Pearson, r

A study is conducted to determine the relationship regarding teachers' age and teaching efficiency.

Specific Problem: Is there a significant relationship regarding teachers' age and teaching efficiency?

Hypothesis:
- H_0: There is no significant relationship regarding teachers' age and teaching efficiency.
- H_0: There is significant relationship regarding teachers' age and teaching efficiency.

Statistical Test: Pearson, r

Type of Measurement Data: Interval Scale and Ratio Scale.

Level of Significance: 0.5

$$a.r = \frac{\sum xy - n(\overline{x})(\overline{y})}{\sqrt{\left(\sum x^2 - n(\overline{x})^2\right)\left(\sum y^2 - n(\overline{y})^2\right)}} \tag{1}$$

$$b.r = \frac{n(\sum xy) - (\sum x)(\sum y)}{\sqrt{\left(n(\sum x^2) - (\sum x)^2\right)\left(n(\sum y^2) - (\sum y)^2\right)}} \tag{2}$$

Figure 1: Formulas for Pearson, r

Teacher	Age	Efficiency			
	x	y	x^2	y^2	xy
A	51	89	2601	7921	4539
B	52	97	2704	9409	5044
C	32	81	1024	6561	2592
D	23	88	529	7744	2024
E	37	84	1369	7056	3108
F	46	78	2116	6084	3588
G	51	99	2601	9801	5049
H	47	79	2209	6241	3713
I	58	75	3364	5625	4350
J	52	90	2704	8100	4680
K	24	91	576	8281	2184
L	27	92	729	8464	2484
M	35	86	1225	7396	3010
N	57	85	3249	7225	4845
O	56	75	3136	5625	4200
$n = 15$	$\sum x = 648$	$\sum y = 1289$	$\sum x^2 = 30136$	$\sum y^2 = 111533$	$\sum xy = 55410$
	$\overline{x} = 43.2$	$\overline{y} = 85.933$			

Figure 2: Pearson, r Given Data

$$a.r = \frac{55410 - 15(43.2)(85.933)}{\sqrt{\left(30136 - 15(43.2)^2\right)\left(111533 - 15(85.93333333)^2\right)}}$$
$$a.r = \frac{-274.584}{\sqrt{1640634.205}}$$
$$a.r = \frac{-274.584}{1280.872439}$$
$$a.r = -0.214464892$$

$$
\begin{aligned}
b.r &= \frac{15(55410) - (648)(1289)}{\sqrt{\big(15(30136) - (648)^2\big)\big(15(111533) - (1289)^2\big)}} \\
b.r &= \frac{-4122}{\sqrt{368728464}} \\
b.r &= \frac{-4122}{19202.30361} \\
b.r &= -0.214661744
\end{aligned}
$$

after solving the value of r by using the two formulas, the resulting *computed r* is,

$$c.r \approx -0.214$$

locating the *table value r* at 0.05 level of sinificance and at $df = n-2 = 15-2 = 13$ degrees of freedom. The *table value r* is

$$t.r = 0.514$$

Since the absolute value of the *computed r* is less than the *table value r*,

$$|c.r \approx -0.214| < t.r = 0.514$$

there is no significant relationship. Therefore the null hypothesis is accepted. This implies that age has no effect upon teaching effectiveness in this study.

T-test(Independent and Uncorrelated Samples)

A researcher wishes to know whether male and female students differ in their mathemiatical abilities. He administered a mathematics aptitude test to 20 male and 22 female stdents in a class.

Specific Problem: Do male and female differ in their mathematical abilities?

Hypothesis:
- H_0: Male and Female do not differ in their mathematical abilities.
- H_1: Male and Female differ in their mathematical abilities.

Statistical Test: T-test for independent and uncorrelated samples. Type of data is interval.

Level of Significance: 0.05

$$SS = \sum x^2 - \frac{(\sum x)^2}{n} \tag{3}$$

Figure 3: Formula for *sum of squares*

$$t = \frac{\overline{x} - \overline{y}}{\sqrt{\frac{SS_x + SS_y}{n_x + n_y - 2}\left[\frac{1}{n_x} + \frac{1}{n_y}\right]}} \tag{4}$$

Figure 4: Formula for T-test

Male	Female		
x	y	x^2	y^2
98	97	9604	9409
81	95	6561	9025
75	81	5625	6561
95	80	9025	6400
94	78	8836	6084
78	80	6084	6400
86	98	7396	9604
79	92	6241	8464
90	91	8100	8281
100	99	10000	9801
78	84	6084	7056
81	88	6561	7744
76	80	5776	6400
77	78	5929	6084
89	80	7921	6400
80	100	6400	10000
87	98	7569	9604
97	84	9409	7056
76	94	5776	8836
81	88	6561	7744
78	99	6084	9801
85	100	7225	10000
$\sum x = 2129$	86	$\sum x^2 = 182933$	7396
$n_x = 22$	97		9409
$\overline{x} = 96.77272727$	92		8464
	$\sum y = 2239$		$\sum y^2 = 202023$
	$n_y = 25$		
	$\overline{y} = 89.56$		

Figure 5: Data for T-test

SS for male group:

$$SS_x = \sum x^2 - \frac{(\sum x)^2}{n_x}$$
$$SS_x = 182933 - \frac{(2129)^2}{22}$$
$$SS_x = |-23096.13636|$$

SS for female group:

$$SS_y = \sum y^2 - \frac{(\sum y)^2}{n_y}$$
$$SS_y = 202023 - \frac{(2239)^2}{25}$$
$$SS_y = 1498.16$$

Compute the T-test,

$$t = \frac{96.77272727 - 89.56}{\sqrt{\frac{23096.13636+1498.16}{22+25-2}\left[\frac{1}{22}+\frac{1}{25}\right]}}$$
$$t = \frac{7.21272727}{\sqrt{546.5399191(0.085454545)}}$$
$$t = \frac{7.21272727}{\sqrt{46.70432011}}$$
$$t = \frac{7.21272727}{6.834055905}$$
$$t = 1.055409463$$

The computed value of t is,

$$t = 1.055409463$$

The table value of t at 0.05 level of significance and $df = n_x + n_y - 2 = 22 + 25 - 2 = 45$ degrees of freedom,

$$t = 2.0141$$

Since the computed value of t is less than the table value of t,

$$t = 1.055409463 < t = 2.0141$$

The researcher fail to reject the null hypothesis. Therefore in this study, Male and Female students do not differ in their mathematical abilities.

Z-TEST

A researcher wishes to know whether Male and Female students differ on their science test scores.

Specific Problem: Is there a significant difference between Male and Female students on their science test scores?

Hypothesis:
- H_0: There is no significant difference between Male and Female students on their science test scores.
- H_1: There is significant difference between Male and Female students on their science test scores.

Refer to next page at Figure 8 for the given data.

$$SD = \sqrt{\frac{\sum x^2 - ((\sum x)^2/n)}{n}} \tag{5}$$

Figure 6: Formula for SD

$$Z = \frac{\overline{x} - \overline{y}}{\sqrt{\frac{S_x^2}{n_x} + \frac{S_y^2}{n_y}}} \tag{6}$$

Figure 7: Formula for Z-Test

x	y	x^2	y^2
100	78	10000	6084
78	100	6084	10000
97	89	9409	7921
85	92	7225	8464
93	99	8649	9801
99	88	9801	7744
84	82	7056	6724
92	91	8464	8281
100	98	10000	9604
97	97	9409	9409
77	90	5929	8100
80	80	6400	6400
75	81	5625	6561
85	88	7225	7744
80	90	6400	8100
87	96	7569	9216
80	77	6400	5929
91	91	8281	8281
93	76	8649	5776
87	86	7569	7396
81	75	6561	5625
83	76	6889	5776
100	76	10000	5776
76	92	5776	8464
96	76	9216	5776
89	84	7921	7056
95	94	9025	8836
81	97	6561	9409
94	76	8836	5776
100	82	10000	6724
95	89	9025	7921
95	99	9025	9801
99	77	9801	5929
98	92	9604	8464
77	90	5929	8100
$n_x = 35$	$n_y = 35$	$\sum x^2 = 280313$	$\sum y^2 = 266968$
$\sum x = 2946$	$\sum y = 2965$		
$\overline{x} = 92.0625$	$\overline{y} = 95.64516129$		

Figure 8: Data for Z-Test

Calculate the SD for group x,

$$SD = \sqrt{\frac{280313 - ((2946)^2/35)}{35}}$$
$$SD = \sqrt{\frac{32343.97143}{35}}$$
$$SD = \sqrt{924.1134694}$$
$$SD = 30.39923468$$

Calculate the SD for group y,

$$SD = \sqrt{\frac{266968 - ((2965)^2/35)}{35}}$$
$$SD = \sqrt{\frac{15790.14286}{35}}$$
$$SD = \sqrt{451.1469388}$$
$$SD = 21.24021984$$

Solve for Z,

$$Z = \frac{92.0625 - 95.64516129}{\sqrt{\frac{30.39923468}{35} + \frac{21.24021984}{35}}}$$
$$Z = \frac{-3.5826692}{\sqrt{0.868549562 + 0.606863424}}$$
$$Z = \frac{-3.5826692}{1.214665792}$$
$$Z = -2.949510082$$

Since the Z is

$$Z = -2.949510082$$

and greater than our critical value

$$Z = -2.949510082 < \pm 1.960$$

The researcher succesfully rejected the null hypothesis, meaning that in this study, there is significant difference between Male and Female students on their science test scores.