Implementation of DBMS
Exercise Sheet 1, Solutions
Klingemann, WS 2024 / 2025

1) We have a uniformly distributed random variable X that can take integer values in the range [1, 100]. What is the mean of X?
Solution: When we have a uniformly distributed random variable that can take integer values in the range [a, b], we can calculate the mean as (a + b) / 2. With a=1 and b=100 we get a mean of 50.5.

2)
a) We have crates that can take up to 12 bottles. We have 100 bottles and want to put all of them in crates. What is the minimum number of crates that we need?
Solution: We need ⌈(100 bottles) / (12 bottles/crate)⌉ = 9 crates

b) We have 26 bottles. Each bottle contains 2l water. We want to fill the water from all these bottles in water containers. Each water container can take up to 5l. What is the minimum number of water containers that we need?
Solution: We have in total 26 bottles * 2l/bottle = 52l of water. Thus, we need ⌈52l / (5l/container)⌉ = 11 container

c) We want to pack table tennis balls (diameter: 40mm) into boxes. Each ball has to be completely in one box. A box has the following dimensions: hight: 40mm, width: 40mm, length: 313mm. What is the minimum number of boxes we need to store 100 balls?
Solution: With the given hight and width of the boxes, we can only arrange the balls in the boxes in form of a row. A row of x balls has the length x * 40mm. To fit into a box, it has to hold: x * 40mm ≤ 313mm. The largest x with this property is:
⌊313mm / 40mm⌋ = 7. Hence, we can put at most 7 balls into a box. Therefore, we need ⌈100 balls / (7 balls/box)⌉ = 15 boxes.

3) You have a textbook with 300 pages. You want to find information about a specific keyword. This information can be scattered in an arbitrary way throughout the book.
a) You know, that there is exactly one page that contains the information you are looking for. How many pages do you have to inspect to get all information about the keyword? Consider the minimum, maximum and mean number.
Solution: As we know, that there is exactly one page that contains the information, we can stop after finding this page. In the best case we find it when we inspect the first page, i.e., the minimum is 1. In the worst case we find it in the last page we inspect, i.e., the maximum is 300. All numbers of pages in this range can occur and are equally likely. Thus, we have a uniformly distributed random variable that can take integer values in the range [1, 300]. Like in task 1 we can calculate the mean as 150.5.

b) There can be different pages that contain information about the keyword. You do not know how many. How many pages do you have to inspect to get all information about the keyword? Consider the minimum, maximum and mean number.
Solution: As we do not know how many pages we have to find, we cannot stop searching when we find the keyword. It is possible that subsequent pages contain the keyword, too. As a result, we have to inspect in any case all 300 pages.

c) We assume that the last page of the book contains an index that lists for different keywords all pages that contain information about the corresponding keyword. In case of the keyword, we are interested in, the index says that exactly the pages 53, 78 and 253 contain information about this keyword. We now want to use the index to get all information about the keyword. How many pages do you have to inspect?

Solution: At first, we have to inspect the index page. From the index we get the information, that we have to inspect 3 more pages. In total we inspect 1+3 = 4 pages.