How linear?

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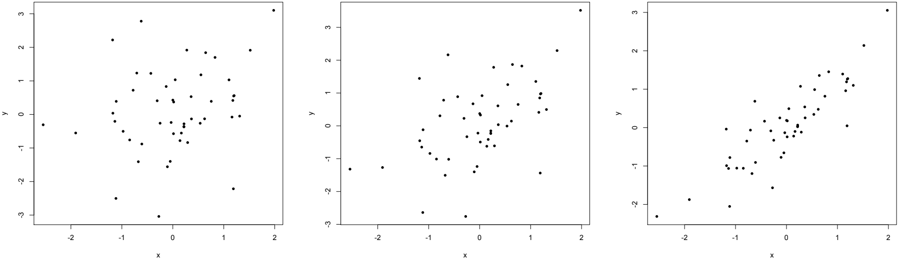

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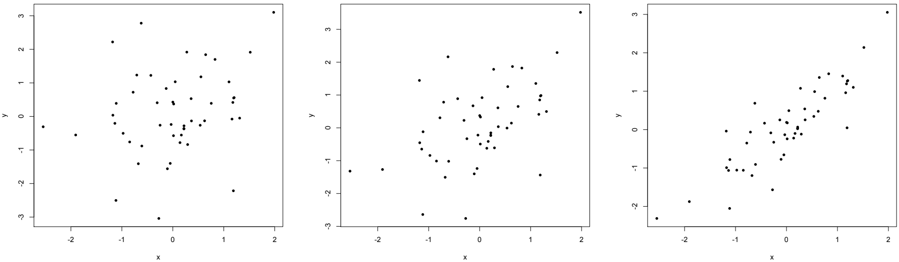

correlation coefficient (r): a number between -1 and 1; it measures **linear association,** that is, how tightly the points are clustered about a straight line.

Example

Data:

(1, 2)
(2, 3)
(3, 1)
(4, 6)
(5, 6)

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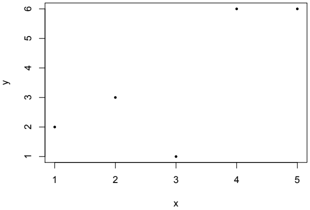

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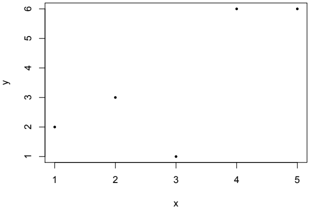

Expect r to be positive but not 1.

Calculating r

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x	y	x in std. units	y in std. units	**product of std. units**
1	2	-1.41	-0.78	1.10
2	3	-0.71	-0.29	0.21
3	1	0	-1.26	0
4	6	0.71	1.16	0.82
5	6	1.41	1.16	1.64
mean = 3	mean = 3.6			**mean = 0.75**
SD = 1.41	SD = 2.06			**= r**

The formula in two languages

Formula for r

1. Convert both lists to standard units.
2. Multiply corresponding pairs of standard units.
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For those who like math notation and have read the algebra supplement:

If the data are (x_i, y_i), $1 \leq i \leq n$, then

$$r = \frac{1}{n} \sum_{i=1}^{n} \left(\frac{x_i - \mu_x}{\sigma_x} \right) \left(\frac{y_i - \mu_y}{\sigma_y} \right)$$

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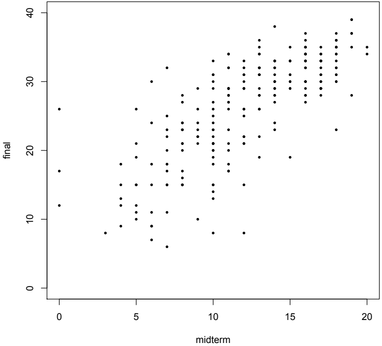
3. It doesn't matter if you **switch the variables x and y; r stays the same.**

Switching axes doesn't affect linearity



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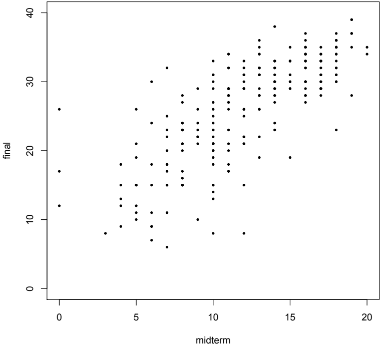

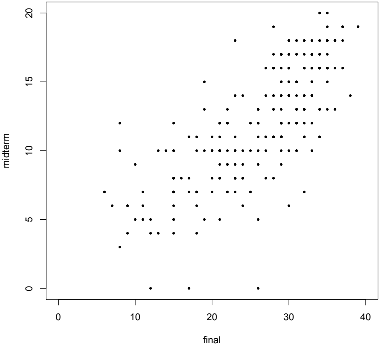

Linear transformations

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5. **Multiplying one the lists by a positive constant** does not change standard units, so r **stays the same.**

6. **Multiplying just one (not both) of the lists by a negative constant** switches the signs of the standard units of that variable, so r **has the same absolute value but its sign gets switched.**