5.2: The Probability Distribution Function

A discrete probability distribution function has two characteristics:

a. Each probability is between zero and one, inclusive.
b. The sum of the probabilities is one.

Example 5.2.1

A child psychologist is interested in the number of times a newborn baby's crying wakes its mother after midnight. For a random sample of 50 mothers, the following information was obtained. Let $X =$ the number of times per week a newborn baby's crying wakes its mother after midnight. For this example, $x = 0, 1, 2, 3, 4, 5$

$P(x) =$ probability that X takes on a value x.

x	$P(x)$
0	$P(x=0) = \frac{2}{50}$
1	$P(x=1) = \frac{11}{50}$
2	$P(x=2) = \frac{23}{50}$
3	$P(x=3) = \frac{9}{50}$
4	$P(x=4) = \frac{4}{50}$
5	$P(x=5) = \frac{1}{50}$

X takes on the values 0, 1, 2, 3, 4, 5. This is a discrete PDF because:

a. Each $P(x)$ is between zero and one, inclusive.
b. The sum of the probabilities is one, that is,

$$\frac{2}{50} + \frac{11}{50} + \frac{23}{50} + \frac{9}{50} + \frac{4}{50} + \frac{1}{50} = 1 \quad (5.2.1)$$

Example 5.2.2

Suppose Nancy has classes three days a week. She attends classes three days a week 80% of the time, two days 15% of the time, one day 4% of the time, and no days 1% of the time. Suppose one week is randomly selected.

a. Let X = the number of days Nancy _____.
b. X takes on what values?
c. Suppose one week is randomly chosen. Construct a probability distribution table (called a PDF table) like the one in Example. The table should have two columns labeled x and $P(x)$. What does the $P(x)$ column sum to?

Solutions

a. Let X = the number of days Nancy attends class per week.

b. 0, 1, 2, and 3

c

x	$P(x)$
0	0.01
1	0.04

x	$P(x)$
2	0.15
3	0.80

WeBWorK Problems

Review

The characteristics of a probability distribution function (PDF) for a discrete random variable are as follows:

1. Each probability is between zero and one, inclusive (*inclusive* means to include zero and one).
2. The sum of the probabilities is one.

Contributors and Attributions

- Barbara Illowsky and Susan Dean (De Anza College) with many other contributing authors. Content produced by OpenStax College is licensed under a Creative Commons Attribution License 4.0 license. Download for free at http://cnx.org/contents/30189442-699...b91b9de@18.114.

Use the following information to answer the next five exercises: A company wants to evaluate its attrition rate, in other words, how long new hires stay with the company. Over the years, they have established the following probability distribution.

Let $X =$ the number of years a new hire will stay with the company.

Let $P(x) =$ the probability that a new hire will stay with the company *x* years.

Glossary

Probability Distribution Function (PDF)

a mathematical description of a discrete random variable (*RV*), given either in the form of an equation (formula) or in the form of a table listing all the possible outcomes of an experiment and the probability associated with each outcome.
