Notes:

Two Proportion Test in Minitab

Key Learning Points

1. Describe the importance of completing two-proportion tests.
2. Explain how to compare two proportions to each other.
3. Utilize two-proportion tests in improvement projects.

What is a Two-Proportion Test?

A two-proportion test is appropriate when we are comparing the proportion of responses from two binomial variables against each other. A binomial variable is a discrete variable that can take on only two values, such as acceptable and not acceptable.

The two-proportion test uses data from samples to estimate if similar proportions for the entire population are equal.

Potential Hypotheses:
H_o: p1=p2, p1-p2=0
H_a: p1¹p2, p1<p2, p1>p2 or p1-p2¹0, p1-p2<0, p1-p2>0

Minitab: Stat > Basic Statistics > 2 Proportions

Test the Theory: Are Office A and Office B Different?

Office A produced 16,000 items and 223 were found to be defective. Office B produced 14,000 items and 150 were found to be defective. Quality performance is measured as defective rate expressed as a proportion.

With these data, is there a statistical difference between the two offices?

Use the Hypothesis Testing Method to determine if the offices are different.

Step 1: State the Practical Problem

The Practical Problem:
Is there a significant difference in defect rates between the two offices?

Step 2: Establish the Hypotheses

The question being asked is:
"Is there a statistical difference in the quality performance between these two offices."

H_o: PA = PB or PA-PB = 0
H_o: The defect rates of the offices are equal, and the difference is expected to be 0.0.

H_a: PA ≠ PB or PA-PB ≠ 0
H_a: The defect rates are not equal, and the difference will not be 0.0.

Step 3: Decide on Appropriate Statistical Test

Since two proportions from binomial data are being compared, a two-proportion test should be used.

Step 4: Set the Alpha Level

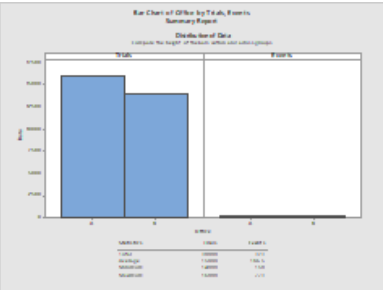
We choose 95% confidence for our test.
$\alpha = 0.05$

Steps 5&6: Set the Power and Sample Size, and Collect the Data

The entire population of data will be used, 16,000 items for Office A, and 14,000 items for Office B.

Step 7: Use the Appropriate Graphical Tool To Explore the Data

The data presented are very basic. We used a simple bar graph to compare the two offices.



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Step 8: Check Data Assumptions

Our only assumption is that the data can only take two values – acceptable and defective.

Step 9: Run the Statistical Test

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- Select Summarized Data
- Sample 1:
  - Number of Events: 223
  - Number of Trials: 16,000
- Sample 2:
  - Number of Events: 150
  - Number of Trials: 14,000

Test and CI for Two Proportions

Method

p_1: proportion where Sample 1 = Event
p_2: proportion where Sample 2 = Event
Difference: $p_1 - p_2$

Descriptive Statistics

Sample	N	Event	Sample p
Sample 1	16000	223	0.013938
Sample 2	14000	150	0.010714

Estimation for Difference

Difference	95% CI for Difference
0.0032232	(0.000732, 0.005715)

CI based on normal approximation

Test

Null hypothesis $H_0: p_1 - p_2 = 0$
Alternative hypothesis $H_1: p_1 - p_2 \neq 0$

Method	Z-Value	P-Value
Normal approximation	2.54	0.011
Fisher's exact		0.012

Statistical Conclusion

Since the p value (0.011) < 0.05, (Remember, if the p is low, the null must go), you reject the null hypothesis.

You can further see this when you look at the confidence interval (95% CI for Difference). 0.0 is not between 0.000732 and 0.005715.

Step 10: Translate the Statistical Conclusion Into a Practical Conclusion

There is a statistical difference between the two offices Quality performance Levels. There is only a 1.2% chance of being wrong with this conclusion.

Notes:

When Should Two Proportion Tests Be Used?

Use a two proportion test when comparing two binomial Ys against each other. Binomial variables can take only two values.

Pitfalls to Avoid

- Discrete tests require large data sets to detect small differences.
- Be sure to test for power if you fail to reject your null hypothesis.

Notes: