Z-TEST FOR ONE SAMPLE MEAN

Z-TEST

- **It is used for testing hypothesis when the population standard deviation is known and the sample size is at least or greater than 30. In the absence, however, of the population standard deviation, the standard deviation of the sample data may be used.**

Z-TEST FOR ONE SAMPLE MEAN

- It is used when there is only one sample in the experiment that is known, and both the standard deviation and the mean of the population are known.

Z-TEST FOR ONE SAMPLE MEAN

- $$z = \frac{\bar{x} - \mu}{\frac{\sigma}{\sqrt{n}}}$$

CRITICAL VALUE OF Z-TEST

Test Type	Level of Significance			
	0.10	0.05	0.025	**0.01**
One-tailed Test	±1.28	±1.645	±1.96	**±2.33**
Two-tailed Test	**±1.645**	**±1.96**	**±2.33**	**±2.58**

STEPS IN TESTING HYPOTHESIS (STEPWISE METHOD)

Below are the steps when testing the truth of a hypothesis.

1. Formulate the null hypothesis. Denote it as H_o and the alternative hypothesis as H_a.

2. Set the desired level of significance (α).

3. Determine the appropriate test statistic to be used in testing the null hypothesis.

4. Compute for the value of the statistic to be used.

5. Compute for the degrees of freedom and tabular/critical values.

6. Make the decision by comparing the computed value and critical/tabular value.

7. State the conclusion/implication.

EXAMPLE 1.

- A report states the mean monthly salary of call center agents is Php 22,000 a month, A random sample of the salaries of 81 call center agents showed a mean monthly salary of Php 23,500 with a standard deviation of Php 3,000. Is there a significant difference between the reported mean and the sample mean of the salaries of the call center agents? Use $\alpha = 0.05$.

SOLUTION

- I. State the null and alternative hypothesis.
- A. $H_o =$ There is no significant difference between the reported mean and the sample mean of the salaries of the call center agents.
    - $H_o\colon \mu = Php\ 22,000$
- B. $H_a =$ There is a significant difference between the reported mean and the sample mean of the salaries of the call center agents.
    - $H_a\colon \mu \neq Php\ 22,000$

SOLUTION

- **II. Set the level of significance.**
  - $\alpha = 0.05$

III. Test Statistic

Z-test for One Sample Mean

SOLUTION

- **IV. Computation**
- **Given:** $\bar{x} = 23,500 \quad \mu = 22,000 \quad \sigma = 3,000$
  - $z = \dfrac{\bar{x} - \mu}{\frac{\sigma}{\sqrt{n}}}$
  - $z = \dfrac{23,500 - 22,000}{\frac{3,000}{\sqrt{81}}} = \dfrac{1500}{333.33}$
  - $z = 4.50$

SOLUTION

- **V. Critical/Tabular Value**
- $z_{tab} = \pm 1.96 \ (\alpha = 0.05)$
- **VI. Decision Rule**
- **Since the $z_{computed\ value}$ is greater than the $z_{tabular\ value}$, reject the null hypothesis and accept the alternative hypothesis.**

SOLUTION

- **VII. Conclusion**
- **Since the $z_{computed\ value}$ of 4.50 is greater than the $z_{tabular\ value}$ of 1.96, reject the null hypothesis and accept the alternative hypothesis, regardless of sign at 0.05 level of significance. The research hypothesis confirms that there is a significant difference between the reported mean and the sample mean of the salaries of the call center agents.**

SEATWORK #3

- 1. The average life of an android phone in the Philippines is 30 months. It is known that the standard deviation of the said phones is 4 months. A test is conducted to validate whether the claim is true. 100 units are randomly chosen to be tested and were found that the mean life is 34 months. Test the hypothesis if the average life of an android phone is greater than 30 months using a level of significance of 5%.

ASSIGNMENT

- 1. A manufacturer claims that the average life of the batteries it manufactures for use for specified electronic games is 150 hours. It is known that the standard deviation on the life of this type of battery is 10 hours. A customer wishes to find out if the manufacturer's claim is really true. Accordingly, he tested 100 of the electronic games using this battery and found out that mean life is 155 hours. Test the hypothesis by using α=0.05.

ASSIGNMENT

- 2. It is known that the average cost of men's t-shirt in malls is higher than Php 600. A researcher selects a random sample of 36 t-shirts from these malls and obtains an average cost of Php 620, with a standard deviation of Php 80. Is there enough evidence for the researcher to accept the claim at α=0.05?

Z-TEST FOR TWO SAMPLE MEAN

Z-TEST FOR TWO SAMPLE MEAN

- Is used when comparing two separate samples drawn at random taken from a normal population
- Used to test whether the difference between the two values of $\bar{x}_1$ and $\bar{x}_2$ is significant or can be attributed to chance.

Formula: $$z = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{s_1^{\,2}}{n_1} + \frac{s_2^{\,2}}{n_2}}}$$

Where:

$\bar{X}_1$ = the mean of sample 1

$\bar{X}_2$ = the mean of sample 2

s_1 = the standard deviation of sample 1

s_2 = the standard deviation of sample 2

n_1 = the size of sample 1

n_2 = the size of sample 2

EXAMPLE

- A bank is opening a new branch in one of two neighborhoods. One of the factors considered by the bank is whether the average monthly family (in thousand pesos) in the two neighborhoods differed. From census records, the bank drew two random samples of 100 families each and obtained the following information.

SAMPLE A	SAMPLE B
$\bar{X}_1 = 10,800$	$\bar{X}_2 = 10,300$
$S_1 = 300$	$S_2 = 400$
$n_1 = 100$	$n_2 = 100$

SOLUTION (USING ONE TAILED TEST)

- **I. State the null and alternative hypothesis.**
- **A. $H_o =$ The average monthly family income in the two neighborhoods, A and B are equal.**
  - $H_o\colon \mu_1 = \mu_2$
- **B. $H_a =$ The average monthly family income of neighborhood A is higher than neighborhood B.**
  - $H_a\colon \mu_1 > \mu_2$

SOLUTION

- **II. Set the level of significance.**
  - $\alpha = 0.05$

III. Test Statistic

Z-test for Two Sample Mean

SOLUTION

- **IV. Computation**

SAMPLE A	SAMPLE B
$\bar{X}_1 = 10,800$	$\bar{X}_2 = 10,300$
$S_1 = 300$	$S_2 = 400$
$n_1 = 100$	$n_2 = 100$

- $$Z = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\frac{(S_1)^2}{n_1} + \frac{(S_2)^2}{n_2}}} = \frac{10,800 - 10,300}{\sqrt{\frac{(300)^2}{100} + \frac{(400)^2}{100}}} = \frac{500}{\sqrt{900 + 1600}} = \frac{500}{50} = 10$$

SOLUTION

- **V. Critical/Tabular Value**
- $z_{tab} = \pm 1.65 \ (\alpha = 0.05)$ **one tailed**
- **VI. Decision Rule**
- **Since the $z_{computed\ value}$ is greater than the $z_{tabular\ value}$, reject the null hypothesis and accept the alternative hypothesis.**

SOLUTION

- **VII. Conclusion**
- **Since the $z_{computed\ value}$ of 10 is greater than the $z_{tabular\ value}$ of 1.65, reject the null hypothesis and accept the alternative hypothesis, regardless of sign at 0.05 level of significance. The research hypothesis confirms that the average family monthly income of neighborhood A is higher than neighborhood B.**

ASSIGNMENT 3

- **3. The Brand A cellphone company claims that its phones have an almost the same lifespan as of the Brand B cellphone company. A test is conducted to validate whether the claim is true. 40 phones from Brand A and 70 phones from Brand B are chosen for testing, and were found that the mean life for each is 32 months for Brand A and 35 months for Brand B. The standard deviation for Brand A is 5 months while 7 months for Brand B. Test the hypothesis if the average life of an android phone from Brand A is less than the average life of android phone from Brand B using a level of significance of 0.01**

T-TEST

T-TEST

- It is used for testing hypothesis when the sample standard deviation is known and the sample size is less than 30.
- The T-test is used to compare two means of two independent samples or two independent groups and the means of correlated samples before and after the treatment.

T-TEST FOR ONE SAMPLE MEAN

- $t_{computed} = \frac{(\bar{x} - \mu)\sqrt{n}}{s}$

EXAMPLE OF T-TEST FOR ONE SAMPLE MEAN

- **1. The Human Resources Development of a company developed a skilled competency test for a certain group of skilled workers. The HRD asserted a tentative hypothesis that the arithmetic mean grade obtained by this group of skilled workers is 100. The test scores were assumed to be normally distributed. The hypothesis was subjected to a two tailed test at 0.01 level of significance. The test was given to a random sample of 16 skilled workers and the results are sample mean is equal to 95 and SD of 5. Is HRD’s tentative hypothesis correct?**

SOLUTION

- **I. State the null and alternative hypothesis.**
- **A. $H_o =$ The arithmetic mean grade obtained by the skill workers is equal to 100.**
    - $H_o\colon \mu = 100$
- **B. $H_a =$ The arithmetic mean grade obtained by the skill workers is not equal to 100.**
    - $H_a\colon \mu \neq 100$

SOLUTION

- **II. Set the level of significance.**
  - $\alpha = 0.01$

III. Test Statistic

T-test for One Sample Mean

SOLUTION

- **IV. Computation**
- **Given:** $\bar{x} = 95$ $\mu = 100$ **s= 5** **n=16**
- $t = \dfrac{(\bar{x}-\mu)\sqrt{n}}{s}$
- $t = \dfrac{(95-100)\sqrt{16}}{5} = \dfrac{-20}{5}$
- **t= -4.00**

SOLUTION

- **V. Critical/Tabular Value**
- **Df=n-1   16-1=15**
- $t_{tab} = \pm 2.947 \;\; (\alpha = 0.01)$
- **VI. Decision Rule**
- **Since the $t_{computed\ value}$ is greater than the $t_{tabular\ value}$, reject the null hypothesis and accept the alternative hypothesis.**

SOLUTION

- **VII. Conclusion**

- **Since the $t_{computed\ value}$ of -4.00 is greater than the $t_{tabular\ value}$ of 2.947, reject the null hypothesis and accept the alternative hypothesis, regardless of sign at 0.01 level of significance. The research hypothesis confirms that the arithmetic mean grade of skilled workers is not equal to 100.**

T-TEST FOR TWO SAMPLE MEAN

- $t = \dfrac{\bar{x}_1 - \bar{x}_2}{\sqrt{\left[\dfrac{(s_1)^2(n_1-1)+(s_2)^2(n_2-1)}{(n_1+n_2)-2}\right]\left[\dfrac{1}{n_1}+\dfrac{1}{n_2}\right]}}$
- df= $(n_1+n_2) - 2$

EXAMPLE OF T-TEST FOR TWO SAMPLE MEAN

- 1. A taxi company wishes to find out whether the use of radial tires and belted tires provide the same fuel consumption. Twelve cars were driven twice over a prescribed test course; and for each test a car used a different type of tire (radial or belted) in random order. The data obtained were recorded, as follows. Is there a significant difference on the fuel consumption of cars using radial and belted tires? Use $\alpha = 0.01$

Type of Tire	Sample Mean	SD
Radial	5.75	1.10
Belted	5.61	1.30

SOLUTION

- I. State the null and alternative hypothesis.
- A. $H_o =$ There is no significant difference on the fuel consumption of cars using radial and belted tires.
  - $H_o \colon \mu_1 = \mu_2$
- B. $H_a =$ There is a significant difference on the fuel consumption of cars using radial and belted tires.
  - $H_a \colon \mu_1 \neq \mu_2$

SOLUTION

- **II. Set the level of significance.**
  - $\alpha = 0.01$

III. Test Statistic

T-test for Two Sample Mean

SOLUTION

- **IV. Computation**

Type of Tire	Sample Mean	SD
Radial	5.75	1.10
Belted	5.61	1.30

- $$t = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\left[\frac{(s_1)^2(n_1-1)+(s_2)^2(n_2-1)}{(n_1+n_2)-2}\right]\left[\frac{1}{n_1}+\frac{1}{n_2}\right]}}$$

- $$t = \frac{5.75 - 5.61}{\sqrt{\left[\frac{(1.10)^2(12-1)+(1.30)^2(12-1)}{(12+12)-2}\right]\left[\frac{1}{12}+\frac{1}{12}\right]}}$$

SOLUTION

- **IV. Computation**

Type of Tire	Sample Mean	SD
Radial	5.75	1.10
Belted	5.61	1.30

- $$t = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\left[\frac{(s_1)^2(n_1-1)+(s_2)^2(n_2-1)}{(n_1+n_2)-2}\right]\left[\frac{1}{n_1}+\frac{1}{n_2}\right]}}$$

- $$t = \frac{5.75-5.61}{\sqrt{\left[\frac{(1.10)^2(12-1)+(1.30)^2(12-1)}{(12+12)-2}\right]\left[\frac{1}{12}+\frac{1}{12}\right]}}$$

$$\boxed{t_{computed} = 0.2848}$$

SOLUTION

- **V. Critical/Tabular Value**
- $df = (n_1 + n_2) - 2$ **(12+12)-2=22**
- $t_{tab} = \pm 2.819 \ (\alpha = 0.01)$
- **VI. Decision Rule**
- **Since the $t_{computed\ value}$ is less than the $t_{tabular\ value}$, reject the alternative hypothesis and accept the null hypothesis.**

SOLUTION

- **VII. Conclusion**

- **Since the $t_{computed\ value}$ of 0.2848 is les than the $t_{tabular\ value}$ of 2.8190, reject the alternative hypothesis and accept the null hypothesis, regardless of sign at 0.01 level of significance. The research hypothesis confirms that there is no significant difference on the fuel consumption of cars using the radial and belted tires.**

QUIZ 1

1. A researcher knows that the average height of Filipino women is 1.525 meters. A random sample of 26 women was taken and was found to have a mean height of 1.56 meters, with standard deviation of .10 meters. Is there reason to believe that the sample are significantly taller than the others at .05 significance level?

QUIZ #2

A college graduate is trying to decide whether to pursue a masters degree or not. He will only do so if he is convinced that masters degree loan more than college graduates. He experimented in 20 master’s degree holders and 25 college graduates. The yearly salaries were P170, 000 and P126, 000 respectively with corresponding standard deviations of P6, 000 and P5,400. Using 0.10 significance level, test is there is a significant difference in the amount of loan that a master’s degree holder and a college graduates could avail.

Quiz #1

An admission test was administered to incoming freshmen in the Colleges of Nursing and Veterinary Medicine with 100 students. Each was randomly selected. The mean scores of the given samples were

$\bar{x}_1 = 10$ and $\bar{x}_2 = 15$ and the variances of the test scores were 40 and 35, respectively. Is there a significant difference between the two groups? Use 0.01 level of significance.