Multivariate descriptives

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1. Two scale variables
2. Categorical and scale variable
3. Two categorical variables

Correlation

Two variables are correlated when the variance in one variable coincides with variance in another variable.

- **Positive correlation**: high values in one variable coincide with high values in another variable.
- **Negative correlation**: high values in one variable coincide with low values in another variable.

Causation

Slightly simplified, for X to be a cause of Y, we generally require:

1. X to precede Y
2. X to correlate with Y (either positively or negatively)
3. no other factor to explain the correlation between X and Y (no **confounding factor**)

Causation: terminology

If X causes Y,

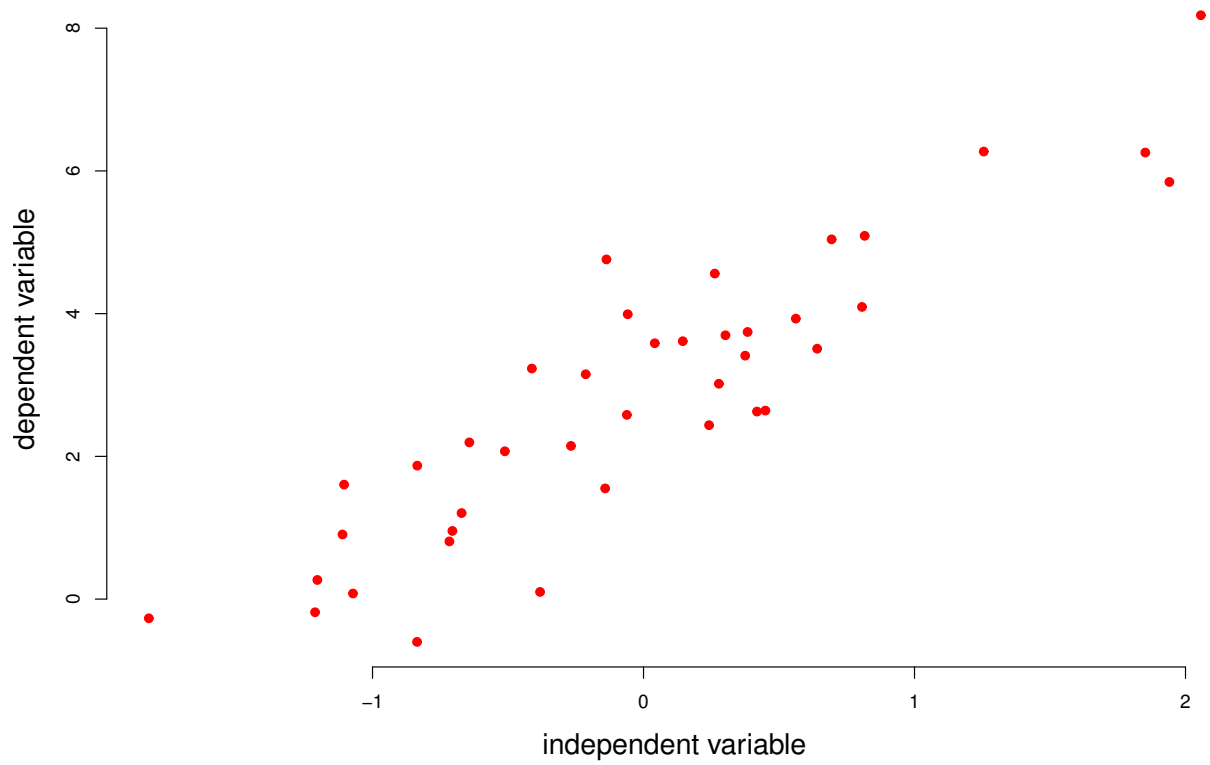
- Y is called the **dependent variable**, or **outcome variable**, or **response**, or . . . ;
- X is called the **independent variable**, or **explanatory variable**, or **factor**, or . . . .

In political science, most common (unfortunately) is the usage of the terms independent and dependent variables.

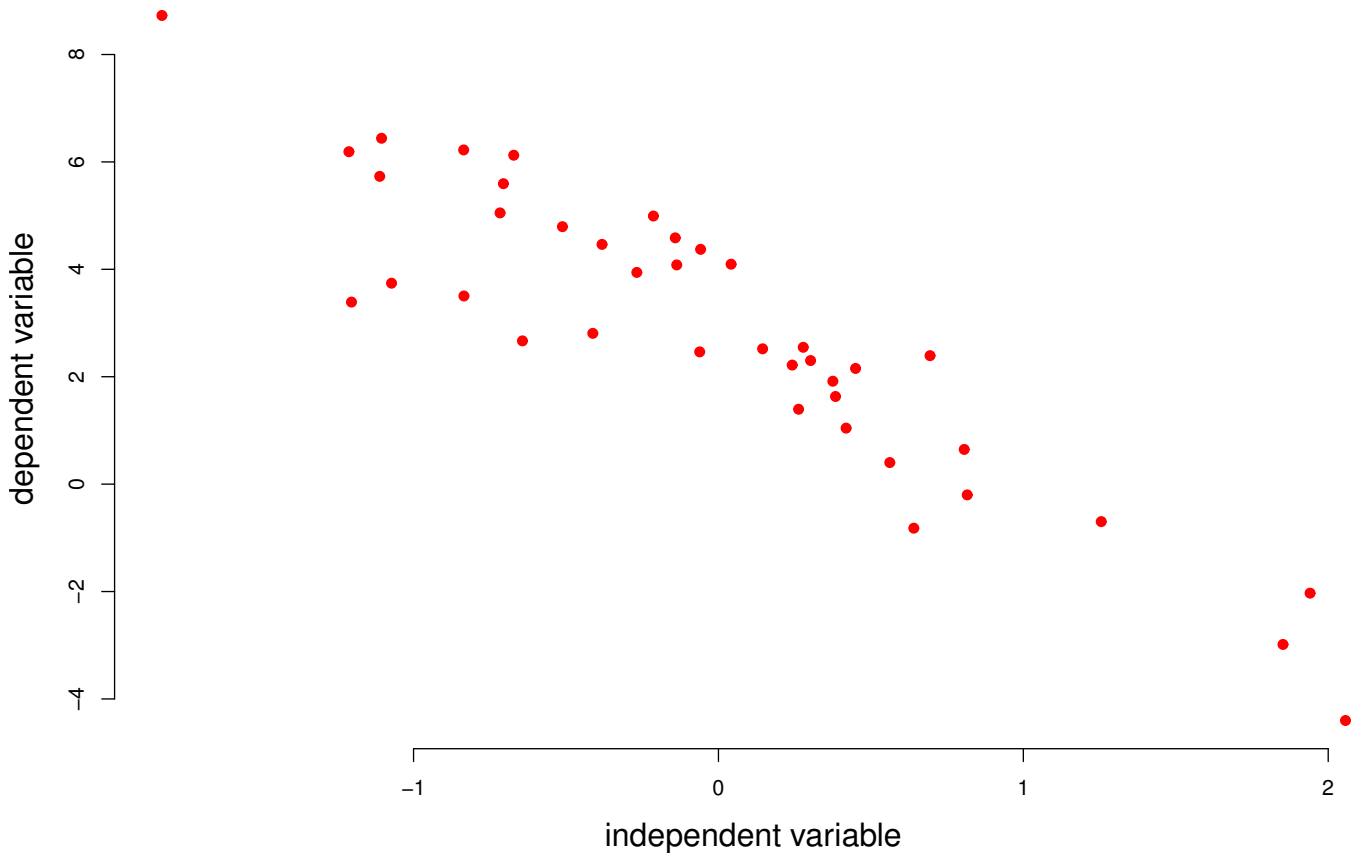
Outline

Scatter plot

The relationship between two continuous variables is most easily displayed using a scatter plot.



Scatter plot



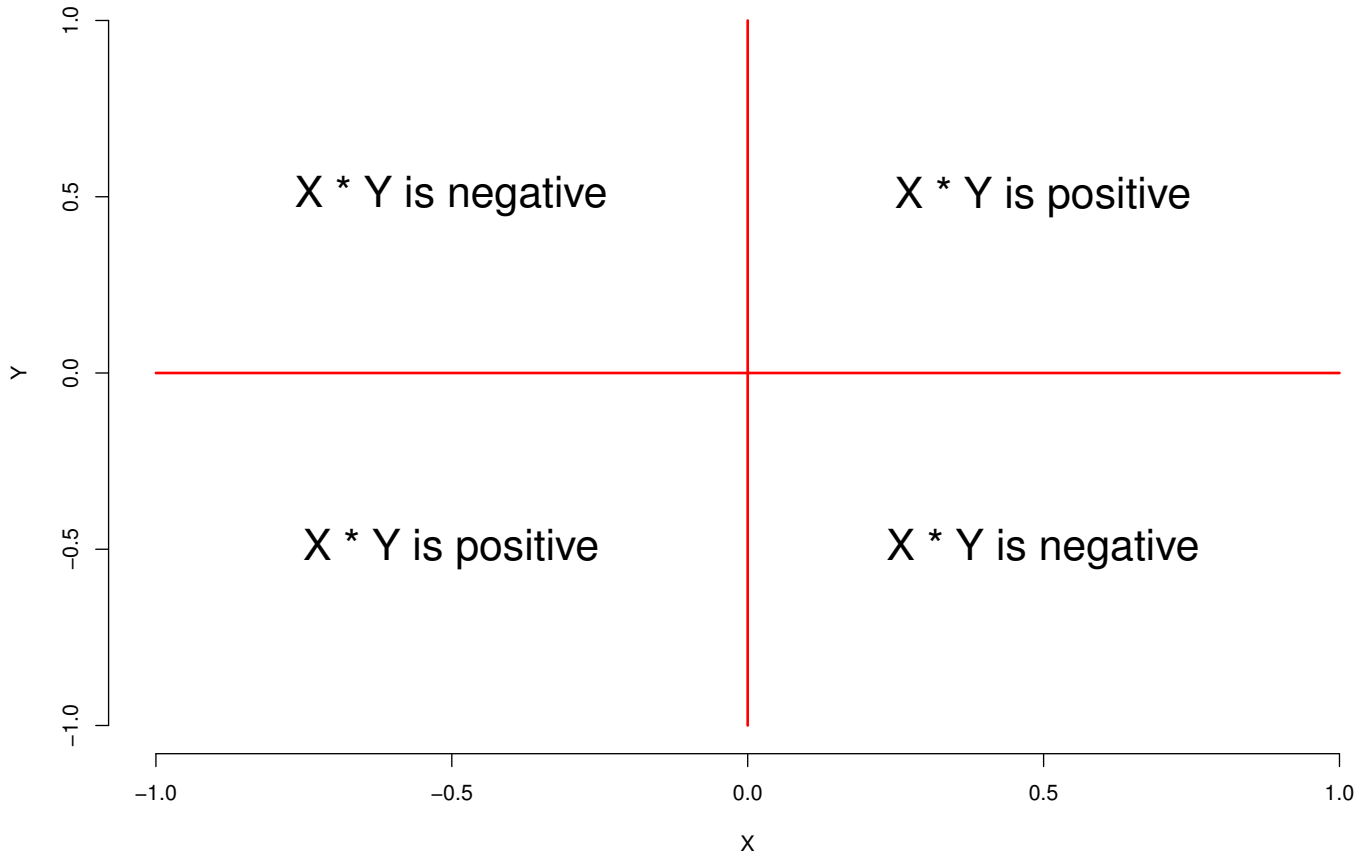
Covariance

$$Var(x) = s^2 = \frac{\sum_{i=1}^{N}(x_i - \bar{x})^2}{N}$$

$$Cov(x, y) = \frac{\sum_{i=1}^{N}(x_i - \bar{x})(y_i - \bar{y})}{N}$$

- Unbounded - size depends on variance in x and y
- Positive correlation: $Cov(x, y) > 0$
- Negative correlation: $Cov(x, y) < 0$

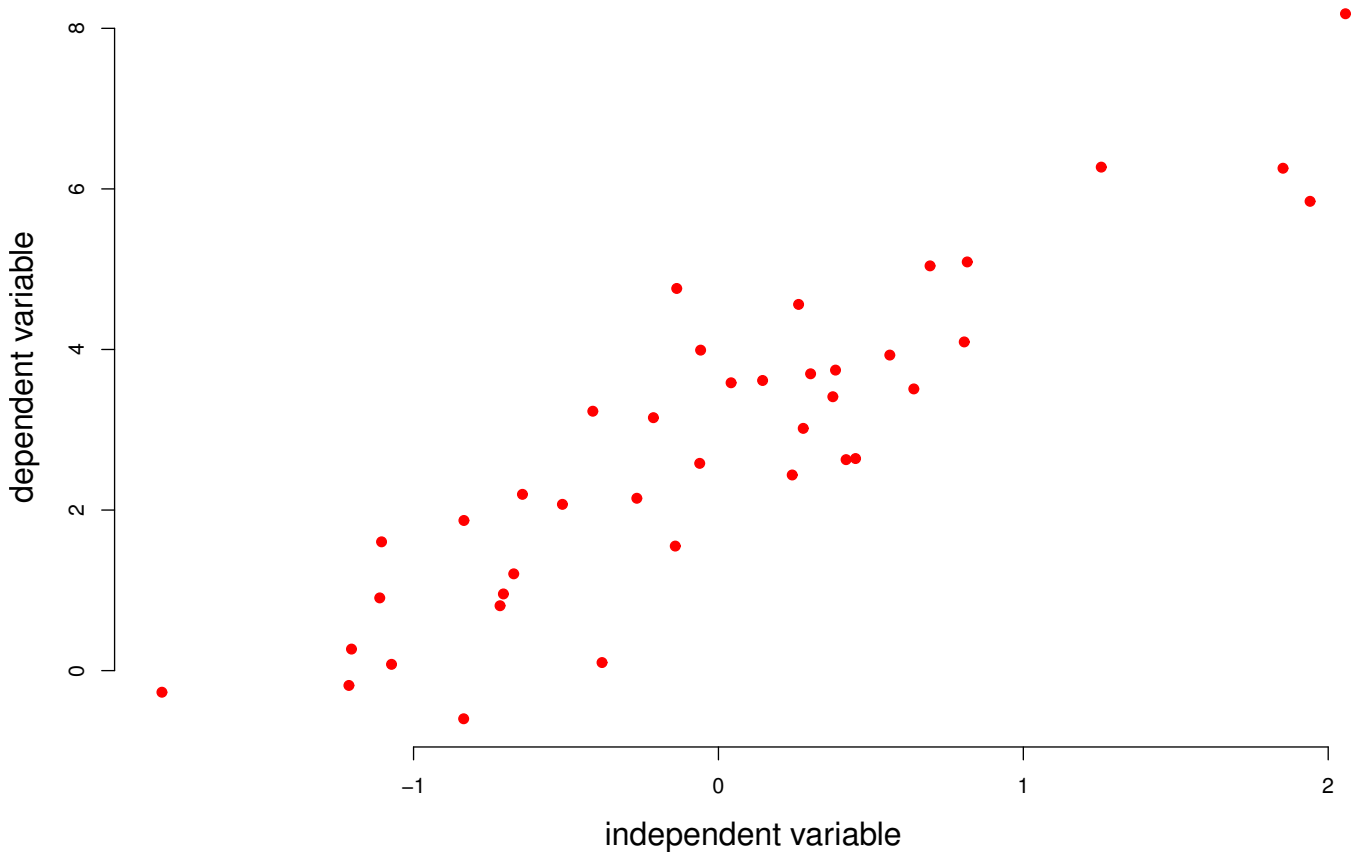
Covariance: intuition



Pearson correlation

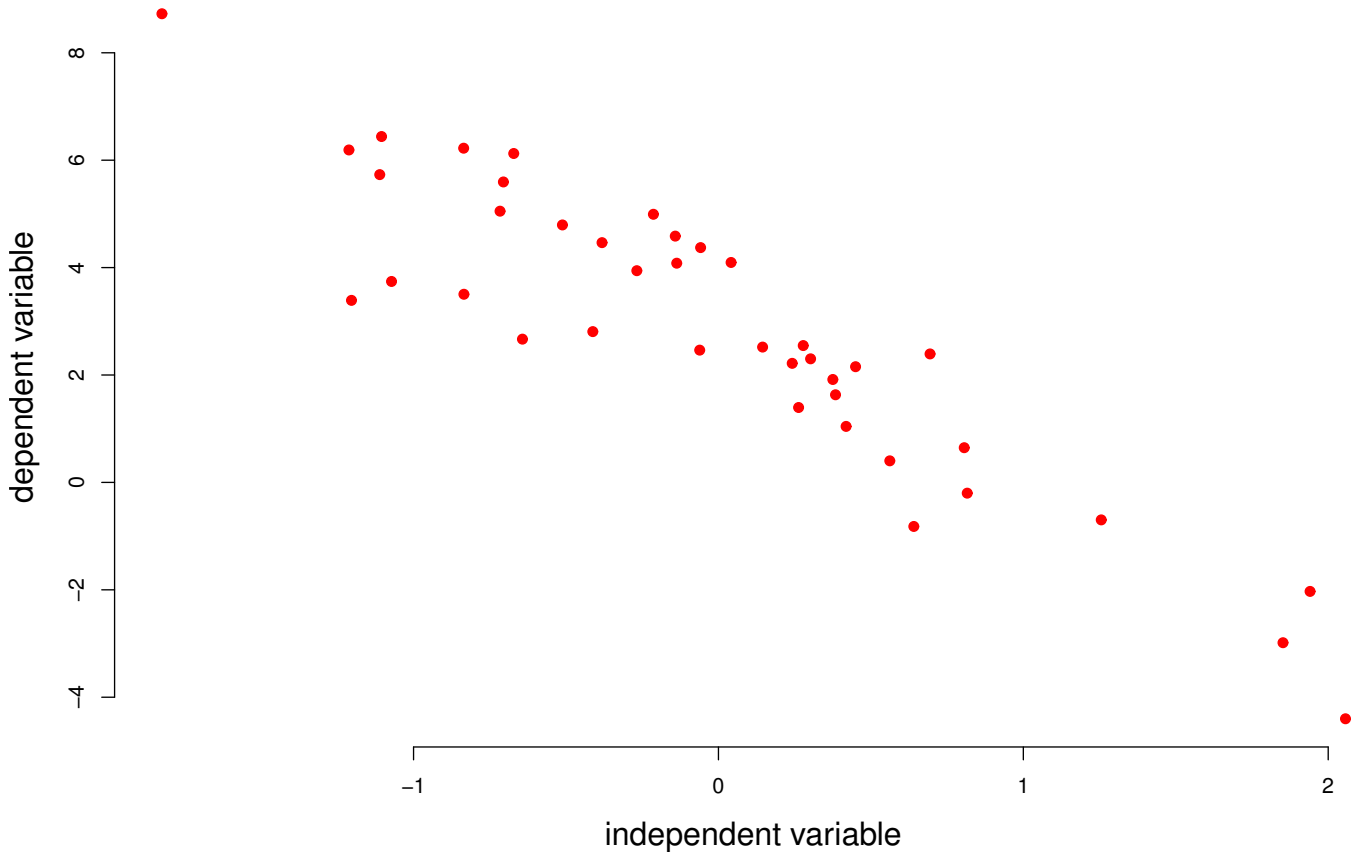
$$r_{xy} = \frac{Cov(x,y)}{s_x s_y} = \frac{\sum_{i=1}^{N}(x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\sum_{i=1}^{N}(x_i - \bar{x})^2} \cdot \sqrt{\sum_{i=1}^{N}(y_i - \bar{y})^2}}$$

- Bounded between -1 and 1
- Positive correlation: $r > 0$
- Negative correlation: $r < 0$



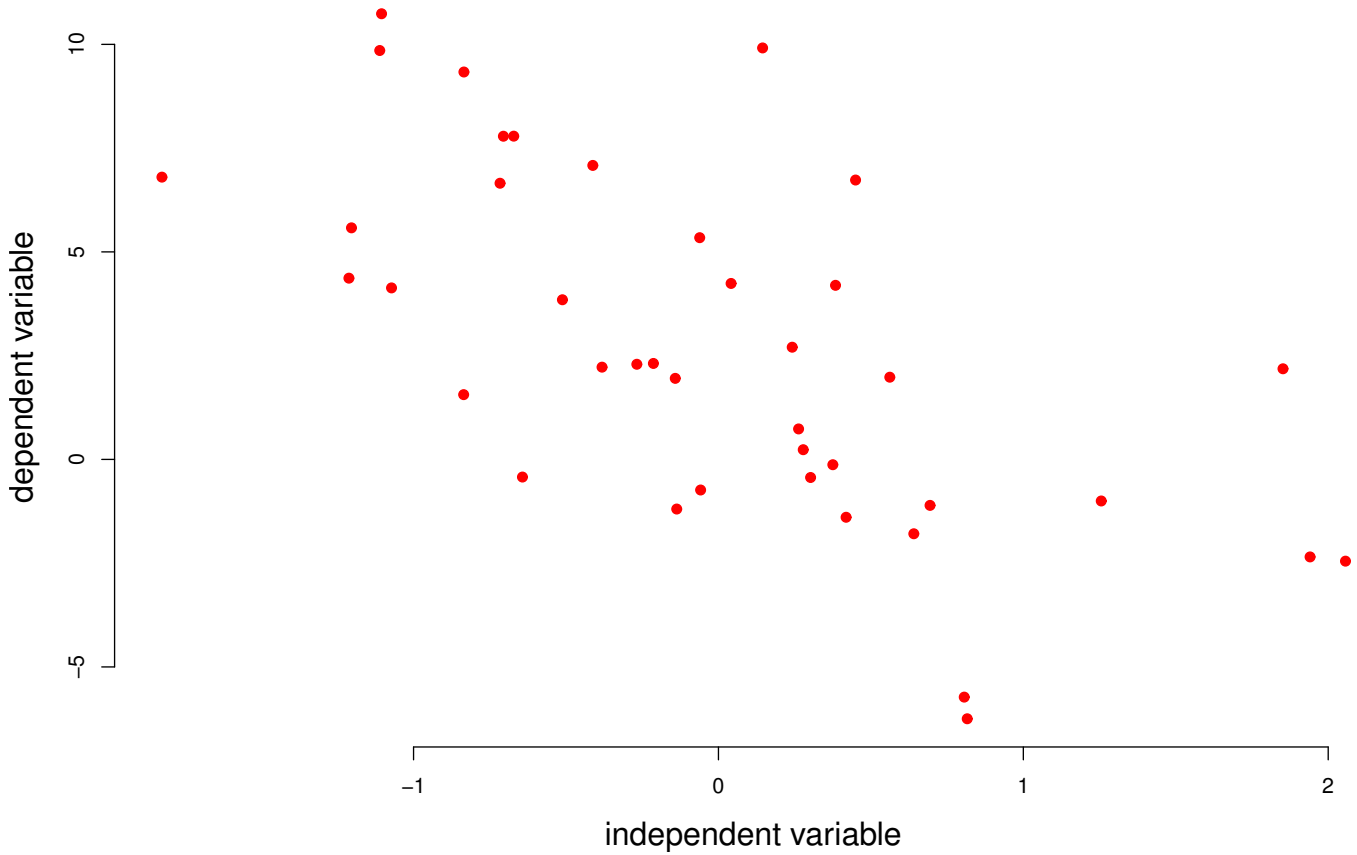
$Var(x) = 1.17$ $Var(y) = 4.95$

$Cov(x, y) = 2.15$ $Cor(x, y) = 0.89$



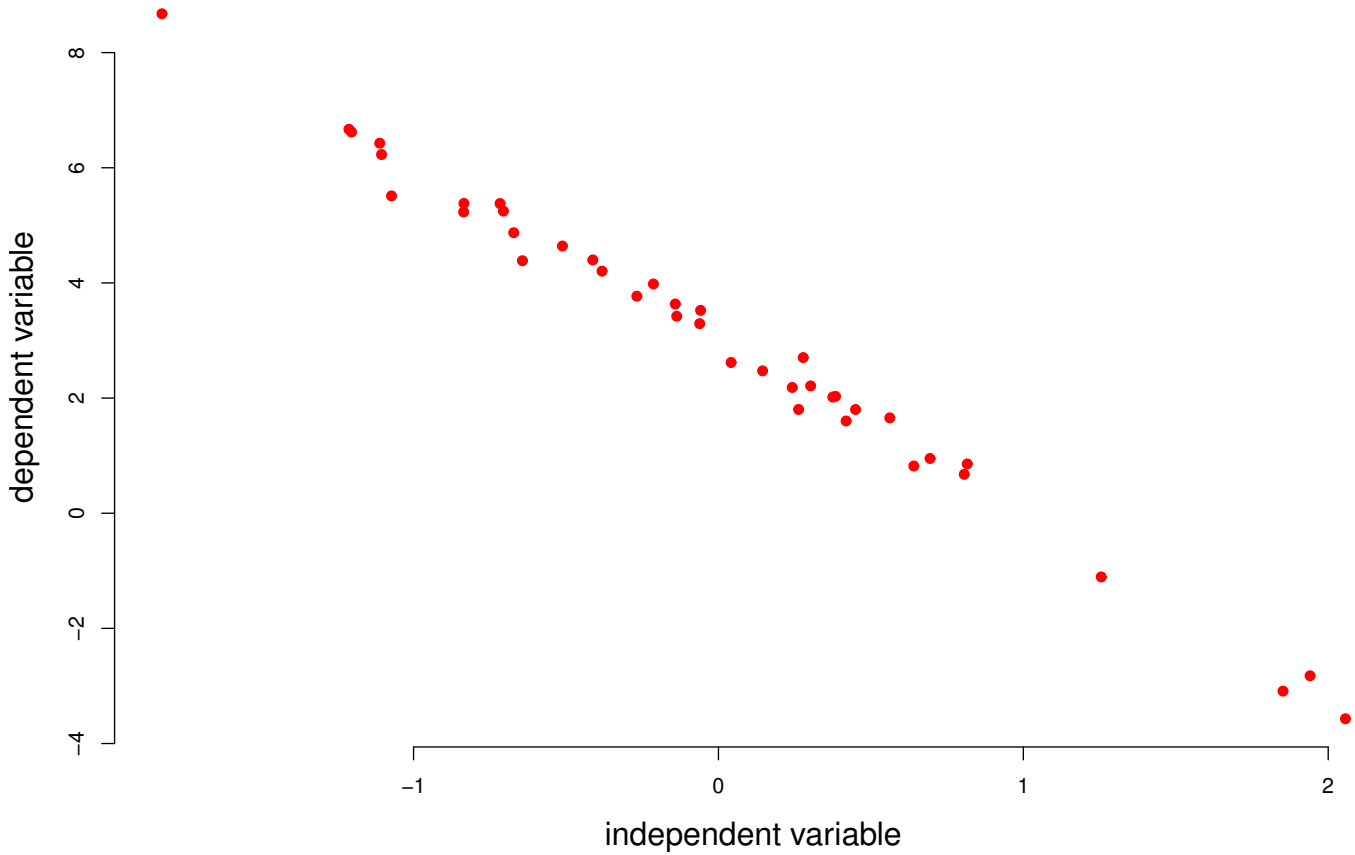
$Var(x) = 1.17$ $Var(y) = 10.60$

$Cov(x, y) = -3.35$ $Cor(x, y) = -0.95$



$Var(x) = 1.17$ $Var(y) = 26.80$

$Cov(x, y) = -4.21$ $Cor(x, y) = -0.75$



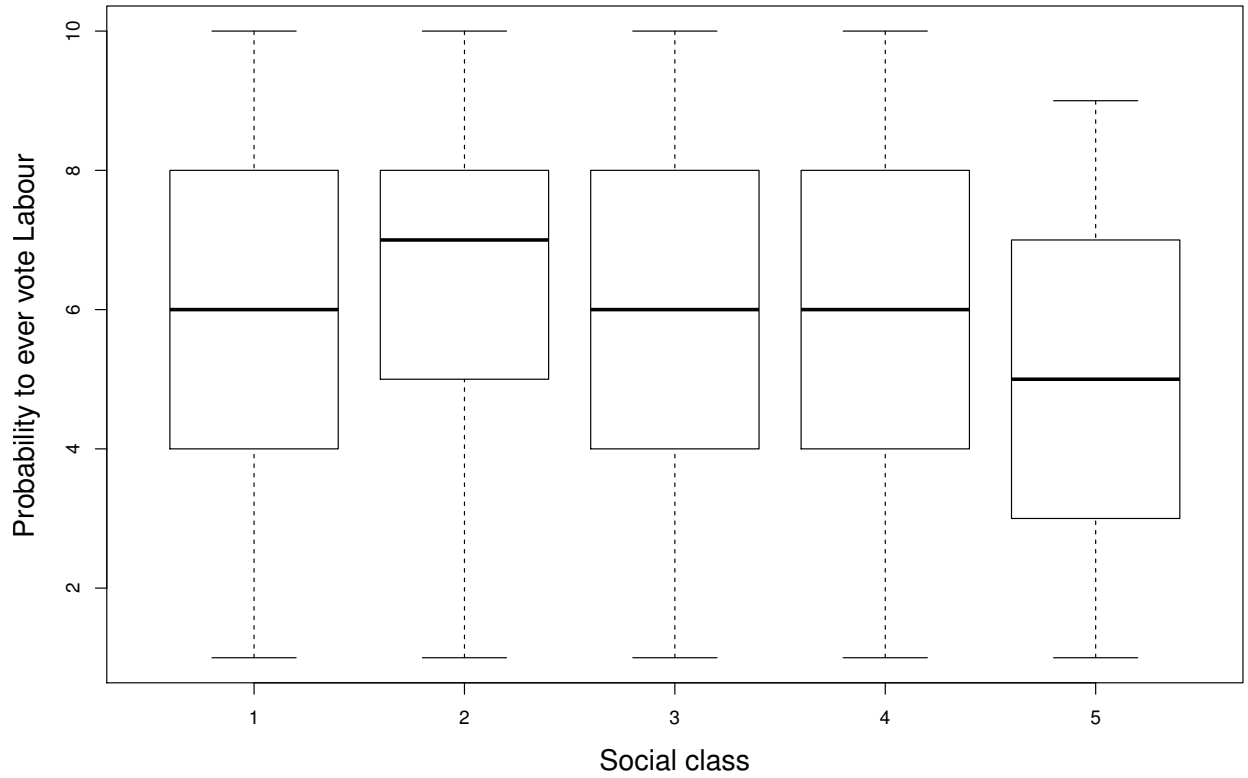
$Var(x) = 1.17$ $Var(y) = 10.90$

$Cov(x, y) = -3.58$ $Cor(x, y) = -0.99$

Outline

Box plots

One way to graphically look at the relation between a categorical and a scale variable is the use of multiple box plots next to each other.



Outline

Example: English parliament

Data from a vote in 1844 to reduce the working day for children to 10 hours.

party	count	perc.	vote	count	perc.
liberals	150	39%	yes	194	50.4%
conversatives	235	61%	no	191	49.6%
total	385			385	

(http://www.let.leidenuniv.nl/history/RES/stat/html/les9.html)

Example: English parliament

	yes	no	total
liberals	94	56	150
conservatives	100	135	235
total	194	191	385

Exercise: calculate row and column percentages.

Which are more appropriate?

(`http://www.let.leidenuniv.nl/history/RES/stat/html/les9.html`)