Chapters 12 and 15

The **probability** of an event is the proportion of times the event occurs in many repeated trials of a random phenomenon.

The **sample space** *S* is the set of all possible outcomes of the random phenomenon. Sets of outcomes are called events. *P* assigns a number $P(A)$ to an event *A* as its probability.

Events *A* and *B* are **disjoint** if they have no outcomes in common.

Probability rules: for events A and B

1. $0 \leq P(A) \leq 1$.
2. P(S) = 1, where S is the sample space.

$$\sum_{i=1}^{n} P(A_i) = 1.$$

All possible outcomes together must have probability 1.

3. P(A or B) = P(A) + P(B), if events A and B are disjoint.
4. P(A doesn't occur) = 1 – P(A).

The mean of a population is μ, the mean of the sample is $\bar{x}$ (x-bar), the standard deviation is σ.

Statistics come from samples, and **parameters** come from populations. We often use a statistic to estimate an unknown parameter. In Ch 15 and 16-17, $\bar{x}$ (sample mean) is a statistics and μ (population mean) is a parameter.

The law of large numbers states that the actually observed mean outcome $\bar{x}$ must approach the mean μ of the population as the number of observations increases.

The central limit theorem says that when n is large the sampling distribution of the sample mean $\bar{x}$ is approximately Normal and has mean μ and standard deviation $\frac{\sigma}{\sqrt{n}}$.

Problems

1. Studies of young surfers in Hawaii indicate that optimal levels of Vitamin D are approximately 20-60 ng/ml (nanograms/milliliter of serum). The vitamin D levels of surfers follow a Normal distribution with mean $\mu = 27\ ng/ml$ and standard deviation $\sigma = 17\ ng/ml$.

- What is the probability that vitamin D level of a randomly selected surfer is greater than 60 ng/ml?

- What is the probability that the average vitamin D level of 4 randomly selected surfers is greater than 60 ng/ml?

2. Cards with the letters X, Y, and Z printed on them are placed in a hat. A card is drawn, the letter is recorded, the card is placed back in the hat, and a second card is drawn. There are nine possible arrangements of letters. For example, XY means the first card drawn had the letter X printed on it and the second card drawn had the letter Y printed on it. Assume all nine arrangements are equally likely.

- What is the sample space?

- Find the probability of event A that both letters are the same

- Find the probability of event B that the letters differ.

3. Two special tetrahedral (four-sided) dice are rolled. On each die, each side is labeled with 1, 2, 3, or 4 dots. After each roll, the sum of the number of dots on the down-faced sides is recorded. Let A be the event that the sum is even. Let B be the event that the sum is 5 or more. Are A and B disjoint? Why or why not?

4. Daniel has a deck of red, green, blue, orange, and yellow colored cards. The probability of drawing a green color card is 0.13. The probability of drawing an orange color card is 0.05. The probability of drawing a red or green card is 0.28, and the probability of not drawing a blue card is 0.76. With this information, find the probabilities of red, blue, and yellow colors.