Prof. Sampat Mali
Department of Mathematics

Type-13 Example-1

Mr. GANGARAM conducted a study to determine if the prevalence and nature of podiatric problem in elderly diabetic patient are different from those found in a similarly age group of non-diabetic patients. Subjects were seen in outpatient clinics were 70 to 90 years old. Among the investigators finding were the following statistics with respect to score on the measurement of deep tendon reflexes

Sample	N	Mean	Standard deviation
Non-diabetic patients	79	2.1	1.1
Diabetic patients	74	1.6	1.2

We wish to know if we can conclude on the basis of these data that on the average diabetic patient have reduced deep tendon reflexes when compared to non-diabetic patients of the same age group.

Solution: By given For First sample n_1=79, Sample mean $\overline{x_1} = 2.1$, Sample standard deviation S_1=1.1, For Second sample n_2=74, Sample mean $\overline{x_2} = 1.6$, Sample standard deviation S_2=1.2,

And Question is $\mu_1 < \mu_2$?

Since problem is of one tailed test we use following hypothesis

H_0: $\mu_1 = \mu_1$

H_1: $\mu_1 < \mu_1$

∵ Both Sample size are large drawn from two different populations and standard deviations of the population are not given

We use large sample test i.e. z-test

Since two samples are drawn from two different populations Therefore we use the formula

$$z = \frac{\overline{x_1} - \overline{x_2}}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}} = \frac{2.1 - 1.6}{\sqrt{\frac{1.1^2}{79} + \frac{1.2^2}{74}}} = 2.6812$$

$\therefore |z| = 2.6812$

$z_\alpha = z_{5\%} = 1.645$

$|z| > z_\alpha$

$\therefore H_0$ is rejected $\therefore$H1 is accepted

$\mu_1 < \mu_1$

∴ We can conclude on the basis of these data that on the average diabetic patient have reduced deep tendon reflexes when compared to non-diabetic patients of the same age group

Prof. Sampat Mali
Department of Mathematics

Type-13 Example-2

Protoporphyrin levels were measured in two samples of subjects. Sample 1 consisted of 50 adult male alcoholics with ring sideroblasts in the bone narrow. Sample 2 consisted of 40 apparently healthy adult nonalcoholic males. The mean Protoporphyrin level and S.D. for the two samples were as follows

Sample	Mean	S.D.
1	340	250
2	45	25

Can one conclude on the basis of these data protoporphysin levels are **higher** in the represented alcoholic population than in the non-alcoholic population?

Solution: By given For First sample n_1=50, Sample mean $\overline{x_1} = 340$, Sample standard deviation S_1=250, For Second sample n_2=40, Sample mean $\overline{x_2} = 45$, Sample standard deviation S_2=25,

And Question is $\mu_1 > \mu_2$?

Since problem is of one tailed test we use following hypothesis

H$_0$: $\mu_1 = \mu_2$

H$_1$: $\mu_1 > \mu_2$

$\because$ Both Sample size are large drawn from two different populations and standard deviations of the population are not given

We use large sample test i.e. z-test

Since two samples are drawn from two different populations Therefore we use the formula

$$z = \frac{\overline{x_1}-\overline{x_2}}{\sqrt{\frac{s_1^2}{n_1}+\frac{s_2^2}{n_2}}} = \frac{340-45}{\sqrt{\frac{250^2}{50}+\frac{25^2}{40}}} = 8.2921$$

$\therefore |z| = 8.2921$

$z_\alpha = z_{5\%} = 1.645$

$|z| > z_\alpha$

$\therefore$H$_0$ is rejected $\therefore$H1 is accepted

$\mu_1 > \mu_2$

$\therefore$ We conclude on the basis of these data protoporphysin levels are higher in the represented alcoholic population than in the non-alcoholic population.

Prof. Sampat Mali
Department of Mathematics

H.W.

1) A sample of height of 6400 English men has a mean of 170cm and S.D. of 6.4cm while a sample of height of 1600 Americans has a mean height of 172cm and S.D. of 6.3cm. Do these data indicate that American are on the average, **taller than** the England ($Z = -11.33$)

2) The average marks scored by 32 boys is 72 with S.D. of 8, while that for 36 girls is 70 with S.D. of 6.Test at 1% LOS whether the boys performance is **better than** girls

($Z = 1.15$)

Vidyalankar Institute of Technology
Accredited A+ by NAAC

Prof. Sampat Mali
Department of Mathematics

Type-14 Example-1

Cortisol level determinations were made on two samples of women at childbirth. Group 1 subjects underwent emergency cesarean section following induced labor. Group 2 subjects delivered by either cesarean section or the vaginal route following spontaneous labor. The sample size, mean, cortisol levels and S.D. were as follows

Sample	Sample size	Mean	S.D.
First Sample	10	435	65
Second sample	12	645	80

Do these data provide sufficient evidence to indicate a **difference** in the **mean cortisol levels in samples** of the population represented?

Solution:

By given For First sample n_1=10, Sample mean $\overline{x_1} = 435$, Sample standard deviation S_1=65,

For Second sample n_2=12, Sample mean $\overline{x_2} = 645$, Sample standard deviation S_2=80,

And Question is $\bar{x}_1 \neq \bar{x}_2$

Since problem is of one tailed test we use following hypothesis

H$_0$: $\bar{x}_1 = \bar{x}_2$

H$_1$: $\boldsymbol{\bar{x}_1 \neq \bar{x}_2}$

∵ Both Sample size are small standard deviations of the population is not given but standard deviations of samples are given

We use small sample test i.e. t-test

Therefore we use the formula

$$t = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{n_1 \times S_1^2 + n_2 \times S_2^2}{n_1 + n_2 - 2} \times \left(\frac{1}{n_1} + \frac{1}{n_2}\right)}} = \frac{435 - 645}{\sqrt{\frac{10 \times 65^2 + 12 \times 80^2}{10 + 12 - 2} \times \left(\frac{1}{10} + \frac{1}{12}\right)}} = -6.356951$$

$$with\ v = n_1 + n_2 - 2 = 10 + 12 - 2 = 20$$

$\therefore |t| = 6.356951$

$t_v(\alpha\%) = t_{20}(5\%)$=2.086

$|t| > t_v(\alpha\%)$

Prof. Sampat Mali
Department of Mathematics

$\therefore H_0$ is rejected $\therefore H_1$ is accepted

$\bar{x}_1 \neq \bar{x}_2$

$\therefore$ Data provide sufficient evidence to indicate a **difference** in the mean cortisol levels in the samples of population represented.

Prof. Sampat Mali
Department of Mathematics

Type-14 Example-2

Researchers wished to know if they could conclude that two populations of infants **differ** with respect to mean age at which they walked alone. The following data were collected

Sample from population A: 9.5, 10.5, 9, 9.75, 10, 13, 10, 13.5, 10, 9.5, 10, and 9.75

Sample from population B: 12.5, 9.5, 13.5, 13.75, 12, 13.75, 12.5, 9.5, 13.5, and 12 what should the researchers concluded?

Solution: By given For First sample n_1=12, Sample Mean$\bar{x}_1 = 10.375$, Sample standard deviation S_1=1.3366,

For Second sample n_2=10, Sample Mean $\bar{x}_2 = 12.25$, Sample standard deviation S_2=1.5166

And Question is$\mu_1 \neq \mu_2$

Since problem is of one tailed test we use following hypothesis

H$_0$: $\mu_1 = \mu_2$

H$_1$: $\mu_1 \neq \mu_2$

∵ Both Sample size are small standard deviations of the population is not given but standard deviations of samples are given

We use small sample test i.e. t-test

Therefore we use the formula

$$t = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{n_1 \times S_1^2 + n_2 \times S_2^2}{n_1 + n_2 - 2} \times \left(\frac{1}{n_1} + \frac{1}{n_2}\right)}} = \frac{10.375 - 12.25}{\sqrt{\frac{10 \times 1.3366^2 + 12 \times 1.5166^2}{10 + 12 - 2} \times \left(\frac{1}{10} + \frac{1}{12}\right)}} = -2.9044$$

$\boldsymbol{with\ v = n_1 + n_2 - 2 = 10 + 12 - 2 = 20}$

$\therefore |t| = \mathbf{2.9044}$

$t_v(\alpha\%) = t_{20}(5\%)$=**2.086**

$|t| > t_v(\alpha\%)$

∴H$_0$ is rejected ∴ H_1 is accepted

$$\mu_1 \neq \mu_2$$

Prof. Sampat Mali
Department of Mathematics

∴ Researchers concluded that two populations of infants **differ** with respect to mean age at which they walked alone.

Type-14 Example-3

Does sensory deprivation have an effect on a person's alpha wave frequency? Twenty volunteer subjects were randomly divided into two groups. Subjects in group A were subjected to a 10-day period of sensory deprivation, while subjects in group B

Group-A	10.2	9.5	10.1	10	9.8	10.9	11.4	10.8	9.7	10.4
Group-B	11	11.2	10.1	11.4	11.7	11.2	10.8	11.6	10.9	10.9

(t = -3.3567)

Solution: By given For First sample n_1=10, Sample Mean$\bar{x}_1 = 10.28$, Sample standard deviation S_1=0.5671,

For Second sample n_2=10, Sample Mean$\bar{x}_2 = 11.08$, Sample standard deviation S_2=0.4354

And Question is $\mu_1 \neq \mu_2$, here $n_1 = n_2 = n = 10$

Since problem is of two tailed test we use following hypothesis

H$_0$: $\mu_1 = \mu_2$

H$_1$: $\mu_1 \neq \mu_2$

∵ Both Sample size are small and of same size standard deviations of the population is not given but standard deviations of samples are given

We use small sample test i.e. t-test

Therefore we use the formula

$$t = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{S_1^2 + S_2^2}{n-1}}} = \frac{10.28 - 11.08}{\sqrt{\frac{0.5671^2 + 0.4354^2}{9}}} = -3.3568 \quad with\ v = 2(n-1) = 2(10-1) = 18$$

∴ $|t| = 3.3568$

$t_v(\alpha\%) = t_{18}(5\%) = 2.101$

$|t| > t_v(\alpha\%)$

∴H$_0$ is rejected ∴ H_1 is accepted

$$\mu_1 \neq \mu_2$$

Prof. Sampat Mali
Department of Mathematics

∴ **We can** concluded that sensory deprivation have an effect on a person's alpha wave frequency

---

Home works

1) Frigerio et al. measured the energy intake on 32 Gambian women. Sixteen of the subjects were lactating (L) and the remainder were non-pregnant and non-lactating (NPNL). The following data were reported.

Sample	Energy intake							
Lactating	5289	6209	6054	6665	6343	7699	5678	6954
	6916	4770	5979	6305	6502	6113	6347	5657
Non-lactating	9920	8581	9305	10765	8079	9046	7134	8736
	10230	7121	8665	5167	8527	7791	8782	6883

(t = 5.6505)

Do these data provide sufficient evidence to indicate a **difference** in the mean of Lacting & non-Lacting Gambian women?

2) Two independent samples of size 8 & 7 contain the following values

Sample-1: 19, 17, 15, 21, 16, 18, 16, 14

Sample-2:15, 14, 15, 19,15, 18, 16

Is the difference between sample mean is significant? (t = .93)
