BINOMIAL & GEOMETRIC DISTRIBUTION

Random Variable → "No. representing event"

X

Gaussian

Continuous

height, weight, runs

72.97 in | 101.2 kg

42.43 in | 52.9 kg

Discrete

Binomial

Geometric

$\{0, 1, 2, 3\}$

X = # No. of heads

$\{H\}, \{T\}$

$\{H, T\}$

$\{1, 0\}$

1000 interviews = 100 offer letters

historical data

prob. of success in each interview = $P(S) = 0.1$

Binomial Distribution

Strategy 1 : Give 10 interviews → Get some offer letters → pick the best offer.

X = No of offer letters received.

$[0, 1, 2, 3, 4 \dots 10]$

Strategy 2 : Keep giving interviews until I get a job

Geometric distribution

$I_1 \quad I_2 \quad \dots \dots \quad I_5$

I_1: P, F

I_5: P, S

✗ ✗ ✓

Trials

Bernoulli Trial

1. Coin flip → H, T
2. Exam → P, F
3. Cricket → Win, lose
4. Sharemarket → profit, loss
5. Rolling dice → odd, even

Success (p)   Failure ($1-p$)

defined in question

$p(s) = p$

$p(f) = 1-p$

Trial	Coin Flips	Success (obtaining heads) #
1	{H, T}	$P(S) = 0.5$ $\quad P(F) = 0.5$ $P(S) = p$ $\quad P(F) = 1-p$
2	{HH, HT, TH, TT} 2, 1, 1, 0 {SS, SF, FS, FF} 2, 1, 1, 0	
3	3, 2, 2, 2 {HHH, HHT, HTH, THH, TTH, THT, HTT, TTT} 1, 1, 1, 0	

Two trials:

X		P[X]
0	{FF}	$(1-p)(1-p)$
1	{SF, FS}	$p(1-p) + (1-p)p$
2	{SS}	$p \times p$

Three trials:

X		P[X]
0	{TTT}	$(1-p)(1-p)(1-p)$
1	{TTH, THT, HTT}	$(1-p)(1-p)p + (1-p)p(1-p) + p(1-p)(1-p)$
2	{HHT, HTH, THH}	$p \cdot p(1-p) + p(1-p)p + (1-p)pp$
3	{HHH}	$p \cdot p \cdot p$

Binomial Process

$n \rightarrow$ # of trials

$k \rightarrow$ # of Successes

$p \rightarrow$ prob of Success in one trial

* Fixed No. of Interviews $\Rightarrow n$

* Each trial is independent
$P(S) \rightarrow$ always remains the same.

* $k \Rightarrow$ Success $\Rightarrow$ No of offer letter

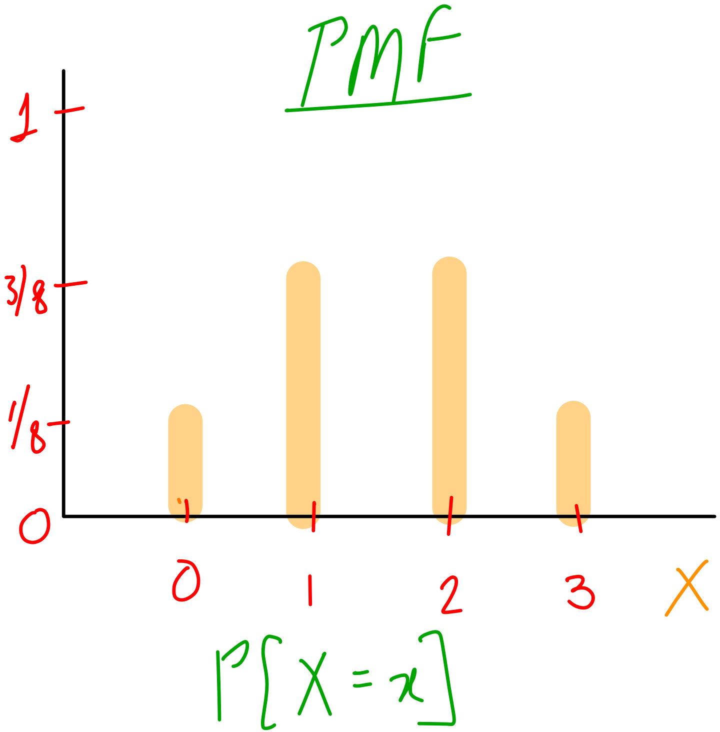
In n trials what is the prob. of k success?

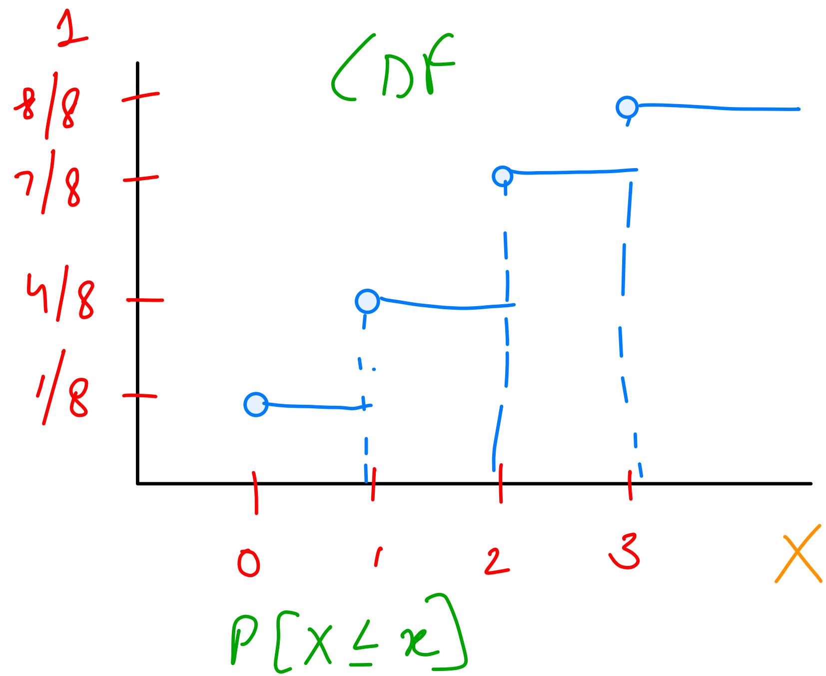
10 5

Binomial

cdf, pmf → Discrete RV

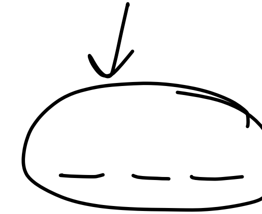
cdf, pdf → Continuous RV





Trials 3

$$\{\overset{3}{HHH}, \overset{2}{HHT}, \overset{2}{HTH}, \overset{2}{THH}, \underset{1}{TTH}, \underset{1}{THT}, \underset{1}{HTT}, \underset{0}{TTT}\}$$



$\boxed{k=0}$

X	k	# outcome	
0	0	1	${}^3C_0\, p^0(1-p)^3$
1	1	3	${}^3C_1\, p^1(1-p)^2$
2	2	3	${}^3C_2\, p^2(1-p)^1$
3	3	1	${}^3C_3\, p^3(1-p)^0$

$$P[X=k] = {}^{n}C_{k}\, p^{k} (1-p)^{n-k}$$

no. of trials

#Success

#failure

$$P[X=k] = {}^{n}C_{k}\, p^{k} \underbrace{(1-p)^{n-k}}$$

prob of failure.

#Success

prob_of Success

1

1 2 1

1 3 3 1

1 4 6 4 1

1 5 10 10 5 1

1 6 15 20 15 6 1

$$E[X] = \sum X \cdot P[X] = \mu$$

Geometric Distribution

prob of success in k^{th} trial.

$P[X = 1]$

$k=1$	S	p
$k=2$	F, S	$(1-p)\,p$
$k=3$	F F S	$(1-p)(1-p)\,p$
$k=4$	F F F S	$(1-p)(1-p)(1-p)\,p$

$$P[X=k] = (1-p)^{k-1} \cdot p^{1}$$

$$E[X] = \frac{1}{p}$$

mean

A bag has **3 Red** and **2 Blue** balls.

You pick a ball, write its colour, and **put it back** in the bag. This is done **4 Times** in total.

If all 4 times, the **Red balls** was drawn, you **win Rs 150**.

Otherwise you **lose Rs 10**.

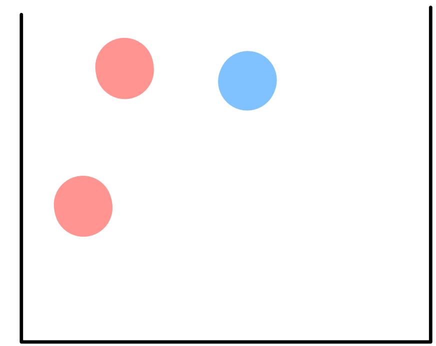
Would you play this game?

R/B R/B R/B R/B

3/5 2/5 3/5 2/5 3/5 2/5 3/5 2/5

R R R R } → +150

everything else } → −10



$X \rightarrow$ # of No. of Red balls

X	$P[X]$	
0	—	
1	—	
2	—	-10
3	—	
4	—	$\rightarrow +150$

$Y \rightarrow$ Money that I can lose/win

Y	$P[Y]$	
$+150$	0.1296	$P[X=4]$
-10	0.8704	$P[X=0]+P[X=1]+P[X=2]+P[X=3]$

$$E[Y] = \sum Y \cdot P[Y] = \mu$$

$$E[Y] = 150 \times 0.1296 + (-10)(0.8704)$$

$$= 19.44 - 8.7$$

$$E[Y] = 10.736$$

$$\boxed{-10, -10, -10, -10, +150, +150, +150, +150}$$

$\underline{10.736} \sim \underline{+ve}$ ✓

$6 \longrightarrow 100000$

$\sim 6 \longrightarrow 25000$

$6 \quad \sim 6$

Y	$P[Y]$	X	$P[X]$
100000	$1/6$	1	$1/6$
-25000	$5/6$	0	$5/6$

$n = 1$

$k = 0, 1$

$$\frac{1}{6}(100000) - (25000)\frac{5}{6} < -ve \quad -4166$$

$\sim 6 \rightarrow 20000$

$$(100000)\frac{1}{6} - \frac{5}{6}(20000) = 0$$

$\sim 6 \longrightarrow 21000 \qquad < 0$

nb Rs value > 20000 X

< 20000 ✓

Dream 11

10

1000 → 10000

2 → 1000
1000

3700 Cr

28%

8000

700 → 7000

1000

298 → 0

1 SQL

2 Tableau

3 Python

4 Libraries

5 P&S

6 Hypothesis

7 Advanced Python

8 Maths for ML

9 10 11 12 ML

13 14 15 DL

16 MLOPS