Dependent and Independent Events

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Problem Analysis

Three events have been given, there corresponding probabilities. We need to simulate and verify that they are independent events. Apart from that, the second part asks us to think of a dependent event and show that the formula P(A^B) = P(A) x P(B) does not work for dependent events.

Solution

The events have been given. There probabilities have been simulated for different number of trials. The probability has been simulated for the following trials, 1,10,50,100,500,1000,5000,10000,50000,100000], i.e. the 1st experiment had 1 trial, the 2nd one had 10 trials, the 3rd one had 50, so on and so forth.

For the dependent events, the following was considered.

Consider that two dice are rolled. Then let

Event 1 (E_1): The number on first dice is 1 {(1, 1), (1, 2), (1, 3), (1, 4), (1, 5), (1, 6)}

Event 2 (E_2): The sum of the numbers on the two dice is 4 {(1, 3), (3, 1), (2, 2)}

E_1 ^ E_2 = {1,3}

$$P(E_1) = \frac{6}{36} = \frac{1}{6} = 0.1667$$

$$P(E_2) = \frac{3}{36} = \frac{1}{12} = 0.083$$

$$P(E_1 \cap E_2) = \frac{1}{36} = 0.027$$

$$P(E_1) \times P(E_2) = \frac{1}{72} = 0.0138 \neq P(E_1 \cap E_2)$$

Thus, these are dependent events.

Simulation Results

These are the results for the same events described above and for those given in the question. Through the graphs, we can easily see that for independent events (see Figure 1), the values for P(A^B) and P(A) x P(B) converge. On the contrary, the values for dependent events (see Figure 2), do not converge.

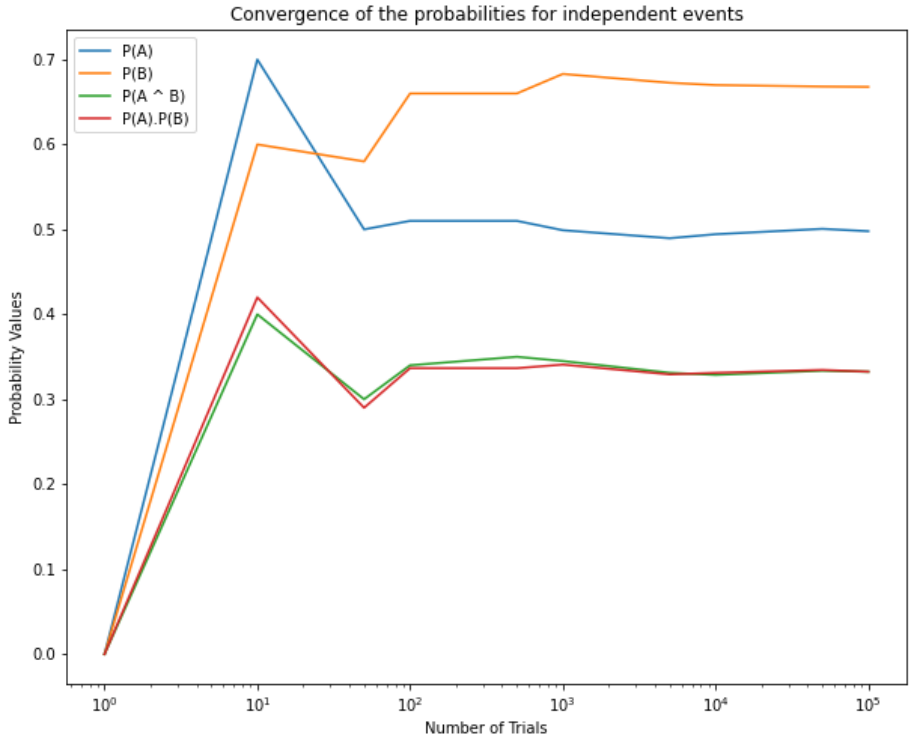

Figure 1: The probabilities converging for independent solutions, as the trials increase

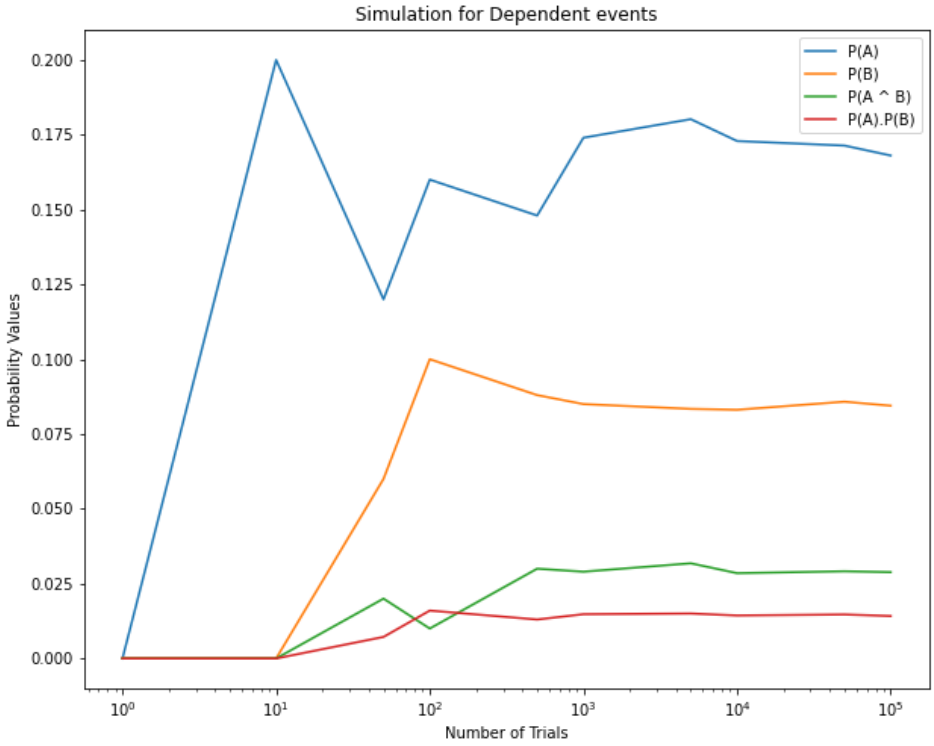

Figure 2: Dependent event, the probabilities do not converge even for large number of trials