MAT 2379, Introduction to Biostatistics

Chapter 1. Interpreting probabilities

A random experiment is an experiment whose outcome is determined by chance and cannot be predicted. The set of all possible outcomes of a random experiment is denoted by S and is called the sample space.

An **event** is a sub-collection of possible outcomes of a random experiment.

Example: Flip a coin. There are two possible outcomes: heads or tails. One possible event E is that the coin lands on heads.

The **probability** of an event is a numeric value which is associated with the chance that the event will take place. It is expressed as a percentage, or a number between 0 and 1.

There are 3 different methods of assigning probabilities:

1. **The personal method**

The probability of an event is a subjective quantity expressing a person's degree of belief that the event will happen. It is usually associated with *one-shot* situations.
This method is not accurate and will not be used in this course.

Example: probability that one will pass a driver's test.

2. The relative frequency method

It is associated with events that occur as results of *repeatable* experiments. How it is calculated? We run the experiment n times and we observe that the event that we are interested in appeared $n(E)$ times. The probability of the event E is calculated as:

$$P(E) = \frac{n(E)}{n}$$

Example 1. A medical team conducted a study of a therapy for the treatment of a disease. 100 patients were considered, out of which 77 gave a "satisfactory/good" response. The probability that the therapy is successful is $77/100 = 77\%$

Example 2. A population of 150 fruitflies is maintained in a lab. In the population, 30 are black because of a mutation, and the rest have normal gray color. One fly is chosen at random. The chance that it is a black fly is $30/150 = 20\%$

3. The classical method

This is appropriate when we have *equally likely* events. This is the method that we use in this course. When using this method, the probability of an event A is defined as:

$$P(A) = \frac{n(A)}{n(S)},$$

where $n(A)$ is the number of possible outcomes of the event A.

Example 3. The familiar chance operation of flipping a coin. If the coin is fair, the probability that it falls heads is $1/2$.