

## Messages

## Nonparametric Tests

- **Nonparametric** means:
  - Rank tests,
  - Nonparametric Regression
  - distribution free (goodness of fit tests)
- Nonparametric Analysis of Variance:
  - Simple Anova = more than 2 samples → **Kruskal-Wallis**
  - Block design = matched samples → Friedman-T.
- Goodness of fit tests:
  - Kolmogorov (-Smirnov) test: very nice in theory
  - **Chisquared test (definition of classes!)** good for practice
  - Skewness and Kurtosis

## Messages

## Randomization tests

- Randomization tests keep the level exactly, without any assumptions on the distribution!
- The test statistic can be arbitrarily complicated. Choice bases on (informal) consideration of power. Use robust test statistic (possibly based on ranks)!
- Confidence intervals can be constructed.

## Messages

## Asymptotics 1

- New Concepts:
  - **Functional**  $T\langle F \rangle$ ,  $T\langle \hat{F}_n \rangle$
  - M estimator  $\int \underline{\psi}\langle \underline{x}, \underline{\theta} \rangle dF\langle \underline{x} \rangle = 0$
- Law of Large Numbers:
  - $\hat{\theta} \rightarrow \theta$  für  $n \rightarrow \infty$ .
  - $\hat{F}_n \rightarrow F$   $T\langle \hat{F}_n \rangle \rightarrow T\langle F \rangle$ .
- **Influence Function** measures the influence of an observation at  $x$  on the estimator (functional).
- Gross Error Model  $G = (1 - \varepsilon)F + \varepsilon H$  often  $H = \Delta_x$ .

## Messages

## Asymptotics 2

- Central Limit Theorem for sums and means  

$$\bar{X} \approx \mathcal{N}(\mu, (\sigma/\sqrt{n})^2)$$
- for functionals:  $T\langle \hat{F}_n \rangle \approx \mathcal{N}\langle T\langle F \rangle, v/n \rangle$   
 $v$  asymptotic variance, given by Influence Function  

$$v = \mathcal{E} \langle \text{IF}\langle X; T, F \rangle^2 \rangle.$$
- Likelihood Ratio Test: differences of  $2 \times \log$ -likelihood between nested models is  $\chi^2$  distributed.
- **Robustness:** Bounded Influence Function and a breakdown point that is not too small.