled	2	
Horizontal Scale Labeled	2	
Vertical Scale Labeled	2	
Appropriate Scale	5	
Appropriate Graph Title	2	
Total	**15**	

Pie Graph	**Possible Points**	**Points Received**
Clear labeling system for each section	6	
Correct sectioning of graph	6	
Appropriate Graph Title	3	
Total	**15**	

Appendix J-Probability and Statistics

NAME: _____

1. In the space below, create a table that compares percent of each color of M&M in your sample with the actual percent made.

2. Did the percentages in your sample reflect the actual percentage made of each color of M&M? If differences exist, explain why you think this happened?

_____

_____

_____

_____

_____

Appendix K-Probability and Statistics

NAME: _____

1. Use the space below to create a data table with class information. This table should include the number of each M&M color found, and the total number of each color.

2. Calculate the probability and percent of each color of M&Ms. Also find the mean, median, and mode for the 3 colors of M&Ms assigned to you by your teacher. Be sure to show and clearly label all your calculations. Use additional paper if necessary.

M&M COLOR	NUMBER	PROBABILITY	PERCENT	MEAN	MEDIAN	MODE
Blue						
Brown						
Green						
Orange						
Pink						
Red						
Yellow						