*Session 4: Assignment 8*

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1. Introduction

This assignment will help you to consolidate the concepts learnt in the session.

1. Problem Statement

**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?

**Note: Solution submitted via github must contain all the detailed steps.**

**3. Output:**

**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

**Given,** the number of voters sampled from the first state (n1) = 100,

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

**Step 1**: Model the differences with a normal population and ensure sample size are big enough:

n1P1 = 100 x 0.52 = 52

n1(1 - P1) = 100 x 0.48 = 48

n2P2 = 100 x 0.47 = 47

n2(1 - P2) = 100 x 0.53 = 53

**Step 2**: Calculate the mean of the difference in sample proportions: E(p1 - p2) = P1-P2= 0.52-0.47= 0.05

**Step 3**: Calculate the standard deviation of the difference.

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

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

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

**Step 4**: Calculate the probability that p1 is less than p2. This is equivalent to calculating the probability that p1 - p2 is less than zero. To Calculate this probability, we need to change the random variable (p1 - p2) into a Z-score. Zp1 - p2 = (x - μ p1 - p2 ) / σd = (0 - 0.05)/0.0706=**-0.7082.** The probability of a Z-score being -0.7082 or less is 0.24

Hence, 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.**