Assignment 3 9th Class Stats

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https://github.com/GunjitMittal/Assignment3/tree/main/Assignment3/codes

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1 Question

Three coins were tossed 30 times simultaneously. Each time the number of heads occurring was noted down as follows:

0	1	2	2	1	2	3	1	3	0
1	3	1	1	2	2	0	1	2	1
3	0	0	1	1	2	3	2	2	0

TABLE 1.1

Prepare a frequency distribution table for the data given above.

2 Solution

Solution: Counting, we can see that in 30 throws we got 6 throws with no heads, 10 throws with 1 head, 9 throws with 2 heads and 5 throws with 3 heads

No. of Heads	Frequency
0	6
1	10
2	9
3	5
Total	30

TABLE 2.1

Let the random variable $X \in \{0,1,2,3\}$ denote the number of heads in the coin-tossing experiment. Now,

$$\Pr(X=i) = \frac{n(X=i)}{\sum_{i=0}^{3} n(X=i)} \tag{2.1}$$

where $i \in \{0,1,2,3\}$ and n(X = i) is the frequency of getting i heads. Also,

$$\text{Number of times 3 coins were tossed} = 30 \tag{2.2}$$

$$\implies \sum_{i=0}^{3} n(X=i) = 30 \tag{2.3}$$

We have,

$$\Pr(X=0) = \frac{6}{30} = 0.20 \tag{2.4}$$

$$\Pr(X=1) = \frac{10}{30} = 0.33 \tag{2.5}$$

$$\Pr(X=2) = \frac{9}{30} = 0.30 \tag{2.6}$$

$$\Pr(X=3) = \frac{5}{30} = 0.17 \tag{2.7}$$

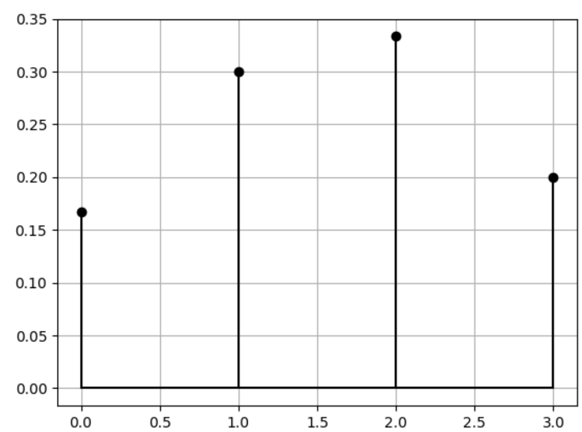

Fig. 2.1. Plot of PMF using above data

Now considering fair coins: Let probability of getting a head be a success and equal to p and probability of getting a tail be a failure and equal to q where $p+q=1$. We can express this as a binomial distribution

$$\sum_{i=0}^{n} \Pr(X=i) = \sum_{i=0}^{n} {}^{n}C_i(\mathrm{p})^i (1-\mathrm{p})^{n-i} \tag{2.8}$$

where $n = 3$ for 3 coins. Therefore,

$$\Pr(X = i) = {}^{3}C_i(\mathrm{p})^i(\mathrm{q})^{3-i} \tag{2.9}$$

For fair coins,

$$\mathrm{p} = \frac{1}{2} \tag{2.10}$$

$$\therefore \mathrm{q} = \frac{1}{2} \tag{2.11}$$

Therefore,

$$\Pr(X = 0) = {}^{3}C_0\left(\frac{1}{2}\right)^0\left(\frac{1}{2}\right)^3 = \frac{1}{8} \tag{2.12}$$

$$\Pr(X = 1) = {}^{3}C_1\left(\frac{1}{2}\right)^1\left(\frac{1}{2}\right)^2 = \frac{3}{8} \tag{2.13}$$

$$\Pr(X = 2) = {}^{3}C_2\left(\frac{1}{2}\right)^2\left(\frac{1}{2}\right)^1 = \frac{3}{8} \tag{2.14}$$

$$\Pr(X = 3) = {}^{3}C_3\left(\frac{1}{2}\right)^3\left(\frac{1}{2}\right)^0 = \frac{1}{8} \tag{2.15}$$

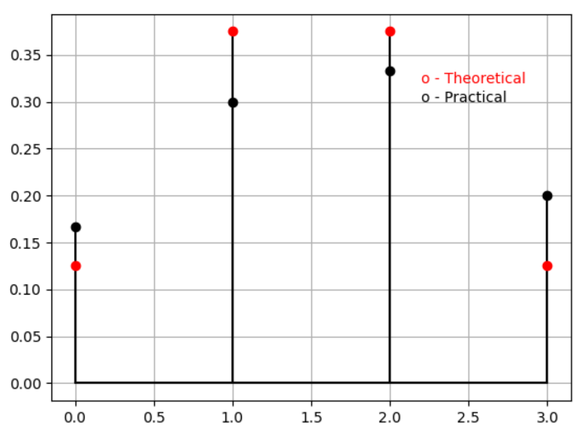

Fig. 2.2. Comparison of theoretical and practical PMF plots