Relative Frequency: Defined

Learning Objective: Explain how relative frequency can be used to estimate the probability of an event.

If we toss a coin, roll a die, or spin a spinner many times, we hardly ever achieve the exact **theoretical** probabilities that we know we should get, but we can get pretty close. When we run a simulation or when we use a random sample and record the results, we are using **empirical** probability. This is often called the **Relative Frequency** definition of probability.

Here is a realistic example where the relative frequency method was used to find the probabilities:

Example: Blood Type

Researchers discovered at the beginning of the 20th century that human blood comes in various types (A, B, AB, and O), and that some types are more common than others. How could researchers determine the probability of a particular blood type, say O? Just looking at one or two or a handful of people would not be very helpful in determining the overall chance that a randomly chosen person would have blood type O. But sampling many people at random, and finding the relative frequency of blood type O occurring, provides an adequate estimate. For example, it is now well known that the probability of blood type O among white people in the United States is 0.45. This was found by sampling many (say, 100,000) white people in the country, finding that roughly 45,000 of them had blood type O, and then using the relative frequency: 45,000 / 100,000 = 0.45 as the estimate for the probability for the event **"having blood type O."**

(Comment: Note that there are racial and ethnic differences in the probabilities of blood types. For example, the probability of blood type O among black people in the United States is 0.49, and the probability that a randomly chosen Japanese person has blood type O is only 0.3).

Let's review the relative frequency method for finding probabilities:

To estimate the probability of event A, written P(A), we may repeat the random experiment many times and count the number of times event A occurs. Then P(A) is estimated by the ratio of the number of times A occurs to the number of repetitions, which is called the **relative frequency of event A**.

$$\text{Relative Frequency of Event A} = \frac{\text{number of times A occurred}}{\text{total number of repetitions}}$$

Scenario: Breakfast-Eating Habits of College Students

What are the breakfast-eating habits of college students?

A group of 460 college students was surveyed over several typical weekdays, and 253 of them reported that they had eaten breakfast that day. Let B be the event of interest—that a college student eats breakfast.

Did I Get This (1/1 point)

Based on this information, what is the estimate of P(B), the probability that a randomly chosen college student eats breakfast?

Your Answer:

55%

Our Answer:

Using the relative frequency of B occurring, we would estimate P(B) to be 253 / 460 = 0.55.

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1/1 point (graded)

Which of the following would provide even more convincing evidence that, indeed, P(B) is roughly 0.55?

- Out of 10 randomly chosen college students, 5.5 reported that they had eaten breakfast that day.
- Out of 20 randomly chosen college students, 11 reported that they had eaten breakfast that day.
- Out of 1,000 randomly chosen college students, 850 reported that they had eaten breakfast that day.
- Out of 1,000 randomly chosen college students, 550 reported that they had eaten breakfast that day. ✔

Answer

Correct:

The relative frequency here (550 / 1,000 = 0.55) is based on a larger number of repetitions (1,000 vs. 460) and therefore provides a better estimate for P(B).

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