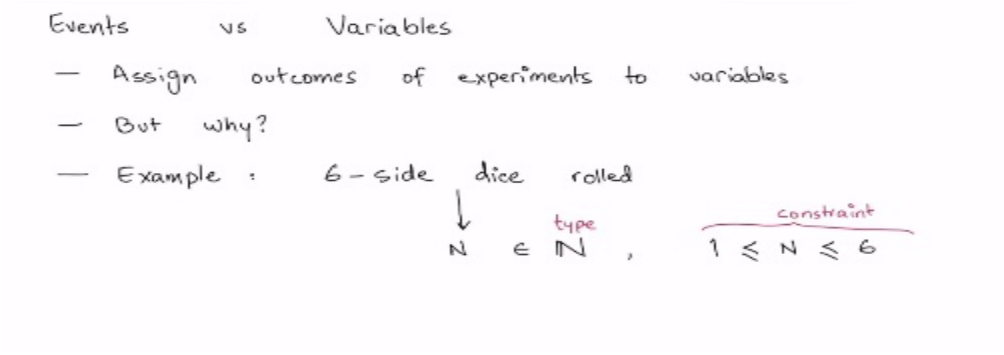
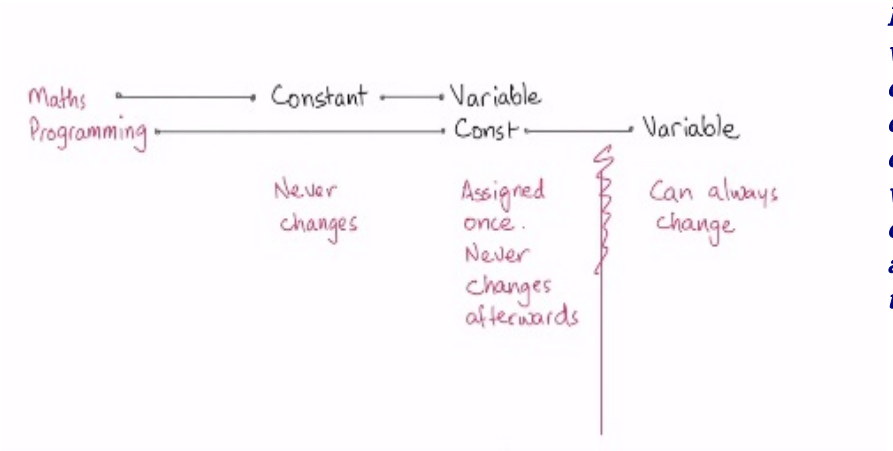
Probability Lecture 14



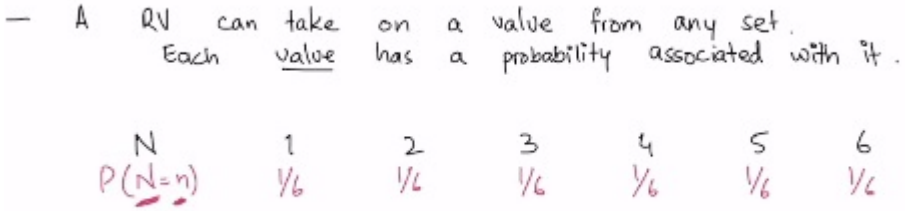
We save the outcome in a variable so that we can convert it into numeric form and then apply constraints to it

In mathematics, a constant is something that never changes, while a variable is something to which we assign a value that then remains unchanged. However, in programming, a constant can be considered a variable of mathematics(something to which we assign a value that then remains unchanged). Conversely, a variable in programming is something that can vary.



However, in probability theory, a variable falls between these two definitions. It takes on a single value determined by some probability distribution, known as a random variable. Therefore, it does not change once assigned, but its values are determined probabilistically rather than explicitly assigned.

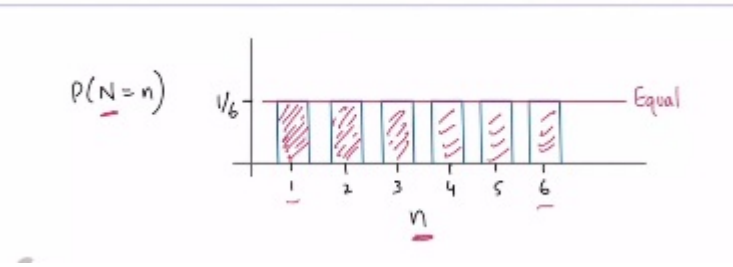
A random variable is a variable that can take on any value from a given set, and associated with each possible value is a probability of that value occurring.



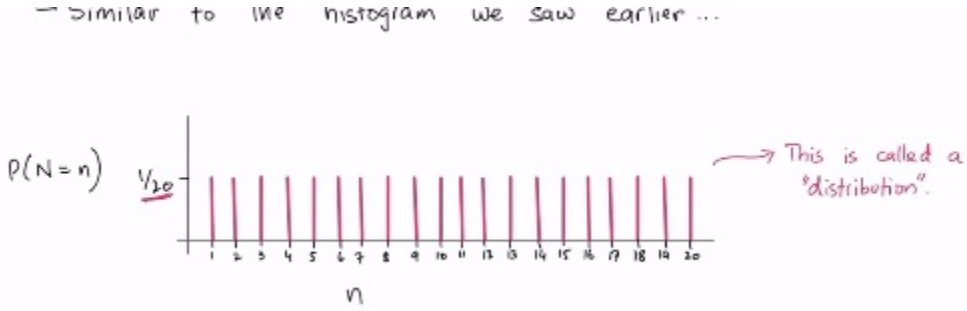
In probability theory, every outcome's probability is stored in a variable, typically denoted as N. An event is represented by a set, and its notation is N taking the value n, denoted as P(N=n).

— Other examples:
  — Pick any person and measure their height
  — Pick any character and convert it to ASCII.

Each outcome of rolling a fair six-sided die is represented in a histogram.

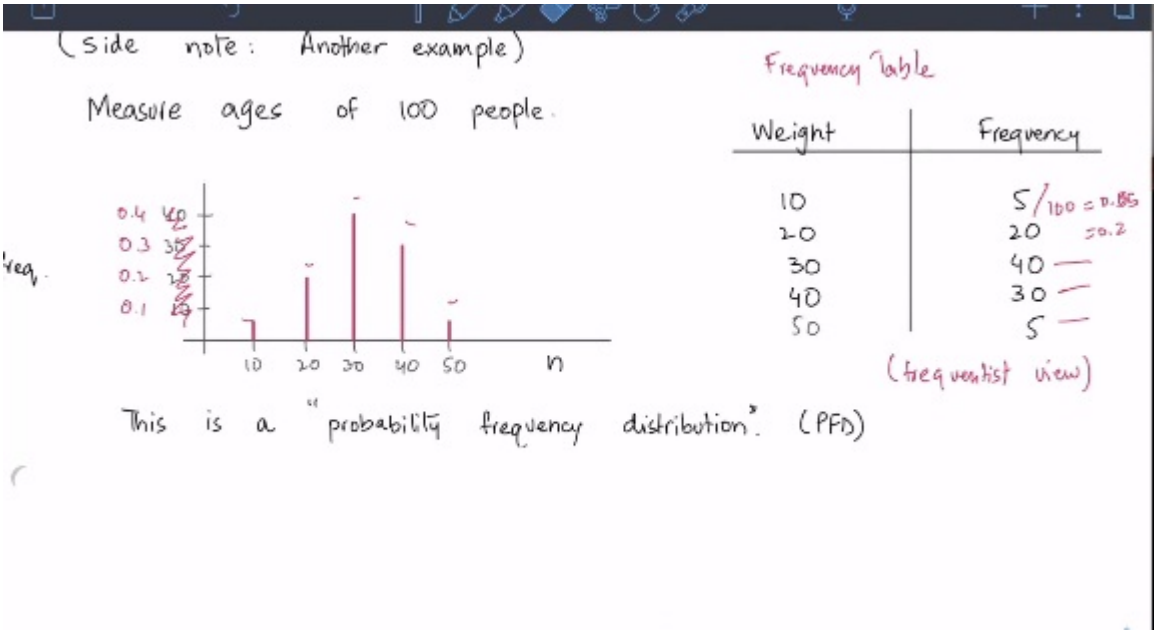


- **Random Variable X representing outcomes:** Values range from 1 to 6.
- **Probability of each outcome:** P(X=1)=P(X=2)=P(X=3)=P(X=4)=P(X=5)=P(X=6)=1.
- **Total probability:** Sum of all probabilities equals 1.



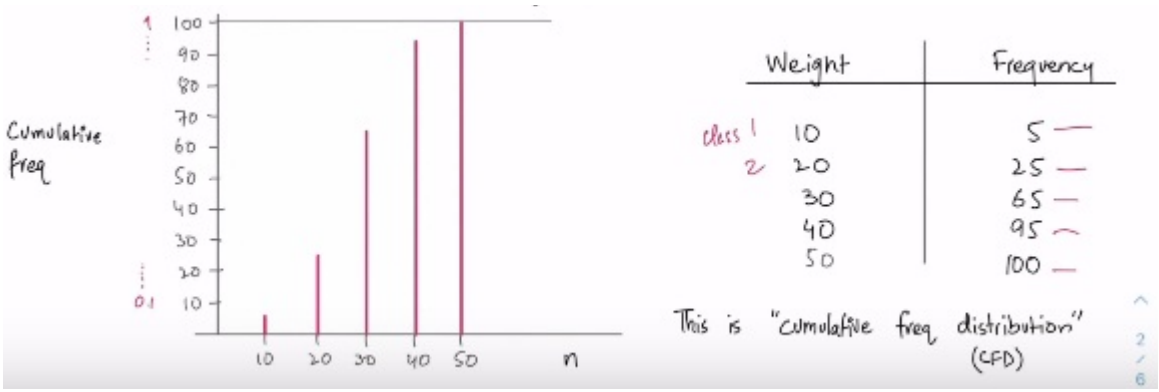
distribution refers to the set of all possible values and their corresponding probabilities or frequencies.

N is a discrete random variable



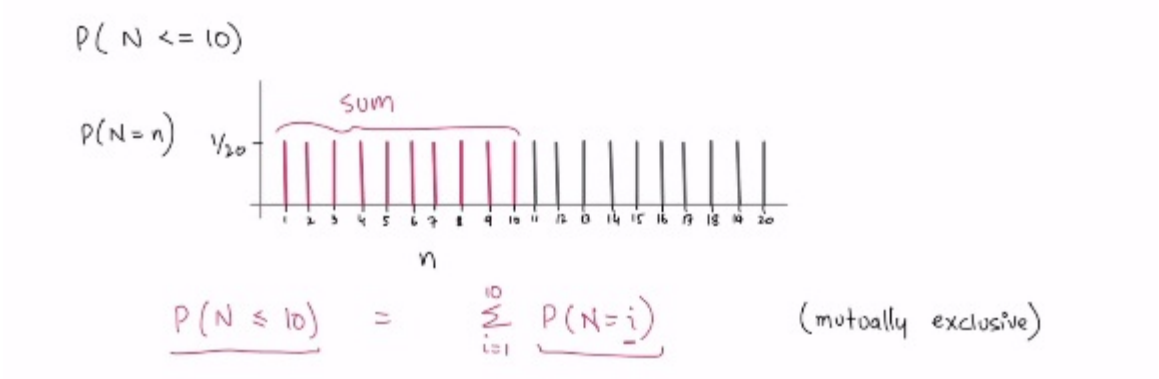
Probability Frequency Distribution (PDF):

- PDF gives the probability of a specific weight occurring among the 100 persons.
- It's calculated by dividing the frequency of each weight by the total number of persons.



- **Cumulative Distribution Function (CDF):**
  - CDF gives the probability of a weight being less than or equal to a certain value.
  - It's obtained by adding up the probabilities of all weights up to that value.
  - Think of it as a running total of probabilities, starting from the smallest weight.

Now, we can perform numerical analysis on variables .
Now, returning to the previous example of rolling a fair six-sided die 20 times, we can calculate P(N≤10) by summing the probabilities of each outcome up to 10.



p(N≤20) must be 1

p(N<1) must be 0

Conclusion:

1. **Random Variables in Probability:**
    - Represent outcomes with probabilities, not fixed values.
    - Discrete random variables have finite possible values.
2. **Probability Distributions:**
    - PDF: Gives probabilities of specific outcomes.
    - CDF: Gives cumulative probabilities up to a certain value.
3. **Numerical Analysis:**
    - Applying constraints or operations to variables.
    - Example: Calculating probabilities like $P(N \leq 10)$.