Assignment 6

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Download all python codes from

```
https://github.com/pranav−159/
    ai1103_Probability_and_Random_variables/
    blob/main/Assignment_6/codes/
    ExperimentalVerification_Assignment6.py
```

and latex-tikz codes from

```
https://github.com/pranav−159/
    ai1103_Probability_and_Random_variables/
    blob/main/Assignment_6/Assignment6.tex
```

1 Problem

GATE 2015 (EE paper-01 new 2), Q.10 (apti. section)

The probabilities that a student passes in Mathematics, Physics and Chemistry are m,p, and c respectively. Of these subjects, the student has 75% chance of passing in at least one, a 50% chance of passing in at least two and a 40% chance of passing in exactly two. Following relations are drawn in m, p, c:

(I) p + m + c = 27/20
(II) p + m + c = 13/20
(III) (p)× (m) × (c) =1/10

(A) Only relation I is true
(B) Only relation II is true
(C) Relations II and III are true
(D) Relations I and III are true

2 Solution

Let M,P,C be the events representing student passes in Mathematics,Physics,Chemistry respectively.

$$\Pr(M) = m \tag{2.0.1}$$
$$\Pr(P) = p \tag{2.0.2}$$
$$\Pr(C) = c \tag{2.0.3}$$

The given information can be represented as

$$\Pr(M + P + C) = 75\% = \frac{3}{4} \tag{2.0.4}$$
$$\Pr(MP + PC + CA) = 50\% = \frac{1}{2} \tag{2.0.5}$$
$$\Pr(MP + PC + CA - 3MPC) = 40\% = \frac{2}{5} \tag{2.0.6}$$

(2.0.5) and (2.0.6) can also be written as

$$\Pr(MP) + \Pr(PC) + \Pr(CM) - 2\Pr(MPC) = \frac{1}{2} \tag{2.0.7}$$
$$\Pr(MP) + \Pr(PC) + \Pr(CM) - 3\Pr(MPC) = \frac{2}{5} \tag{2.0.8}$$

Subtracting and solving the above two equations we get,

$$\Pr(MPC) = \frac{1}{10} \tag{2.0.9}$$
$$\Pr(MP) + \Pr(PC) + \Pr(CM) = \frac{7}{10} \tag{2.0.10}$$

Using inclusion-exclusion principle, We can express (2.0.4) as

$$\Pr(M) + \Pr(P) + \Pr(C) - [\Pr(MP) + \Pr(PC) + \Pr(CM)] + \Pr(MPC) = \frac{3}{4} \tag{2.0.11}$$
$$p + m + c - \frac{7}{10} + \frac{1}{10} = \frac{3}{4} \tag{2.0.12}$$
$$p + m + c = \frac{27}{10} \tag{2.0.13}$$

There is no constant answer for the product of p,m,c which is shown in simulation.

$\therefore$ Only relation I is true.

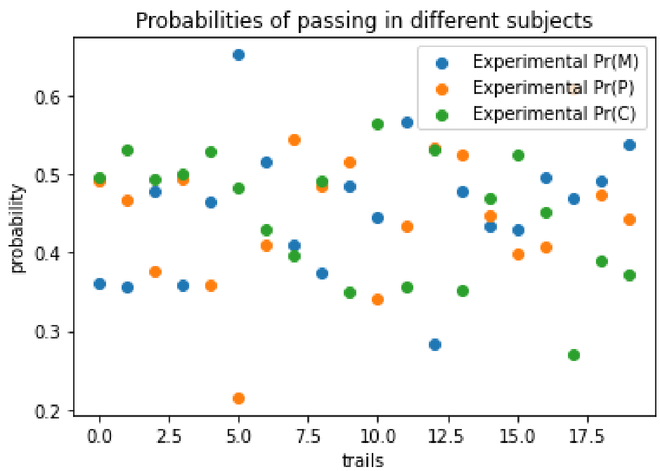

Fig. 4: Probabilities of passing in different subjects in different trails

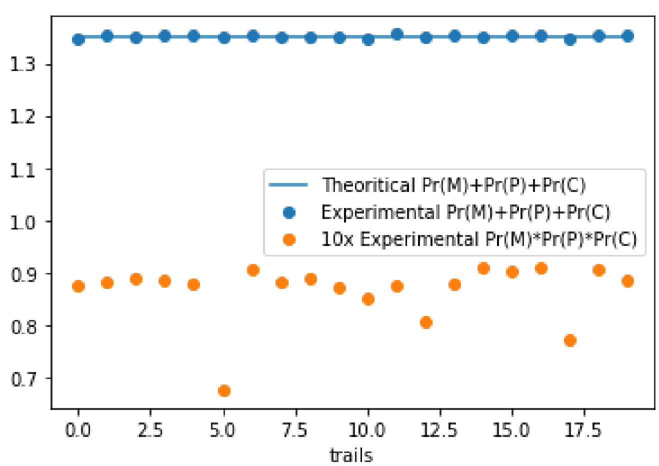

Fig. 4: Sums and Products of probabilities in different trails