Exercise Sheet 8

Exercise 26

A microchip manufacturer gets the actual data for the daily demand of the last year concerning their flagship model (`data_AnnualDemand.txt`). Analyse if the demand did change concerning the average of 1140 items of the last years.
Use the appropriate statistical tests with a level of significance of 1% and justify your choice.

Exercise 27

A study has been conducted at the institute for elderly research in order to investigate the efficiency of a new drug for neuro enhancement. The achieved scores of the participants ($n = 100$) for a memory test before and after multi-week administration of the drug are included in the file `data_NeuroEnhancement.txt` (column 1: person ID, column 2: before, column 3: after). Did the drug have a performance-enhancing effect on the memory of elderly people? Justify the choice of the appropriate statistical test, analyze the data at a level of significance of $\alpha = 0.01$ and interpret the result.

Exercise 28

Along the A10 highway at Groedig as well as in Golling a device measures the daily pollution with fine particles. Analyse if the pollution with fine particles at both locations during the year was equal or significantly different (`data_FineParticles.txt`, column 1: Groedig, column 2: Golling). Justify the choice of the appropriate statistical test and interpret the results ($\alpha = [0,05; 0,01]$).

Exercise 29

A fellow at CERN has measured Brown's molecular movements and provides his data in `data_MolecularMovements.txt`. You offer your support and verify if the measured movements

a) follow a normal distribution

b) follow the expected mean value of $\mu = 300$ (own implementation + verification with a test provided by python package of your choice)

Use the appropriate statistical tests with a level of significance of 5% and justify their choice.

Exercise 30

Implement a simulation of a galton board with $n = 2$ layers: from the top, a ball runs onto the first nail and subsequently to the left or the right, each time onto a second nail. If the ball runs twice left from the nail, it drops into container B_0. If the ball runs one time left and then right or vice versa, it drops into container B_1. All other balls drop into container B_2. In total $N = 100$ balls are rolled. The expected number of balls follows (based on the linearity of the expectation value) a binominal distribution multiplied with the number N,

$$E[B_k] = N \cdot \binom{n}{k} \cdot 0.5^k \cdot 0.5^{n-k}$$

Therefore, the direction of the ball at a nail to the right is considered as 'success' and their number counted to compute container k, into which the ball drops. Which statistical test finds here its correct application and can the test reliably recognise a skewed first nail, which directs the ball in 60% to the left (5% level of significance)?