**Problem Statement 1:**

In one state, 52% of the voters are Republicans, and 48% are Democrats. In a second state, 47% of the voters are Republicans, and 53% are Democrats. Suppose a simple random sample of 100 voters are surveyed from each state.

What is the probability that the survey will show a greater percentage of Republican voters in the second state than in the first state?

**Solution**

For this analysis, let

P1 = the proportion of Republican voters in the first state,

P2 = the proportion of Republican voters in the second state,

p1 = the proportion of Republican voters in the sample from the first state, and

p2 = the proportion of Republican voters in the sample from the second state.

The number of voters sampled from the first state (n1) = 100

The number of voters sampled from the second state (n2) = 100

The solution involves four steps.

Make sure the sample size is big enough to model differences with a normal population.

Because n1P1 = 100 \* 0.52 = 52

n1 (1 - P1) = 100 \* 0.48 = 48

n2P2 = 100 \* 0.47 = 47

n2 (1 - P2) = 100 \* 0.53 = 53

All above ones are each greater than 10, the sample size is large enough.

Find the mean of the difference in sample proportions:

E (p1 - p2) = P1 - P2 = 0.52 - 0.47 = 0.05.

Find the standard deviation of the difference.

sd = sqrt{ [ P1(1 - P1) / n1 ] + [ P2(1 - P2) / n2 ] }

sd = sqrt{ [ (0.52)(0.48) / 100 ] + [ (0.47)(0.53) / 100 ] }

sd = sqrt (0.002496 + 0.002491) = sqrt(0.004987) = 0.0706

Find the probability. This problem requires us to find the probability that p1 is less than p2. This is equivalent to finding the probability that p1 - p2 is less than zero. To find this probability, we need to transform the random variable (p1 - p2) into a z-score. That transformation appears below.

z p1 - p2 = (x - µ p1 - p2 ) / sd = = (0 - 0.05)/0.0706 = -0.7082

Using Stat Trek's Normal Distribution Calculator, we find that the probability of a z-score being -0.7082 or less is 0.24.

Therefore, the probability that the survey will show a greater percentage of Republican voters in the second state than in the first state is 0.24.