Exploring Probability with Dice and Test Scores

By Andrew Dixon & Amy Forgey

Activity Overview

1. In this activity students will investigate probabilities of independent events and interpret the probabilities they calculate.
2. At the 8th grade level, this activity can be used to solve simple problems involving probability and compare probabilities of events.

Concepts

TN Grade 8 Standards

Grade Level Expectations:

GLE 0806.1.5	Use mathematical ideas and processes in different settings to formulate patterns, analyze graphs, set up and solve problems and interpret solutions.
GLE 0806.5.1	Explore probabilities for compound, independent and/or dependent events.
GLE 0806.5.2	Select, create, and use appropriate graphical representations of data (including scatterplots with lines of best fit) to make and test conjectures.

Checks for Understanding:

0806.5.1	Solve simple problems involving probability and relative frequency.
0806.5.2	Compare probabilities of two or more events and recognize when certain events are equally likely.

State Performance Indicators

N/A

Teacher Preparation

Before the activity, the teacher should pre-load the activity file ExploringProbability.tns on to the student handheld devices. This can be done via Connect-to-Class software, TI-Nspire computer link software, or by using link cables with the handhelds.

Classroom Management Tips

1. This activity can be done by the students using the pre-made document file or by them creating various parts of the file as chosen by the teacher.
2. This activity is intended to be student-centered with the students working in small cooperative groups.

TI-Nspire™ Applications

- ✓ Notes
- ✓ Lists & Spreadsheets
- ✓ Data & Statistics
- ✓ Calculator

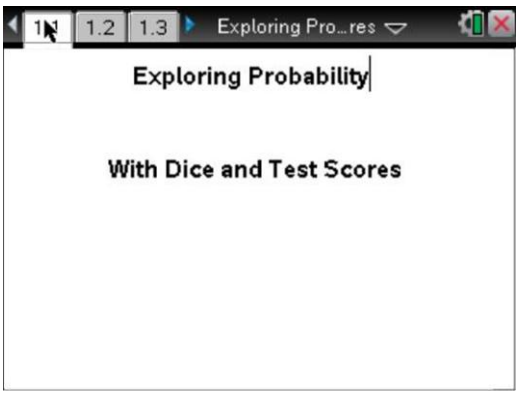
Step-by-Step Directions

Steps:

1. From the Home Screen:
   - Choose **2 My Documents**.
   - Navigate to the appropriate folder containing the .tns file ExploringProbability.tns.
   - Highlight the file and press [ ] or [enter].
   - Choose whether or not to save changes to any previously opened document.

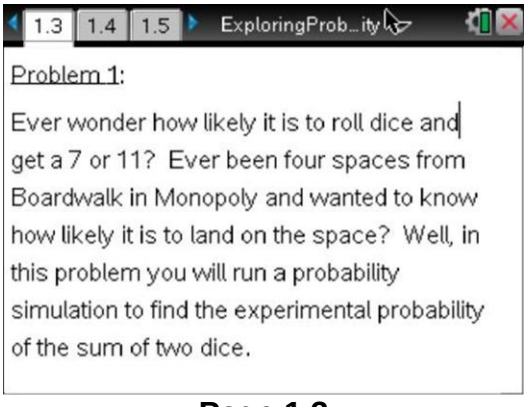
Home Screen

2. Page 1.1 is the title page for the activity. Press [ctrl] and the left or right arrows of the NavPad to navigate through the document. Pressing [ctrl] and the up arrow will give you a thumbnail view of all pages in the document. Page 1.2 lists standards addressed in this activity.



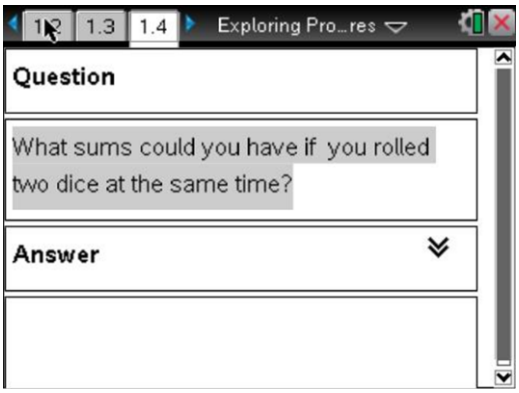
Title Page

3. Page 1.3 begins the dice problem of the lesson.



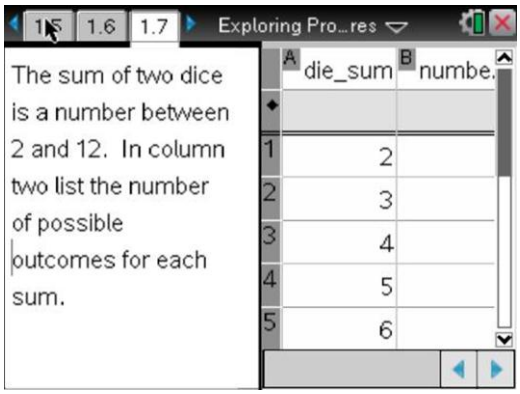
Page 1.3

4. Pages 1.4 through 1.6 are question and answer pages. The students should answer questions before moving to the first spreadsheet.



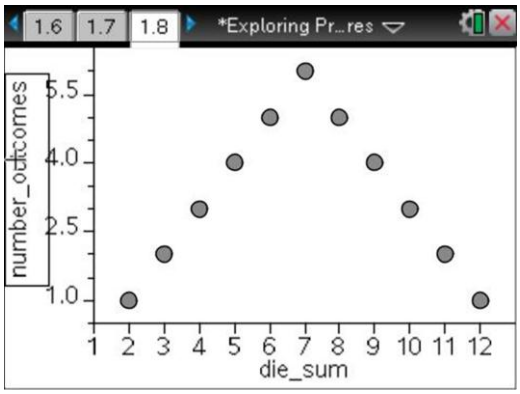
Page 1.4

5. Page 1.7 is a List and Spreadsheet page for the students to enter the number of possible outcomes for each sum.



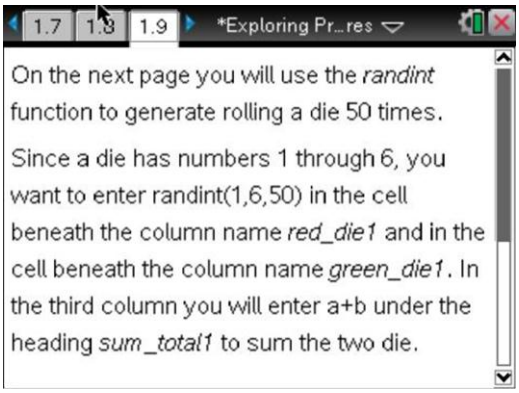
Page 1.7

6. Page 1.8 is the graph of the spreadsheet for the previous page. Students may need to go to the menu screen, 5: Window/Zoom, 2: Zoom data.



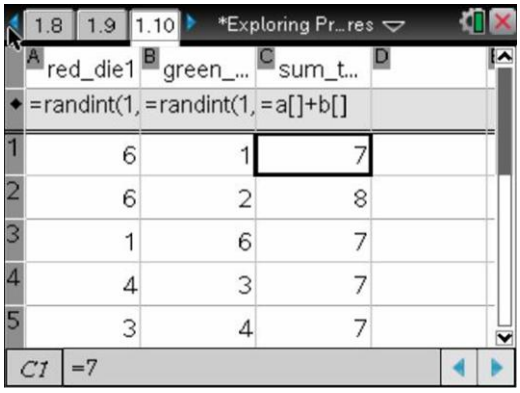
Page 1.8

7. Page 1.9 gives instructions on how to run the dice simulation.



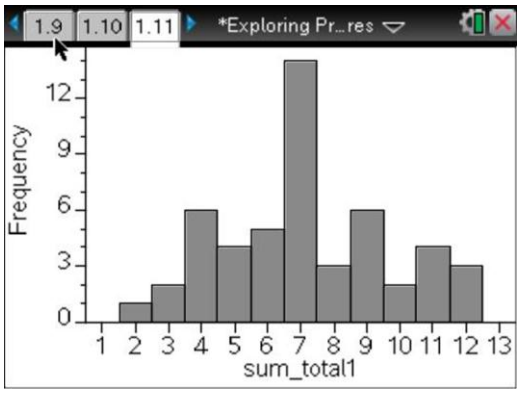
Page 1.9

8. Page 1.10 is a spreadsheet containing three columns. The first two columns are for simulating rolling two dice. In the cell beneath the columns' headers students should enter *randint*(1,6,50) The third column is the sum of the two dice. The cell underneath *sum_total1* should contain *a+b*.



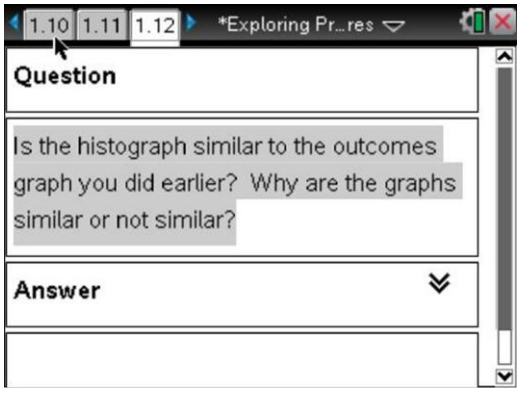
Page 1.10

9. Page 1.11 is the graph of the spreadsheet from page 1.10. Students will need to go to the menu screen, 5: Window/Zoom, 2: Zoom data.



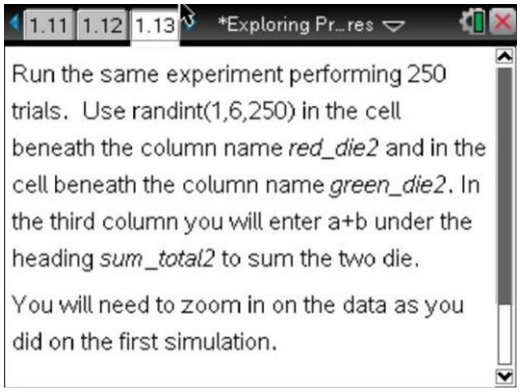
Page 1.11

10. Page 1.12 asks the students a question about the histogram from 1.11 and the graph from 1.8. Students should compare and contrast the two graphs.



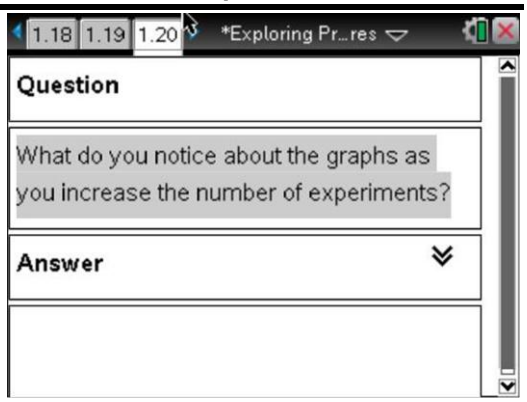
Page 1.12

11. Pages 1.13 through 1.19 instruct students to run the simulation two more times with more dice rolls. Page 1.16 asks the same question as page 1.12.



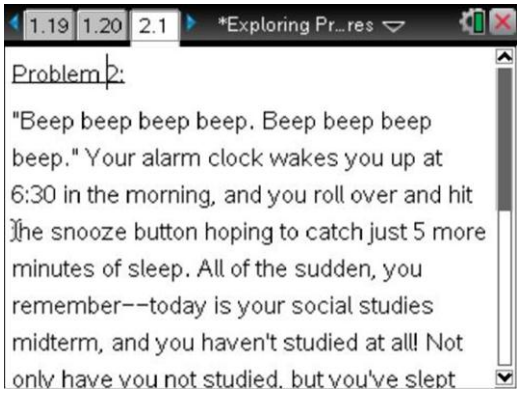
Page 1.13

12. Page 1.20 asks the students to draw conclusions on what happened when they increased the number of trials.



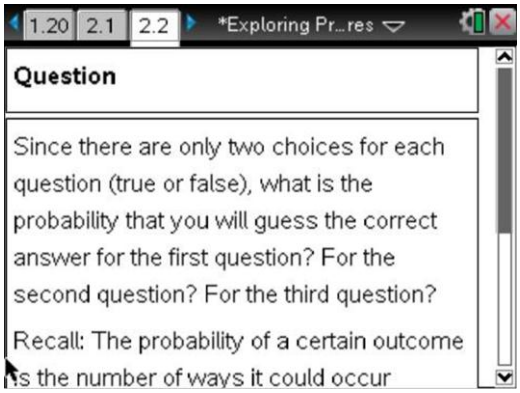
Page 1.20

13. Page 2.1 introduces the first Test Score problem in this activity.



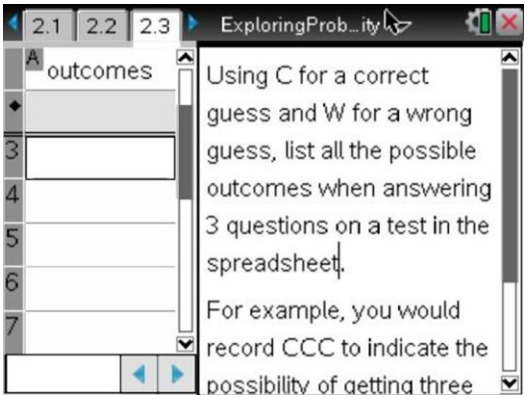
Page 2.1

14. Page 2.2 is a Q&A page. The student should read the question and arrow down to get to the answer section of the page. Answers to all questions are included in the Assessment and Evaluation section at the end of this handout.



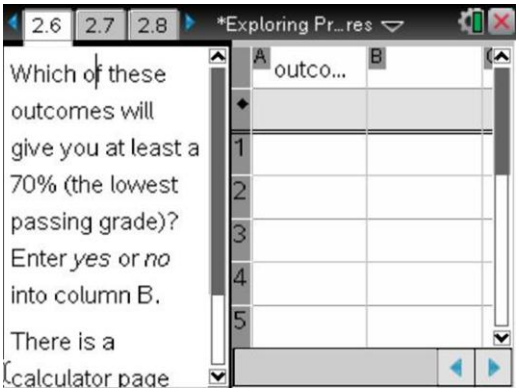
Page 2.2

15. Page 2.3 contains a Notes page as well as a Lists & Spreadsheets page. The student should fill in the outcomes (When the error box appears, the student should press enter until it goes away). These outcomes will be filled in on every spreadsheet that has the column heading *outcomes* throughout the entire document.



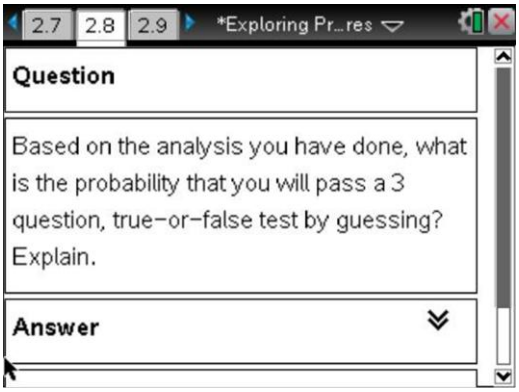
Page 2.3

16. To complete page 2.6, the student can either use the Calculator on the following page or press the Scratchpad button to bring of the Scratchpad Calculator.



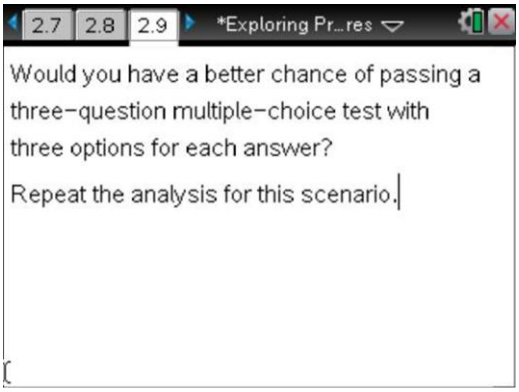
Page 2.6

17. Students must answer a question about the probability of passing the test on page 2.8. They should say that the probability of passing the test is $\frac{1}{8}$ and give a brief explanation of how they reached that answer.



Page 2.8

18. Page 2.9 introduces the second Test Score problem. Students should complete this problem using similar strategies from the previous problems.



Page 2.9

Assessment & Evaluation

- ✓ The teacher can collect student files using Connect-to-Class software or TI-Nspire™ Computer Link software.
- ✓ Sample answers to questions in .tns file:

1.4 Q: What sums could you have if you rolled two dice at the same time?

A: We would have 2 through 12

1.5 Q: Are the sums equally likely?

A: No. For instance, the sum 2 can only be accomplished one way while 3 can come from 1 and 2 or 2 and 1.

1.6 Q: Which sum is most likely? Which sum is least likely? Explain your answers

A: Seven is the most likely. It can happen when rolling 1 then 6, 2 then 5, 3 then 4, 4 then 3, 5 then 2, and 6 then 1. Two and twelve are the least likely. Two only happens when rolling 1 then 1. Twelve only happens when rolling 6 then 6.

1.12 Q: Is the histograph similar to the outcomes graph you did earlier? Why are the graphs similar or not similar?

A: The histographs should look like the graph they generated from the number of possible outcomes. The graph will follow the probability distribution curve.

1.20 Q: What do you notice about the graphs as you increase the number of experiments?
A: As the number of dice rolls goes up the histographs will fit the probability distribution curve better than with fewer trials.

2.2 Q: Since there are only two choices for each question (true or false), what is the probability that you will guess the correct answer for the first question? For the second question? For the third question?

A: The probability of guessing the correct answer for each question is $\frac{1}{2}$ or 0.5.

2.3 Q: Using C for a correct guess and W for a wrong guess, list all the possible outcomes when answering 3 questions on a test on the spreadsheet above.
A: CCC, CCW, CWC, WCC, CWW, WWC, WCW, WWW

2.4 Q: If you are truly guessing, what is the probability associated with each of the eight outcomes?

A: $\frac{1}{8}$

2.5 Q: Describe how you found the probabilities on the previous page.

A: By dividing the number of ways to achieve the outcome by the number of possible outcomes.

2.6 Q: Which of these outcomes will give you at least a 70% (the lowest passing grade)?

A: CCC

2.8 Q: Based on the analysis you have done, what is the probability that you will pass a 3 question true-or-false test by guessing? Explain.

A: $\frac{1}{8}$ because only one of the eight possible outcomes will give a score of 70% or higher.

2.10 Q: Since there are three choices for each question, what is the probability that you will guess the correct answer on a question? What is the probability that you will guess the wrong answer on a question?

A: The probability that I will guess the correct answer is $\frac{1}{3}$ and the probability that I will guess the wrong answer is $\frac{2}{3}$.

2.11 Q: If we use C for a correct guess and W for a wrong guess, as we did in the first part of this problem, what are the possible outcomes when answering 3 questions on a test? Should they be the same as on a three-question true-or-false test?

If you think they are the same, enter "outcomes" beneath A to automatically fill the column. Otherwise, call it "outcomes2."

A: The outcomes will be the same as on a three-question true-or-false test, so the student should enter “outcomes” beneath the heading of column A.

2.12 Q: What is the probability associated with each of the eight outcomes? Enter your answers in the following spreadsheet.

A:

outcomes	***probabilities***
CCC	$\frac{1}{3}\times\frac{1}{3}\times\frac{1}{3}=\frac{1}{27}$
CCW	$\frac{1}{3}\times\frac{1}{3}\times\frac{2}{3}=\frac{2}{27}$
CWC	$\frac{1}{3}\times\frac{2}{3}\times\frac{1}{3}=\frac{2}{27}$
WCC	$\frac{2}{3}\times\frac{1}{3}\times\frac{1}{3}=\frac{2}{27}$
WWC	$\frac{2}{3}\times\frac{2}{3}\times\frac{1}{3}=\frac{4}{27}$

WCW	$\frac{2}{3}\times\frac{1}{3}\times\frac{2}{3}=\frac{4}{27}$
CWW	$\frac{1}{3}\times\frac{2}{3}\times\frac{2}{3}=\frac{4}{27}$
WWW	$\frac{2}{3}\times\frac{2}{3}\times\frac{2}{3}=\frac{8}{27}$

2.13 Q: How did you find the probabilities on the previous page?

A: By multiplying the probability of a wrong answer ($\frac{2}{3}$) by the probability of a correct answer ($\frac{1}{3}$) according to the number of times it appears. For example, for the outcome CCW, the probability would be $\frac{1}{3}\times\frac{1}{3}\times\frac{2}{3}=\frac{2}{27}$.

2.14 Q: Which of these outcomes will give you at least a 70% (the lowest passing grade)?

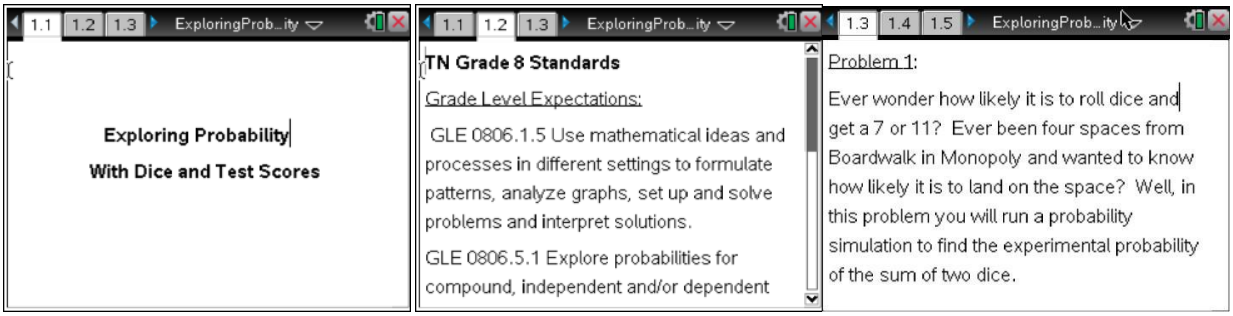
A: CCC

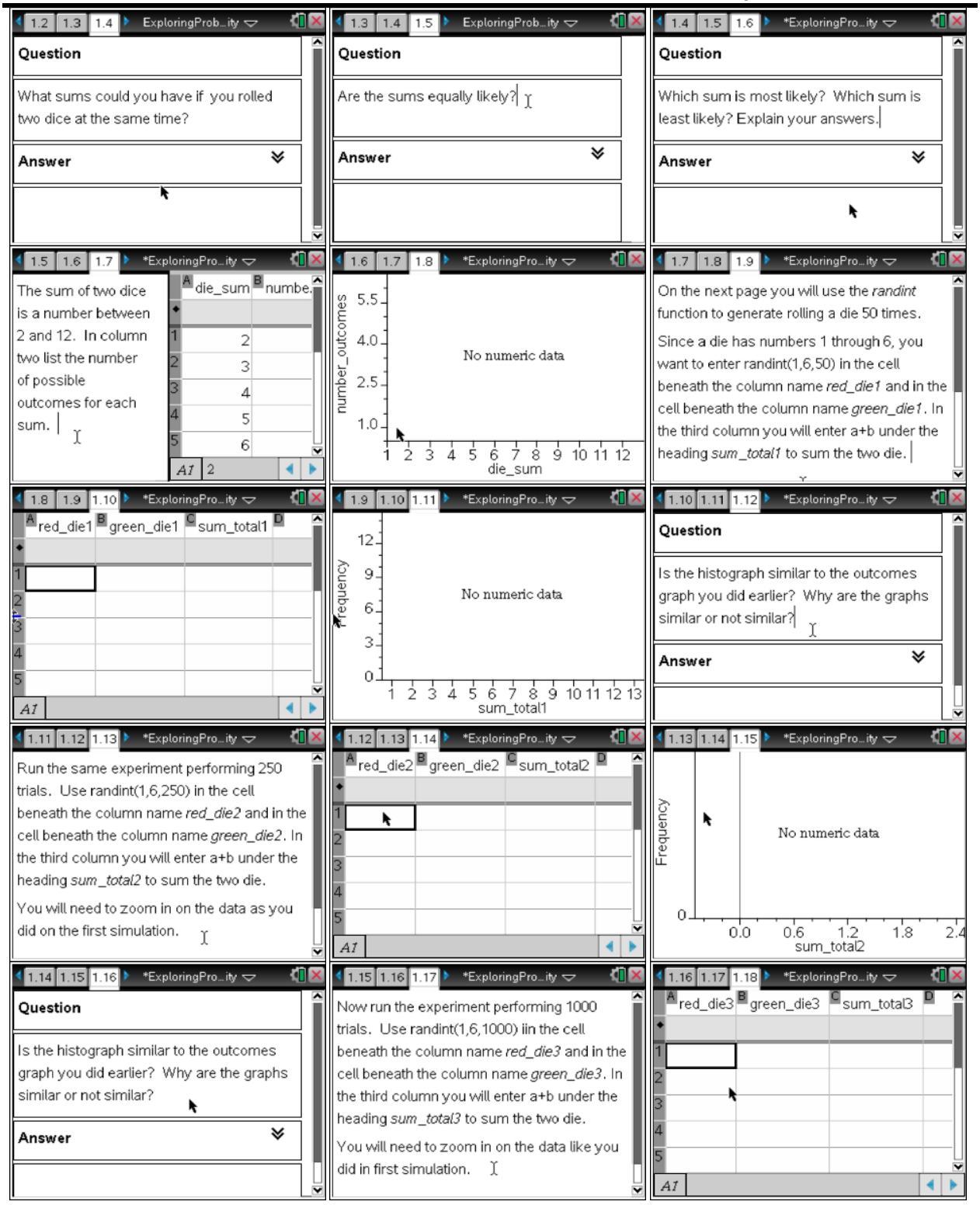
2.16 Q: Based on the analysis you have done, what is the probability that you will pass a 3 question multiple-choice test with three choices for each question by guessing? Explain.

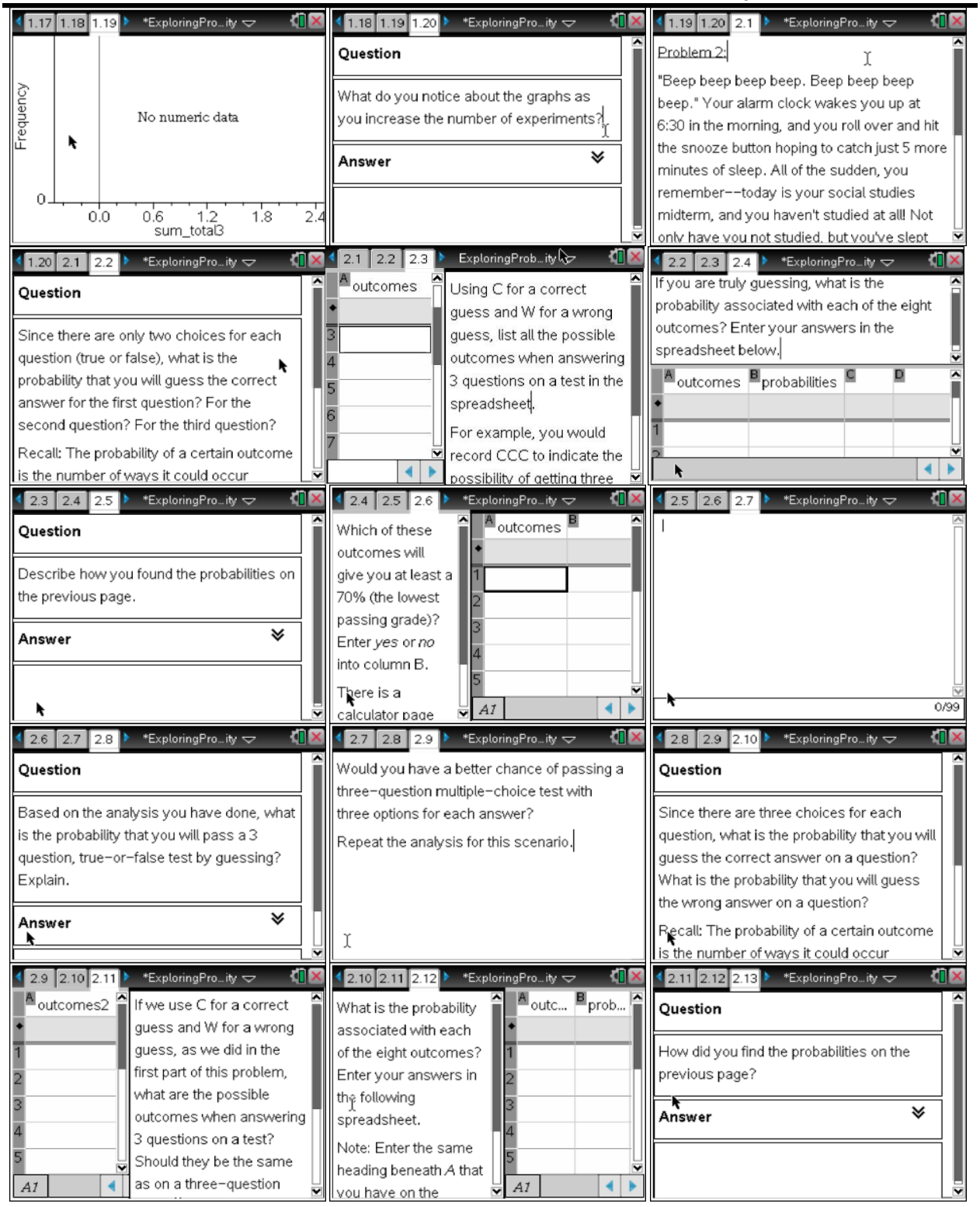
A: $\frac{1}{27}$ because only the outcome CCC gives a score of 70% or higher on the test, and the probability of getting all three answers correct is $\frac{1}{27}$.

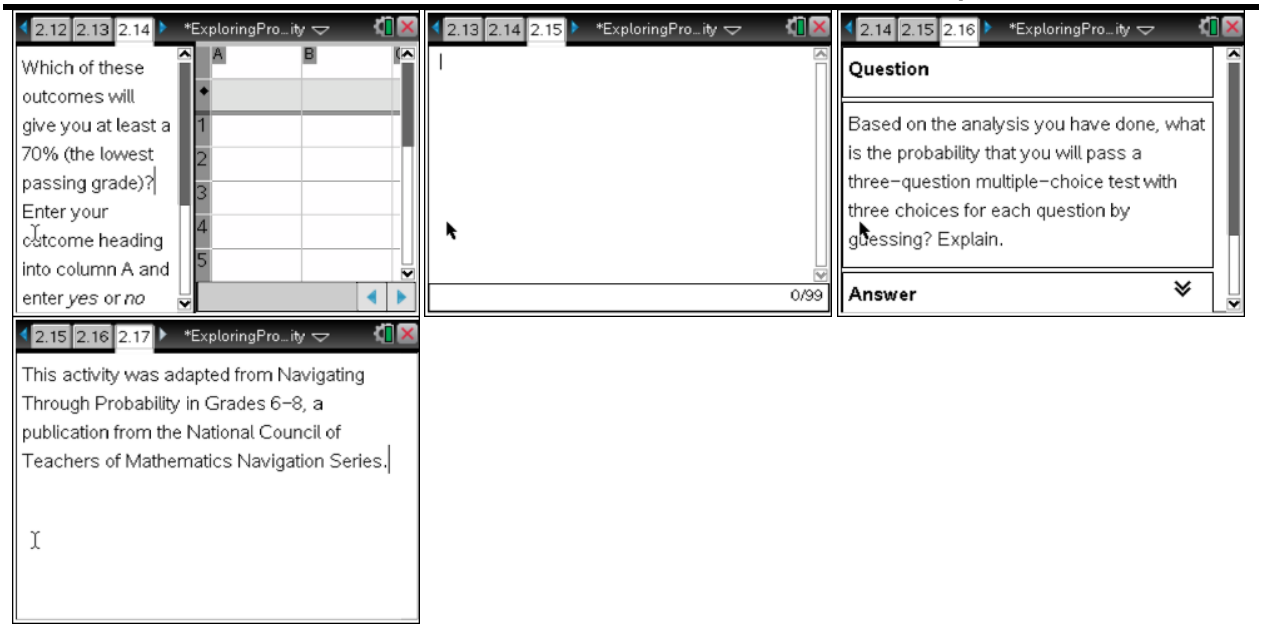
Student TI-Nspire™ Document

ExploringProbability.tns




Question
What sums could you have if you rolled two dice at the same time?
Answer
Question
Are the sums equally likely?
Answer
Question
Which sum is most likely? Which sum is least likely? Explain your answers.
Answer
The sum of two dice is a number between 2 and 12. In column two list the number of possible outcomes for each sum.
die_sum
numbe.
number_outcomes
No numeric data
die_sum
On the next page you will use the randint function to generate rolling a die 50 times.
Since a die has numbers 1 through 6, you want to enter randint(1,6,50) in the cell beneath the column name red_die1 and in the cell beneath the column name green_die1. In the third column you will enter a+b under the heading sum_total1 to sum the two die.
red_die1
green_die1
sum_total1
Frequency
No numeric data
sum_total1
Question
Is the histograph similar to the outcomes graph you did earlier? Why are the graphs similar or not similar?
Answer
Run the same experiment performing 250 trials. Use randint(1,6,250) in the cell beneath the column name red_die2 and in the cell beneath the column name green_die2. In the third column you will enter a+b under the heading sum_total2 to sum the two die.
You will need to zoom in on the data as you did on the first simulation.
red_die2
green_die2
sum_total2
Frequency
No numeric data
sum_total2
Question
Is the histograph similar to the outcomes graph you did earlier? Why are the graphs similar or not similar?
Answer
Now run the experiment performing 1000 trials. Use randint(1,6,1000) iin the cell beneath the column name red_die3 and in the cell beneath the column name green_die3. In the third column you will enter a+b under the heading sum_total3 to sum the two die.
You will need to zoom in on the data like you did in first simulation.
red_die3
green_die3
sum_total3


1.17 1.18 1.19 *ExploringPro...ity
Frequency
No numeric data
0
0.0 0.6 1.2 1.8 2.4
sum_total3
1.18 1.19 1.20 *ExploringPro...ity
Question
What do you notice about the graphs as you increase the number of experiments?
Answer
1.19 1.20 2.1 *ExploringPro...ity
Problem 2:
"Beep beep beep beep. Beep beep beep beep." Your alarm clock wakes you up at 6:30 in the morning, and you roll over and hit the snooze button hoping to catch just 5 more minutes of sleep. All of the sudden, you remember--today is your social studies midterm, and you haven't studied at all! Not only have you not studied, but you've slept
1.20 2.1 2.2 *ExploringPro...ity
Question
Since there are only two choices for each question (true or false), what is the probability that you will guess the correct answer for the first question? For the second question? For the third question?
Recall: The probability of a certain outcome is the number of ways it could occur
2.1 2.2 2.3 ExploringProb...ity
outcomes
Using C for a correct guess and W for a wrong guess, list all the possible outcomes when answering 3 questions on a test in the spreadsheet.
For example, you would record CCC to indicate the possibility of getting three
2.2 2.3 2.4 *ExploringPro...ity
If you are truly guessing, what is the probability associated with each of the eight outcomes? Enter your answers in the spreadsheet below.
outcomes
probabilities
2.3 2.4 2.5 *ExploringPro...ity
Question
Describe how you found the probabilities on the previous page.
Answer
2.4 2.5 2.6 *ExploringPro...ity
Which of these outcomes will give you at least a 70% (the lowest passing grade)? Enter *yes* or *no* into column B.
There is a calculator page
outcomes
A1
2.5 2.6 2.7 *ExploringPro...ity
0/99
2.6 2.7 2.8 *ExploringPro...ity
Question
Based on the analysis you have done, what is the probability that you will pass a 3 question, true-or-false test by guessing? Explain.
Answer
2.7 2.8 2.9 *ExploringPro...ity
Would you have a better chance of passing a three-question multiple-choice test with three options for each answer?
Repeat the analysis for this scenario.
2.8 2.9 2.10 *ExploringPro...ity
Question
Since there are three choices for each question, what is the probability that you will guess the correct answer on a question? What is the probability that you will guess the wrong answer on a question?
Recall: The probability of a certain outcome is the number of ways it could occur
2.9 2.10 2.11 *ExploringPro...ity
outcomes2
If we use C for a correct guess and W for a wrong guess, as we did in the first part of this problem, what are the possible outcomes when answering 3 questions on a test? Should they be the same as on a three-question
A1
2.10 2.11 2.12 *ExploringPro...ity
What is the probability associated with each of the eight outcomes? Enter your answers in the following spreadsheet.
Note: Enter the same heading beneath *A* that you have on the
outc...
prob...
A1
2.11 2.12 2.13 *ExploringPro...ity
Question
How did you find the probabilities on the previous page?
Answer



This activity was adapted from *Navigating Through Probability in Grades 6-8*, a publication from the National Council of Teachers of Mathematics Navigation Series.