Theory

1. We measure the concentration of a solution with chromatography. It is known, that the variance of the analysis is 0.02 $(g/cm^3)^2$. If we measure the concentration with 4 repetitions what will be the variance of the average?

2. What is the meaning of significance level when doing hypothesis tests?

3. Central limit theorem

4. How would you test if a scale is biased or not? What test should be used? What would be the null hypothesis? When would you commit an error of first kind in this situation? When would you commit an error of second kind in this situation?

5. In analytical practice it is usual to make repeated observations. What are the statistical reasons for that?

6. Why do the sample mean and sample variance differ from the expected value and variance of the population, respectively?

7. The purity of a hydrocarbon is tested by measuring its boiling point. If the boiling point exceeds 85°C the purity is below the required level. 7 samples are taken from the hydrocarbon and their boiling point is measured.
It is suspected that the purity does not achieve the required level. What test should be used to prove this claim? What would be the null hypothesis? When would you commit an error of first kind in this situation? When would you commit an error of second kind in this situation?

Calculation

1. The nominal weight of a chocolate bar is $50+/-2.5$g. Measuring several chocolate bar it was found that the average (expected) weight is 49.5g and the variance of the weight is $1.3g^2$.
On average, how many percent of the chocolates has a weight above the nominal maximum?

2. The weight of 5 randomly selected coffee packs are: 250.6, 248.5, 250.0, 249.5, 248.9 g.
a) Would you believe at 0.05 significance level that the variance of the weight is <u>less than</u> $3g^2$?
b) Give a 99% lower limit for the expected value of the weight!
c) Give a 99% confidence interval for the expected value of the weight!
d) Give a 90% confidence interval for the variance of the weight!
b) Give a 90% lower limit for the variance of the weight!

3. The temperature of the Danube was measured 6 times during lst of June. The average of the measured temperature is 18.5 ºC and the standard deviation (calculated from the sample) is 0.8   ºC.
a) In what range can be the expected value and variance of the Danube's temperature on that day with 95% probability?
b) Would you believe at 0.5 significance level, that the expected value of the Danube's temperature is 20 ºC?