NAME _____ DATE _____ PERIOD _____

13-4 Study Guide and Intervention

Simulations

Design a Simulation A **probability model** is a mathematical model that matches something that happens randomly. A **simulation** is a way to use the model to recreate a situation to help determine the situation's probability.

To design a simulation:

1. Determine each possible outcome and its theoretical probability.
2. State any assumptions.
3. Describe an appropriate probability model for the situation.
4. Define a trial for the situation and state the number of trials to be conducted.

Example **Joni got on base 40% of her times at bat last season. Design a simulation to determine the probability that she will get on base in her next at bat this season.**

The possible outcomes are Joni gets on base (40%) and Joni doesn't get on base (60%). Assume that Joni will have 90 at bats this season.

Use a spinner divided into two sectors, one containing 40% of the spinner's area, or a central angle of 144°, and the other 60%, or 216°. A trial, one spin of the spinner, will represent one at bat. A successful trial will be getting on base and a failed trial will be not getting on base. The simulation will contain 90 trials.

Exercises

Design a simulation using a geometric probability model.

1. **WRESTLING** Carlos is the star of the wrestling team. Carlos pinned 80% of his opponents in wrestling matches last season.

   Sample answer: Possible outcomes are: pinning (80%), not pinning (20%). Assume Carlos has 20 matches this season. Make a spinner that has one sector with a central angle of 288° and one sector with an angle of 72°. One spin will represent one match. A successful trial will be a pin. An unsuccessful trial will be a non-pin. The simulation will consist of 20 trials.

2. **JEANS** A trendy jeans store sells jeans in 4 different styles. Last year 45% of their sales was straight leg jeans, 30% was boot cut jeans, 15% was low rise jeans, and 10% was easy fit.

   Sample answer: Possible outcomes are: straight leg (45%), boot cut (30%), low rise (15%), easy fit (10%). Assign the integers 1–20: straight leg 1–9, boot cut 10–15, low-rise 16–18, and easy fit 19–20. A trial will represent a customer's choice. The simulation will consist of 20 trials.

3. **MOVIE RENTALS** A local video store has 5 videos in its fairytale section. Last month Cinderella was rented 35%, Snow White was rented 30%, Sleeping Beauty was rented 20%, Rumpelstiltskin 10%, and Rapunzel 5%.

   Sample answer: Possible outcomes are: Cinderella (35%), Snow White (30%), Sleeping Beauty (20%), Rumpelstiltskin (10%), and Rapunzel (5%). Assign the integers 1–20: Cinderella 1–7, Snow White 8–13, Sleeping Beauty 14–17, Rumpelstiltskin 18–19, and Rapunzel 20. A trial will represent a renter's choice. The simulation will consist of 40 trials.

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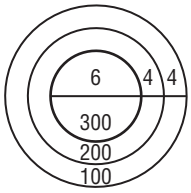
Simulations

Summarize Data from a Simulation After a simulation is created, the results must be reported with numerical and graphical displays of the data. Compare theoretical and experimental probabilities or expected and average values depending on the type of simulation you run.

Example **In a carnival game, a ball is rolled up an incline toward circular regions with different point values. The center circle has a diameter of 6 inches and each successive circle has a radius 4 inches greater than the previous circle.**

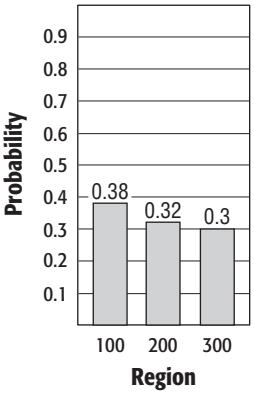


Let the random variable X represent the point value assigned to a region on the game. The expected value $E(X)$ is found by adding the products of each region's point value and the geometric probability of landing in that region.

$$E(X) = 100 \cdot \frac{72}{121} + 200 \cdot \frac{40}{121} + 300 \cdot \frac{9}{121} \approx 148$$

The frequency table shows the result of the simulation after using a graphing calculator to generate 50 trials. Use these numbers to construct a bar graph and to calculate average value.

Outcome	Frequency
Region 100	19
Region 200	16
Region 300	15
Total	50



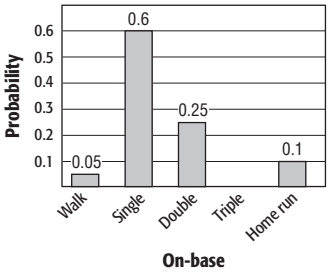
$$\text{Average value} = 100 \cdot \frac{19}{50} + 200 \cdot \frac{16}{50} + 300 \cdot \frac{15}{50} = 192$$

The average value is higher than the expected value.

Exercises

1. **BASEBALL** For a particular baseball player, out of the total number of times he reaches base he gets a walk 6% of the time, a single 55% of the time, a double 30% of the time, a triple 1% of the time, and a home run 8% of the time. The frequency table shows the results of a simulation. Construct a bar graph and compare the experimental probabilities with the theoretical probabilities.

Outcome	Frequency
Walk	5
Single	60
Double	25
Triple	0
Home run	10
Total	100



***P*(walk) = 5%, *P*(single) = 60%, *P*(double) = 25%, *P*(triple) = 0, *P*(home run) = 10%; the singles and home runs were greater than predicted, the walks, doubles, and triples were less than predicted**

2. **CARNIVAL** In a game similar to the game in the above Example, there are four regions in which the ball can fall. The probability that Jani can get 100 points in a roll is 25%, the probability of 200 points is 50%, of 300 points is 20%, and of 400 points is 5%. Calculate the expected value for each roll. ***E*(X) = 205**