

Assignment 2

AI1110: Probability and Random Variables
Indian Institute of Technology, Hyderabad

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10.15.1.12 A game of chance consists of spinning an arrow which comes to rest pointing at one of the numbers 1, 2, 3, 4, 5, 6, 7, 8 (see Fig. 4), and these are equally likely outcomes. What is the probability that it will point at:

- (i) 8?
- (ii) an odd number?
- (iii) a number greater than 2?
- (iv) a number less than 9?

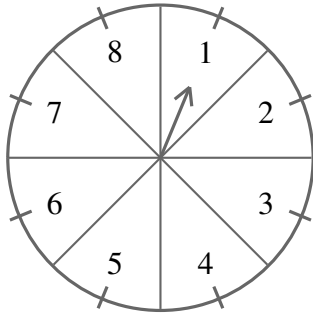


Fig. 4. Spinner

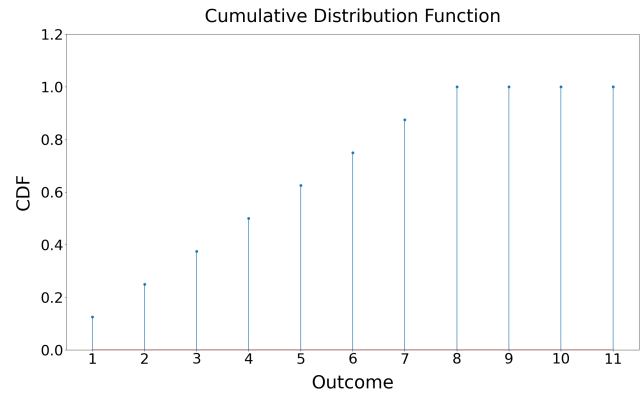
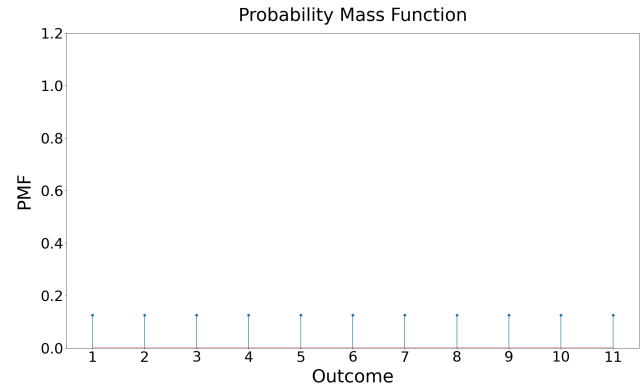
Solution: Let X be a random variable defined as the value given by the pointer. The distribution is uniform since all the outcomes are equally likely.

$$\therefore \Pr(X = i) = \frac{1}{8} \quad (1)$$

Let $F_X(i)$ be the Cumulative distribution function(CDF) such that;

$$F_X(i) = P(X \leq i) \quad (2)$$

$$= \begin{cases} 0, & i \leq 0 \\ \frac{i}{8} & 1 \leq i \leq 8 \\ 1, & i \geq 9 \end{cases} \quad (3)$$



See python code for PMF and CDF plots: [1]

- (i) For $i = 8$, required probability is equivalent to;

$$\Pr(X = 8) = F_X(8) - F_X(7) \quad (4)$$

$$= \frac{1}{8} = 0.125 \quad (5)$$

- (ii) For i being odd, required probability is equivalent to;

$$\begin{aligned} \Pr(X = \{1, 3, 5, 7\}) \\ &= F_X(7) - F_X(6) + F_X(5) - F_X(4) \\ &\quad + F_X(3) - F_X(2) + F_X(1) - F_X(0) \end{aligned}$$

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$$= \frac{4}{8} = 0.5 \quad (6)$$

(iii) For i greater than 2, required probability is equivalent to;

$$\Pr(X > 2) = 1 - \Pr(X \leq 2) \quad (7)$$

$$= 1 - (F_X(2) - F_X(0)) \quad (8)$$

$$= \frac{6}{8} = 0.75 \quad (9)$$

(iv) For i less than 9, required probability is equivalent to;

$$\Pr(1 \leq X < 9) = F_X(8) - F_X(0) \quad (10)$$

$$= \frac{8}{8} = 1 \quad (11)$$

See simulation using python: [2]

REFERENCES

- [1] https://github.com/Gunethra/AI1110_2023/tree/master/Assignment_2/code/pmf.py
https://github.com/Gunethra/AI1110_2023/tree/master/Assignment_2/code/cdf.py.
- [2] https://github.com/Gunethra/AI1110_2023/tree/master/Assignment_2/code/code.py.