Z-Test

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Evaluating Asthma Rates: Hospital Sample Versus General Population

One Population Proportion Z-Test

(https://biomath.med.uth.gr/en/statistics-calculators)

Evaluating Asthma Rates: Hospital Sample Versus General Population

Example

In a hospital, a random sample of $n_1 = 215$ women was collected from patient lists, and $r = 39$ of them were found to have a history of asthma (i.e., the observed rate of asthma is $p = \frac{39}{215} = 18\%$). It is known that the prevalence rate of the disease is $P = 15\%$

Question

Does the percentage of women diagnosed with asthma in the sample match the prevalence in the general population?

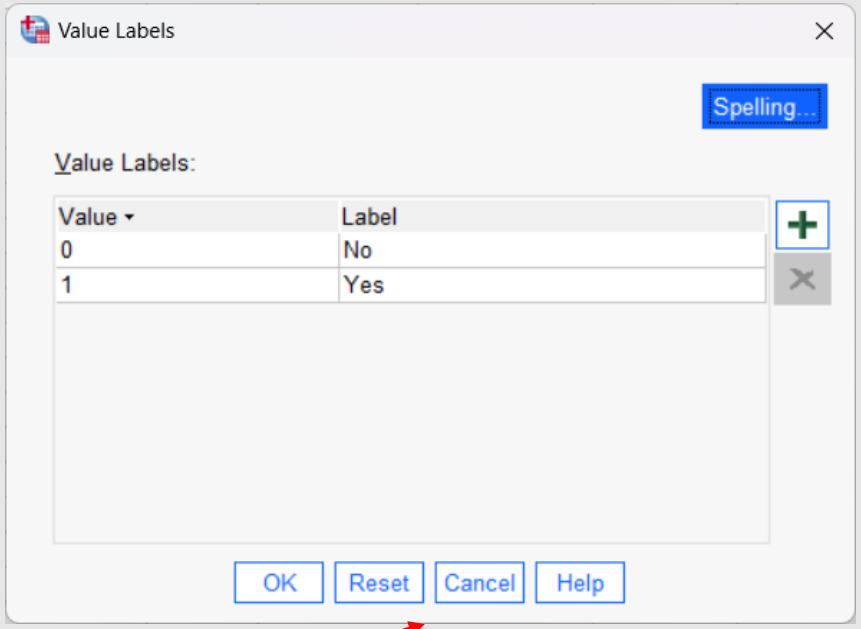
$\boldsymbol{H_0}$: The asthma rate in the hospital sample is equal to the prevalence rate in the general population

$$H_0: p = P$$

Entering data and defining variables

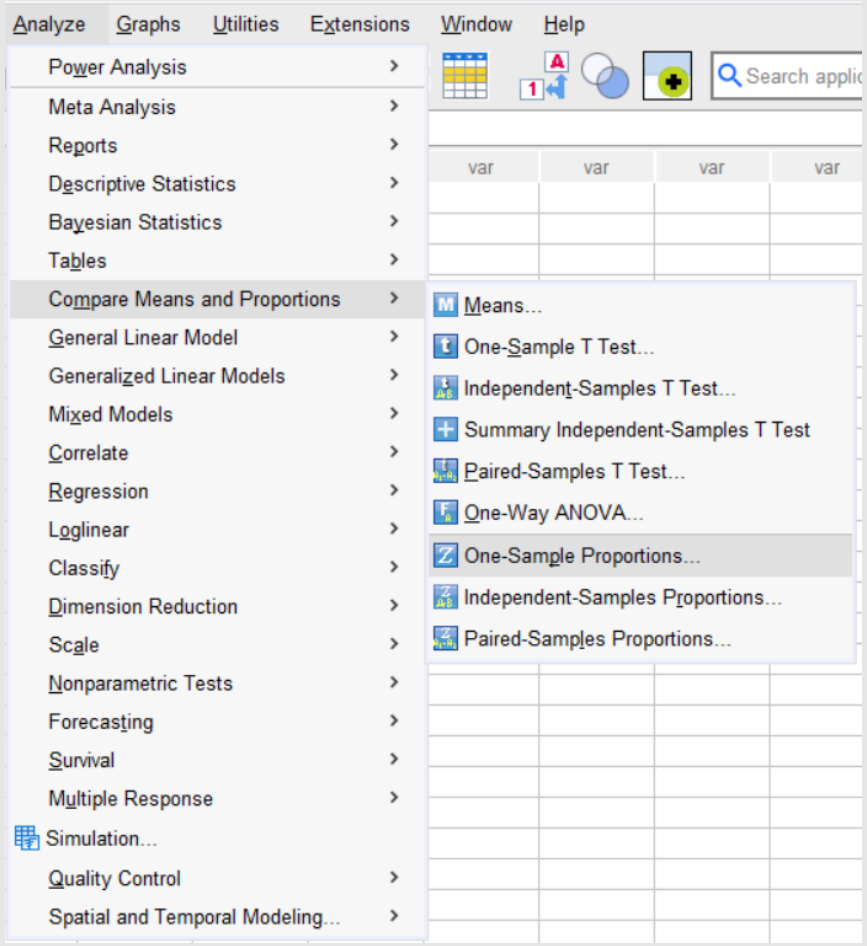
	asthma
1	1
2	1
3	1
4	1
5	1
6	1
7	1

In the dataset, there are 39 cases with a history of asthma, coded as 1, and 176 cases without a history of asthma, coded as 0

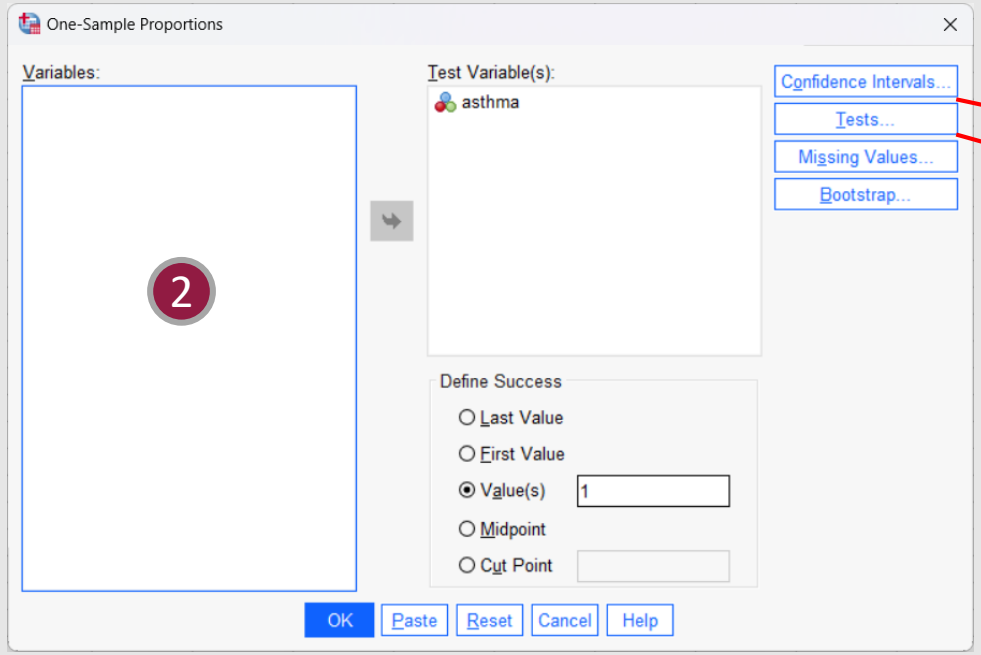


	Name	Type	Width	Decimals	Label	Values	Missing	Columns	Align	Measure
1	asthma	Numeric	8	0		{0, No}...	None	15	Right	Nominal

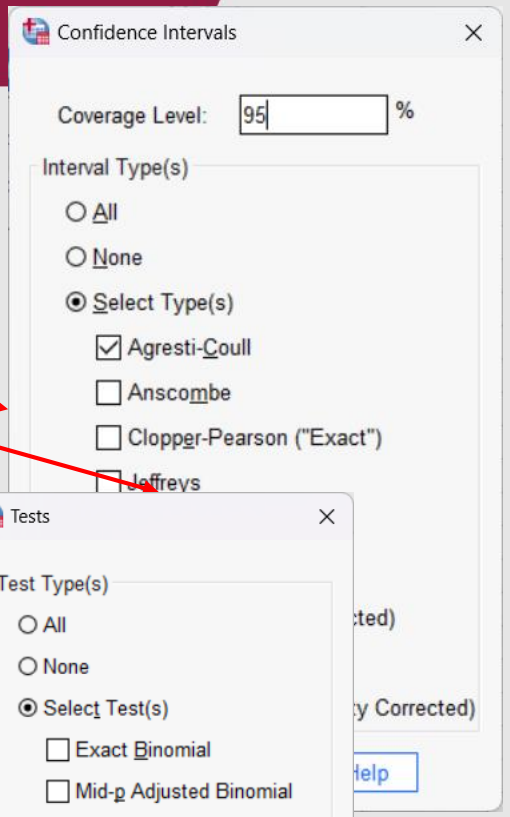
Running the Z-Test

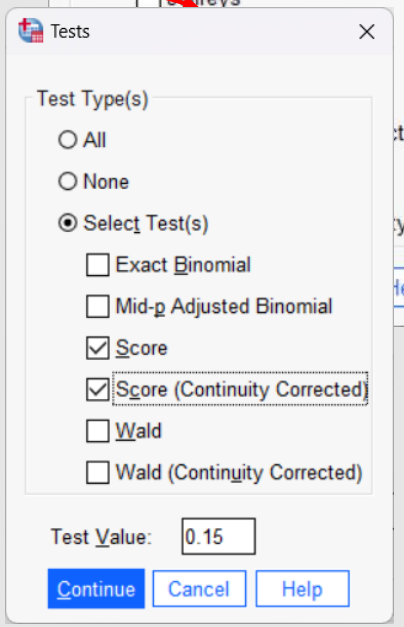


1. To analyze the data, select **Analyze** from the menu, then choose **Compare Means and Proportions** and **One-Sample Proportions…**



2. In window (2) drag the variable **asthma** from the left panel to the **Test Variable(s):** box**.** In the **Define Success field,** choose **Value(s)** and enter 1





Interpretation of the results

SPSS reports the wrong standard error. The correct standard error is 0.0244

One-Sample Proportions Confidence Intervals

	Interval Type	Successes	Observed Trials	Proportion	Asymptotic Standard Error	95% Confidence Interval Lower	Upper
asthma = Yes	Agresti-Coull	39	215	.181	.026	.135	.239

One-Sample Proportions Tests

	Test Type	Successes	Observed Trials	Proportion	Observed - Test Value[a]	Asymptotic Standard Error	Z	Significance One-Sided p	Two-Sided p
asthma = Yes	Score	39	215	.181	.031	.026	1.289	.099	.197
	Score (Continuity Corrected)	39	215	.181	.031	.026	1.194	.116	.233

a. Test Value = .15

The value $z = 1.289$ is greater than the 5% critical value of the standard normal distribution, which is 1.96

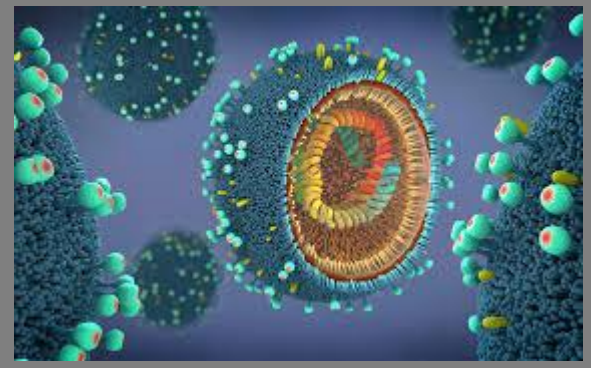
The results ($P \geq 0.05$) of the z-test indicated that the observed rate of asthma (18.14%) did **not significantly differ** from the population prevalence rate (15%)

Practice

1. A study of diseases in native Americans (Kizer et al. 2006) found 381 obese or overweight patients in 449 patients. In the general population of the USA, the percentage obese or overweight is 65%.
   The researchers wanted to determine if the percentage of obesity/overweight native Americans was different than that of the general population
2. Kim et al. (2004) studied the measles-rubella vaccination-rates in Korea. They compared the proportion of children with measles antibodies to the World Health Organization (WHO) target proportion (for children aged 5 to 9 years old: 10%)
   The aim of the study was to test if the proportion of Korean children with the measles antibody in the population was 10% or lower (i.e., better). In the study, 55 children out of 972 had the antibody present

Comparing Influenza Rates in Vaccinated vs. Placebo Groups

Two Proportion Z-Test



Comparing Influenza Rates in Vaccinated vs. Placebo Groups

	Treatment	
Influenza	**Vaccine**	**Placebo**
Yes	20	80
No	220	140

Example

Of the 240 ($n_1 = 240$) people vaccinated with the real vaccine, 20 ($p_1 = 20$) got influenza, compared to 80 ($p_2 = 80$) out of 220 ($n_2 = 220$) who were vaccinated with a placebo.

Question

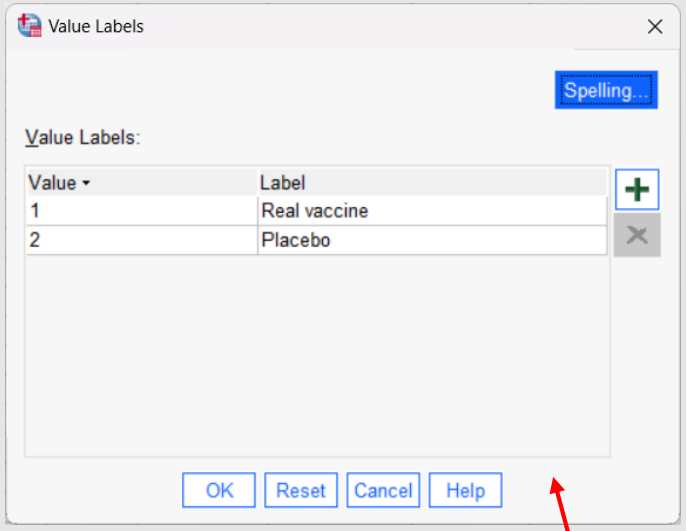
Is there any indication that the vaccine was effective?

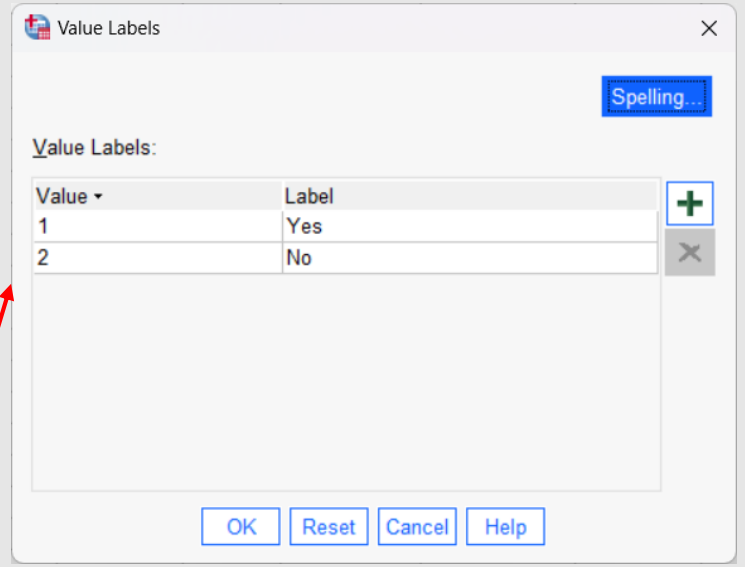
$\boldsymbol{H_0}$: The vaccination does not affect the influenza rate; the proportions of influenza cases in the vaccinated group (p_1) and the placebo group (p_2) are equal

$$H_0: p_1 = p_2$$

Entering data and defining variables

	influenza	treatment	freq
1	1	1	20.00
2	1	2	80.00
3	2	1	220.00
4	2	2	140.00

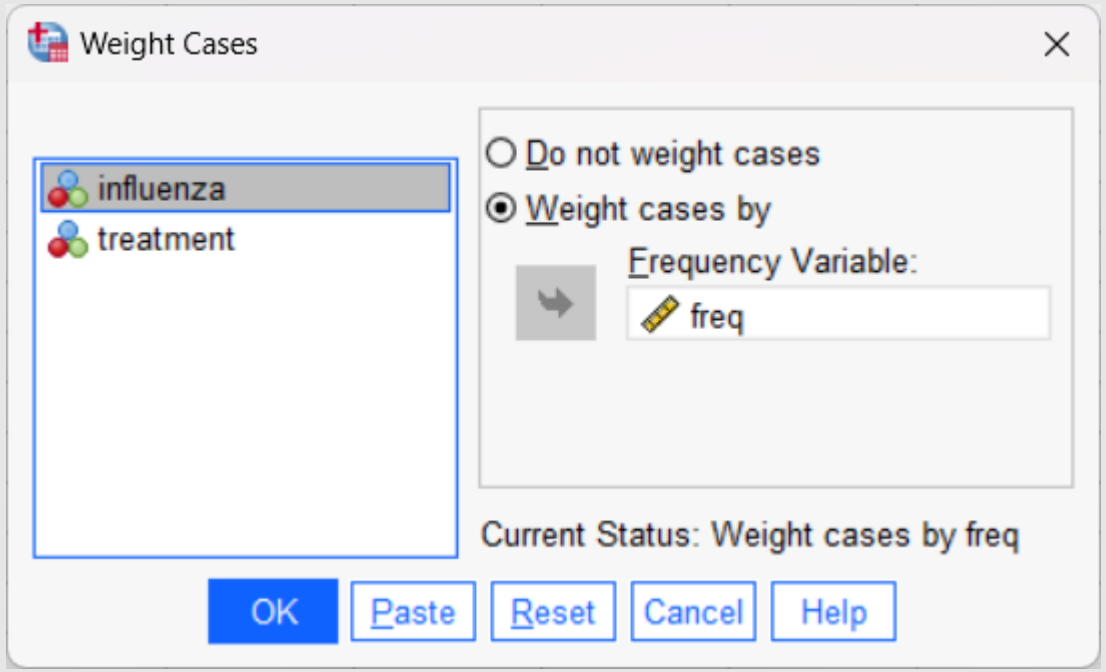




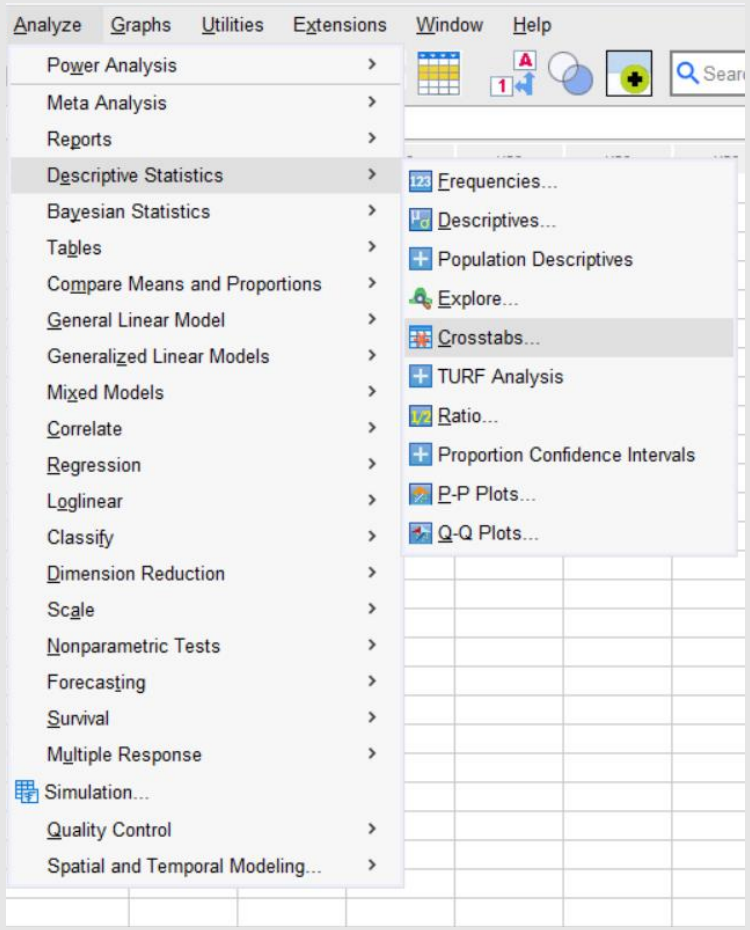
	Name	Type	Width	Decimals	Label	Values	Missing	Columns	Align	Measure
1	influenza	Numeric	8	0		{1, Yes}...	None	15	Right	Nominal
2	treatment	Numeric	8	0		{1, Real vaccine}...	None	13	Right	Nominal
3	freq	Numeric	8	2		None	None	11	Right	Scale

Entering data and defining variables

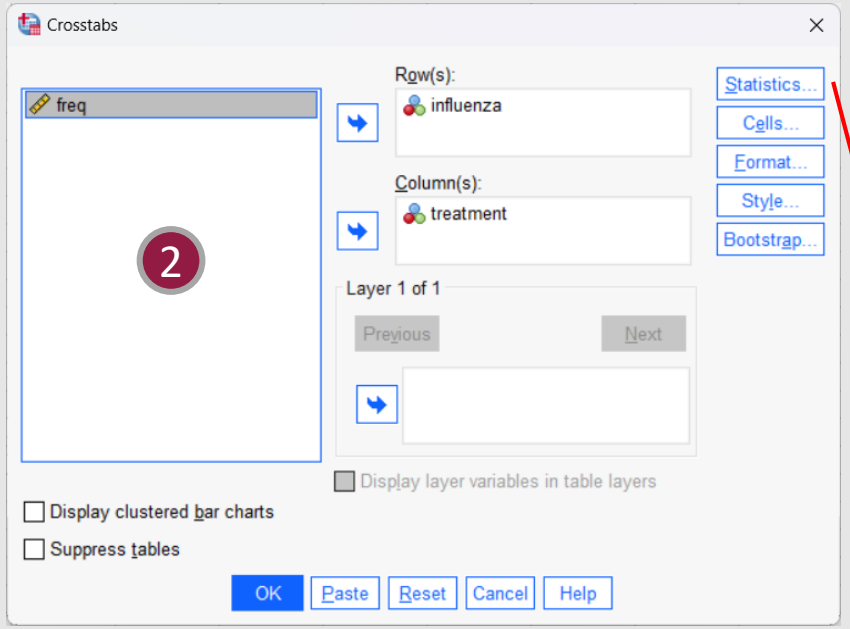
Select **Data** from the menu, then choose **Weight Cases…**

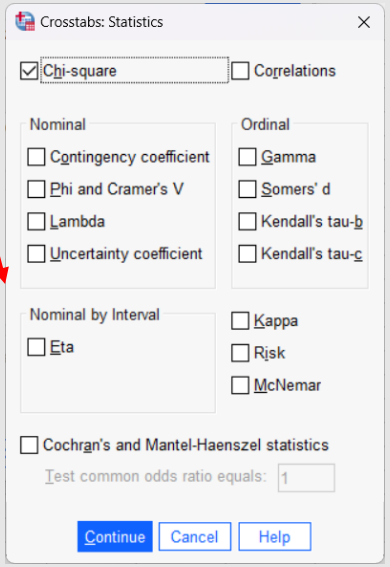


Running the Z-Test



1. To analyze the data, select **Analyze** from the menu, then choose **Descriptive Statistics** and **Crosstabs…**





2. In window (2) drag the variable **influenza** from the left panel to the **Row(s):** box, and the variable **treatment** to the **Column(s):** box**.** Press the **Statistics…** button, select **Chi-square**, and then press **Continue** and **OK**

Interpretation of the results

influenza * treatment Crosstabulation

Count

		treatment		
		Real vaccine	Placebo	Total
influenza	Yes	20	80	100
	No	220	140	360
Total		240	220	460

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	53.008[a]	1	<.001		
Continuity Correction[b]	51.374	1	<.001		
Likelihood Ratio	55.606	1	<.001		
Fisher's Exact Test				<.001	<.001
Linear-by-Linear Association	52.893	1	<.001		
N of Valid Cases	460				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 47.83.

b. Computed only for a 2x2 table

$$Z = \sqrt{Pearson\ Chi - Square} = \sqrt{53.008} = 7.2806$$

Since p-value = Asymptotic Significance (2-sided) < 0.001 we reject the null hypothesis

Therefore, there is evidence ($P < 0.001$) that actual vaccination reduces the risk of contracting influenza, **statistically significant**

Practical exercise

1. Researchers want to test the effectiveness of a new anti-anxiety medication. In clinical testing, 64 out of 200 people taking the medication report symptoms of anxiety. Of the people receiving a placebo, 92 out of 200 report symptoms of anxiety. Is the medication working any differently than the placebo? Test this claim using alpha = 0.05.

2. Suppose a Drug Company develops a new drug, designed to prevent colds. The company states that the drug is equally effective for men and women. To test this claim, they choose a simple random sample of 100 women and 200 men from a population of 100.000 volunteers.

   At the end of the study, 38% of the women caught a cold; and 51% of the men caught a cold. Based on these findings, can we reject the company's claim that the drug is equally effective for men and women? Use a 0.05 level of significance.