Assignment_17.11438 - - Statistics 3

Problem 1:

Blood glucose levels for obese patients have a mean of 100 with a standard deviation of 15. A researcher thinks that a diet high in raw cornstarch will have a positive effect on blood glucose levels. A sample of 36 patients who have tried the raw cornstarch diet have a mean glucose level of 108. Test the hypothesis that the raw cornstarch had an effect or not.

Ans:

1. The population mean is 100. Sample mean is 108, standard deviation is 108. Sample size is 36

   Determine the type of hypothesis testing (Null or Alternate). I will choose Null hypothesis.
   H0: $\mu = 100$
   H1: $\mu > 100$

2. Set up the significance level. It is not given in the problem so assuming it as 5% (0.05).
3. Compute the random chance probability using z score and z-table.
   For this set of data: $z = (108-100) / (15/\sqrt{36}) = 3.20$

4. The P-value associated with the Z-value of 3.2 is 0.9993. This means that the probability of having a value less than 108 is 0.9993, while the probability of having a value equal to (or more than) 108 is (1-0.9993), which is equal to 0.0007.
5. It is less than 0.05 so we will reject the Null hypothesis i.e. there is raw cornstarch effect.

Problem 2:

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?

Answer:

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.

1. We need to ensure the sample size is big enough to model differences with a normal population.

   $n1P1 = 100 * 0.52 = 52$
   $n1(1 - P1) = 100 * 0.48 = 48$
   $n2P2 = 100 * 0.47 = 47$ and
   $n2(1 - P2) = 100 * 0.53 = 53$ are each greater than 10

   The sample size is large enough.

2. Mean of the difference in sample proportions:

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

3. Standard deviation of the difference.

   $\sigma d = \text{sqrt}\{ [P1(1 - P1) / n1] + [P2(1 - P2) / n2] \}$
   $\sigma d = \text{sqrt}\{ [(0.52)(0.48) / 100] + [(0.47)(0.53) / 100] \}$
   $\sigma d = \text{sqrt} (0.002496 + 0.002491) = \text{sqrt}(0.004987) = 0.0706$

4. Probability. This requires 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.

   $$z\ p1 - p2 = (x - \mu\ p1 - p2\ ) / \sigma d = = (0 - 0.05)/0.0706 = -0.7082$$

   Probability of a z-score being -0.7082 or less is 0.24.

Problem 3:

You take the SAT and score 1100. The mean score for the SAT is 1026 and the standard deviation is 209. How well did you score on the test compared to the average test taker?

Step 1: X-value into the z-score equation. X-value is SAT score, 1100.

$$Z = \frac{1100 - \mu}{\sigma}$$

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Step 2: Put the mean, μ, into the z-score equation.

$$Z = \frac{1100 - 1026}{\sigma}$$

Step 3: Write the standard deviation, σ into the z-score equation.

$$Z = \frac{1100 - 1026}{209}$$

Step 4: (1100 – 1026) / 209 = .354. This means that score was .354 std devs above the mean.

Step 5: Look for z-value in the z-table to see what percentage of test-takers scored below me.

z-score of .354 is .1368 + .5000 = .6368 or 63.68%