UNIT-V

Inferential and Comparative Statistics

Statistical packages for data analyses – SPSS. Tests of significance; Independent “t” test, Dependent “t” test – chi – square test, level of confidence and interpretation of data. Application of parametric and non-parameric statistical techniques in research. Meaning of correlation – co-efficient of correlation – calculation of co-efficient of correlation by the product moment method and rank difference method. Concept of ANOVA and ANCOVA.

MEANING OF CORRELATION

- Correlation refers to a **statistical measure** that describes the extent to which two variables change together.
- In other words, it **quantifies the degree** to which there is a **relationship or association** between two sets of **data.**
- Correlation only measures the strength and direction of a **linear relationship** between **two variables**.
- There are different methods for calculating correlation coefficients, with the **Pearson correlation coefficient** and **Spearman rank correlation coefficient.**

PEARSON CORRELATION COEFFICIENT

- The Pearson correlation coefficient measures the linear relationship between two continuous variables. It takes values between **-1** and **+1**, where:
- **+1** indicates a perfect positive linear relationship (as one variable increases, the other increases proportionally).
- **-1** indicates a perfect negative linear relationship (as one variable increases, the other decreases proportionally).
- **0** indicates no linear relationship between the variables.

- The formula for the Pearson correlation coefficient **(r)** between variables **X** and Y is given by: $$r = \frac{n\sum xy - (\sum x)(\sum y)}{\sqrt{[n\sum x^2 - (\sum x)^2][n\sum y^2 - (\sum y)^2]}}$$

PEARSON OR PRODUCT MOMENT CORRELATION

Example: Dataset

- Imagine that you're studying the relationship between newborns' weight and length. You have the weights and lengths of the 10 babies born last month at your local hospital. After you convert the imperial measurements to metric, you enter the data in a table:

Weight (kg)	Length (cm)
3.63	53.1
3.02	49.7
3.82	48.4
3.42	54.2
3.59	54.9
2.87	43.7
3.03	47.2
3.46	45.2
3.36	54.4
3.3	50.4

STEP- I

- **Weight = x**
- **Length = y**
- $x = 3.63 + 3.02 + 3.82 + 3.42 + 3.59 + 2.87 + 3.03 + 3.46 + 3.36 + 3.30$
- $\Sigma x = 33.5$
- $y = 53.1 + 49.7 + 48.4 + 54.2 + 54.9 + 43.7 + 47.2 + 45.2 + 54.4 + 50.4$
- $\Sigma y = 501.2$

X	y	x^2	y^2
3.63	53.1	(3.63)2 = 13.18	(53.1)2 = 2 819.6
3.02	49.7	9.12	2 470.1
3.82	48.4	14.59	2 342.6
3.42	54.2	11.7	2 937.6
3.59	54.9	12.89	3 014
2.87	43.7	8.24	1 909.7
3.03	47.2	9.18	2 227.8
3.46	45.2	11.97	2 043
3.36	54.4	11.29	2 959.4
3.3	50.4	10.89	2 540.2

STEP- II

- x^2 = 13.18 + 9.12 + 14.59 + 11.70 + 12.89 + 8.24 + 9.18 + 11.97 + 11.29 + 10.89
- Σx^2 = 113.05
- y^2 = 2 819.6 + 2 470.1 + 2 342.6 + 2 937.6 + 3 014.0 + 1 909.7 + 2 227.8 + 2 043.0 + 2 959.4 + 2 540.2
- Σy^2 = 25 264

X	*Y*	x^2	y^2	*xy (x*y)*
3.63	53.1	13.18	2 819.6	3.63 * 53.1 = 192.8
3.02	49.7	9.12	2 470.1	150.1
3.82	48.4	14.59	2 342.6	184.9
3.42	54.2	11.7	2 937.6	185.4
3.59	54.9	12.89	3 014	197.1
2.87	43.7	8.24	1 909.7	125.4
3.03	47.2	9.18	2 227.8	143
3.46	45.2	11.97	2 043	156.4
3.36	54.4	11.29	2 959.4	182.8
3.3	50.4	10.89	2 540.2	166.3

STEP- III

- Σxy = 192.8 + 150.1 + 184.9 + 185.4 + 197.1 + 125.4 + 143.0 + 156.4 + 182.8 + 166.3

- Σxy = 1 684.2

$$n = 10$$
$$\sum x = 33.5$$
$$\sum y = 501.2$$
$$\sum x^2 = 113.05$$
$$\sum y^2 = 25\,264$$
$$\sum xy = 1\,684.2$$

$$r = \frac{n\sum xy - (\sum x)(\sum y)}{\sqrt{[n\sum x^2 - (\sum x)^2][n\sum y^2 - (\sum y)^2]}}$$

$$r = \frac{16\,842 - 16\,790.2)}{\sqrt{[1\,130.5 - 1\,122.25][252\,640 - 251\,201.4]}}$$

$$r = \frac{10\sum 1\,684.2 - (33.5)(501.2)}{\sqrt{[(10)(113.05) - (33.5)^2][(10)(25\,264) - (501.2)^2]}}$$

$$r = \frac{51.8}{\sqrt{11\,868.45}}$$

$$r = 0.47$$

English (mark)	Maths (mark)	Rank (English)	Rank (maths)
56	66	9	4.5
75	70	3	2
45	40	10	10
71	60	4	7
61	66	6.5	4.5
64	56	5	9
58	59	8	8
80	77	1	1
76	67	2	3
61	63	6.5	6

English (mark)	Maths (mark)	Rank (English)	Rank (maths)	d	d^2
56	66	9	4.5	4.5	20.25
75	70	3	2	1	1
45	40	10	10	0	0
71	60	4	7	-3	9
61	65	6.5	4.5	1	4
64	56	5	9	-4	16
58	59	8	8	0	0
80	77	1	1	0	0
76	67	2	3	-1	1

- Where d = difference between ranks and d^2 = difference squared.
- We then calculate the following:

$$\sum d_i^2$$

= 20.25+1+0+9+4+16+0+0+1+0.25= 51.50

$$\rho = 1 - \frac{6\sum d_i^2}{n(n^2-1)}$$

$$\rho = 1 - \frac{6X\ 51.50}{10(100-1)}$$

$$\rho = 1 - \frac{309}{10\ X\ 99}$$

$$\rho = 1 - \frac{309}{990}$$

$$\rho = 1 - 0.32$$

ρ= 0.68

- as $n = 10$. Hence, we have a **ρ (or r_s)** of **0.67**. This indicates a ***strong positive relationship*** between the ranks individuals obtained in the maths and English exam. That is, the higher you ranked in maths, the higher you ranked in English also, and vice versa.