Exercise 3

1. An automobile club published in its annual report that after recording all new cars sold in the last year, 50% had defects within the first year. Among the cars sold in the first half of this year, a random sample of size $n = 400$ was carried out and it was found that of these, only 45.8% had defects within the first year. The automobile club claims that this improvement is due to its increased publishing activities. With a probability of error of $\alpha = 5\%$, can the null hypothesis that quality has not improved be rejected?

2. An insurance company has calculated the premium for a certain risk assuming $550 €$ cost per claim. After several months, $n = 225$ claims had been incurred and settled. An evaluation of these cases showed an average amount of $562 €$ per claim, with a standard deviation of $160 €$.

   (a) With a probability of error of $\alpha = 5\%$, can it still be assumed that the average damage is $550 €.$?

   (b) What sample mean of a sample of size $n = 225$ would just allow the null hypothesis to be retained?

3. Another insurance company calculated the premium for a given risk assuming that the expected value of the cost C per claim is $E(C) = 750 €$ and that C is normally distributed. At the end of two months, $n = 16$ incurred claims resulted in an average amount of $810 €$ per claim, and the empirical variance in this sample was 600. With a probability of error of $\alpha = 0,05$, can it still be assumed that the average damage has not increased (null hypothesis)?

4. It is to be examined whether a presented coin is "fair", i.e. the results "heads" and "tails" are equally probable. The coin is tossed 196 times, with the side "heads" being on top 114 times. Perform a significance test at the level $\alpha = 0,05$ to test whether the coin is fair.

5. Due to a reform in the health insurance system, the Ministry of Health requires data on the average age of the insured people. A sample of size 100 at health insurance company A yields a mean age of 45 years, while a sample of size 150 at health insurance company B yields a mean age of 40 years. The standard deviation of age was estimated to be 14 years for A and 15 years for B. With a probability of error of 5%, can the hypothesis be maintained that the mean age is the same in both health insurance funds?

6. A company has run an advertising campaign and asks whether the mean order volume has increased afterwards. X denotes the amount of a randomly picked order after the advertising campaign and Y before the advertising campaign. Both draws are assumed to be normally distributed. Two independent samples with $n_X = 15$ and $n_Y = 10$ yield $\bar{x} = 56,4$ and $\bar{y} = 54,2$. Also, $\sigma_X^2 = 13,4$ and $\sigma_Y^2 = 12,0$ are known. Did this increase the order quantity to $\alpha = 0,1$?

7. A bakery chain is considering opening a new branch. The opening is supposed to depend on the disposable average income in the district of $1500\,€$ on the one hand and on the income dispersion on the other hand. The hypothesis that the dispersion measured by the standard deviation of the average income does not exceed $200\,€$ is tested with a significance level of 5%. For this purpose, the new graduates of the Jade University conducts a survey among $n = 16$ persons. This results in a standard deviation $\hat{\sigma} = 250\,€$.

8. From a sample of Oldenburg and Wilhelmshaven students, we obtain the following data regarding their consumption expenditures on food

	150–250 EUR	250–350 EUR	350–450 EUR
Wilhelmshaven	17	33	30
Oldenburg	20	40	40

Test the characteristics of origin and consumption expenditure on food for independence for a significance level of $\alpha = 5\%$.