

# 10.3.2.4.4

EE24BTECH11024 - G. Abhimanyu Koushik

## Question:

A three coins are tossed once, what is the probability of getting atmost 2 heads?

## Solution:

The sample space is

$$\Omega = [HHH, HHT, HTH, HTT, THH, THT, TTH, TTT] \quad (0.1)$$

Assuming equally likely outcomes,

$$\Pr(\omega \in \Omega) = \frac{1}{8} \quad (0.2)$$

Define a discrete random variable  $X$  = number of heads

$$\Pr(X \leq 2) = 1 - \Pr(X > 2) \quad (0.3)$$

$$= 1 - \frac{1}{8} = \frac{7}{8} \quad (0.4)$$

## Simulation:

To run a simulation we need to generate random numbers with uniform probability, which is done as shown below(Algorithm taken from OpenSSL's random\_uniform.c):

- 1) Generate 32 bits of entropy using /dev/urandom.
- 2) Treat this as a fixed point number in the range [0, 1)
- 3) Scale this to desired range using fixed point multiplication and treat as 64bit number(upper 32 bits integer and rest as fractional part)
- 4) Return the integer part of the fixed point numbers

The following shows how the relative frequency reaches true probability with increasing number of trials of the event.

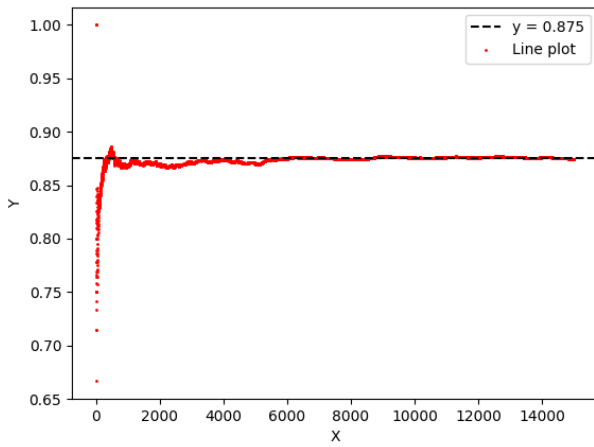


Fig. 4.1: Relative Frequency tends to True Probability