MATHEMATICS E-156, SPRING 2014
Mathematical Foundations of Statistical Software

Section Problems #1
February 2, 2014

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Both these problems are standard probability problems. The challenge is to solve tham by brute force in R, creating a data frame and then counting what fraction of the rows correspond to the specified event.

1. Classic Bayes's Rule

   A flight out of Mogadishu airport has 100 passengers, all male.

   20% of them wear explosive shoes, and within this group 60% have beards. Among the 80% who wear non-explosive shoes, only 5% have beards.

   Create a data frame with one row per passenger and two columns "Shoes" and "Beard." Make a 2x2 contingency table using these columns.

   Then extract the subset of bearded passengers. Use it to calculate the conditional probability that if you inspect a randomly chosen passengerwith a beard, he will turn out to have explosive shoes.

2. (This problem would be tedious to do by pencil and paper.)

   The Red Sox and Cardinals are playing another World Series.

   Games 1, 2, 6, and 7 are in Boston, where the Red Sox have a probability of 2/3 of winning. Games 3, 4, and 5 are in St. Louis, where their probability of a Red Sox victory is only 1/2.

   Make a 3-element vector for the Boston games, with a 1 for Red Sox victory. Make a 2-element vector for the St. Louis Games, again with a 1 for Red Sox victory. Use expand.grid() to make a data frame with $3^4 2^3 = 648$ rows that correspond to equally-likely outcomes if the teams play 7 games, and use it to make a histogram of the number of Red Sox vctories if the teams play all seven games. There is an R function named rowsum() that looks potentially useful, but you will have to check the online documentation.

   Of course, an actual World Series ends when one team has won four games. Extract the subset that corresponds to an event like "the Red Sox win the series in six games," and figure out the probability of that event. There are eight such events. Different members of the class can analyze different events, and someone should check that the probabilites sum to 1.