Correlation & Regression

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Statistics

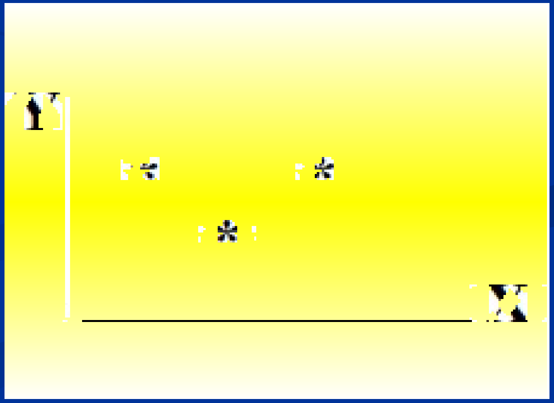
Correlation

Finding the relationship between two quantitative variables without being able to infer causal relationships

Correlation is a statistical technique used to determine the degree to which two variables are related

Scatter diagram

- Rectangular coordinate
- Two quantitative variables
- One variable is called independent (X) and the second is called dependent (Y)
- Points are not joined
- No frequency table



Example

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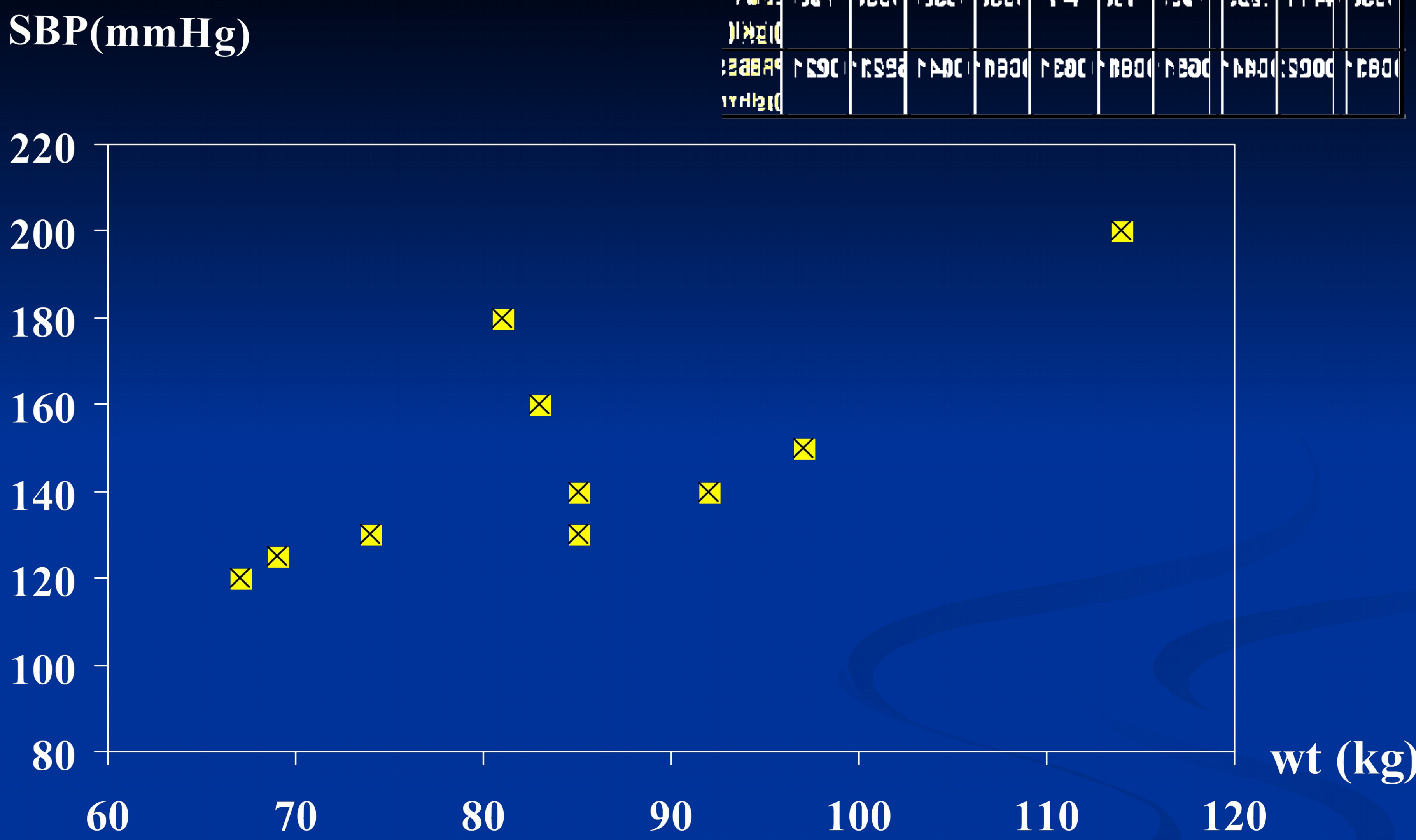
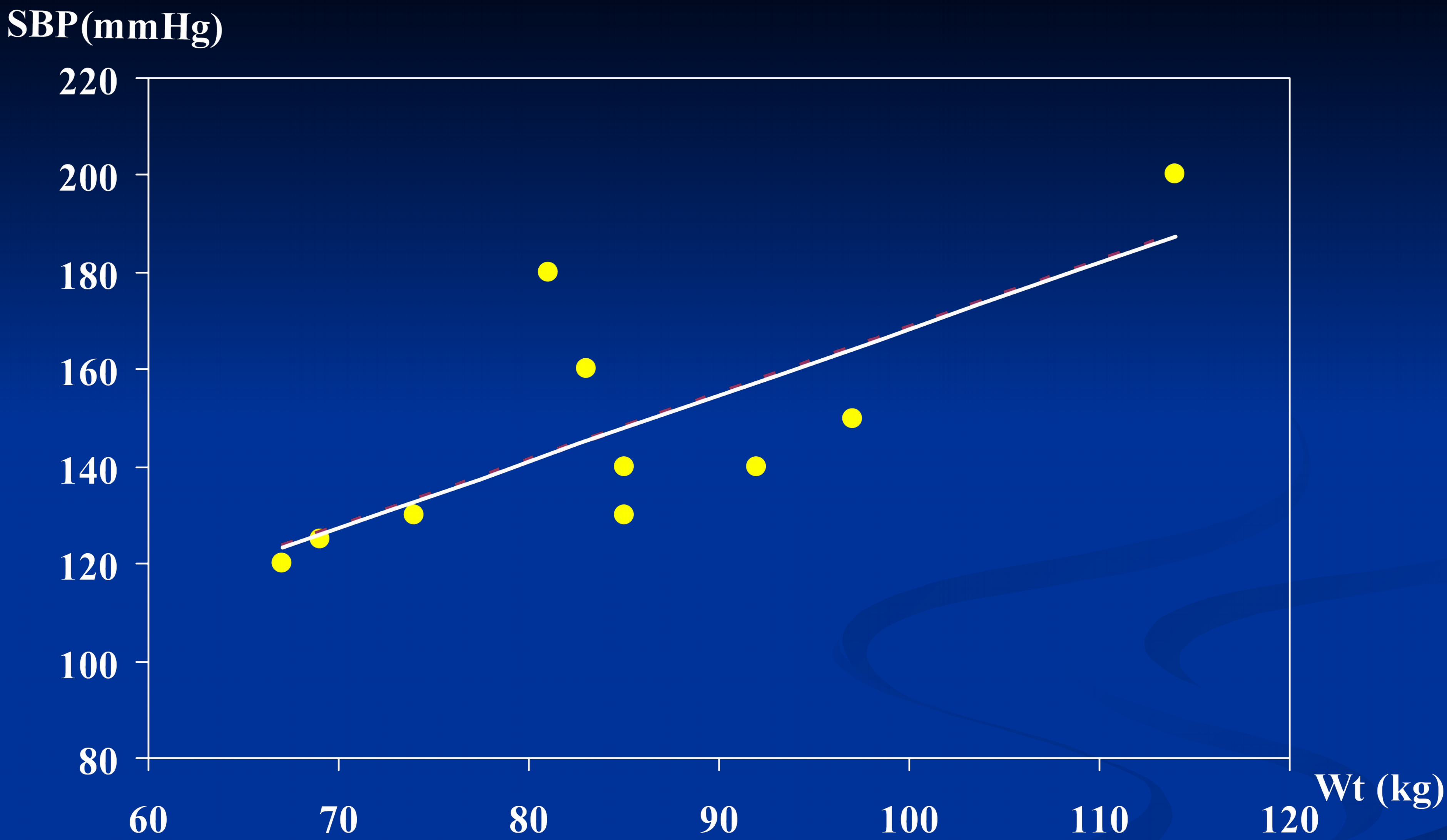


Scatter diagram of weight and systolic blood pressure



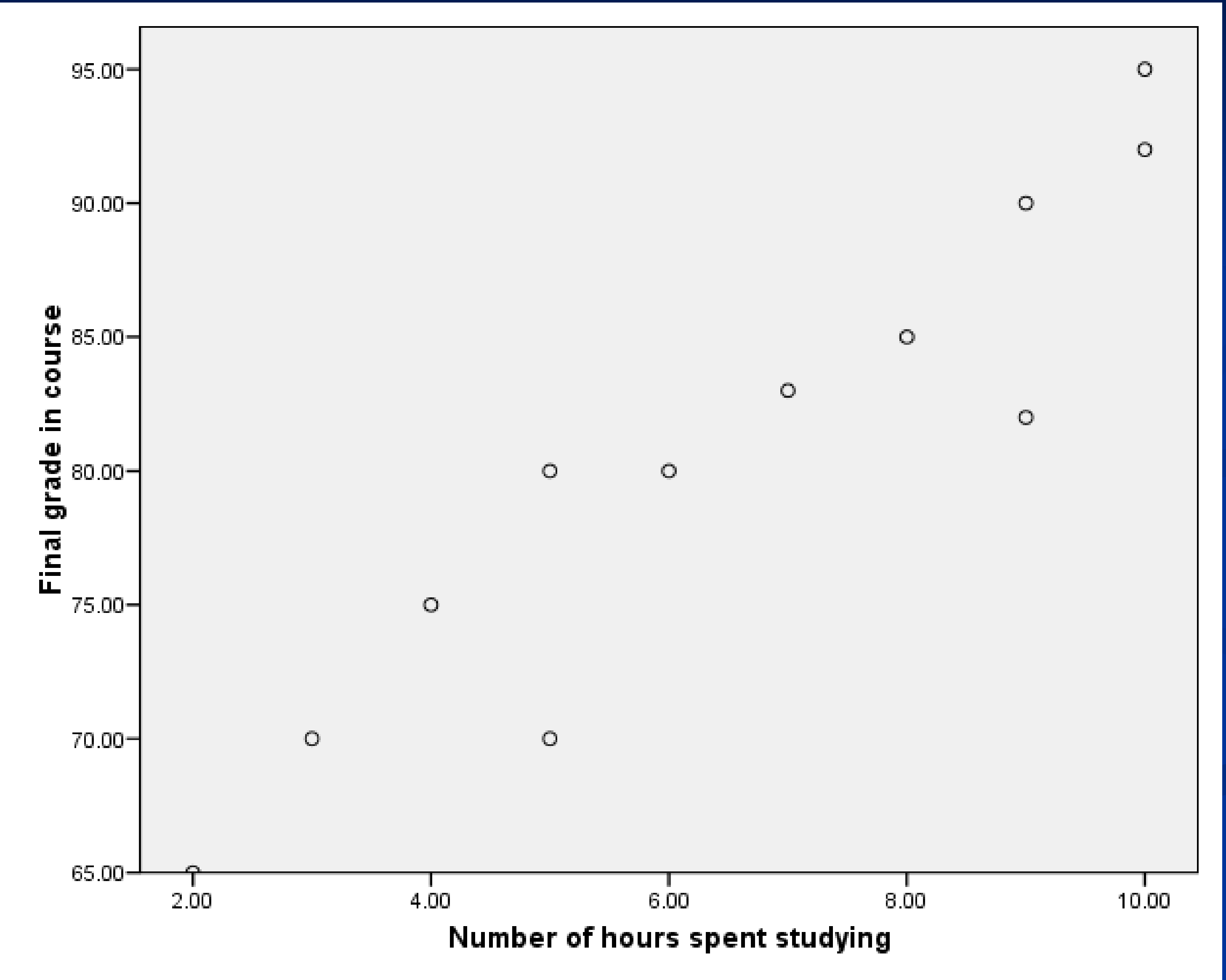
Scatter diagram of weight and systolic blood pressure

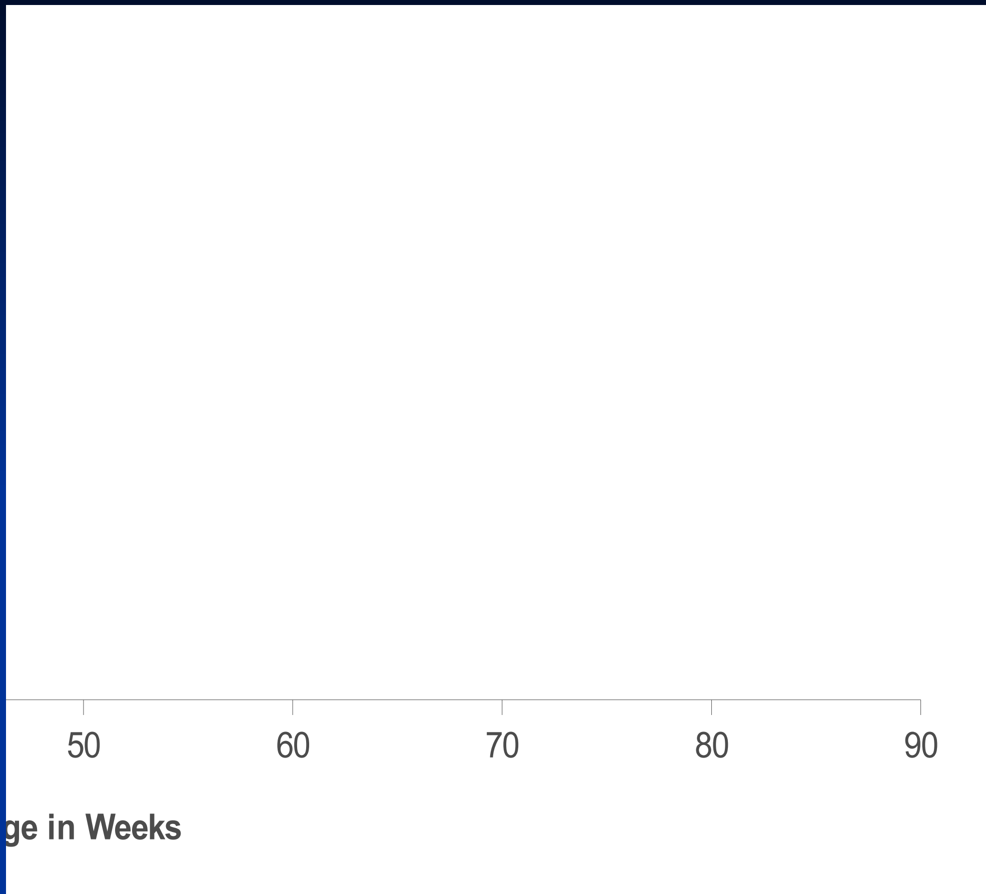
Scatter plots

The pattern of data is indicative of the type of relationship between your two variables:

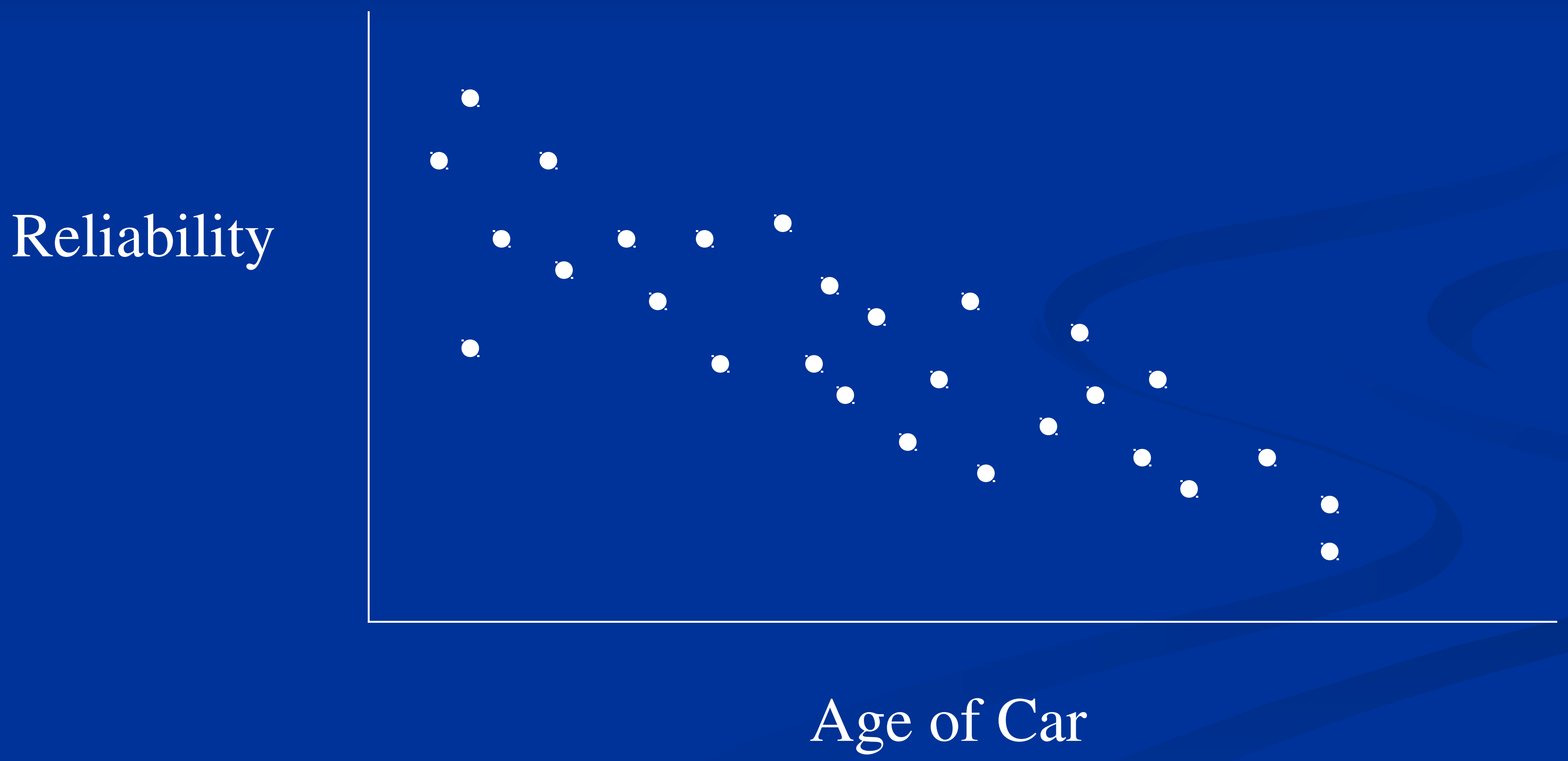
- positive relationship
- negative relationship
- no relationship

Positive relationship

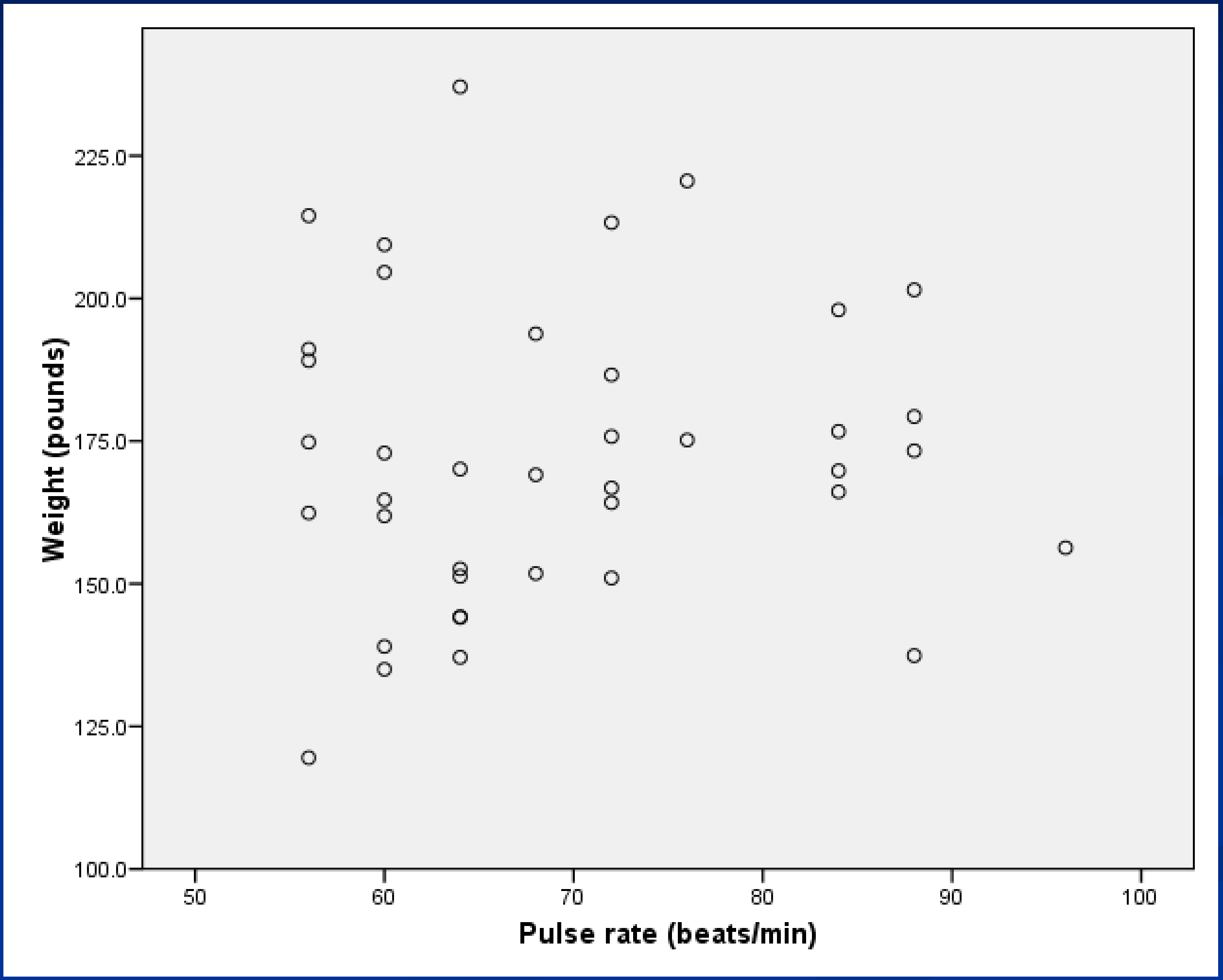



50
60
70
80
90
ge in Weeks

Negative relationship



No relation



Weight (pounds)
225.0
200.0
175.0
150.0
125.0
100.0
50
60
70
80
90
100
Pulse rate (beats/min)

Correlation Coefficient

Statistic showing the degree of relation between two variables

Simple Correlation coefficient (r)

- It is also called Pearson's correlation or product moment correlation coefficient.
- It measures the nature and strength between two variables of the quantitative type.

- The sign of r denotes the nature of association

- while the value of r denotes the strength of association.

- If the sign is +ve this means the relation is direct (an increase in one variable is associated with an increase in the other variable and a decrease in one variable is associated with a decrease in the other variable).

- While if the sign is -ve this means an inverse or indirect relationship (which means an increase in one variable is associated with a decrease in the other).

- The value of r ranges between (-1) and (+1)
- The value of r denotes the strength of the association as illustrated
  by the following diagram.

- If r = Zero this means no association or correlation between the two variables.
- If $0 < r < 0.25$ = weak correlation.
- If $0.25 \le r < 0.75$ = intermediate correlation.
- If $0.75 \le r < 1$ = strong correlation.
- If $r = l$ = perfect correlation.

How to compute the simple correlation coefficient (r)

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

:Example

A sample of 6 children was selected, data about their age in years and weight in kilograms was recorded as shown in the following table . It is required to find the correlation between age and weight.

serial No	Age (years)	Weight (Kg)
1	7	12
2	6	8
3	8	12
4	5	10
5	6	11
6	9	13

These 2 variables are of the quantitative type, one variable (Age) is called the independent and denoted as (X) variable and the other (weight) is called the dependent and denoted as (Y) variables to find the relation between age and weight compute the simple correlation coefficient using the following formula:

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

Serial .n	Age (years) (x)	Weight (Kg) (y)	xy	X^2	Y^2
1	7	12	84	49	144
2	6	8	48	36	64
3	8	12	96	64	144
4	5	10	50	25	100
5	6	11	66	36	121
6	9	13	117	81	169
Total	=x∑ 41	=y∑ 66	xy=∑ 461	=x2∑ 291	=y2∑ 742

$$r = \frac{461 - \dfrac{41 \times 66}{6}}{\sqrt{\left[291 - \dfrac{(41)^2}{6}\right] . \left[742 - \dfrac{(66)^2}{6}\right]}}$$

r = 0.759

strong direct correlation

EXAMPLE: Relationship between Anxiety and Test Scores

Anxiety)X(	Test score (Y)	X^2	Y^2	XY
10	2	100	4	20
8	3	64	9	24
2	9	4	81	18
1	7	1	49	7
5	6	25	36	30
6	5	36	25	30
$X = 32\sum$	$Y = 32\sum$	$X^2 = 230\sum$	$Y^2 = 204\sum$	$XY=129\sum$

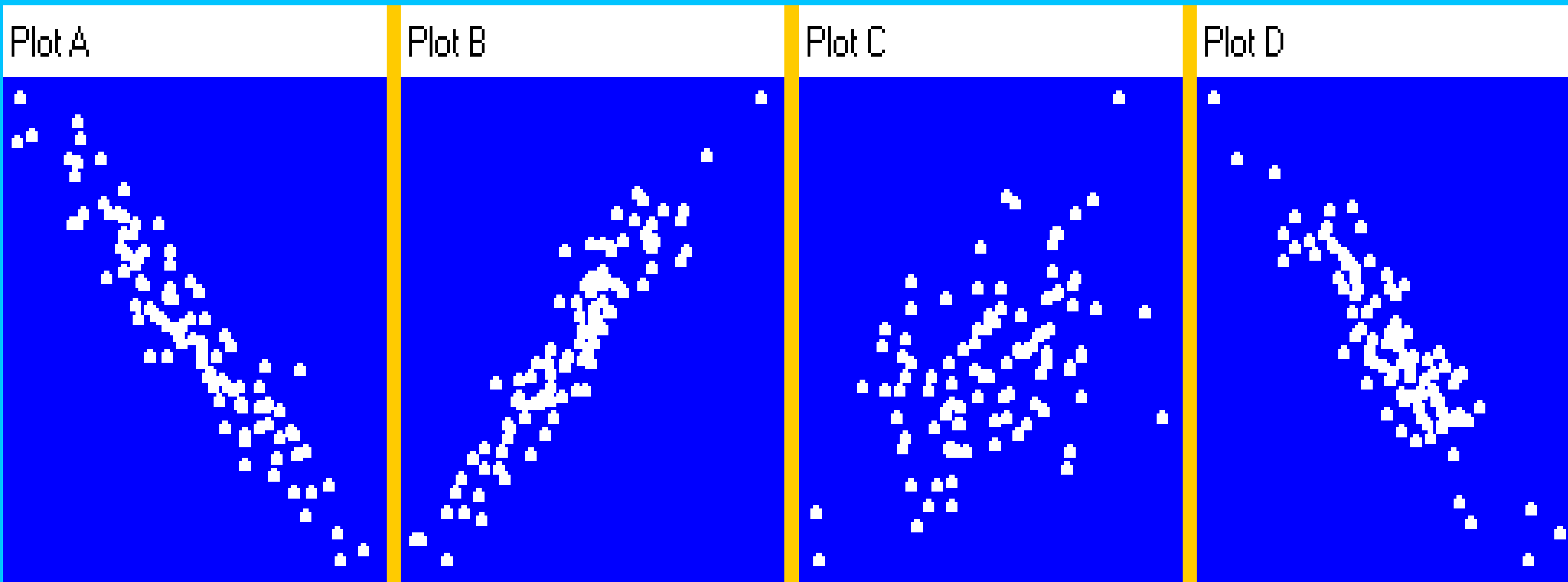
Calculating Correlation Coefficient

$$r=\frac{(6)(129)-(32)(32)}{\sqrt{\left(6(230)-32^2\right)\left(6(204)-32^2\right)}}=\frac{774-1024}{\sqrt{(356)(200)}}=-.94$$

r = - 0.94

Indirect strong correlation

exercise



r = -0.95	A	B	C	D
r = -0.9	A	B	C	D
r = 0.49	A	B	C	D
r = 0.93	A	B	C	D

Thank You