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# EXERCISE #4 - Statistics

1. What is the distinction between a population and a sample?

A population is an entire group that you want to draw conclusions about. A sample is the specific group that you will collect data from. The size of the sample is always less than the total size of the population. In research, a population doesn't always refer to people.

2. What is the difference between a parameter and a statistic?

A parameter is a number describing a whole population (e.g., population mean), while a statistic is a number describing a sample (e.g., the sample mean). The goal of quantitative research is to understand characteristics of populations by finding parameters

3. A hospital conducts a survey of patients who were given an experimental, lifesaving treatment. Hospital administrators call patients at home and ask them to participate in the survey. What types of sampling bias might be involved?

When they conduct the survey, a healthy patient might say that the experiment was good but anunhealthy patient might say that the service and experiment were not good as per. Also, some people might refuse to answer their questions to avoid controversy.

So, we can say that the survey might be biased as well. So, this Hospital Survey might be considered as a Non-response, Healthy User Bias.

4. What does the Central Limit Theorem say about populations and samples?

The central limit theorem states that if you have a population with mean μ and standard deviation σand take sufficiently large random samples from the population with replacement, then the distribution of the sample means will be approximately normally distributed.

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5. If a population has a mean of 600 and a standard deviation of 50, what is the Standard Error of the Mean for a sample size of 100? What does this value indicate?

The confidence level = 0.95

The significance level, $\alpha = 0.05$

The population standard deviation, $\sigma = 50$

The sample size, $n = 100$

Critical value of z using the z-distribution table: $z_{critical} = z_{(\alpha/2)} = z_{0.025} \approx \pm 1.96$

The margin of error: $E = (z \cdot \sigma)/\sqrt{n} = (1.96 \times 50)/\sqrt{100} = 9.8$

Therefore, At 95% confidence, the margin of error is 9.8

6. In Hypothesis Testing, what is the difference between a one-tailed and two-tailed test?

A one-tailed test has the entire 5% of the alpha level in one tail (in either the left, or the right tail).
A two-tailed test splits your alpha level in half (as in the image to the left).
Let's say we're working with the standard alpha level of 0.5 (5%).
A two tailed test will have half of this (2.5%) in each tail.

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7. A company wants to determine if two different sales departments had statistically the same number of sales per week over the last nine weeks. Perform a Student's t-Test on the following results. We recommend using a spreadsheet!

| | Sales per Week | | Dept A | Dept B | Dept A | Dept B |
|---|---|---|---|---|---|---|
| | Dept A | Dept B | $(x_1-\bar{x_1})$ | $(x_2-\bar{x_2})$ | $(x_1-\bar{x_1})^2$ | $(x_2-\bar{x_2})^2$ |
| 1 | 40 | 43 | 2 | 2 | 4 | 4 |
| | 36 | 41 | -2 | 0 | 4 | 0 |
| 2 | 42 | 44 | 4 | 3 | 16 | 9 |
| 3 | 36 | 39 | -2 | -2 | 4 | 4 |
| | 35 | 37 | -3 | -4 | 9 | 16 |
| 4 | 35 | 35 | -3 | -6 | 9 | 36 |
| 5 | 41 | 44 | 3 | 3 | 9 | 9 |
| 6 | 43 | 46 | 5 | 5 | 25 | 25 |
| 7 8 | 34 | 40 | -4 | -1 | 16 | 1 |
| 9 | 342 | 369 | Sum: $s_2$= | | 96 | 104 |
| Sum: | $\bar{x_1}$ = 38 | $\bar{x_2}$ = 41 | | | 12 | 13 |

$H_B$

$$_0: \bar{x}_A \geq \bar{x}$$

$$H_1: \bar{x}_A < \bar{x}_B$$

$\Sigma$ $^{-}{}_2$

$$s_2 = \frac{(x - x)}{n - 1}$$

$$t = \frac{|\bar{x}_1 - x_2|}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}} = \frac{|\quad - \quad|}{\sqrt{\frac{144}{9} + \frac{169}{9}}} = \frac{\quad}{\sqrt{\frac{313}{9}}} = \frac{\quad}{\frac{17.69}{3}} = \frac{\quad}{5.896} = 0.5088$$

38 41 3 3 3

If t-Critical for a one-tailed test with 95% confidence and 16 degrees of freedom is 1.74, what can we conclude about these departments?

From the given question, we got the test statistic as 0.5088, and from 16 degrees of freedom and a 1.753 t_critical value, we can say that among the two departments, the second department has a better sale.