Alexander Georges Gretener, M.Sc.
Mariia Okuneva, M.Sc.
Anna Titova, Dr.

Advanced Statistics I (Winter Term 2023/24)

Problem Set 3

1. An urn contains 5 red and 4 green balls. Three balls are drawn without replacement. What is the probability that a red ball is drawn more than once? Note that the underlying process is a hypergeometric one (i.e. refer to the corresponding distribution on the formulary).

2. Find the probability that two throws with three unbiased dice will show the same configuration if

   (a) the dice are distinguishable

   (b) the dice are not distinguishable

3. There are 30 students in a statistics class, 9 of whom are female. Also, 12 of the students are computer science majors, 4 of which are female.

   (a) Fill the blanks in the following table:

	Female	Not Female	
CS	4		12
Not CS			
	9		30

   (b) Based on this sample, construct a table for probabilities:

	Female	Not Female	
CS			
Not CS			
			1

   (c) Using this data, give the following probabilities: $P(F)$, $P(CS)$, $P(F \cap CS)$, $P(F|CS)$, $P(\overline{CS}|\overline{F})$.

4. Consider the framework of an early test for HIV antibodies known as the ELISA test. The probability of a positive outcome given the tested person has HIV is 97.7% and of a negative outcome given the person is healthy is 92.6%. A study found that the probability of HIV occurring among North American population is about 0.26%. What is the probability that a person actually has HIV given they've tested positive?

5. The following table represents the data on survivors and deceased passengers of the Titanic distributed among classes.

	Class			
	1^{st}	2^{nd}	3^{rd}	Crew
Survived	203	118	178	212
Deceased	122	167	528	673

(a) What is the probability that a random person selected from this sample was travelling 1^{st} class?

(b) What is the probability that a particular survivor travelled with the crew? 1^{st} class?

(c) Are the events of being deceased and having travelled 3^{rd} class stochastically independent?