

STA2001 Probability and Statistics I

Computer-based Exercise 2

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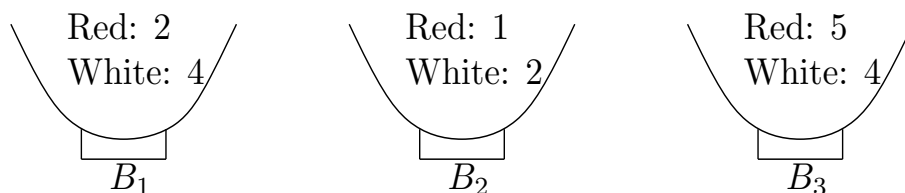
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The goal of this exercise is to verify the motivation example for the Bayes' Theorem in the lecture note by using numerical simulation.

Problem 1. *There are three bowls and the random experiment is to select a bowl first, and then draw a chip from the selected bowl. Assume that the probabilities to select each bowl are*

$$P(B_1) = \frac{1}{3}, \quad P(B_2) = \frac{1}{6}, \quad P(B_3) = \frac{1}{2}.$$

and moreover, for each selected bowl, all chips in the bowl are “equally likely”.



- Let $R = \{\text{draw a red chip}\}$. We know from the lecture that $P(R) = \frac{4}{9}$.
- Suppose now that the outcome of the experiment is a red chip but we don't know from which bowl the chip was drawn. We know from the lecture that

$$P(B_1|R) = \frac{1}{4}, \quad P(B_2|R) = \frac{1}{8}, \quad P(B_3|R) = \frac{5}{8}.$$

The task is to simulate this random experiment 100000 times by computer and check the relative frequencies of the event R and the event $B_i|R$, $i = 1, 2, 3$.

You should draw a figure to show the profiles of the relative frequency of R and $B_i|R$, $i = 1, 2, 3$ as the random experiment is repeated from 1 to 100000 times.

You are free to use any programming languages to answer this question.

- In Python, the module `random` should be used and the function `randint` can be used as a random number generator to simulate the random experiment, i.e., to generate a random integer. Check the link below for more information: <https://docs.python.org/3/library/random.html>
- In Matlab, the function `randi` can be used as a random number generator to simulate the random experiment, i.e., to generate a random integer. You can find the reference of the function `randi` by typing in `help randi` in the command window of Matlab.

To answer this question, attach both your script and figure.