# CHAPTER 7: PROBABILITY

## *7.1: Experiments, Sample Spaces and Events*

An ***experiment*** is an activity with an observable result. Tossing coins, rolling dice and choosing cards are all probability experiments.

The result of the experiment is called the ***outcome*** or ***sample point***. The set of all outcomes or sample points is called the ***sample space*** of the experiment.

*Example*
What is the sample space for flipping a fair coin? Rolling a 6-sided die?

An ***event*** is a subset of a sample space. That is, an event can contain one or more outcomes that are in the sample space.

*Example*
What are all possible events for the experiment of flipping a fair coin?

*Example*
How many events are possible when a six-sided die is rolled?



*Example*
What is the sample space for flipping a fair coin three times?

Find the event E where $E = \{x|x$ has exactly one head$\}$

Find the event $E$ where $E = \{x|x$ has two or more heads$\}$

Find the event $E$ where $E = \{x|x$ has more than 3 heads$\}$

A sample space in which each of the outcomes has the same chance of occurring is called a UNIFORM SAMPLE SPACE.

*Example*
A bowl contains the letters AGGIES. How many outcomes are in the uniform sample space?

What is the uniform sample space for rolling two fair six-sided dice?

1~1 2~1 3~1 4~1 5~1 6~1
1~2 2~2 3~2 4~2 5~2 6~2
1~3 2~3 3~3 4~3 5~3 6~3
1~4 2~4 3~4 4~4 5~4 6~4
1~5 2~5 3~5 4~5 5~5 6~5
1~6 2~6 3~6 4~6 5~6 6~6

These sample spaces have all been finite. That is, we can list all the elements. An infinite sample space has to be described; you can't list all the elements:

*Example*
What is the sample space for the time spent working on a homework set?

Describe the event of spending between one and two hours on a homework set.



## *7.2 Definition of Probability*

The probability of an event, $P(E)$ is a number between 0 and 1, inclusive. If $P(E)=0$, then the event $E$ is impossible. If $P(E)=1$, then the event $E$ is certain.

The ***theoretical probability*** of an event $E$ occurring is based on the sample space $S$ having equally likely outcomes. Then probability of the event $E$ occurring is

$$P(E)=\frac{\text{number of outcomes in event E}}{\text{number of outcomes in the sample space}}=\frac{n(E)}{n(S)}$$

*Example*
Consider flipping a fair coin three times. Find the following probabilities:

(a) Exactly one head is seen.

(b) Two or more heads are seen.

(c) More than 3 heads are seen.