Seminar 8

Checking of Normality, Testing of Hypothesis for Non-Normal Data

1. Use the data sample from the previous seminar describing the lengths of 30 screws (in *mm*). We tested the hypothesis $H_0 : \mu = 20$ against different alternatives **under the assumption of normality**. **But was this assumption reasonable?** Can we really claim that our data sample is normally distributed (lets say at the significance level $\alpha = 0.05$)? Use both graphical methods and numerical approach.

   (a) Firstly, estimate parameters μ and σ of the normal distribution $N(\mu, \sigma)$ using the maximum likelihood method. Then plot the **histogram** of our data together with the **density** of the normal distribution with the estimated parameters.

   (b) Create the **Q-Q plot** of the theoretical and empirical quantiles against each other. Do you think the data are normally distributed?

   (c) Plot the **empirical cumulative distribution function** of the data together with the theoretical distribution function of the normal distribution with the estimated parameters.

   (d) Create the **P-P plot** of the theoretical and empirical **cumulative distribution functions** against each other.

   (e) Use some of the **normality tests** (from the lecture) to decide about the normality of our data at the significance level $\alpha = 0.05$.

2. Use the data sample `toss_a_coin.RData` from the 5th seminar describing the number of tossed heads from 100 tosses. Can we claim the coin was *unspoiled* (fair)?

   (a) Test the null hypothesis $H_0 : \mu = 50$ against a *two-sided* alternative at the significance level $\alpha = 0.05$. Use the test **without the assumption of normality** (see the lecture 6 slides).

   (b) Can we consider our data as normally distributed (based on the central limit theorem)? Check it (choose any appropriate method).

   (c) Test the null hypothesis $H_0 : \mu = 50$ against a *right-sided* alternative $H_1 : \mu > 50$ at the significance level $\alpha = 0.05$. Use the test **with the assumption of normality** (one-sample t-test).