Problems for the problem-solving sessions

Ch1.1-4

a) Problem 6
b) Referring to written exam 20190924, solve problems 1-3
c) Problem 19
d) Give an intuition for the result of ex. 1.4.11
e) Problem 31a

Ch1.5

a) Relate ex 1.5.11-12
b) Problem 37
c) Problem 41
d) Problem 48
e) Of the travelers arriving at a small airport, 60% fly on major airlines, 30% fly on privately owned planes, and the remainder fly on commercially owned planes not belonging to a major airline. Of those traveling on major airlines, 50% are traveling for business reasons, whereas 60% of those arriving on private planes and 90% of those arriving on other commercially owned planes are traveling for business reasons. Suppose that we randomly select one person arriving at this airport. What is the probability that the person is traveling on business?

Ch1.6

a) Relate ex 1.6.5 including the concepts of sensitivity and specificity
b) Problem 72
c) Problem 82
d) Problem 86
e) Problem 89

Ch2.1-3

a) Problem 2
b) Problem 3a
c) Problem 4
d) Problem 12
e) Problem 19

Ch2.4-7

a) Problem 24a
b) Referring to written exam 20191016, solve problems 8 and 9
c) You are offered to play the following game. A roulette wheel is spun 3 times. If any of the 38 numbers (0,00,1-36) is repeated, you lose 100 USD, else you win 5 USD. Should you accept to play this game? Argue by computing the relevant probability and expected value.
d) Problem 38a
e) Problem 45
f) Problem 57
g) Problem 79

Ch5

a) Problem 1
b) Problem 13
c) Let X and Y be independent standard uniform r.v. Let Z=X+Y.
   (i) Try to intuitively figure out the expectation and pdf of Z.
   (ii) Conduct a simulation to find the (approximate) E[Z], V[Z], and f(z)
   (iii) Let W=10X+Y. Repeat (i) and (ii), but for W instead.

Ch3.1-5

a) Problem 4
b) Problem 6a
c) Problem 34. This problem should be solved by a simulation where you give an approximate answer to the (a) and (b) questions.

Ch3.6

a) Referring to Problem 43. Verify by simulations that the answer on page 556 in book is correct.
b) Referring to Problem 45a, find the solution by simulations.
c) Problem 48a and 48c
d) Problem 50

Ch3.7-9

a) Referring to written exam 20190924, solve problems 4-7
b) Referring to written exam 20191016, solve problems 4-7
c) Refer to Problem 103a-c and find the answers by means of simulations (skip the expected value and variance conditional on x).

Ch4.1-3

a) Problem 10
b) Relate ex. 4.3.1
c) Problem 13
d) Solve problem 15 by means of a simulation

Ch6.1-2

Conduct a simulation study to check which is the more efficient estimator of μ, the sample mean ($\bar{x}$) or the sample median ($\tilde{x}$)? Both estimators are unbiased and consistent, nonetheless everyone is using the mean! Sensible?

Simulation set up:

1. Fix n, μ, σ, R
2. Generate a rth sample of n $N(\mu,\sigma)$ random variables.
3. Compute $\bar{x}\_r$ and $\tilde{x}\_r$ for the same sample.
4. Repeat steps 2-3 R times.
5. Calculate the standard deviation for the R values of obtained mean and median.
6. Modify the settings in step 1 to verify that the conclusion that arose in step 5 was not specific to the values fixed.

Ch6.3-4

Referring to example 6.4.12. Replicate the analysis by computing confidence interval by the normal approximation as well as by Bootstrap. In doing so you shall add two more observations to the data set with the values 14.1 and 143.6 such that your data set of analysis consists of 32 observations.

Ch6.4

An algorithm A has been found to succeed in obtaining a solution on a very large set of test problems with an expected computing time of 40s, where the solution time is exponentially distributed (i.e. the rate parameter is 0.025).

Drawing randomly from the same pool of test problems, a newly developed algorithm B has obtained solutions in 20 tests accordingly (in sec): 11, 12, 17, 19, 20, 20, 24, 28, 31, 36, 50, 51, 52, 55, 61, 72, 73, 100, 100, 100, where "100s" refers to a test where a solution was not obtained within 100 s and the algorithm was terminated. It is believed that the computing time is also exponential for the B-algorithm.

- Find the ML-estimate of the expected computing time for algorithm B
- Find an interval estimate for the rate parameter and examine if algorithm B is comparable to A or better or worse
- Produce a prediction interval for a 21st test where a random test problem is selected. What is the risk that the computing time would exceed 120s?

Ch8.1-3.1

a) Problem 4
b) Consider the Simple Random Walk in section 8.3.1. Assume S(n) represents your financial equity in your company. At the starting point S(0)=5. In line with the Simple Random Walk, your equity either increases or decreases with one unit at each time-point. If your equity falls below, you are broke and out-of-business. Fortunately, p=0.6 so if you manage to stay afloat you will eventually end up rich. Now, you shall examine a great number of scenarios by means of simulations according to the Simple Random Walk to identify the chance of avoiding business failure. Examine S(n=20) and S(n=200). What are the approximate probabilities of you being in business at these two instances? What is the expected equity at these instances if you are in business? How much does the equity vary at the two instances, again provided you are in business?

Ch8.4

a) Solve Problem 44. Set up a simulation to verify your solutions.