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Introduction

Math Mammoth Data and Graphs is a worktext that covers common statistical graphs and some related topics for grades 1-5. It is a worktext, containing both the “text” (instruction) and the “work” (exercises and problems).

The book starts with the easiest kinds of bar graphs and pictograms, with only three or four categories, and small numbers. Students both draw bar graphs and answer simple word problems about them. As the lessons advance, the numbers in the bar graphs get bigger and there are more categories in them. These lessons are meant for grades 1-4.

After bar graphs, the book has a section on various kinds of line graphs, including double and triple line graphs. Most of these lessons are best suited for 4th and 5th grades.

The last section of the book covers average (also called the mean) and mode, and how these two concepts relate to line and bar graphs. (This is also meant for grades 4-5.) Other math curricula tend to also introduce the median, but I decided to omit it from this level. There is plenty of time to learn that concept later, for example in *Math Mammoth Statistics & Probability*. Introducing all three concepts at the same time tends to jumble them together and become confusing. I feel it is better initially to just introduce and contrast the two concepts of the mean and mode, in order to give the student a solid foundation.

*Wishing you success in teaching math,
Maria Miller, the author*

Helpful Resources on the Internet

We have compiled a list of external Internet resources that match the topics in this book. This list of links includes web pages that offer:

- **online practice** for concepts;
- online **games**, or occasionally, printable games;
- **animations** and interactive **illustrations** of math concepts;
- **articles** that teach a math concept.

We heartily recommend you take a look at the list. Many of our customers love using these resources to supplement the bookwork. You can use the resources as you see fit for extra practice, to illustrate a concept better, and even just for some fun. Enjoy!

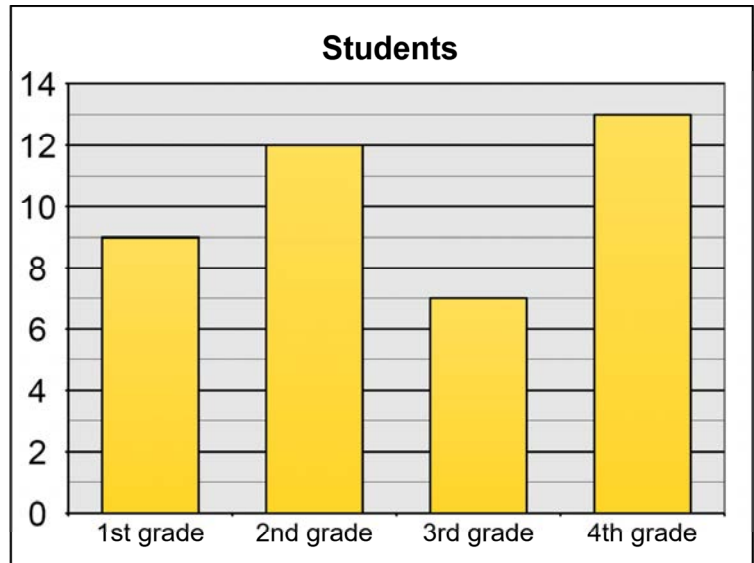
<https://l.mathmammoth.com/blue/datagraphs>



More Bar Graphs

1. Here, the bar for first grade students reaches the line between 8 and 10. That's 9 students.

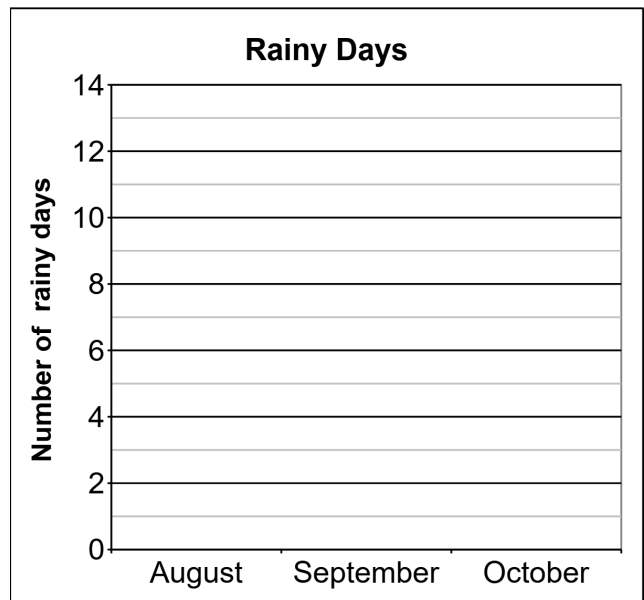
- How many students are in 3rd grade?
- How many students are in 4th grade?
- How many students are in 1st and 2nd grades, in total?
- Make your own question about the graph!



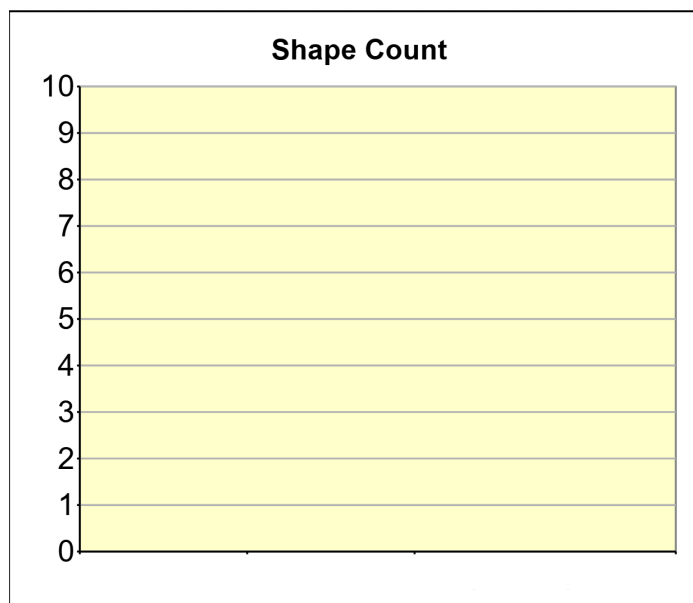
2. a. Make a bar graph by drawing a bar for each month in the image.

Month	Rainy days
August	7
September	12
October	13

- How many more rainy days did October have than September?
- How many more rainy days did October have than August?



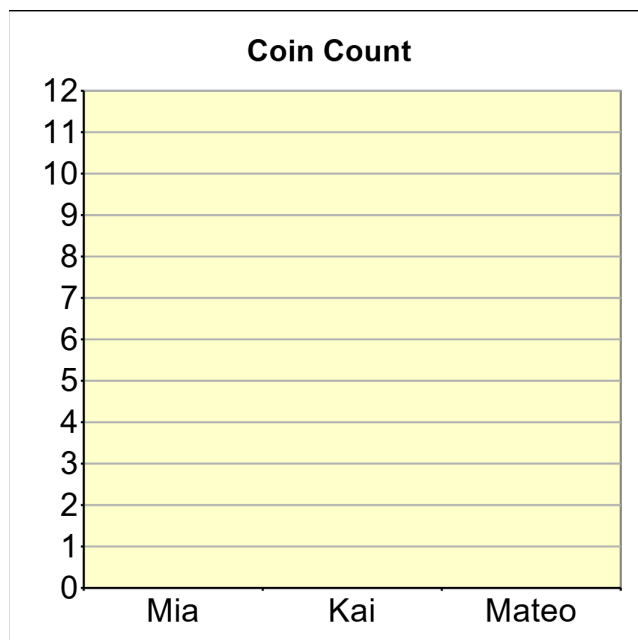
3. Draw a bar graph to show the count of each kind of shape (circles, triangles, squares).
You will also need to label the bars in the image.



4. Here you see how many coins Mia, Kai, and Mateo have.

Mia	
Kai	
Mateo	

- a. Make a bar graph.
- b. Make your own question about the graph, and answer it.



Tally Marks

(This lesson is optional.)

1. **Tally marks.** Tally marks are counting marks. When people count, they make one tally mark for each thing they count. For one item or thing, draw one tally mark as “|”. The fifth tally mark is drawn across the four others like this: .

Write the number that matches the tally.

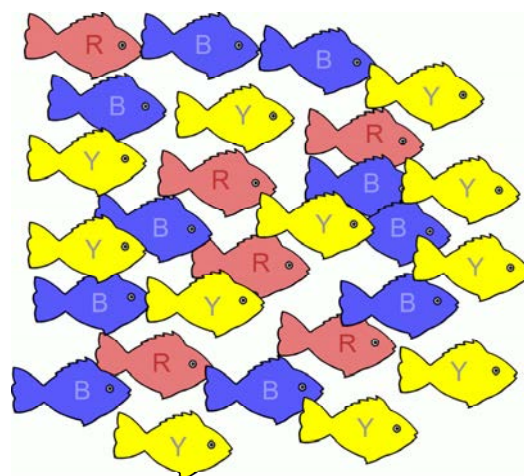
 a. _____	 b. _____	 c. _____	 d. _____
--	--	--	--

2. Draw tally marks for these numbers.

a. 7	b. 14
c. 16	d. 32
e. 41	f. 28

3. Count the fish. Use tally marks to keep track. Mark each fish you count and make a tally mark for it. That way you won't count the same fish twice. Then write the number under “Count”.

	Tally Marks	Count
Red		
Blue		
Yellow		



Pictographs

This is a **pictograph**. It shows how many flowers each child picked, using little pictures.

Below the pictograph is the **legend** or the **key**. It explains that one little picture of a flower means 8 flowers, not one.

For example, for Sofia we see two pictures of flowers. This means she picked 16 flowers.

Flowers Picked	
Ava	  
Sofia	 
Oliver	   
Liam	

 = 8 flowers

- Look at the pictograph above and answer the questions.
 - How many more flowers did Ava pick than Liam?
 - How many did Sofia and Ava pick together?
 - Who picked more, Oliver & Liam together, or Ava and Sofia together?
- The children picked fruit from Grandpa Jerry's fruit trees. They picked 35 oranges, 10 mangos, 40 bananas and 25 apples. Make a pictograph to show this. Draw **one** fruit **picture** to mean **10 fruits**. Draw a picture of a half fruit to mean **5 fruits**.

Fruits We Picked	
oranges	
mangos	
bananas	
apples	

Key

 = 10 oranges

 = 10 mangos

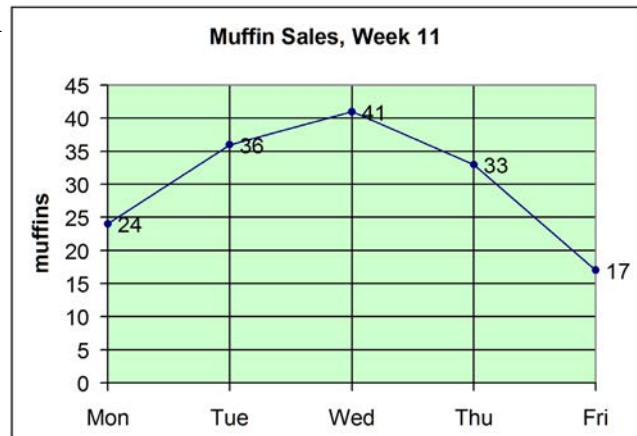
 = 10 bananas

 = 10 apples

Line Graphs 2

Mary sold muffins every day at 2 pm in the school cafeteria. She recorded her sales in the table.

Muffin Sales, Week 11	
Day	Muffins sold
Mon	24
Tue	36
Wed	41
Thu	33
Fri	17



We can draw a line graph out of this data because the data is organized by *time* (days of the week). To do that, we first plot the individual data points in a coordinate grid. Then we draw lines to connect neighboring points.

Besides that, the line graph also needs:

- a **title** on top for the whole graph
- **labels** for the **tick marks** on the two axes
- a **label** for the **vertical axis** (the y-axis)
- a **label** for the **horizontal axis** (the x-axis) unless it is very clear what it is about. In the graph above, the labels “Mon,” “Tue,” and so on show very clearly that they are days of the week, so we don’t necessarily need a title, “Days of the week,” for the horizontal axis.

Use a **line graph** for data that is organized by some *unit of time* (hours, days, weeks, years, *etc.*)

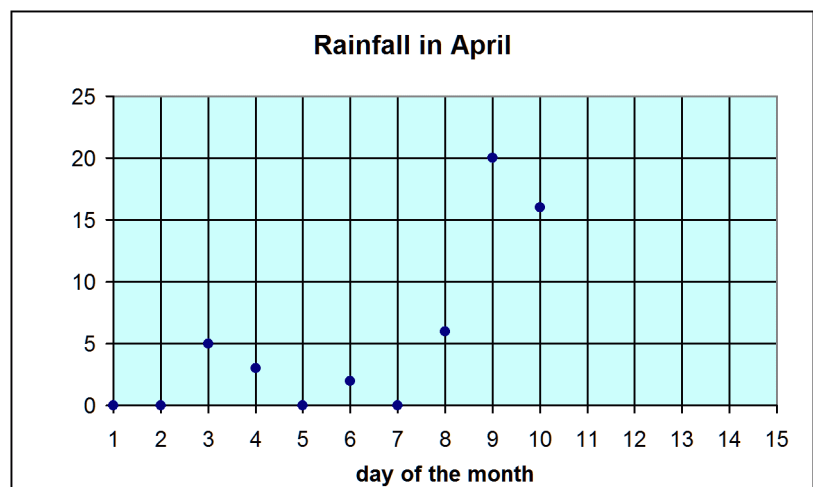
- a. Add a label for the vertical axis that says “Rainfall (mm)”.
(The “mm” stands for millimeters.)

- b. Add five more data points to the graph according to this data:

Day	11	12	13	14	15
rainfall (mm)	9	0	0	13	2

- c. Draw a line between each two consecutive points.

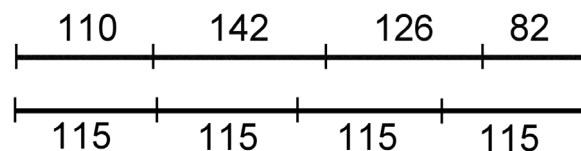
- d. How many “dry” days were there in the first half of April?



Average

The Millers went on a trip. The first day, they drove 110 miles, the second day, 142 miles, the third day, 126 miles, and the last day, 82 miles. The Millers drove a total of 460 miles.

In the diagram, we have put those distances as sticks one after another, though of course in reality they did not drive just straight stretches of roads.

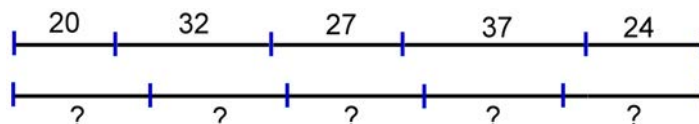


IF they had driven 115 miles each day, it would have totaled the same 460 miles.

On average, the Millers drove 115 miles a day, or their ***average*** daily mileage was 115 miles.

What is the average of 20, 32, 27, 37, and 24?

First find the total by adding. Then, divide that into equal parts.



$20 + 32 + 27 + 37 + 24 = 140$. $140 \div 5 = 28$. So, the **average** of 20, 32, 27, 37, and 24 is 28.

If these numbers were the ages of club members, we would say the average age of the members is 28 years. However, they could also be distances, weights, volumes, or just plain numbers.

1. Judith's test scores were 78, 87, 69, and 86.
Find her average score.
2. John measured the temperature five times during a day.
These are the results that he recorded:
18°C, 22°C, 26°C, 23°C, and 16°C.
Find the average temperature for the day.
3. Dad drove 414 km in six hours.
How many kilometers did he drive,
on the average, in one hour?

This image shows a full page of blank graph paper. The grid consists of small squares formed by thin gray lines. There are 20 columns and 20 rows of squares, creating a total of 400 square units. The background is white, and the grid lines are a uniform light gray color.

Mean, Mode, and Bar Graphs

Do you think you could calculate the average from the data shown in the bar graph? After all, there are numbers involved.

Actually, we cannot. To see why, you need to think *what kind of original data* produced this graph. What was asked of the people in the study? What did they respond?

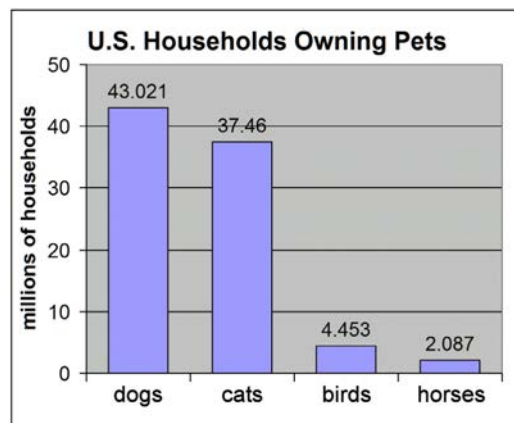
The people were asked something like, “What pets do you have?” The people would have answered, “cat,” or “dog,” and so on.

The original data set consists simply of the words “cat,” “dog,” “bird,” and “horse”—each one listed many times, because each mention of a “cat” would mean the answer of one particular household.

cat, cat, dog, dog, dog, bird, dog, dog, bird, cat, dog, horse, dog, cat, dog,...

We cannot calculate anything from this kind of data set because it is not numerical data! However, we CAN find the most commonly occurring item, and that is called the **mode**.

In this case, the mode is *dog*. It made the highest bar on the graph.



The mode is the most commonly occurring item in a data set.

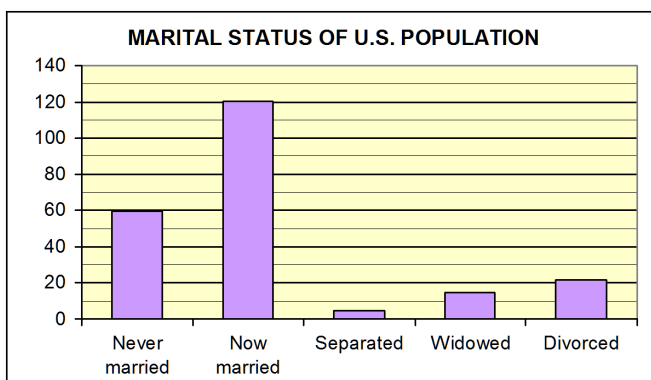
- Sometimes a set of data has two or more modes. For example, the data set *green, green, blue, blue, black, brown, hazel* has two modes: both green and blue are equally common.
- If none of the items occurs twice or more, there is no mode. For example, this data: *green, blue, pink, red, black, brown, purple* has no mode.

1. Find the mode of the data set shown in the bar graph on the right.

2. a. Find the mode of this data:

water, pop, juice, pop, juice, water,
milk, water, pop, pop, juice, pop

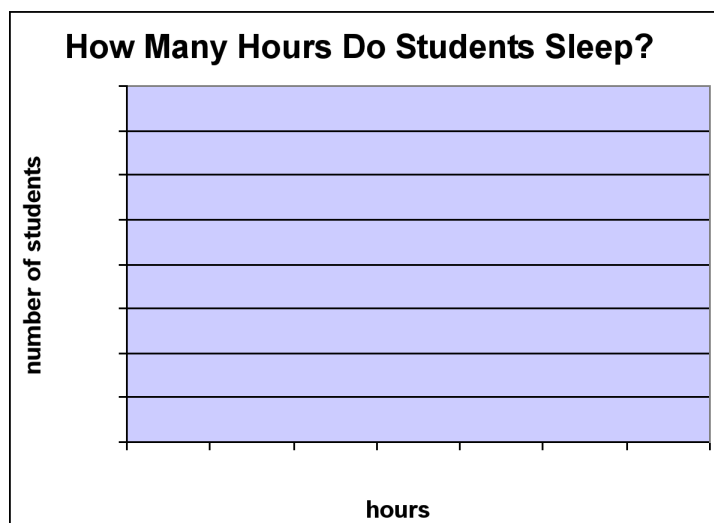
b. If the above are the answers of 12 people to some question, what could have been the question?



Review 2

1. Find the mean and mode of this data set to the nearest hundredth: 5, 9, 13, 12, 16, 10, 19, 11, 10.
2. Four hundred eight students were asked about how many hours they had slept the previous night. The results are summarized in the table below:

Hours of Sleep	Frequency
6	2
7	15
8	56
9	148
10	137
11	40
12	10
total	408



a. Draw a bar graph. Note that you need to choose the scaling on the vertical axis.

b. Find the mode.

c. Which of the following could be a part of the *original* data set?

(Hint: Imagine the original data set. Think: What was asked? What did the students answer?)

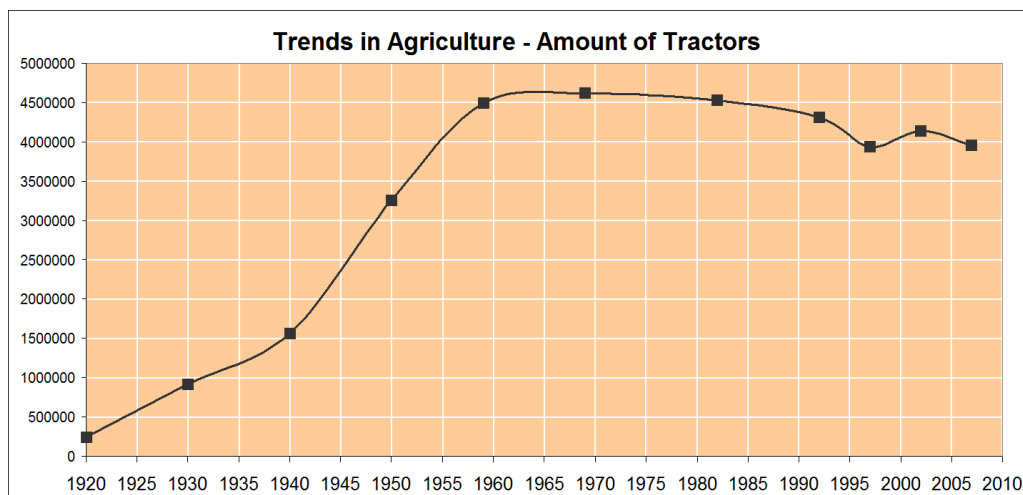
2, 15, 56, 148, 137, 40, 10, 2, 15, ...

6, 10, 8, 8, 9, 7, 11, 10, 9, 10, 11, ...

d. Which of the following do you think is the average for this data set?

9.4 hours 8 hours 11.1 hours

3. The line graph below shows the number of tractors in the U.S. over several decades.



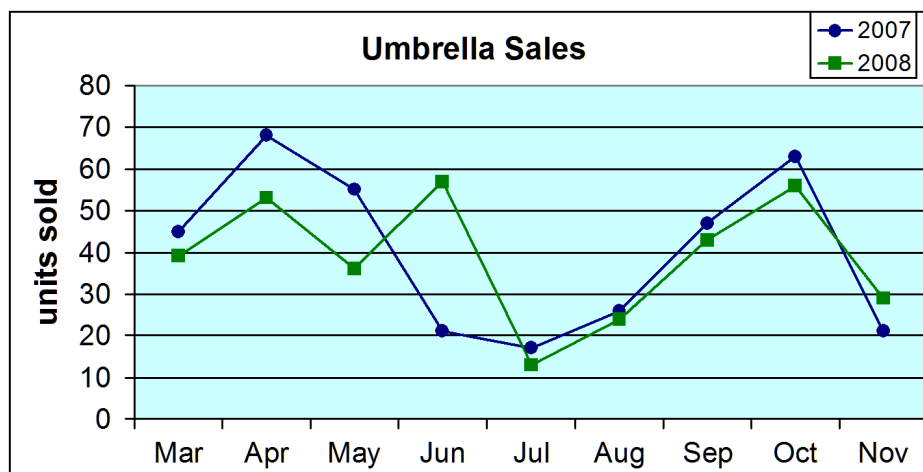
Source: Census of Agriculture

a. During which decade did the amount of tractors rise the quickest?

What was the *approximate* amount of increase in tractors during that decade?

b. About how many-fold was the increase in tractors between 1930 and 1960?

4. A department store was tracking the sales of many items, including umbrellas.



a. In 2007, which months were the sales less than 40 umbrellas?

How about in 2008?

b. Find the month with the greatest difference between 2007 and 2008 sales.