Random Variables

A random variable assigns a numerical value for every outcome of the experiment We can also calculate the probabilities of random variables taking on a specific value, or range in the case of continuous RVs. → this results in probability distributions.

Discrete RVs

e.g. two dice

Let Random Variable X = Sum on the two dice

one dice = $\{1, 2, 3, 4, 5, 6\}$

then $X = \{2, 3, 4, \ldots, 12\}$

What is the pdf?

Let us consider all options

Create matrix

	1	2	3	4	5	6
1	2	3	4	5	6	7
2	3	4	5	6	7	8
3	4	5	6	7	8	9
4	5	6	7	8	9	10
5	6	7	8	9	10	11
6	7	8	9	10	11	12

then

$P(X=2) = 1/36$

$P(X=3) = 2/36$ ← pdf

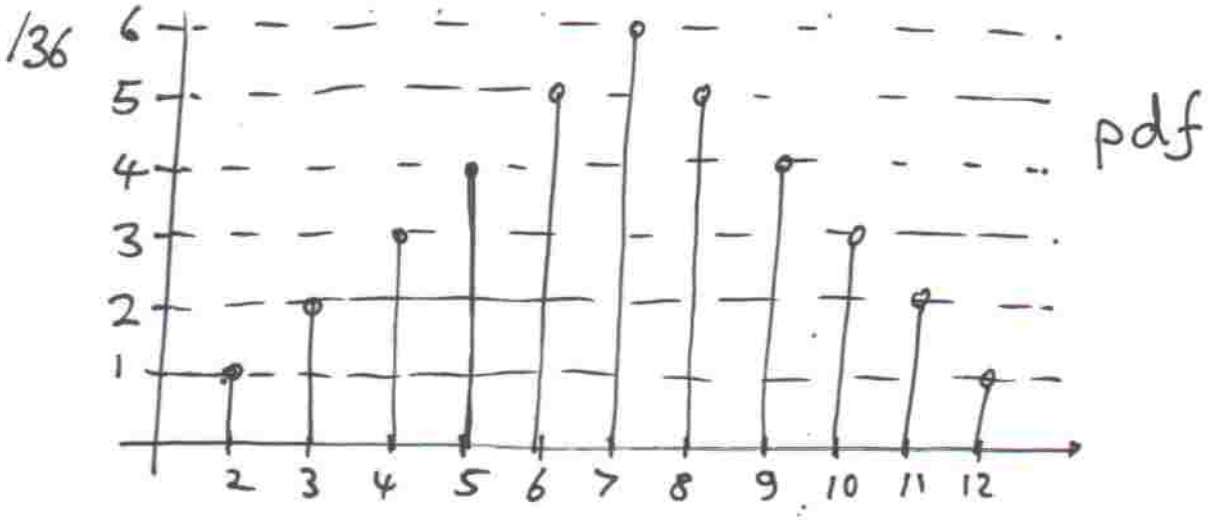
$P(X=7) = 6/36$

$P(X=12) = 1/36$

Cumulative distribution function (cdf) is:

$$F(x) = P(X \leq x), \quad -\infty < x < \infty$$

Let us plot the pdf first



cdf

$P(X \leq 2) = 1/36$

$P(X \leq 3) = 1+2 = 3/36$

$P(X \leq 4) = 1+2+3 = 6/36$

$\vdots$

$P(X \leq 12) = 36/36 = 1$

Plot!

Expected value or Mean = μ

for a discrete RVs is

$$E(X) = \mu = \sum x \cdot P(X = x)$$

for our example = ? try it !

Continuous distribution

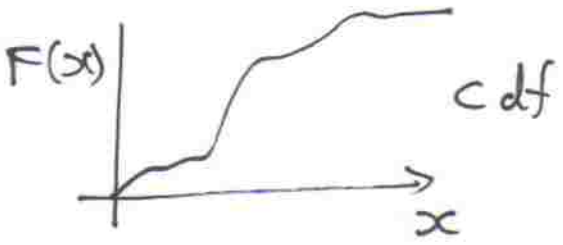
pdf is continuous = $f(x)$

prob is defined in a range

so $P(X = x)$ is not defined

cdf = $F(x) = P(X \leq x) = \int_{-\infty}^{x} f(x)\,dx$

= area below x



More on these later