Statistik I - Exercise session 5
23.6.2014 & 30.6.2014

Info

- Classroom: SPA1 220
- Time: Mondays, 16:15 - 17:45
- in English
- Assignments on webpage (lvb>staff>PB)

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Schedule:

Date	Week	Exercises
28.04.14	E1	1-2, 1-3 (even), 1-10
05.05.14	E1	1-2, 1-3 (even), 1-10
12.05.14	E2	1-20, 1-22, 1-32
19.05.14	E2	1-20, 1-22, 1-32
26.05.14	E3	1-80, 1-83, (1-98)
02.06.14	E3	1-80, 1-83, (1-98)
09.06.14	–	–
16.06.14	E4	2-4, 2-14, 3-1, 3-7, (3-11)
23.06.14	E5	3-25, 3-37, 3-55
30.06.14	E5	3-25, 3-37, 3-55
07.07.14	E6	3-61,4-1,4-7, (4-29)
14.07.14	E6	3-61,4-1,4-7, (4-29)

Review

- week 9 & week 10
- Slides: Fundamentals of Theory of Probability (cca 36-66)

Probability addition theorem

$$\begin{aligned} P(A \cup B) &= P(A) + P(B) - P(A \cap B) \\ P(A \cup B \cup C) &= P(A) + P(B) + P(C) - P(A \cap B) - P(A \cap C) - P(B \cap C) \\ &+ P(A \cap B \cap C) \end{aligned}$$

Addition theorem for disjoint events($A_i \cap A_j = 0$ **für** $i \neq j$)

$$P(A_1 \cup A_2 \cup \ldots \cup A_n) = P(A_1) + P(A_2) + \ldots + P(A_n) = \sum_{i=1}^{n} P(A_i)$$

Conditional Probability $P(A|B) = \frac{P(A \cap B)}{P(B)}$, $P(B) > 0$ and $P(B|A) = \frac{P(A \cap B)}{P(A)}$, $P(A) > 0$

Independent events $P(A|B) = P(A|\overline{B}) = P(A)$ and $P(B|A) = P(B|\overline{A}) = P(B)$

Multiplication Rule

$$\begin{aligned} P(A \cap B) &= P(A) \cdot P(B|A) = P(B) \cdot P(A|B) \\ P(A_1 \cap A_2 \cap A_3) &= P(A_1) \cdot P(A_2|A_1) \cdot P(A_3|A_1 \cap A_2) \end{aligned}$$

Multiplication Rule for independent events

$$P(A \cap B) = P(A) \cdot P(B)$$

Total Probability

$$\begin{aligned} P(B) &= P(A_1 \cap B) + P(A_2 \cap B) + \ldots + P(A_n \cap B) = \sum_{i=1}^{n} P(A_i \cap B) \\ &= P(B|A_1) \cdot P(A_1) + P(B|A_2) \cdot P(A_2) + \ldots + P(B|A_n) \cdot P(A_n) \\ &= \sum_{i=1}^{n} P(B|A_i) \cdot P(A_i) \end{aligned}$$

Bayes' Theorem $P(A_j|B) = \frac{P(B|A_j) \cdot P(A_j)}{\sum_{i=1}^{n} P(B|A_i) \cdot P(A_i)}$ $\forall j = 1, \ldots, n$

Exercises

Exercise 3-25 - Old building

In an old building with outdated electricity system, it happens often that the power system fails or the water supply freezes. Although both situations occur independently of each other, they are dependent on the season. So, naturally, water freezes only in winter with 80% probability. The power system fails,even if it is not winter, with 40% probability. In winter the power system does not fail with the same probability. Assume that the winter time makes up 30% of the entire season.

a) Formalize the events mentioned in the test. What are their probabilities?

b) What is the probability of the freezing water supply?

c) What is the probability of the power failure?

d) What is the probability of the freezing of water supply and power failure at the same time?

e) What is the probability of the freezing of the water supply when power has already failed?

f) What is the probability of the power failure when the water supply has been already frozen?

g) What is the probability that at least one of the situations happens? is the probability that most one of the situations happens?

Exercise 3-37 - Cheating

Prof. Antischumm dislikes cheating during the exams. Therefore he invented The Cheatdiagnostic-machine available on the following exam: 90% of the students who cheat are recognized as cheating, and 90% students who do not cheat are recognized as honest. From experience he also knows that 10% of all students cheat.

a) Define the events and their probabilities according the information in the text.

b) What is the probability that the machine provides a suspicion of cheating?

c) What is the probability that student really cheated when machine provided a corresponding suspicion?

Exercise 3-55-Weekend house

Sonne' family has a weekend house at Rügen. They can come to the island of Rügen through Rügenddamm or by ferry. The family decides how to get there by flipping the (fair / ideal) coin: head - Rügenddamm, number - Ferry. If it does not rain, Sonne's family always goes to to Rügen for the weekend. The probability of traffic jam in Rügenddamm is 25%, for ferry 10%. When it rains, family stays at home. What is the probability that Sonne family will not be stuck in traffic jam, when there is a probability of raining for this season is 0.2.