**Exercise 2.42**

Three lottery tickets for first, second, and third prizes are drawn from a group of 40 tickets. Find the number of sample points in S for awarding the 3 prizes if each contestant holds only 1 ticket.

**Solution**

As each place in the drawing has different prizes, this is a permutation problem. The number of permutations of n distinct objects taken r at a time is given by the equation:

In this exercise, we are selecting 3 distinct objects from a group of 40 tickets. Plugging these numbers into the above equation yields:

Therefore, the number of sample points in S for awarding the 3 prizes if each contestant holds only 1 ticket and there are 40 contestants is 59,280.

**Exercise 2.77**

In the senior year of a high school graduating class of 100 students, 42 studied mathematics, 68 studied psychology, 54 studied history, 22 studied both mathematics and history, 25 studied both mathematics and psychology, 7 studied history but neither mathematics nor psychology, 10 studied all three subjects, and 8 did not take any of the three. Randomly select a student from the class and find the probabilities of the following events.

1. A person enrolled in psychology takes all three subjects.
2. A person not taking psychology is taking both history and mathematics.

**Solution**

**Part A**

Per Rule 2.3, the probability of event A is

Where N is the sample space, and n is the number of events that correspond to event A. For this problem, N is equal to the number of students who studied psychology, 68, and n is equal to the number of students who studied all three subjects, 10. Plugging into the equation we get:

Therefore, the probability that a person enrolled in psychology takes all three subjects is 0.147.

**Part B**

For part B, we must first find both N and n for the equation utilized above. To solve for N, we take the complement of the number of students who studied psychology. 68 students studied psychology, and since there are 100 students, there are 100-68=32 students who are not taking psychology.

To find the value for n, we much find the number of students who studied history and mathematics, but did not study psychology. To calculate this, we subtract the number of students who took all three courses from the number of students who took history and mathematics. In this case, 22-10 = 12.

Combining these two together in the previously used equation from Rule 2.3 we get:

Therefore, the probability that a person not taking psychology is taking both history and mathematics is 0.375.

**Summary**

In the first exercise we calculated the size of the sample space of a lottery which has prizes for first, second, and third place, and 40 contestants that can be selected. Utilizing the equation for calculating the number of possible permutations, we calculated the size of the sample space to be 59,280. In the second exercise we needed to calculate the probability of two separate events. The first required that we determine the probability that a person enrolled in psychology takes all three subjects. This was done utilizing Rule 2.3 and was determined to be 0.147. The second part of the exercise required that we calculate the probability that a person not taking psychology is taking both history and mathematics. This was done using the same rule and was determined to be 0.375.