5 Probability Distributions (Discrete Variables)

5.1 Random Variables

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Americans are very much in love with the automobile, and many have more than one available to them.

The national average is 2.28 vehicles per household, with nearly 34% being single-vehicle and 31% being two-vehicle households. However, nearly 35% of all households have three or more vehicles.

Vehicles, x	1	2	3	4	5	6	7	8
$P(x)$	0.34	0.31	0.22	0.06	0.03	0.02	0.01	0.01

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By pairing the number of vehicles per household as the variable *x* with the probability for each value of *x*, a probability distribution is created. This is much like the relative frequency distribution.

If each outcome of a probability **experiment** is assigned a numerical value, then as we observe the results of the experiment, we are observing the values of a random variable. This numerical value is the *random variable value*.

Random variable A variable that assumes a unique numerical value for each of the outcomes in the sample space of a probability experiment.

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In other words, a random variable is used to denote the outcomes of a probability experiment. The random variable can take on any numerical value that belongs to the set of all possible outcomes of the experiment. (It is called random” because the value it assumes is the result of a chance, or random, event.)

Each event in a probability experiment must also be defined in such a way that only one value of the random variable is assigned to it **mutually exclusive events)**, and every event must have a value assigned to it **(all-inclusive events)**.

Example 1 – *Random Variables*

a. We toss five coins and observe the "number of heads" visible. The random variable x is the number of heads observed and may take on integer values from 0 to 5.

b. Let the "number of phone calls received" per day by a company be the random variable. Integer values ranging from zero to some very large number are possible values.

c. Let the "length of the cord" on an electrical appliance be a random variable. The random variable is a numerical value between 12 and 72 inches for most appliances.

Example 1 – *Random Variables* cont'd

d. Let the "qualifying speed" for race cars trying to qualify for the Indianapolis 500 be a random variable. Depending on how fast the driver can go, the speeds are approximately 220 and faster and are measured in miles per hour (to the nearest thousandth).

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Numerical random variables can be subdivided into two classifications:
discrete random variables and *continuous random variables*.

Discrete random variable A quantitative random variable that can assume a countable number of values.

Continuous random variable A quantitative random variable that can assume an uncountable number of values.

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The random variables “number of heads” and “number of phone calls received” in Example 1 parts a and b are discrete.

They each represent a count, and therefore there is a countable number of possible values. The random variables “length of the cord” and “qualifying speed” in Example 1 parts c and d are continuous.

They each represent measurements that can assume any value along an interval, and therefore there is an infinite number of possible values.