Chapter 4 - Probability

Read Chapter 4 introduction first, then read the notes and try the WEBCT assignment questions. If you need more practice, try the practice questions with answers available on the web.

Introduction Chapter 4

Probability is that branch of statistics that tries to quantify our uncertainty with respect to some well specified question. We need some basic understanding of probability and its rules so that we can more deeply understand the statistical methods in the coming chapters.

View the Video – What is Probability

What is Probability?

Probability is the quantification of uncertainty. Consider the following: Let A be a statement which may be true or false but whose truth value is unknown.

- P(A) =<u>the probability of A</u> is a number between 0 and 1 that measures the degree to which we are uncertain about its true value.
- P(A) = 1 means we are certain A is true
- P(A) = 0 means we are certain A is false
- $P(A) = \frac{1}{2}$ means we are completely uncertain
- P(A) = 3/4 more certain that A is true

P(not A) = 1.0 - P(A) = 1.0 - 3/4 = .25

Example (1): Consider people exposed to chemotherapy. What is the probability of the events A and B below? The researcher would try to assign probabilities to these events.

A = people exposed to particular dosage will develop a tumor. P(A) = .05 a rare event

B = people exposed to particular dosage will survive 6 months. P(B) = .90 a likely event

Example (2): Weather Prediction, consider the question : C = It will rain tomorrow. P(C) = .01 a very rare event P(not C) = 1.0-.01=.99 an almost certain event.

How Do We Assign Probabilities?

The most commonly used procedure in empirical research is <u>relative frequency</u>. Think of a system such as memory test or clinical evaluation that can be repeatedly performed. Suppose A is a statement about a performance whose true value is known after observing the outcome. Perform the system "n" times and record the <u>relative frequency of A</u>. We call this relative frequency (that which falls between 0 and 1 in a large number of repetitions) the <u>probability of A</u>.

Example: Coin Toss

Toss a coin 4 times, let A = number of heads. We obtain 1 head in 4 tosses. Proportion of heads or relative frequency is 1/4 = .25. Toss the coin 10 times and obtain 3 heads. The relative frequency of heads is 3/10 = .3. Toss the coin 100 times. Obtain 45 heads. The relative frequency is .45. Now toss the coin a 1000 times and the proportion of heads is .512. In a large number of tosses the relative frequency is the probability of A, P(A).

Remember: Tips for Success

- 1) Read the text.
- 2) Read the notes.
- 3) Try the assignment.
- 4) If needed, try the exercise questions.
- 5) Try the link to the Virtual Statistics Lab if you need more help with a concept.
- 6) Try the self tests for practice on each chapter of the text at:
 www.whfreeman.com/ips
- 7) Steady work = success