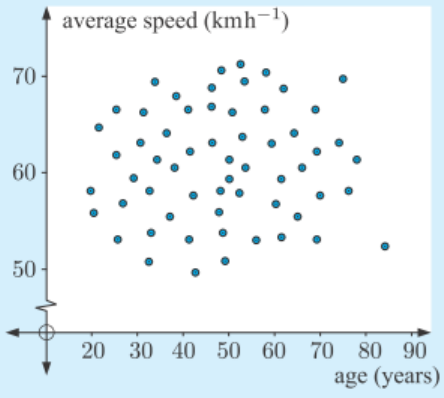
Positive correlation		Negative correlation	
$r = 1$	perfect positive correlation	$r = -1$	perfect negative correlation
$0.95 \leqslant r < 1$	very strong positive correlation	$-1 < r \leqslant -0.95$	very strong negative correlation
$0.87 \leqslant r < 0.95$	strong positive correlation	$-0.95 < r \leqslant -0.87$	strong negative correlation
$0.5 \leqslant r < 0.87$	moderate positive correlation	$-0.87 < r \leqslant -0.5$	moderate negative correlation
$0.1 \leqslant r < 0.5$	weak positive correlation	$-0.5 < r \leqslant -0.1$	weak negative correlation
$0 \leqslant r < 0.1$	no correlation	$-0.1 < r \leqslant 0$	no correlation

Example 1 **Self Tutor**

The Department of Road Safety wants to know if there is any association between *average speed* in the metropolitan area and the *age of drivers*. They commission a device to be fitted in the cars of drivers of different ages.

The results are shown in the scatter diagram.
The r-value for this association is $+0.027$.
Describe the association.



As r is close to zero, there is no correlation between the two variables.

We observe this in the graph as the points are randomly scattered.

Example 2

Self Tutor

The Botanical Gardens have been trying out a new chemical to control the number of beetles infesting their plants. The results of one of their tests are shown in the table.

Sample	*Quantity of chemical* (g)	*Number of surviving beetles*
A	2	11
B	5	6
C	6	4
D	3	6
E	9	3

a Draw a scatter diagram of the data.

b Determine Pearson's correlation coefficient r.

c Describe the correlation between the *quantity of chemical* and the *number of surviving lawn beetles.*

We first enter the data into separate lists:

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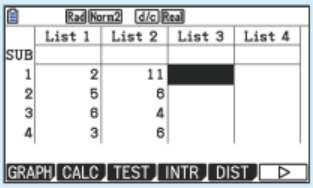

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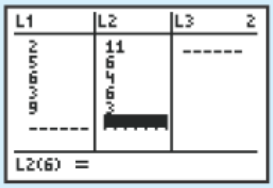

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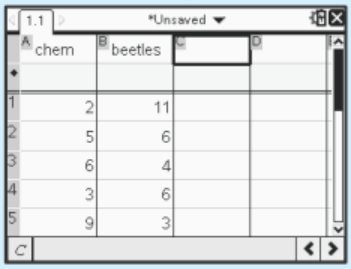

a

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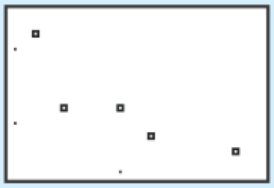

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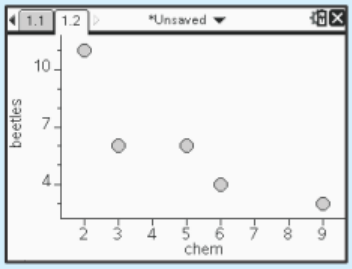

b

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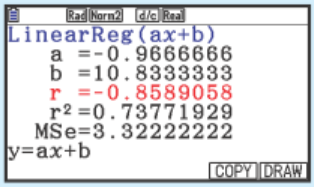

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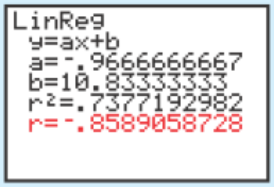

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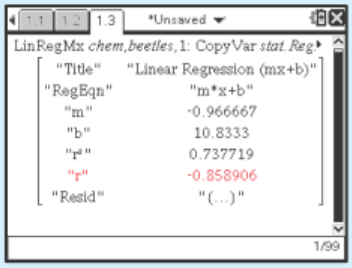


So, $r \approx -0.859$.

c There is a moderate, negative correlation between the *quantity of chemical used* and the *number of surviving beetles.*

In general, the more chemical that is used, the fewer beetles that survive.

Example 3

Self Tutor

Sue investigates how the volume of water in a pot affects the time it takes to boil on the stove. The results are given in the table.

Find and interpret Pearson's correlation coefficient between the two variables.

Pot	*Volume* (x L)	*Time to boil* (y min)
A	1	3
B	2	5
C	4	7
D	5	9

	x	y	$x-\overline{x}$	$y-\overline{y}$	$(x-\overline{x})(y-\overline{y})$	$(x-\overline{x})^2$	$(y-\overline{y})^2$
	1	3	-2	-3	6	4	9
	2	5	-1	-1	1	1	1
	4	7	1	1	1	1	1
	5	9	2	3	6	4	9
Totals:	12	24			14	10	20

$\therefore\ \overline{x} = \dfrac{\sum x}{n}$ $\qquad \overline{y} = \dfrac{\sum y}{n}$ $\qquad r = \dfrac{\sum(x-\overline{x})(y-\overline{y})}{\sqrt{\sum(x-\overline{x})^2 \sum(y-\overline{y})^2}}$

$= \dfrac{12}{4}$ $\qquad = \dfrac{24}{4}$ $\qquad = \dfrac{14}{\sqrt{10 \times 20}}$

$= 3$ $\qquad = 6$ $\qquad \approx 0.990$

There is a very strong correlation between the *volume of water* and the *time for the water to boil*. As the volume of water increases, so does the time required.

Example 4

Self Tutor

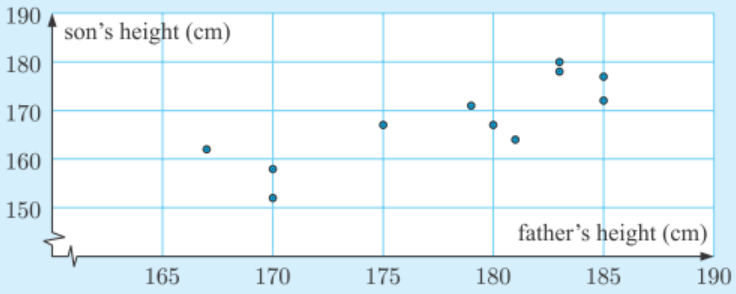
At a father-son camp, the heights of the fathers and their sons were measured.

Father's height (x cm)	175	183	170	167	179	180	183	185	170	181	185
Son's height (y cm)	167	178	158	162	171	167	180	177	152	164	172

a Draw a scatter diagram of the data.

b Calculate r^2 for the data and interpret its value.

a



b Using technology, $r^2 \approx 0.683$.

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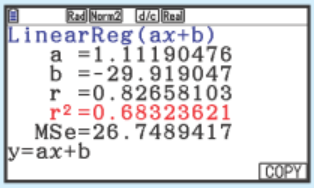

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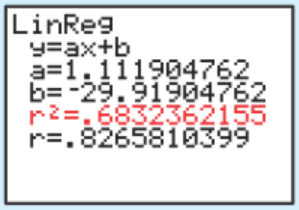

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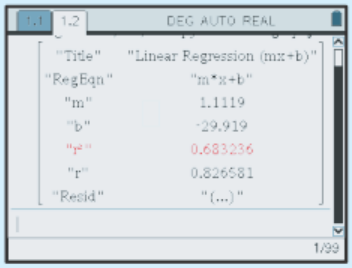

68.3% of the variation in the son's height can be explained by variation in the father's height.