1. Conditional Probability Problem--Football

From viewing tapes of previous games, a football coach identifies the following six tendencies regarding the next opponent:

a. 70% of the plays are runs to the right (R).

b. 30% of the plays are runs to the left (L).

c. When the play goes to the right, offensive player X has a balanced stance (B) 20% of the time and

d. a shifted stance (S) 80% of the time.

e. When the play goes to the left, offensive player X has a balanced stance 90% of the time and

f. a shifted stance 10% of the time.

Write each item above in probability notation, using the letters R, L, S and B

a. b. c.

d. e. f.

Create a probability table with columns R and L, and rows S and B. Fill in all the numbers.

Compute the following probabilities:

P (L | B) =

P (R | B) =

P (L | S) =

P (R | S) =

Are X's stance and play direction independent? Explain.

You coach the defense: "Always expect a right-side play." What percentage of the time will they be correct?

You coach the defense: "If player X is balanced, expect a left-side play; if player X is shifted, expect a right-side play." What percentage of the time will they be correct?

Conditional Probability Problem--Medical Screening Test

Consider a medical screening test to identify cases of an illness that has no symptoms in its early stages. The disease afflicts one-tenth of one per cent of the population. The test is 98% accurate. That is, 98% of people who have the illness will test positive and 2% will test negative (false negatives); and 98% of people who do not have the illness will test negative and 2% will test positive (false positives).

Terminology note: The P (P | D) is called "sensitivity" of the test--its ability to detect when the disease is present. The P (N | W) is called "specificity" of the test--its ability to detect when the disease is not present. These are both 98% in the above example. Sensitivity and specificity need not be equal. Developers of medical tests can manipulate the sensitivity and specificity--when one is increased, the other decreases.

Create a probability table with columns D (disease) and W (well), and rows P (positive) and N (negative). Fill in all the numbers.

Suppose you undergo the screening test and the result is positive. What is the probability that you actually have the disease? What if the test is negative?

Conditional Probability Problem--Three Envelopes

There are three envelopes that look alike. One contains two $1 bills, one contains two $100 bills, and one contains one $1 bill and one $100 bill. You are permitted to choose one envelope. Then you are asked to remove one bill from the envelope without looking at the other bill. Suppose that a $100 bill comes out. What is the probability that the other bill is $100? A probability table may be used, but is not necessary.

\*\*Here is the same problem in another form. Three index cards are in an envelope. One card is white on both sides. One card is red on both sides. One card is white on one side and red on the other. One card is taken out of the envelope at random and carefully placed on a table so that only one side of the card has been seen. The visible side is red. What is the probability that the other side is also red?

Conditional Probability Problem--Three Diseases

Three diseases, A, B and C are mutually exclusive--they cannot occur together. Disease A afflicts one per cent of the population, B afflicts one-half of one per cent of the population, and C afflicts two per cent of the population. Sometimes a disease can be present without the victim having any symptoms. 10% of the A victims have no symptoms, 5% of the B victims have no symptoms, and 25% of the C victims have no symptoms. Symptoms are present only when disease A, B or C is present.

If a person has symptoms, what are the probabilities that he/she has disease A? B? C?

If a person has no symptoms, what are the probabilities that he/she has disease A? B? C?

Use a probability table with columns A, B, C and W (well), and rows S (symptoms) and NS (no symptoms).