Tests of hypotheses

(I) TESTS WITH ONE SAMPLE

Parametric tests (normality required)

- **expectation** (known × unknown variance) - test of true average
  Ex: *A company declares that its production is more than 150 products per day. Somebody opposes and says that it is less.*
  Prg: **Parametric|Test for Population Mean ...** (solves both z-test and t-test in the Results window)

- **proportion** - test of a part from the whole
  Ex: *City manager says that only 5% of drivers exceed the permitted speed at certain street. Police is convinced that the ratio is higher.*
  Prg: **Categorical|One Sample Proportion Test ...**

- **variance** - test of variability of a variable
  Ex: *Quality of production is given by the dispersion of weight of products is. If it is higher then a given level, the machines must be adjusted. Test, if the machines are OK or it is necessary to tune them.*
  Prg: **Parmetric|Chi-Square Test for Variance ...**

Nonparametric tests (normality is not required)

- **Wilcoxon test**: tests median of rv from one sample
  – H0: median is equal to the assumed value
  – test is all sided
  Ex: *Compare caloric intake measured at 11 selected women with the recommended value 7725 kJ.*
  Prg: **Nonparmetric|One Sample|Wilcoxon Signed-Rank Test ...**

Tests of distribution type

- **test of normality**
  – H0: rv is normal
  Prg: **Parametric|Normality Tests** ... and select one

- **Kolmogorov-Smirnov test**: tests given distribution. It is based on comparison of assumed and empirical DF.
  – H0: rv has assumed distribution
  – right sided test with special crit. vals
  Prg: **Nonparametric|Two Samples (Unpaired)|Kolmogorov-Smirnov Test ...**

- **Chi-square test of homogeneity**: test of distribution type. It compares observed and expected frequencies.
  – H0: rv has the assumed distribution
  – right sided test
  Ex: *We have measured number of accidents for week days and weekends. Test if they are*

uniformly distributed.
Prg: **Categorical|Chi-Square Homogeneity Test ...**

(II) TESTS WITH TWO SAMPLES

Parametric

- **two expectations** (independent × paired samples)
  Ex (indep): *Company A claims that its production is greater than that of B. Assistant of company B denies it. Test. ...* how to determine the side.
  Prg: **Parametric|Test for Two Population Means|t-Test (Independent Samples) ...**
  Ex (paired): *Uniformity of tire removal at the front wheels of cars of a specific mark has been investigated. The producer of the cars proclaims uniformity. Test it.*
  Prg: **Parametric|Test for Two Population Means|Paired t-Test**

- **two proportions**
  Ex: *Ratio of drivers violating rules in town is greater than outside. Test it.*
  Prg: **Categorical|Two Sample Proportion Test ...**

- **two variances**
  Ex: *Variability of weights of products from company A is greater than those, from company B. Test it.*
  Prg: **Parametric|Bartlett's Test for Variances ...**

Nonparametric

- **Mann-Whitney test**: tests equality of two medians (independent samples)
  − H0: the medians are equal
  − both sided test
  Ex: *Marks form math were checked at two classes of secondary school. 5 marks from the first and 8 marks from the second class were recorded. Compare the classes.*
  Prg: **Nonparametric|Two Samples (Unpaired)|Mann-Whitney U Test**

- **Wilcoxon test**: tests two medians (paired samples)
  − H0: medians are equal
  − all sided test
  Ex: *At a secondary school an improvement of students in math was checked. In the 1st class eight students were selected and their marks recorded. In the 2nd class the marks of the same students were recorded again. Test, if the results of individual students are improved.*
  Prg: **Nonparametric|Two Samples (Paired)|Wilcoxon Signed-Rank Test ...**

- **McNemar test**: tests improvement after some action. Data are yes/no - two by two table of frequencies.
  − H0: no improvement
  − right sided
  Ex: *22 selected people were tested for cold (yes/no). Then, they received some drug and after a week they were tested again. Test the effectiveness of the drug.*
  Prg: **Categorical|McNemar Test**

(III) Tests with more samples

Parametric

- **analysis of variance**: tests equality of several expectations
  − H0: expectations are equal
  − right sided test
  Ex: *Test if the power of engine of vehicles of five marks is the same.*
  Prg: **Parametric|Analysis of Variance|One-Way ANOVA ...**

- **anova with two factors**: tests equality in columns and rows.
  Ex: *Five cars are tested by three drivers. Test the cars and the drivers.*
  Prg: **Parametric|Analysis of Variance|Two-Way ANOVA (no replication) ...**

- **Bartlett test** - test of equality of more variances
  Prg: **Parametric|Bartlett's Test for Variance ...**

Nonparametric

- **Kruskal-Wallis test**: nonparametric anova.
  − H0: medians are equal
  − right sided test
  Ex: as for anova1
  Prg: **Nonparametric|Three or More Samples|Kruskal-Wallis H Test ...**

- **Friedman block test**: equality of medians
  − H0: medians are equal
  − test is right sided
  Ex. *5 shops are rated by 3 inspectors (each shop is rated by each inspector; inspectors are factors of no interest = block). Evaluate quality of the shops.*
  Prg: **Nonparametric|Block Design|Friedman Test ...**

(IV) Tests of independence

- **Test of association** of two discrete random variables.
  Ex: *We measure speed and consumption on driven cars. Is there a relation between these two variables?*
  Prg: **Categorical|Measure of Association ...**

- **Pearson test**: tests independence of two rvs. It tests correlation coefficient. (parametric test)
  − H0: rvs are independent
  − test is both sided
  Ex: *Test the data x and y if they are suitable for linear regression.*
  Prg: **Parametric|Pearson Correlation ...**

- **Spearman test**: nonparametric Pearson. Works with ranks.
  − H0: rvs are independent
  − test is both sided
  Prg: **Nonparmetric|Correlation|Spearman Rank Correlation Test ...**

- **Chi-square test of independence**: test if independence of two rvs. Compares observed and expected frequencies. Based on the definition of independence $f(x, y) = f(x) f(y)$.
  - H0: rvs are independent
  - test is right sided.

  Ex: *We asked 200 people from three different areas about they pay (low, normal, high). Test if the pay depends on the area.*

  Prg: **Categorical|Chi-Square Independence Test ...**