Real-Life Math

FRACTIONS, RATIOS, AND RATES

SECOND EDITION

WALCH PUBLISHING

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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.

Foreword

As a mathematician, I have to admit that I always used to greet the question, "When are we ever going to use this?" with some annoyance. It was obvious to me that students needed the material to do well on my tests and maybe in future classes. Admittedly, that doesn't give students, unless they really just love math, much on which to hang their hats. With greater experience, I began answering the question with esoteric phrases about how well math trains one's mind and why training the mind is the highest goal of a good education. Still, some students stare at me blankly, trying to find the "real" meaning of their math voyage.

Well, we really DO use math every day. Yes, sometimes it is just to balance a checkbook or to make change, but in an incredible variety of professional and personal settings, we use math skills that were drilled into us without the slightest hint of a context. Once I started to think about all the areas of life where math and mathematical thought were central, I started having fun. I have talked with stockbrokers, restaurateurs, mechanics, haberdashers, contractors, baseball statisticians, bankers, carpet salespeople, and grocers to learn about how they use math each day. I hope that these activities will be as much fun for your students and provide them with as much contextual background as they have for me. As a teacher, you will be amazed by how open professionals in other fields are to helping your students extend their understanding and grounding in learning math.

—Tom Campbell

Name ______________________________ Date ______________________

1. A Construction Site

Rulers and measuring tapes are often divided into inches. Inches are sometimes broken into halves, quarters, eighths, tenths, or sixteenths depending on the measurer. The inches can also be grouped in sets of 12 into feet. Most measurements in the construction business are given in feet, inches, and fractions of inches.

Brian McDonald has a general contracting business. He and his employees always measure carefully to make sure they cut their materials correctly. On a recent job site, they encountered the following situations. Give Brian's crew a hand with their measurements by answering the questions below.

1. Brian is putting in a countertop. He is going to put the countertop flush against the wall on one end and trim it with a board that is $9/16$ inch thick on the other end. If Brian wants the counter to end exactly 9 feet, $6\,1/2$ inches from the wall, how long should he cut the countertop?

2. Brian has hired Matteen to build the deck. Matteen can just fit a deck that is 13 feet, 6 inches along the side of the house by 10 feet 4 inches out from the house. The customer wants a railing; however, that will be $3\,1/2$ inches wide, running around the three sides not attached to the house. What will be the dimensions of the "livable space" on the deck?

3. Brian has hired Sarah to build a square window frame out of wood that is $3/4$ inch thick. The dimensions need to be 4 feet, $3\,1/4$ inches square. If Sarah cuts the two sides of the square to be 4 feet, $3\,1/4$ inches long, how long should she cut the top and bottom pieces to fit between these two sides?

(continued)

Name ______________________________ Date ______________________

1. A Construction Site

4. Lori has been hired to build the frame and outer walls of the house. The exterior walls will be made of $\frac{3}{8}$-inch drywall, $3\frac{1}{2}$-inch-wide studs, $\frac{1}{4}$-inch-thick exterior plywood, and $\frac{5}{16}$-inch-thick siding. How thick are the new walls altogether?

5. Rayhan has been hired to build a rectangular box out of $\frac{3}{8}$-inch-thick wood as a curio shelf. He wants the box to be 6 inches long and $4\frac{1}{4}$ inches wide. If he insets the bottom into the box, to what dimensions should he cut the piece for the bottom?

6. The house is 26 feet, $4\frac{3}{4}$ inches wide on the outside. Brian wants to cut his clapboards to fit the sides, but he knows that the corner trim covers $3\frac{1}{8}$ inches in from the edge on each end. How long should he cut the clapboards?

7. Concrete will be poured into forms at the job site tomorrow. The wall to be poured is to be 15 feet, $5\frac{3}{8}$ inches long. Rayhan and Brian already have a form that is 12 feet, 6 inches long. How long should they make an additional form to make the wall the right length?

8. Brian has asked Matteen to build a doorway for an existing door. Matteen knows that the door is $41\frac{3}{4}$ inches wide and $90\frac{3}{8}$ inches tall. He knows the jamb will be $4\frac{3}{4}$ inches thick on the top and two sides of the doorway. What are the dimensions of the hole he should create in the wall to accommodate the doorjamb and the door?

Name ______________________________ Date ____________________

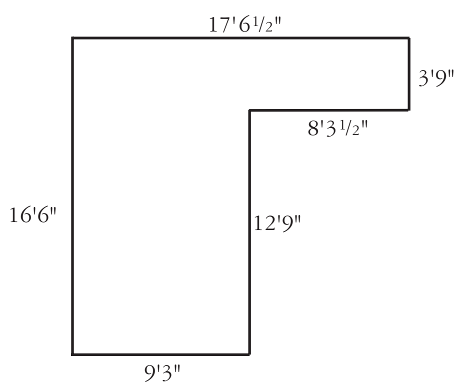
2. Selling Carpet

Kevin's Carpet World has been installing office carpeting for years. They are now trying to break into the home carpeting business. When customers come into the salesroom, Kevin asks them to bring an accurate floor plan of the room(s) to be carpeted. The staff can then calculate the square yardage of the floor to determine the price of the carpeting. Kevin's prices include a 6-pound pad and installation, so customers have only one price to consider.

For each situation below, help Kevin determine the price of the carpet installation.

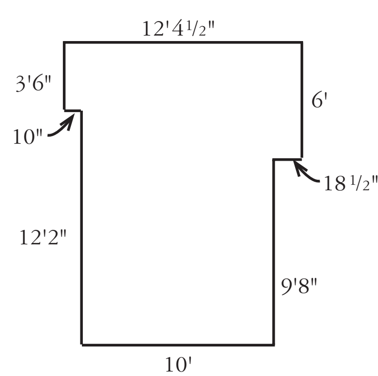
1. The Winston family is installing a playroom in their basement. They like the Berber carpet that is on sale for $12.99 a square yard. What price should be charged assuming the following floor plan is accurate?

   Total cost: ____________



2. The Khin family is carpeting their living room. They have chosen a deep-pile carpet that sells for $24.95 a square yard. How much should they be charged based on the following floor plan?

   Total cost: ____________



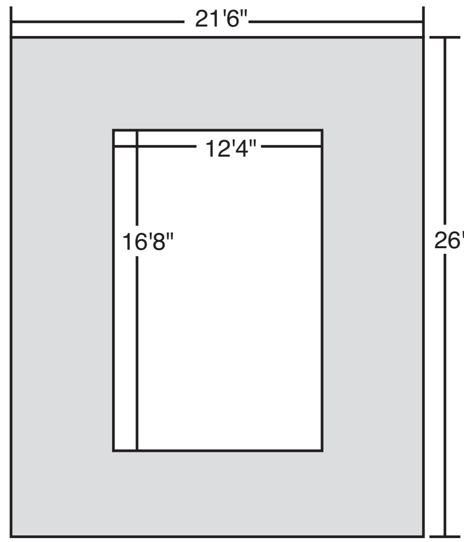
(continued)

Name ______________________________ Date ______________________

2. Selling Carpet

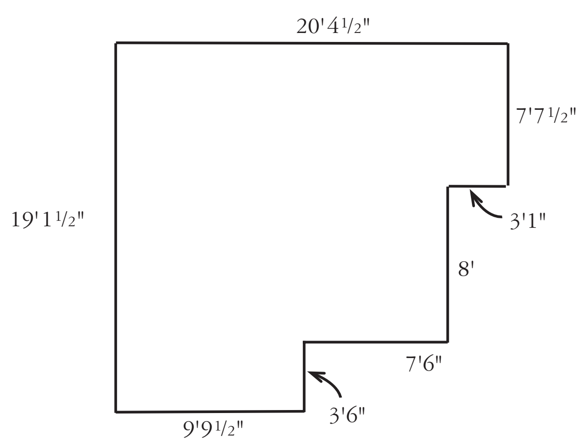
3. The Trafton family wants to install outdoor carpeting around their in-ground pool. The outdoor carpeting they have selected is $8.99 a square yard. How much should they be charged based on the following plan of the pool area?

   Total cost: ______________



4. The Cowen family is carpeting their dining room. They have chosen a low-pile carpet that sells for $18.75 a square yard. How much should they be charged based on the following floor plan?

   Total cost: ______________



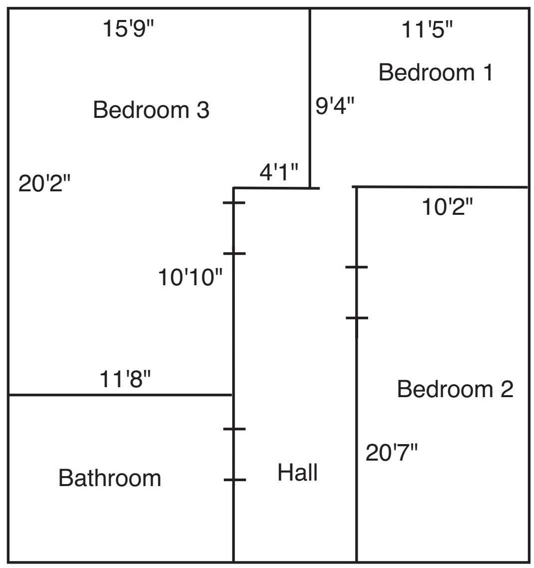
(continued)

Name ______________________ Date ______________

2. Selling Carpet

5. The Taylor family is carpeting their bedrooms. They have chosen a soft carpet that sells for $18.15 a square yard. How much should they be charged based on the following floor plans?

   Total cost: ____________



teacher's page

3. Sports Standings

2. Eastern Conference Standings for the NBA as of March 19, 2006

Atlantic Division				
Team	Wins	Losses	PCT	GB
New Jersey	36	28	.563	—
Philadelphia	31	34	.477	5.5
Boston	27	39	.409	10
Toronto	24	42	.364	13
New York	19	45	.297	17

Central Division				
Team	Wins	Losses	PCT	GB
Detroit	52	13	.800	—
Cleveland	37	29	.561	15.5
Indiana	33	30	.524	18
Milwaukee	33	33	.500	19.5
Chicago	29	37	.439	23.5

Southeast Division				
Team	Wins	Losses	PCT	GB
Miami	44	21	.677	—
Washington	33	31	.516	10.5
Orlando	24	41	.369	20
Atlanta	20	43	.317	23
Charlotte	18	49	.269	27

(continued)

teacher's page

3. Sports Standings

3.

Team	PCT	Reason for Invitation
1. Detroit	.800	First place in Central Division
2. Miami	.677	First place in Southeast Division
3. New Jersey	.563	First place in Atlantic Division
4. Cleveland	.561	Best percentage among non-leaders of division
5. Indiana	.524	Second best percentage among non-leaders of division
6. Washington	.516	Third best percentage among non-leaders of division
7. Milwaukee	.500	Fourth best percentage among non-leaders of division
8. Philadelphia	.477	Fifth best percentage among non-leaders of division

4. Chicago is in ninth place with a .439 winning percentage. They are 2.5 games behind Philadelphia.

Name ______________________ Date ______________

3. Sports Standings

Newspapers print the standings of various sports leagues daily. The team in first place is usually listed at the top. “First place” status is based on best “winning percentage,” but “games behind” can also be used. Jose is a sports editor for the *Sunville Times.* He has to check the standings each day for accuracy (whether they are current or outdated).

Jose computes the winning percentage (PCT) by dividing the number of wins a team has by the number of games they have played. Jose then determines the games behind (GB) for each team. He subtracts a team’s wins from the first place team’s wins, then adds the team’s losses to this difference. The next step is to subtract the first place team’s losses. The resulting number is divided by 2.

Help Jose with his job by filling in the PCT and the GB fields in the charts below.

1. National League Final Standings 1962

Team	Wins	Losses	PCT	GB
St. Louis	93	69		
Cincinnati	92	70		
Philadelphia	92	70		
San Francisco	90	72		
Milwaukee	88	74		
Los Angeles	80	82		
Pittsburgh	80	82		
Chicago	76	86		
Houston	66	96		
New York	53	109		

2. Eastern Conference Standings for the NBA as of March 19, 2006

Atlantic Division				
Team	Wins	Losses	PCT	GB
New Jersey	36	28		
Philadelphia	31	34		
Boston	27	39		
Toronto	24	42		
New York	19	45		

(continued)

Name ______________________________ Date ____________________

3. Sports Standings

Southeast Division				
Team	**Wins**	**Losses**	**PCT**	**GB**
Miami	44	21		
Washington	33	31		
Orlando	24	41		
Atlanta	20	43		
Charlotte	18	49		

Central Division				
Team	**Wins**	**Losses**	**PCT**	**GB**
Detroit	52	13		
Cleveland	37	29		
Indiana	33	30		
Milwaukee	33	33		
Chicago	29	37		

3. Now that you have calculated all the winning percentages and how far each team is behind in its division, determine who is in the lead to be a playoff team. Each division winner goes to the playoffs, and the five teams that are not division winners but have the best winning percentages are invited to the playoffs as well. Which eight teams would be invited to the playoffs based on these standings? Complete the chart on the next page.

(continued)

Name ______________________________ Date ____________________

3. Sports Standings

Team	PCT	Reason for Invitation
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		

4. Which team is sitting in ninth place, and how far from being in the playoffs are they?

Real-Life Math

PROBABILITY

SECOND EDITION

WALCH PUBLISHING

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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.

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Foreword

You've seen it happen many times—a player in a dice game claims she is "due" for doubles; strangers discover that they have a mutual acquaintance and think that this must be more than a chance meeting; a friend plays the lottery obsessively or enters online contests with a persistent dream of winning. All these behaviors reflect how people perceive probability in daily life. People who lack an accurate sense of probability are easily drawn in by false claims and pseudoscience, are vulnerable to get-rich-quick schemes, and exhibit many of the behaviors mentioned above.

The modeling and measurement of probabilities are fundamentals of mathematics that can be applied to the world around us. Every event, every measurement, every game, every accident, and even the nature of matter itself is understood through probabilistic models, yet few people have a good grasp of the nature of probability. Even students who have taken typical mathematics courses are unlikely to acquire the mathematical skills necessary to apply probabilistic models to real-world situations.

This book will help fill the gaps. This collection of activities will supplement general math, pre-algebra, or algebra courses, and will add focus to a course dedicated to probability. The activities will help students develop the mathematical foundation needed to understand how probability works. There are two sets of activities: One set (Activities 1–7) focuses on certain mathematical basics that are needed to understand applied examples. The other set (Activities 8–26) provides real-world examples. The first set is important because students will be lost when they see a problem if they do not understand a few basic principles and do not have the ability to do basic calculations. The second set forms the bulk of the book, moving from simple experiments to more challenging applications.

After mastering the activities in this book, students will have tools to help them evaluate the probabilities of events they will encounter, and in the process, they will learn to make better decisions in life.

—Eric T. Olson

teacher's page

1. Probability All Around Us

Event	Nonrandom Property	Random Property
weather	seasonal change, local climate	precipitation, temperature on specific days
car accidents	safe or unsafe driving practices	specific cars or conditions met on the road
class grades	amount of study and preparation	appearance of specific questions on tests
customers at mall	hours open, time of day	specific pattern of customer arrival
state lottery	decisions about games offered, prizes	numbers drawn or winning patterns on tickets

2. The term *random* describes events that have underlying variability. Single random events cannot be predicted absolutely. However, using probability and probability models, it is possible to predict the frequencies of outcomes in a large set of random events.

Extension Activity

Have students spend a day or more observing events with random properties and report back to class.

Name ________________________________ Date ____________________

1. Probability All Around Us

After your third softball game in a row is rained out, you are talking with your teammates. One of them says, "Some things just seem to happen. We scheduled these games months ago, but who could have predicted so much rain?"

You ask, "I wonder if this is what my math teacher means by 'random events'?"

Then you all start thinking about how many situations in daily life seem to happen randomly.

1. The table below lists five common events that have both random and nonrandom aspects. Explain what is random and what is not random about each. Then come up with five examples of your own.

Event	Nonrandom Property	Random Property
1. weather		
2. car accidents		
3. class grades		
4. customers at mall		
5. state lottery		
6.		
7.		
8.		
9.		
10.		

2. Describe what is meant by *random event.* Explain the relationship between probability and randomness.

7. Scrambled Word Puzzles

or trying to solve the puzzle first, to narrow down the number of possible arrangements of the letters.

Extension Activity

Have students search the Internet for sites concerning scrambled word puzzles. Some such sites have interactive programs that supply answers for scrambled words. Ask students to speculate on how such programs might work.

Name ______________________________ Date ______________________

7. Scrambled Word Puzzles

Many daily newspapers feature a puzzle in which four or five words are scrambled. You figure out what the words are, then use letters found in certain positions of these words to decode a joke or clever phrase. Use your knowledge of probability to solve this type of puzzle.

1. How many ways is it possible to arrange the 4 letters *A, P, S,* and *T*? Write all the possibilities below. How many of the possibilities are actual words?

   number of possible arrangements ________

   number of actual words ________

2. How many ways is it possible to arrange

   a. 5 distinct letters?

   b. 6 distinct letters?

   c. the letters in the word *GEESE*?

   d. two groups of 3 distinct letters?

3. Complete the puzzle below. Describe any strategies that you used to unscramble the words.

Probability Puzzler

Unscramble these four words, putting one letter in each square, to form four words related to probability.

N A R M O D

☐ ☐ ■ ☐ ■ ☐

S P E S M L A

■ ☐ ☐ ☐ ☐ ■ ■

D C E E U D

■ ☐ ■ ☐ ☐ ☐

C I T R D E P

☐ ☐ ☐ ■ ☐ ☐ ☐

Now arrange the letters in the gray boxes above to answer the following riddle.

What did Luis find when he turned to the back of his probability textbook?

☐ ☐ ☐ ☐ AND ☐ ☐ ☐ ☐

8. Trials: Single Coin Toss

Context

sports

Math Topic

probability distributions

Overview

There is no better way to understand probability than to do simple experiments. Perhaps the easiest way to generate random events is to toss a coin.

Use Activity 9 if you wish to study the binomial model on which these trials are based.

Objectives

Students will be able to:

- conduct and record the results of experimental trials
- make a graph to analyze the results

Materials

- one copy of the Activity 8 handout for each pair of students
- one coin for each pair of students
- graph paper
- calculator

Teaching Notes

Students should pair off. Within each pair, one student will toss or spin the coin to produce good random trials. The other will record the results. Students should switch jobs halfway through the trials. It is recommended that the person tossing the coin catch it rather than let it bounce on the floor.

Students will record 20 trials of 10 tosses each. The exact sequence of heads and tails in each trial should be written on the sheet. For each trial, the students should count and record the number of times the outcome was heads.

Students can then complete a histogram showing the frequency with which heads occurred 0 times, 1 time, 2 times, and so forth, up to 10 times in the trials.

If you decide to do Activity 9, make sure that students save their data from this activity.

Answers

1–2. Results will vary. The theoretical distribution of probability is

0H, $^{1}/_{2^{10}}$

1H, $^{10}/_{2^{10}}$

2H, $^{44}/_{2^{10}}$

3H, $^{117}/_{2^{10}}$

4H, $^{205}/_{2^{10}}$

(continued)

8. Trials: Single Coin Toss

5H, $^{246}/_{2^{10}}$

6H, $^{205}/_{2^{10}}$

7H, $^{117}/_{2^{10}}$

8H, $^{44}/_{2^{10}}$

9H, $^{10}/_{2^{10}}$

10H, $^{1}/_{2^{10}}$

For 20 iterations of the 10 flips, occurrences of 0H, 1H, 9H, and 10H will be rare, with total probability under 5% that any of these will happen. However, many students will experience one or perhaps two of these rare events within their 20 iterations. The rest of the theoretical distribution is 2H, 1 occurrence; 3H, 2 occurrences; 4H, 4 occurrences; 5H, 5 occurrences; 6H, 4 occurrences; 7H, 2 occurrences; 8H, 1 occurrence.

Extension Activity

Have students recreate this activity with a die, investigating the probability of any one of the 6 sides being rolled. One partner will roll the die, and the other will record the results. They should record 20 trials of 10 rolls each. After all the data are collected, ask students to make a histogram showing the frequency with which their selected number (1–6) occurred.

Name ____________________ Date ____________________

8. Trials: Single Coin Toss

You know there is a 50–50 chance that your team will win the coin toss at the beginning of a football game. But what is your team's probability of coming out ahead (or behind) in winning the toss during the course of a 10-game season? Find out in this simulation.

1. One partner will toss or spin a coin to produce good random trials. The other will record the results on this sheet. Switch jobs halfway through the trials. It is recommended that the person tossing the coin catch it rather than let it bounce on the floor. Record 20 trials of 10 tosses each. The exact sequence of heads and tails should be written in the table under "Outcomes." For each trial, record the number of times the outcome was heads out of the 10 tosses.

Trial	No. of Heads	Outcomes	Trial	No. of Heads	Outcomes
1			11		
2			12		
3			13		
4			14		
5			15		
6			16		
7			17		
8			18		
9			19		
10			20		

2. After all data are obtained, make a histogram on a sheet of graph paper showing the frequency with which heads occurred 0 times, 1 time, 2 times, and so forth, up to 10 times in the trials.

9. Analysis: Single Coin Toss

Context

simple experiment

Math Topic

binomial model

Overview

In this activity, students use their data from Activity 8 to study the binomial model. Any independent trials built on events that have two possible outcomes, success or failure, fall under the binomial model. In this activity, students study the single coin toss, where success is defined as an outcome of heads and failure as an outcome of tails.

Objectives

Students will be able to:

- understand the binomial distribution
- compare experiment and theory for 10 coin tosses

Materials

- one copy of the Activity 9 handout for each student
- data from Activity 8
- calculator

Teaching Notes

To determine the likelihood of getting a certain number of heads out of 10 tosses of a coin, it is necessary to understand a mathematical model of this situation: the binomial model. This activity lets students calculate the binomial probabilities for their data and compare the calculated probabilities to their actual results.

The term *binomial* follows from the expression $(p + q)^n = 1$. When this expression is expanded into all of its binomial terms, the terms, each of which represents a certain number of successes and failures, all add up to 1. The general expression for an individual binomial probability (P) is:

$$P_{n,m} = \binom{n}{m} p^m q^{(n - m)}$$

In this expression, n is the number of trials, m is the number of trials with successes, p is the probability of success, and q is the probability of failure $(1 - p)$.

It may be easier to teach students how to use the binomial model for a specific case. Say you want to know, before tossing a coin 10 times, the probability of getting 7 heads. First, you need to determine how many ways there are to "choose" 7 events (i.e., get heads 7 times) out of 10 events (i.e., 10 tosses), because any combination of 7 events being heads would result in a total of 7. From our discussion on combinations, we know there are $(10 \times 9 \times 8 \times 7 \times 6 \times 5 \times 4)/7!$, or 120, such combinations.

(continued)

Name ______________________________ Date ______________________

9. Analysis: Single Coin Toss

1. Complete the table showing the probability of each of the possible outcomes of a series of 10 coin tosses. Use the data you collected in Activity 8.

   Number of trials from Activity 8: _____

No. of heads	No. of combinations	Probability of individual outcome	Total probability	No. of heads from actual trials	Percent of heads from actual trials
0					
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					

2. What have you learned about the meaning of a mathematical probability of $1/2$ from observing and recording many actual events with this probability?

Real-Life Math

DATA ANALYSIS

SECOND EDITION

WALCH PUBLISHING

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How to Use This Series

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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

Name ______________________________ Date ______________________

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.

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,

(continued)

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.

Name ______________________________ Date ______________________

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.

(continued)

Name ______________________________ Date ______________________

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?

Real-Life Math

TABLES, CHARTS, AND GRAPHS

SECOND EDITION

WALCH PUBLISHING

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Making Graphs

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.

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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.

Foreword

A college professor of mine once explained to our class that there were three kinds of lies, "lies, —— lies, and statistics." His premise for the morning's lecture was that since most Americans had little or no education in reading statistics critically, we were all susceptible to being hoodwinked by number manipulators. This was a course for math majors, and we all wondered when he would get off his soapbox. Unfortunately, he was able to prove his point. Because students rarely read tables and graphs in the context of learning about them, they tend to see any graphically presented, organized piece of information as being necessarily true.

Years later, I watched an engineering supervisor present his error statistics for the first quarter of the year. In his business, two or three errors a quarter was too many, and his department had made five. However, he showed a bar graph of the number of errors in the previous five quarters, with the *y*-axis going up to 200. The bars in the graph were razor-thin blips at the bottom of the page, so five errors appeared essentially the same as one. As the supervisor received an ovation for his "fine work," I knew that reading charts, graphs, and tables critically needed to be a focus in my classroom. The activities in this book are designed to teach students to use these devices to read and interpret organized data, to organize their own data, and to think about how presentations can affect the way data are interpreted.

—Tom Campbell

Name ______________________________ Date ______________________

2. Hat Sizes

Many hats are adjustable, but some are still sized. These include cowboy hats, top hats, dress hats, and fitted baseball caps. Most hat stores use a chart such as the one below to find a person's hat size by measuring the circumference of his or her head. Use the chart below to answer the questions that follow.

Hat Size	Circumference in Inches	Circumference in Centimeters	Hat Size	Circumference in Inches	Circumference in Centimeters
$6\frac{3}{4}$	$21\frac{1}{4}$"	54.5 cm	$7\frac{3}{4}$	$24\frac{3}{8}$"	62.5 cm
$6\frac{7}{8}$	$21\frac{5}{8}$"	55.5 cm	$7\frac{7}{8}$	$24\frac{3}{4}$"	63.5 cm
7	22"	56.5 cm	8	$25\frac{1}{8}$"	64.5 cm
$7\frac{1}{8}$	$22\frac{3}{8}$"	57.5 cm	$8\frac{1}{8}$	$25\frac{1}{2}$"	65.5 cm
$7\frac{1}{4}$	$22\frac{3}{4}$"	58.5 cm	$8\frac{1}{4}$	$25\frac{7}{8}$"	66.5 cm
$7\frac{3}{8}$	$23\frac{1}{8}$"	59.5 cm	$8\frac{3}{8}$	$26\frac{1}{4}$"	67.5 cm
$7\frac{1}{2}$	$23\frac{1}{2}$"	60.5 cm	$8\frac{1}{2}$	$26\frac{5}{8}$"	68.5 cm
$7\frac{5}{8}$	24"	61.5 cm			

1. A haberdasher in Phoenix, Arizona, gets an online order for a hat. The person's head measures $23\frac{1}{2}$ inches around. What size hat should he make?

2. Kirsi's head measures 61.5 centimeters in circumference. What size hat does he wear?

3. Amanda's head measures $22\frac{3}{8}$ inches in circumference. What hat size does she wear?

4. Jel knows that his hat size is $8\frac{1}{2}$. What is the circumference of his head in inches?

5. Riel remembers that his hat size is $7\frac{3}{8}$. What is the circumference of his head in centimeters?

6. Assume that you have a friend with a very large head, a little larger than size $8\frac{1}{2}$. Determine the next row of the chart to help him out.

   Size: __________
   circumference (inches): ___________
   circumference (cm): ___________

Name ______________________________ Date ______________________

3. Reading a Nutrition Table

Adriana's doctor has advised her to carefully check the ingredients of what she eats. At breakfast this morning, while eating her cereal, she read the following information from her milk jug and her cereal box.

Cereal

Nutrition Facts
Serving Size 1 Cup

Amount per Serving	Cereal	with 1/2 cup skim milk
Calories	180	220
Calories from fat	10	10
	% Daily Value	
Total Fat 1g	2%	2%
Saturated Fat 0g	2%	2%
Polyunsaturated Fat 0g		
Monounsaturated Fat 0g		
Cholesterol 0g	0%	1%
Sodium 350mg	15%	17%
Potassium 160mg	5%	10%
Total Carbohydrate 41g	14%	15%
Dietary Fiber 5g	21%	21%
Soluble Fiber 1g		
Sugars 5g		
Other Carbohydrates 31g		
Protein 5g		
Vitamin A	0%	6%
Vitamin C	10%	10%
Calcium	4%	20%
Iron	45%	45%
Thiamin	25%	25%
Riboflavin	6%	15%
Niacin	25%	25%
Vitamin B^6	25%	25%
Folic Acid	25%	25%
Vitamin B^{12}	25%	35%
Vitamin D	0%	25%
Phosphorus	10%	25%
Magnesium	14%	17%
Zinc	20%	21%
Copper	8%	8%

1% Milk

Nutrition Facts
Serving Size 1/2 Cup

Amount per Serving	
Calories	55
Calories from fat	10
	% Daily Value
Total Fat 1.25 g	2%
Saturated Fat 0.75 g	4%
Polyunsaturated	
Monounsaturated Fat	
Cholesterol 8mg	2%
Sodium 63mg	3%
Potassium 0mg	0%
Total Carbohydrate 7g	2%
Dietary Fiber 0 mg	0%
Soluble Fiber 0 mg	0%
Sugars 6g	
Other Carbohydrates 0 mg	
Protein 4g	
Vitamin A	5%
Vitamin C	20%
Calcium	15%
Iron	0%
Thiamin	
Riboflavin	
Niacin	
Vitamin B^6	
Folic Acid	
Vitamin B^{12}	
Vitamin D	25%
Phosphorus	
Magnesium	
Zinc	
Copper	

(continued)

Name ______________________ Date ______________________

3. Reading a Nutrition Table

Use the nutrition tables to answer the following questions.

1. Approximately how many calories are there in a half-cup of skim milk?

2. How many more calories are there in a half-cup of 1% milk than in a half-cup of skim milk?

3. What is the recommended daily allowance of sodium, in milligrams?

4. What is the recommended daily allowance of carbohydrates, in grams?

5. List three ingredients in milk that are indicated on the cereal box label but not mentioned on the milk label.

6. How many cups of skim milk would you have to drink to get 100% of the daily requirement of riboflavin?

7. Suggest a reason that no percentage is listed on the "Sugars" line of either table.

8. How can the cereal have 0 grams of saturated fat and still contain 2% of the suggested daily value?

Real-Life Math

ALGEBRA

SECOND EDITION

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Real-Life Math Set, TB23691 • enasco.com/math

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Ratios, Proportions, and Percents

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Systems of Equations II

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.

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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.

Introduction

Organization

The book is organized around four themes of interest to students: Sports, Money, Science/Technology, and Travel/Transportation. There are eight topics addressing key algebraic concepts: Literal Equations—Formulas; Ratios, Proportions, and Percents; Data and Graphs; Systems of Equations I and II; Quadratics; Nonlinear Functions; and Miscellaneous topics. There are four activities for each of the eight topics, making a total of 32 student activities.

NCTM Standards

The activities address many of the NCTM standards for grades 9 through 12: algebra, data analysis and probability, problem solving, communication, connections, and representation.

Order of Activities and Time Considerations

The activities are arranged to reflect the order in which algebraic concepts are presented in many textbooks. You can use this resource to enrich a concept presented in your textbook or use the activities as an introduction to a new concept. The activities can be done in any order; however, before students start the Systems of Equations activities, they should have some facility with the concepts presented in the first part of the book.

Because students' ability levels and schools' schedules vary greatly, time suggestions for the activities are not given. Prior to using an activity, review it and decide how much time would be appropriate for your students.

Level of Difficulty

Some activities use more difficult algebraic concepts than others. As a general rule, the activities in the second half of the book are more difficult than those in the first half. The lessons that are less difficult mathematically still involve higher-order thinking skills.

Graphing Calculators and Other Technology

Students should have access to graphing calculators. However, keep in mind that many students have difficulty choosing appropriate settings (e.g., intervals for the x and y axes) for their graphs. Review with them how to choose correct settings prior to using the activities. In addition, many of the lessons ask students to build tables, find lines and curves of best fit, and perform linear, quadratic, and exponential regressions. You may want to review these functions on your specific model of graphing calculator prior to using the activities with your students. It's always tricky to know whether to allow students to construct graphs by hand first and then use their graphing calculators, or to let them use the graphing calculator right from the start. Experiment, and decide which method works best. In some of the activities, students can use spreadsheet, word processing, graphing, and desktop publishing software.

Name ______________________________ Date ____________________

1. The Grass Is Greener

Imagine you are a baseball coach at a large high school. You are about to write a memo to the athletic director (AD) requesting funding to resod the baseball field. Because the Athletic Department's budget is always very tight, you know that the AD will ask you to carefully document the costs that you submit. Devise and carry out a plan to calculate how much sod you will need for the baseball field. Use the baseball field at your school as a model for making the plan.

Sod Information

- One roll of sod covers 40 square yards.
- The price per roll is $98.

Make a Plan

1. Consult with the other members of your group. Devise a strategy to determine the amount of sod you will need for the baseball field. The formulas below may prove useful (b = base; h = height; s = side; r = radius; N = a central angle measuring $N°$).

   area of a triangle: $\frac{1}{2}bh$ area of a trapezoid: $\frac{1}{2}h(b_1 + b_2)$

   area of a rectangle: bh area of a circle: π^2

   area of a square: s^2 area of a sector: $\frac{N}{360}\pi r^2$

2. On a separate sheet of paper, describe your plan for measuring the baseball field. Then have your teacher approve the plan.
3. Carry out your plan and measure the baseball field.
4. Review the plan you gave to the teacher. Describe any modifications you had to make to your original plan after you started measuring.
5. What are the dimensions of the baseball field?
6. How many square feet of sod will you need?
7. How many rolls of sod will you request?
8. What is the total cost of the sod?
9. On a separate sheet of paper, draft a memo to the athletic director stating your request. Include an enclosure showing how you arrived at your cost.

teacher's page

2. My First Car

Context

money

Topic

literal equations—formulas

Overview

In this activity, students calculate monthly payments for cars they would like to buy.

Objectives

Students will be able to:

- calculate monthly payments using a formula
- evaluate the impact on monthly payments as parameters change

Materials

- one copy of the Activity 2 handout for each student
- classified ads or publications selling cars
- computers with spreadsheet program (optional)

Teaching Notes

- Students can work individually, with a partner, or in small groups for this activity.
- Model using the formula for calculating monthly payments prior to having students use it. You may wish to suggest that students use a spreadsheet for the formula.
- Remind students to change annual percentage rates from percentages to decimals, and point out to them that n is the number of months—not years—of the loan.
- Students could also use online car ads if they have access to the Internet.

Answers

Answers will vary depending on cars selected.

Extension Activity

Students can investigate other loan types and calculate monthly loan payments.

Name ______________________________ Date ______________________

2. My First Car

Deciding what type of car to buy is a big decision. Unless you can pay cash for a car, the decision can be made for you by how much you can afford to pay each month. If you borrow money, the amount you pay each month depends on how much you borrow, for how long, and at what interest rate. Work through the questions below to find out how monthly payments change depending on the amount of the loan, the interest rate, and the length of the loan.

The formula for calculating the monthly payment of a loan is given below.

$$m = \frac{A(\frac{r}{12})(1+\frac{r}{12})^n}{(1+\frac{r}{12})^n - 1}$$

In the formula, m = the monthly payment, A = the amount of the loan, r = the annual interest rate (expressed as a decimal), and n = the number of months of the loan.

1. Look through the classified ads section of the newspaper or other publication and choose three different cars to buy. List the three cars and their prices below.

Cars and Prices

Car name			
Price			

2. Use the formula listed above to calculate the monthly payment of the cars you have selected. In this case, let n = 48 months (4 years) and r = 8.25%. List the monthly payments in the table.

Monthly Payments on a 4-Year Loan

Car name			
Monthly payment			

(continued)

13. Only a Matter of Time

Context

sports

Topic

systems of equations

Overview

In this activity, students assume the role of a sportswriter who has been assigned to write an article comparing the performance of men and women in sporting events.

Objectives

Students will be able to:

- analyze and interpret data
- derive linear equations from data
- graph and interpret linear equations
- use data and graphs to draw conclusions

Materials

- one copy of the Activity 13 handout for each student
- graph paper
- graphing calculators
- reference material that contains historical sports information, such as almanacs and sports encyclopedias

Teaching Notes

- Students can work individually or in pairs on this activity.
- Introduce the activity by asking a question such as "Do you suppose there are any athletic events in which men's and women's winning times are the same?" You may want to follow up with a question such as "Is it possible that in the future, women will surpass men in certain athletic events?"
- It's difficult to compare men's and women's sporting events because often all factors are not equal. It is best to consider timed sporting events in which the format and conditions of the event are identical.
- Some students are unsure of how to begin constructing a graph. Make sure those students are clear on how to select axes and appropriate intervals.
- Likewise, when they are using graphing calculators, many students have difficulty choosing appropriate settings for their graphs. Review this procedure prior to using the activity.
- Students should have some familiarity working with lines of best fit and doing linear regressions.

(continued)

Name ______________________________ Date ________________

13. Only a Matter of Time

Imagine you have been hired as a sportswriter for a new sports magazine. Your new boss, the magazine's editor, has just reviewed the latest demographic report of its readership and is concerned about the magazine's shortage of female readers. This is a new magazine, and the editor wants to increase readership. He can't afford to let half the market slip away. So the editor assigns you the job of writing an article that highlights female athletes. After doing some initial research, you notice a trend in sporting events in which men and women compete against the clock. You have done your research and have collected a lot of data, and you are now ready to analyze the data to support your article.

The winning times and years for the men's and women's Olympic 100-meter freestyle are listed in the tables below. Use the information to answer the questions that follow.

Men's 100-Meter Freestyle

Year	Time (seconds)
1920	61.4
1924	59.0
1928	58.6
1932	58.2
1936	57.6
1948	57.3
1952	57.4
1956	55.4
1960	55.2
1964	53.4
1968	52.2
1972	51.2
1976	50.0
1980	50.4
1984	49.8
1988	48.6
1992	49.0
1994	48.7
1996	48.7
2000	48.3
2004	48.17

Women's 100-Meter Freestyle

Year	Time (seconds)
1920	73.6
1924	72.4
1928	71.0
1932	66.8
1936	65.9
1948	66.3
1952	66.8
1956	62.0
1960	61.2
1964	59.5
1968	60.0
1972	58.6
1976	55.7
1980	54.8
1984	55.9
1988	54.9
1992	54.6
1994	54.5
1996	54.5
2000	53.83
2004	53.84

Source: www.databaseolympics.com

(continued)

Real-Life Math

DECIMALS AND PERCENTS

SECOND EDITION

WALCH PUBLISHING

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Percent of Increase/Decrease

Problem Solving with Decimals and Percents

More Problem Solving with Decimals and Percents

How to Use This Series

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Introduction

Organization

The book is organized around four themes or contexts that are of high interest to students: Sports, Money, Entertainment, and Travel/Transportation. Within each context, there are eight different concepts or topics addressing decimals and percents. The concepts are Reading and Writing Decimals and Percents; Decimals and Percent Equivalents; Comparing Decimal Numbers; Basic Operations with Decimals; Percent of a Number; Percent of Increase/Decrease; Problem Solving with Decimals and Percents; and More Problem Solving with Decimals and Percents. The activities are grouped by concept, with four different contexts for teaching each concept. Choose the context—or contexts—that you find most appropriate for your students.

Order of Activities

The activities in the book are arranged to reflect the order in which decimal and percent concepts are presented in many textbooks. As such, you can supplement or enrich a concept presented in the textbook with this resource, or use the activities as an introduction to a new concept. The activities can also be done in any order; however, before students do the problem-solving and percent activities, they should have some facility with the concepts presented in the first part of the book.

Level of Difficulty

Some activities use more difficult mathematical concepts than others. As a general rule, the activities in the second half of the book are more difficult than those in the first half. It should be noted that the lessons that are less difficult mathematically still involve using higher-order thinking skills.

Time Considerations

Since student ability levels and school schedules vary greatly, time suggestions for the activities are not given. Before using an activity, review it and decide how much time would be appropriate for your students.

Calculators and Other Technology

A practical way of using calculators with the activities is to allow them if the situation described in the activity would warrant the use of a calculator in real life. In some of the activities, students can use spreadsheets, word processing, and desktop publishing software.

(continued)

Introduction

Organizing the Classroom

The Teacher Guide pages list suggestions on how to arrange students for the activities. Some of the lessons work best for individual student work, other lessons are more appropriate for students working in pairs, and some lessons work best for groups of students. The final decision on how to organize your students is left up to you.

Evaluation and Assessment

In cases where appropriate, selected answers are given. However, since the lessons model real-life situations, exact answers cannot always be provided.

Name ______________________________ Date ______________________

1. The Track Banquet

A track coach has to do more than just prepare the team for track meets. Another responsibility may be to speak at a banquet at the end of the season. Imagine you are a track coach preparing a speech for the upcoming banquet. In the speech, you want to mention all the school records set this year. This means you'll have to read decimal numbers out loud. Follow the directions below to make sure you are prepared for your speech.

For each school track record listed below, use words to write it out in two different ways.

Example: In the 100-meter race, Sam Speedy set a new record of 10.24 seconds.

- "ten and twenty-four hundredths of a second"
- "ten point two four seconds"

1. In the 100-meter race, Hideo Ikeda set a new record of 10.91 seconds, and Nicole Devers set a new record of 12.01 seconds.

2. In the 400-meter race, Shawnel Johnson set a new record of 44.312 seconds, and Gwen Dawson set a new record of 51.83 seconds.

3. In the 110-meter hurdles, Alex Santiago set a new record of 14.05 seconds.

4. The girls set a new school record in the 400-meter relay of 46.955 seconds.

5. Michael O'Brien set a new school record in the 400-meter hurdles of 52.001 seconds.

Name ______________________ Date ______________________

6. Doing Your Part

1. The table below lists the 2005 individual income tax rate percentages and taxable income level for people who are single. In the last column, write the decimal equivalent for each tax rate percentage.

2005 Individual Income Tax Rate for Singles

Taxable income level	Tax rate (percent)	Tax rate (decimal)
$0–$7300	10%	
$7301–$29,700	15%	
$29,701–$71,950	25%	
$71,951–$150,150	28%	
$150,151–$326,450	33%	
$326,451 and up	35%	

Source: http://www.irs.gov/

2. The table below lists the voter turnout in presidential elections from 1944 to 2004. For each election year, voter participation is listed as a decimal amount of the voting-age population. Change the voter participation decimal amounts to equivalent percentages and write them in the table.

Voter Turnout in Presidential Elections, 1944–2004

Year	Voter participation (decimal amount of voting-age population)	Voter participation (% amount of voting-age population)	Year	Voter participation (decimal amount of voting-age population)	Voter participation (% amount of voting-age population)
1944	.56		1976	.535	
1948	.511		1980	.54	
1952	.616		1984	.531	
1956	.593		1988	.502	
1960	.628		1992	.559	
1964	.619		1996	.49	
1968	.609		2000	.513	
1972	.5521		2004	.553	

Source: http://www.infoplease.com/

Name ____ Date ____________________________

17. TV Time

Circle graphs help you visualize the amount or share of related items to the whole in terms of percent. A whole circle represents 100%, and each individual category listed in the graph represents that particular category's percent out of the total 100%.

When you watch television, what percent of the time do you think you spend actually watching the program? Let's find out. As you watch television tonight, make a chart to keep track of commercials, station breaks and previews, and the program itself. Do this by noting the time when each program, commercial, or preview starts and stops. Do this for one hour. When you are finished watching, calculate what percent of time each category represents. Construct a circle graph showing the results. Then answer the questions that follow.

Steps for constructing a circle graph:

1. Change the percent amount to a decimal.

   Example: 24.8% × 0.248

2. Multiply the decimal amount by 360 to find the number of degrees.

   Example: 0.248 × 360 = 89.28°

3. Round the number of degrees to a whole number.

   Example: 89.28° × 89°

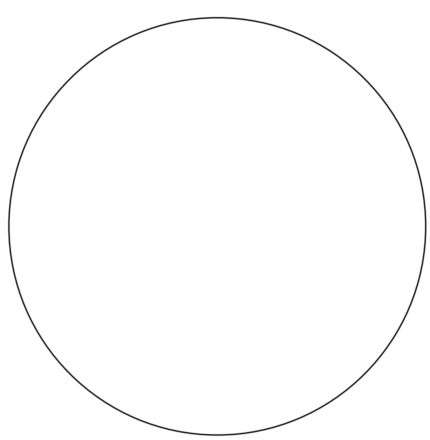
4. Use your protractor to draw a sector equal to the number of degrees on your graph.

Television Time in Percents

program: ______________ preview: ______________

commercial: ______________ other: ______________

station break: ______________



(continued)

Name ______________________________ Date ____________________

24. CDs

The company you work for manufactures three different types of recordable CDs. As a production supervisor, you have to forecast production levels for next year. To do that, you will examine the manufacturing trends over the previous years. The table below lists the production levels in millions for each of the three types of CD your company manufactured, and the amounts that were produced. Use that information to answer the questions that follow.

Units Manufactured, 2002–2006

CD	2002	2003	% change 2002–2003	2004	% change 2003–2004	2005	% change 2004–2005	200	% change 2005–2006
Type 1	407.5	495.4		662.1		722.9		778.9	
Type 2	366.4	339.5		345.4		272.6		225.3	
Type 3	2.3	1.2		1.9		2.2		2.9	

1. Fill in the table above with the percent changes from year to year.
2. How many units of each type of CD will you recommend be manufactured next year?

   type 1: ______________

   type 2: ______________

   type 3: ______________

3. In the space below or on a separate sheet of paper, draft a memo to the production division manager that details your recommended production levels for the next year.

Real-Life Math

GEOMETRY

SECOND EDITION

WALCH PUBLISHING

Table of Contents

(continued)

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.

Introduction

Organization

This book is organized around six different contexts addressing geometry: Geometry Around Us; Construction and Landscaping; Design and Marketing; Art; Sports and Recreation; and Miscellaneous. For organizational purposes, the topics covered in each activity are listed on the teacher guide page for that activity.

Order of Activities

You'll find that the activities in this book parallel most topics taught in a typical geometry course. You can supplement or enrich a concept presented in your textbook with this resource or use the activities as an introduction to a new concept.

Level of Difficulty

Some activities use more difficult mathematical concepts than others. It should be noted that the less difficult lessons, mathematically speaking, still require higher-order thinking skills.

Time Considerations

Because students' ability levels and schools' schedules vary, time suggestions for the activities are not given. Before using an activity, review it and decide how much time would be appropriate for your students.

Calculators and Other Technology

A practical way of using calculators with the activities is to consider whether or not the situation described in the activity would warrant the use of a calculator in real life. If the situation does, then allow students to use calculators; if it doesn't, then don't allow them to use calculators. In some of the activities, students can use spreadsheet, word-processing, and desktop-publishing software.

Organizing the Classroom

The Teaching Notes sections include suggestions on how to arrange students for the activities. Some of the activities work best for individual student work, others are more appropriate for students working in pairs, and some work best for groups of students.

Evaluation and Assessment

Where appropriate, selected answers are given. However, because the lessons model real-life situations, exact answers cannot always be provided.

teacher's page

1. Talking Geometry

Context

geometry around us

Topic

geometric terms

Overview

In this activity, students build confidence about their prior knowledge of geometry by brainstorming about the geometric terms they already know. Then they use those words to create sentences showing how those geometric terms are used in everyday speech.

Objectives

Students will be able to:

- list common geometric terms used in everyday speech
- build confidence in their prior knowledge of geometry
- create sentences using common geometric terms

Materials

- one copy of the Activity 1 handout for each student
- dictionary (optional)

Teaching Notes

- Students should work in small groups for this activity.
- This activity is intended as an introductory activity to the class and works best at the beginning of the term. However, it can still be used after the course has started.
- After all the groups have generated lists of geometric terms, have them give you their lists so you can keep a master list with a frequency tally of terms on the board or overhead.
- Let students know that they don't have to be able to define each term; they'll do that in Activity 2.
- Once all the geometric terms have been posted, have students analyze the list and determine which terms appear most often. There might also be some debate about whether or not a term is actually related to geometry.
- If students are struggling with creating their sentences, share some sentences that other groups of students have written as they are working.
- Students do not have to use the classes' most common words when creating their sentences.
- When students are finished writing their sentences, post the most creative sentences around the room.

(continued)

Name ______________________________ Date ______________________

8. Hanging Drywall

Most interior walls in homes and offices are made of drywall. Drywall is made of gypsum and is less than half an inch thick. It is sold in sheets that measure 4 feet by 8 feet. A drywall hanger will put up entire sheets of drywall where possible, but then will have to fill in around it with smaller pieces cut from the larger sheets.

Once the sheets are hung, a paper "tape" and plaster "mud" are used to fill in the gaps between the sheets and between the sheets and the ceiling (but not the gaps between the sheets and the floor, which are covered by a baseboard). Filling the gaps makes the wall look continuous and smooth. The fewer taped and mudded joints, the less work the drywall hanger has.

Before a drywall hanger starts the job, he or she must decide how many 4-by-8-foot sheets are needed to complete the job. If a wall is 16 feet long and the ceiling is 8 feet high, four sheets of drywall can just be hung next to each other. Unfortunately, few walls or rooms are designed to make the drywall hanger's job that easy.

Read the problems below. In each case, find a way to complete the job using the fewest partial pieces of drywall and the least number of joints.

1. You need to hang drywall on a wall that is 20 feet long and 10 feet high. How should you position the 4-by-8-foot sheets to limit the number of joints and the number of sheets used? Describe your plan below. Be sure to list the number of sheets of drywall used and the total length of joints filled.

2. You need to hang drywall on a wall that is 13 feet long and 11 feet high. How should you position the sheets to limit the number of joints and the number of sheets used? Describe your plan. List the number of sheets of drywall used and the total length of joints filled. Then draw a scale model of your plan.

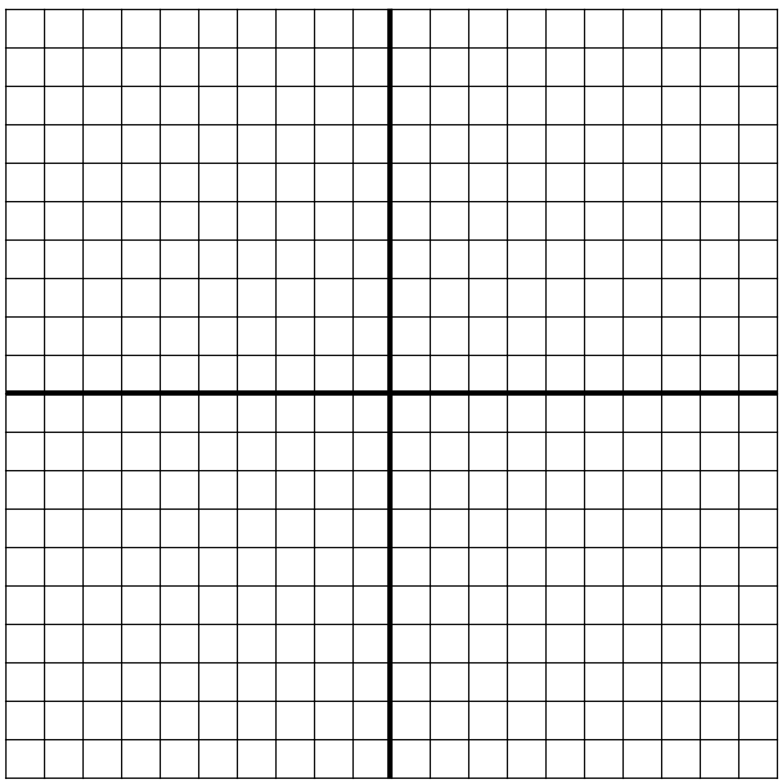
Name ______________________________ Date ____________________

12. Quilts

Quilts are a traditional American form of art that have been around for centuries. Quilts are typically constructed by designing a block pattern or template on a grid. Each individual block is then joined with other blocks to form the overall pattern. Follow the steps below to create your own quilt design.

Use the books your teacher provides or search the Internet for a web site that shows quilt designs. While you are looking over the designs, consider how the patterns work. Pay particular attention to the symmetry, rotation, reflection, or translations that might be present in the design. Choose one quilt pattern to study in greater detail.

Using the quilt pattern you chose, describe its pattern in terms of symmetry, rotation, reflection, or translations. Then draw the basic design in the grid that follows.



(continued)

Name ______________________ Date ______________

12. Quilts

Grid Design

Now it is your turn to come up with a design of your own.

Step 1: On a sheet of grid paper, outline a square. The square will form the foundation of your quilt design.

Step 2: Make a pattern inside the square. For now, keep the design simple. For example, you may want to create a design using symmetrical triangles.

Step 3: Draw the reflection of your design.

Step 4: Make six to eight copies of the design and its reflection.

Step 5: Using the squares you made, create different designs using rotations, reflections, and translations. When you are satisfied with a pattern, tape or glue it onto a piece of poster board.

Write a brief description of how your design works.

Problem Solving with Your Design

1. Suppose you wanted to make your quilt fit on a queen-size bed. How much material of each color would you need? A standard-sized queen mattress measures 80×60 inches.

2. Suppose you wanted to make your quilt fit on a king-size bed. How much material of each color would you need? A standard-size king mattress measures 84×72 inches.

Name ______________________ Date ______________________

16. Air Supply I

Divers have to plan for many different things before they actually get in the water. One of the most important things they have to plan for is how much air they will need for a scuba dive. As such, dive supervisors learn how such things as changes in pressure, temperature, and breathing rates affect the available volume of air.

Imagine you are a dive supervisor planning a scuba dive. First, you will explore the relationship between volume and pressure, as described by Boyle's law. Second, you will apply what you have learned to determine the duration of the air supply for a scuba dive.

Boyle's Law

One of the first gas laws that divers learn about is Boyle's law. Boyle's law explains the relationship between pressure and volume: At constant temperature, the absolute pressure and the volume of a given mass of gas are inversely proportional. As you go deeper in the water, the pressure increases, and the volume of gas decreases; or you could say the opposite—as the pressure decreases, the volume increases. Understanding this relationship is important because as a diver goes deeper, less air is available. For example, suppose you had a 1-gallon milk container at the surface of the water. This milk container is under 1 atmosphere (atm) of pressure. 1 atm is equal to 14.7 pounds per square inch, or psi. If you inverted the milk container and took it to a depth of 33 feet, it would be under 2 atm of pressure (29.4 psi). Every 33 feet of water is equal to 1 atm of pressure. Because there is now twice the absolute pressure on the container, the volume is decreased to one-half gallon. If you took the container to a depth of 66 feet, then the pressure would be equal to 3 atm and would compress the volume to one-third gallon.

Boyle's law can be expressed as:

Boyle's law

$$P_1V_1 = P_2V_2$$

where

P_1 = initial pressure

V_1 = initial volume

P_2 = final pressure

V_2 = final volume

(continued)