

Please complete these problems before the exercise session on Tuesday 19 December, 2023, 8:30. Please be prepared to present your solutions to any problems that you completed successfully.

1. An alarm clock manufacturer reports that 3% of the products are faulty. Birgitta selects a random sample of these alarm clocks and notices that 6% of the clocks are faulty. Test the proportion of faulty products reported by the manufacturer using the proportion test. Formulate the null hypothesis and the alternative hypothesis (use a two tailed alternative hypothesis). What does the test tell you about the proportion of faulty products, when
  - (a) the sample size is 50?
  - (b) the sample size is 350?
2. Opinion polls are often conducted before parliamentary elections. In an upcoming election, two polls were conducted. In poll 1, the sample size was 1000 and 200 out of the 1000 eligible voters reported that they support the party Statistocrats. In poll 2, which was conducted later, the sample size was 1120 and 200 out of the 1120 eligible voters reported that they support Statistocrats. Based on these polls, can one conclude that support of Statistocrats has decreased?
3. Using a random number generator, generate a sample of 50 observations from the standard normal distribution, a sample of 50 observations from the  $\chi^2$  distribution with 3 degrees of freedom, and a sample of 50 observations from the standard uniform distribution  $\mathcal{U}(0, 1)$ . In addition, generate another sample of 50 observations from the standard normal distribution and add an outlier to it by setting the value of the first observation to  $-15$ . Study the normality or non-normality of the generated samples.
  - (a) Plot a histogram of each sample.
  - (b) Calculate the sample means, medians, and the skewness and kurtosis values of the samples.
  - (c) Test normality of the samples using the Bowman and Shenton normality test.
  - (d) Plot rank plots of each sample and test normality using the Shapiro–Wilk normality test.
4. A dice is rolled 120 times with the following results: the score one appears 12 times, two 16 times, three 20 times, four 17 times, five 22 times, and six 33 times. Use the  $\chi^2$  goodness-of-fit test to test the fairness of this dice. Formulate the null hypothesis and the alternative hypothesis of the test. Calculate the value of the test statistic. What is the  $p$ -value of the test? Use significance level 3%. Is the null hypothesis rejected?