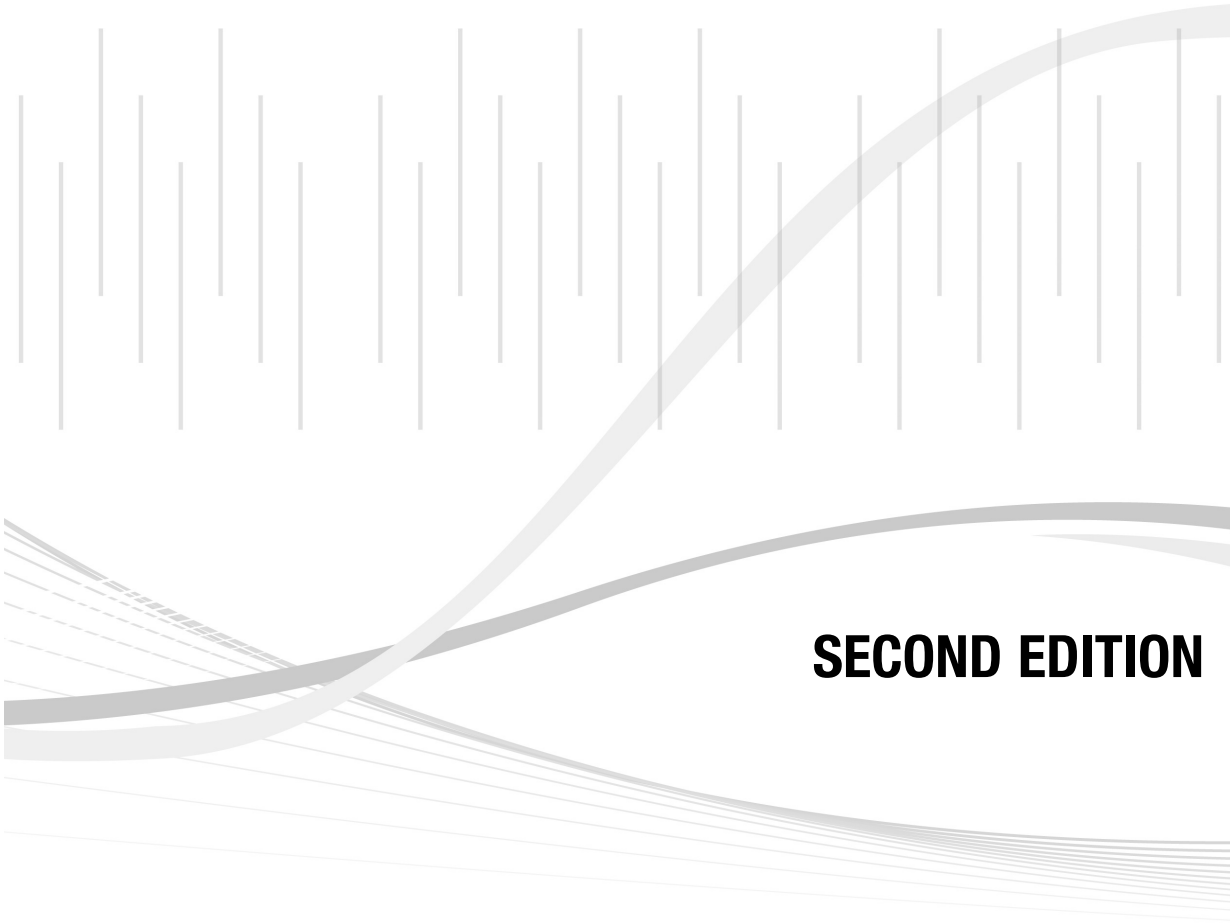
Real-Life Math

DATA ANALYSIS



SECOND EDITION

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How to Use This Series

The *Real-Life Math* series is a collection of activities designed to put math into the context of real-world settings. This series contains math appropriate for pre-algebra students all the way up to pre-calculus students. Problems can be used as reminders of old skills in new contexts, as an opportunity to show how a particular skill is used, or as an enrichment activity for stronger students. Because this is a collection of reproducible activities, you may make as many copies of each activity as you wish.

Please be aware that this collection does not and cannot replace teacher supervision. Although formulas are often given on the student page, this does not replace teacher instruction on the subjects to be covered. Teaching notes include extension suggestions, some of which may involve the use of outside experts. If it is not possible to get these presenters to come to your classroom, it may be desirable to have individual students contact them.

We have found a significant number of real-world settings for this collection, but it is not a complete list. Let your imagination go, and use your own experience or the experience of your students to create similar opportunities for contextual study.

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Foreword

Every person who pays any attention to the media is bombarded by data. Reports about the effectiveness of new medical treatments, financial market results, hundreds of sports scores, and many other numerical items flood newspapers, airwaves, and the Internet. Included in these reports are key numbers that measure, summarize, and communicate essential facts about the data. These key numbers are *statistics.*

Many people can rattle off lots of detailed statistics about sports, cars, or other areas of high interest. But trying to understand the mathematics underlying statistics puts most people to sleep. This book attempts to deepen students' mathematical understanding of statistics by presenting supplemental activities focused on subject matter with natural appeal—real-life examples and real data about the students themselves. It will fit into a general math, pre-algebra, or algebra course.

After mastering the activities in this updated second edition of the book, students will have many new tools to help them wade through the voluminous statistics they will encounter. In the process, they will learn how to make better decisions in life.

—Eric T. Olson

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1. Statistics: How to Measure Anything

1. The table below lists five features of daily life that have statistical aspects. Explain what statistics are involved. Then write five more examples of your own.

Feature	Statistics involved (including related factors)
1. climate	
2. car accidents	
3. class grades	
4. customers at mall	
5. state lottery	
6.	
7.	
8.	
9.	
10.	

2. Explain what is meant by the term *statistic.* Give an example.

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2. Gathering Data: Reaction Times

Context

driving

Math Topic

data collection

Overview

There is no better way to understand statistics than to do simple experiments. This activity allows students to generate a small data set by measuring their own reaction times. The data collected here will also be used in later activities. They are a prerequisite for Activities 8, 12, and 13.

Objectives

Students will be able to:

- collect a set of data in a simple experiment
- describe experiences during an experiment in qualitative terms

Materials

- one copy of the Activity 2 handout for each student
- one 12-inch (30-cm) ruler for each pair of students
- calculators

Teaching Notes

The idea in this activity is to collect some real experimental data that students later may analyze statistically. It is put in the context of research concerning driving.

The experiment involves two students. One student sits, while the other student stands behind the sitting student. The standing student holds a ruler vertically with thumb and forefinger near the 12-inch end so that the 1-inch end points downward and is visible to the sitting student. The students should be positioned so that the sitting student can see the 1-inch end of the ruler but cannot see the standing student's hand. The sitting student should then place whichever hand he or she wants in a grasping position at the 1-inch mark near the bottom of the ruler, but not touching the ruler. The sitting student should use the upper part of his or her horizontally positioned thumb to align with the 1-inch mark of the ruler.

To conduct a trial, the standing student should carefully drop the ruler at a random moment. The sitting student should then catch it as quickly as possible. The sitting student should record the distance the ruler dropped before he or she caught it. Note that this distance is equal to the change of position from the initial alignment to where the ruler was caught. If students initially align their thumbs with the 1-inch mark,

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teacher's page

2. Gathering Data: Reaction Times

the change of position will be equal to the final position less 1. This distance will be converted into the time required for the sitting student to react to the falling ruler. Students should conduct 15 trials, switch roles, and conduct 15 more trials. They should record their own results on their own copies of the handout.

After all the distance data are collected, students should convert them to time data. The falling ruler can be considered to be an object in free fall without air friction. Thus, if d represents the change of position in inches, then t (time in seconds) can be calculated using this formula:

$$t = (0.072)\sqrt{d}$$

If d is in centimeters, then t may be calculated as follows:

$$t = (0.045)\sqrt{d}$$

Answers

1. Results will vary considerably. Make absolutely sure that all students record change of position, not merely the final position. Help students calculate the correct values for the actual reaction time using the formulas above.
2. Not all trials will proceed perfectly. Two common occurrences will be premature anticipation and lack of attention by the subject (sitting student). Students should record any such events. These notes will become important when students are asked to explain and deal with outliers in the data.

Extension Activities

- Have students write a paragraph explaining how the Department of Motor Vehicles might use data about people's reaction times.
- Have students write a procedure for an experiment to test people's reaction times under different conditions. For example, how would reaction times be affected by dim light, or by a bright light shining in the eyes? What about sudden loud noises? If you wish, have students perform some of these experiments to see how their reaction times change, and whether their predictions of the effects of different conditions were correct.

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2. Gathering Data: Reaction Times

Imagine you work for the State Department of Motor Vehicles and are studying people's reaction times. (The ability to react quickly is very important while driving.) You want to test a simple experiment requiring very little equipment that you think may give you good results.

1. Work in pairs. One partner will be seated. The second partner will stand behind the seated one while holding a ruler in front of the sitting partner. Carefully follow your teacher's instructions about how to conduct a trial. At a random moment, the standing partner will release the ruler. The seated partner will catch it. You will measure the ruler's change of position between the moment of release and the moment the ruler is caught. The sitting partner should not be able to see the standing partner. Careful measurements are required! Make sure the sitting partner correctly aligns and records thumb position before and after the trial. Do 15 trials, switch roles, and do 15 more. The sitting partner should record his or her own data in the Change of Position column on his or her own handout. Your teacher will explain how to calculate the value for reaction time. Time is measured in seconds.

   The change in position shows, in inches, how long it took you to react and catch the falling ruler. Now you need to convert this distance measurement to a time measurement. To find the time in seconds, use the following formula:

   $$t = (0.072)\sqrt{d}$$

   Example: If your thumb was at the 2.25-inch mark when you caught the ruler, then d (the distance the ruler traveled) is 1.25 inches. To calculate the time it took you to react, find the square root of d: 1.118. Now multiply 0.072 by 1.118. The answer is 0.08 seconds.

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2. Gathering Data: Reaction Times

Trial	Change of position	Reaction time $t = (0.072)\sqrt{d}$	Trial	Change of position	Reaction time $t = (0.072)\sqrt{d}$
1			9		
2			10		
3			11		
4			12		
5			13		
6			14		
7			15		
8					

2. Explain any problems you had during your trials. Did the partner being tested (the sitting partner) ever improperly anticipate or forget to react to the ruler falling? How did you solve these problems? Which trials were affected?

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