Statistical tests

Intro to Statistical Inference Part 2

Chuvakin Sergey

«School of Advanced Studies»

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Outline

- Compare more than two groups
- Chi-squared test
- Correlations

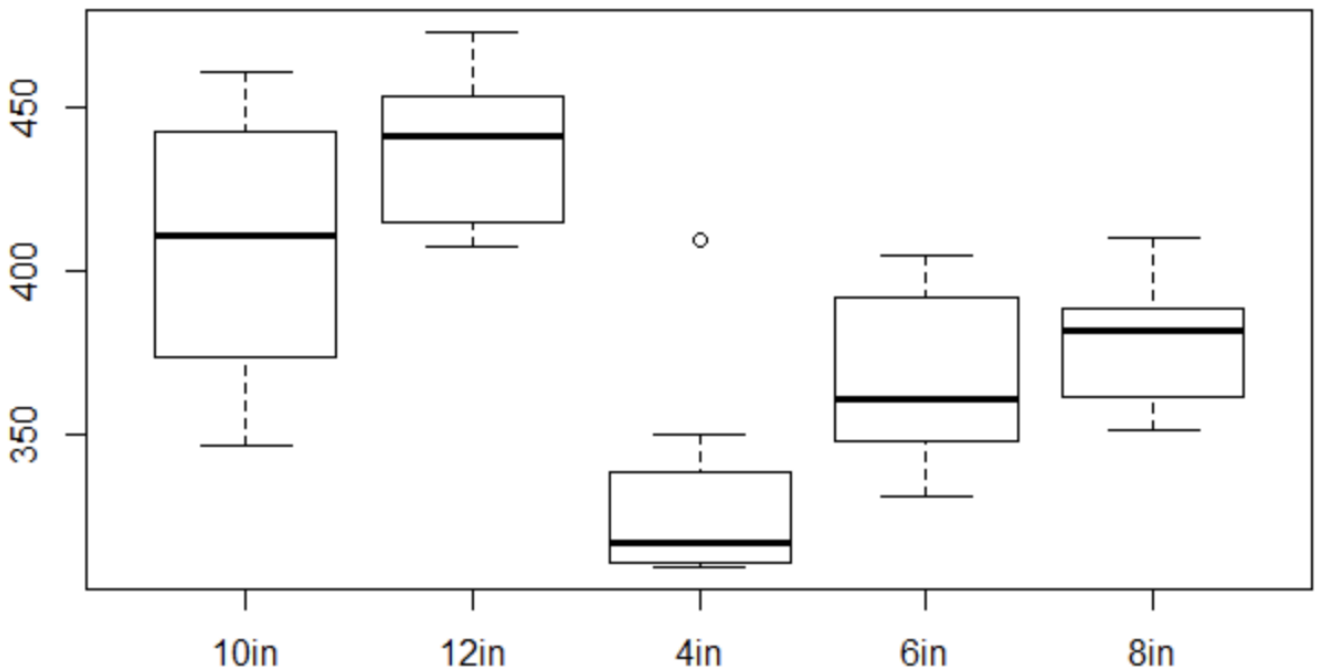
Compare more than two groups

ANOVA - ANalysis Of VAriance - statistics that help to point out the difference between two or more groups. Detailed information here

⚠ Variances of groups should be homogenious
⚠ The post hoc test is required

Compare more than two groups

Post hos test - is a test that usually conducted after analysis («post hoc»), to precise inferences. I.e. it could be box plots!



Chi-Square test

χ^2 - Popular statistics to test if matrix has non uniform distribution.
It return Chi square that can be easily transformed to P-value.
Let's use example for explanation!

H0 - Gender and preference for cats or dogs are independent.
H1 - Gender and preference for cats or dogs are not independent.

Chi-Square test

	Cat	Dog
Men	207	282
Women	231	242

Chi-Square test

	Cat	Dog	
Men	207	282	489
Women	231	242	473
	438	524	962

Chi-Square test

	Cat	Dog	
Men	$\frac{489 \times 438}{962}$	$\frac{489 \times 524}{962}$	489
Women	$\frac{473 \times 438}{962}$	$\frac{473 \times 524}{962}$	473
	438	524	962

Chi-Square test

	Cat	Dog	
Men	222.64	266.36	489
Women	215.36	257.64	473
	438	524	962

Chi-Square test

Subtract expected from observed, square it, then divide by expected:
In other words, use formula

$$\frac{(O-E)^2}{E}$$

where:

O = Observed (actual) value
E = Expected value

Chi-Square test

	Cat	Dog	
Men	$\frac{(207-222.64)^2}{222.64}$	$\frac{(282-266.36)^2}{266.36}$	489
Women	$\frac{(231-215.36)^2}{215.36}$	$\frac{(242-257.64)^2}{257.64}$	473
	438	524	962

Which gets us:

	Cat	Dog	
Men	1.099	0.918	489
Women	1.136	0.949	473
	438	524	962

Chi-Square test

Now add up those calculated values:
$1.099 + 0.918 + 1.136 + 0.949 = 4.102$
Chi-Square is 4.102
Than look into table here.
Make inference!

Correlation

Correlation - is the most popular way to answer the question: what is the relation between two variables. It returns metrics between 0 and 1 that shows how two vector move together. It's standartized version of covariance

- Reference point: cov x,y=0 means X and Y have nothing incommon
- Positive covariance values indicate positive association: the bigger X the bigger Y
- Negative covariance values indicate negative association: thebigger X the smaller Y

Correlation

One of the assumtions of correlation is - variables whould be measured in one space. For example we can compare number of death per capita and per 100 000.

Standardization is a general method of transforming inputvariables (e.g. X or Y) or some statistical measures of interest(e.g. covariance coefficient) in a way that eliminates scale effects.

E.g., standardizing a normally distributed variable means converting it to the standard normal distribution (with zero mean and unit standard deviation). After standardization, this variable is no longer measured in meters, years, or dollars, but in standard deviations

Correlation

Generic standardization formula (Z-score formula):

$$z_i = \frac{x_i - \hat{x}}{\sigma_x}$$

Covariance

$$Cov(X, Y) = E[(X - \mu_x)(Y - \mu_y)]$$

Correlation

$$r = \frac{cov_{x,y}}{\sigma_x \times \sigma_y}$$

Correlation

Correlation

Assumptions

- Continious variables
- Normal distribution

Correlation

Assumptions

Otherwise use non-parametric alternatives!

- Spearman's ρ (also reads as rho)
- Kendall's τ (reads as tau)
- Interpretation is pretty much the same as with Pearson's r:same effect size cut-offs, same p-value thresholds
- Use the method = argument of cor() or cor.test to choose a relevant correlation coefficient (three options: pearson(default), spearman, and kendall, all should be typed inlower case)