Statistics.
Exercises - 3. lecture

Exercise 16

Below you are given two samples of the deviation, which occurred when repeating the measurement of the angle 0 gon.

A total station was successively headed towards a direction determined by a collimator. The horizontal circle has been read for each heading. The difference between successive readings is determining the observed error of the angular measurement.

sample 1	sample2	sample 1	sample2
-13.5	+13.5	+0.5	+8.0
-2.0	-12.5	+14.5	+5.0
-6.0	+5.0	-1.0	-5.0
-3.0	-9.0	-3.5	+8.0
-12.5	-8.0	-1.0	-3.0
+2.0	+6.0	+4.0	-9.5
+13.5	-4.5	+10.0	+11.5
+2.5	-12.0	+7.5	+12.5
+5.0	+6.0	-7.5	-5.5
+3.5	-4.5	+1.0	-1.5
-12.0	-7.0	-4.0	+2.5
+5.0	-4.0	+1.5	-7.0
+2.5	+3.5		

Data are available for python in `exe16.py`.

(a) Determine the estimated mean and standard deviation for each sample.

(b) Is it likely that the means are zero, - or is there an indication of a systematic deviation from zero?

(c) Is it likely, that the two samples are subject to the same kind of error generating mechanism?

(d) Is it likely, that the two samples have the same mean?

Suppose that the two samples have equal means and variances, i.e. they can be joined to form a single sample.

(e) Again we ask: Is it likely that the mean is zero, - or is there an indication of a systematic deviation from zero?

(f) Determine a 90% confidence interval of an eventual systematic error.

Exercise 17

Reconsider the scenario described in exercise 16, where we accept that the samples may be pooled. Furthermore, suppose that the standard deviation is accepted to be $\sigma = 7.5$ gon.

(a) Consider testing whether the sample mean deviates systematically from zero, when the level of significance is 5%.

Determine a test statistic and the associated interval of acceptance. Note that the size of the sample is 50.

(b) Determine the power function of the above test.

(c) What sample size is needed to detect a 1 gon systematic deviation, if we require to be 90% sure to detect this deviation?

Exercise 19

In the area of Aalborg a number of distances have been measured for quality control.

36 distances have been measured twice using a fotogrammetric method. The differences are uset to determine an estimate of the standard deviation, which amounts to $s = 4.7cm$.

Results from traditional surveying methods are divided into 4 groups, where the first two groups are measurements before 1966, whereas the other groups are measurements after 1966, where EDM had become a common measuring method. The results are summarized by:

Period	Group no.	degrees of freedom	Deviation(cm)
before 1966	1	145	11.0
before 1966	2	142	10.0
after 1966	3	71	6.1
after 1966	4	69	4.7

Is it reasonable to believe that the photogrammetric method is the most accurate?