

Geometry 13.4

Design simulations to estimate probabilities

Summarize data from simulations

How likely
↙

probability model - *describes*
simulation

random -

expected value

Law of large numbers

1 Design a Simulation A **probability model** is a mathematical model used to match a random phenomenon. A **simulation** is the use of a probability model to recreate a situation again and again so that the likelihood of various outcomes can be estimated. To design a simulation, use the following steps.

Key Concept Designing a Simulation

Step 1 Determine each possible outcome and its theoretical probability.

Step 2 State any assumptions.

Step 3 Describe an appropriate probability model for the situation.

Step 4 Define what a trial is for the situation and state the number of trials to be conducted.

Must have the same probabilities as your situation

(Minimum #trials 30)

(slip of paper)

Model:
spinner
dice 6
random number
flip coin 2
etc.

Example 1 Design a Simulation by Using a Geometric Model



BASKETBALL Allen made 70% of his free throws last season. Design a simulation that can be used to estimate the probability that he will make his next free throw this season.

spinner

Step 1 Possible outcomes

Made 70% Missed 30%

Assumption(s) if any

Step 2 Appropriate model (prob. must match the situation)

Step 3 Spinner

Describe what a trial will be

Determine # of trials (min. 30 unless otherwise stated)

1 spin

30 trials



Step 4

Note: if using a spinner, always describe the percent for each section AND number of degrees in each section.

The drawing (sketch) of your spinner should be proportional to your description

Guided Practice

1. **RESTAURANTS** A restaurant attaches game pieces to its large drink cups, awarding a prize to anyone who collects all 6 game pieces. Design a simulation using a geometric model that can be used to estimate how many large drinks a person needs to buy to collect all 6 game pieces.



dice/spinner

1 2 3 4 5 6

Step 1 Possible outcomes

* assumptions *equally likely*

Step 2 model *dice each roll reps. sticker #*

Step 3 *roll dice (min 30)*

trial
min 30

Step 4



Example 2 Design a Simulation by Using Random Numbers

EYE COLOR A survey of East High School students found that 40% had brown eyes, 30% had hazel eyes, 20% had blue eyes, and 10% had green eyes. Design a simulation that can be used to estimate the probability that a randomly chosen East High student will have one of these eye colors.

spinner

Step 1

Outcomes

Br 40% H 30% B 20% G 10%

assumptions

no albino, no hetero

Step 2

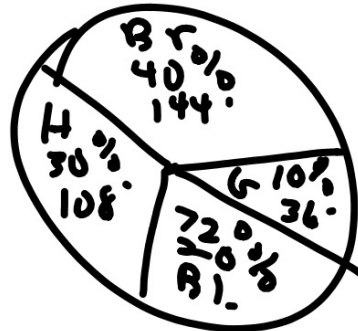
model

Spinner

Step 3

trial

Spin (no lines)
min 30

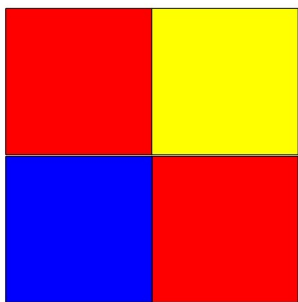


Step 4

2. **SOCCER** Last season, Yao made 18% of his free kicks. Design a simulation using a random number generator that can be used to estimate the probability that he will make his next free kick.

	Made	Miss	
Outcome	18%	82%	Use 100 slips of paper...
Assumptions			
Model			
Trial	100 slips paper 1-100		
	1-18 made 19-100 miss		
	draw + record		
	min 30		

Expected value



Dart board:

Expected value:

Red = 1 point

Yellow = 4 points

Blue = 6 points

$$\begin{array}{r} .5(1) = .5 \\ .25(4) = 1 \\ .25(6) = 1.5 \\ \hline 3 \end{array}$$

Overall average amount expected on a random
typical turn... (if you play multiple rounds)

Expected value:

Roll number cube:

1 = 4 pts

even number = 10 pts


3 = 1 pt

5 = 2 pts

roll	pts.		
1	→ 4	→ $\frac{1}{6} \cdot 4 =$	$\frac{2}{3}$
2, 4, 6	→ 10	→ $\frac{3}{6} \rightarrow \frac{1}{2} \cdot 10$	5
3	→ 1	→ $\frac{1}{6} \cdot 1$	$\frac{1}{6}$
5	→ 2	→ $\frac{1}{6} \cdot 2$	$\frac{1}{3}$
			<hr/>
			$6\frac{1}{6}$

Average amount expected on a typical turn...(overall)

* **Expected value**, also known as mathematical expectation, is the average value of a random variable that one *expects* after repeating an experiment or simulation a theoretically infinite number of times. To find the expected value $E(X)$ of a random variable X , follow these steps.



 **Key Concept** Calculating Expected Value

"point value"

Step 1 Multiply the value of X by its probability of occurring.

Step 2 Repeat Step 1 for all possible values of X .

Step 3 Find the sum of the results.



overall average if you play multiple rounds...

13.4 p. 943
1-15 all