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Agenda

* Cummulative Distributive Function [CDF]
* Variance, standard Deviation
* Empirical vs Theoretical probability
* Expectation
* Casino Case Study / Example
* Binomial Distribution

** Assignments

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Recap

1. Descriptive & Inferential

2. Mean, Median, Mode, Range, IQR,

   Range → outliers

   Range → Max - Min

   IQR → $Q_3 - Q_1$

   Q_3 → 75^{th}

   Q_1 → 25^{th}

3. Random variable

   - Discrete
   - Continuous

4. CDF

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$\Rightarrow$ 25 percentile $\longrightarrow$ 63.5

CDF

63.5 $\longrightarrow$ 0.25

$\underbrace{\qquad\qquad\qquad}_{25\%} <= 63.5$

$F(x) = y$

10000

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(i) G 68 inches
A 64 inches
error $\boxed{4}$

(ii) G 63 inches
A 68 inches
$\boxed{5}$

$\Rightarrow$ ** $(\text{Actual} - \text{Guess})^2 \Rightarrow$ $\boxed{\text{square error}}$

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$\Rightarrow$ Best $\Rightarrow$ mean

$\mu \rightarrow$ Mean

10 times

Variance $= \dfrac{(H_1 - \mu)^2 + (H_2 - \mu)^2 + \text{----} + (H_{10} - \mu)^2}{10}$

$= \text{inches}^2$

n times

Variance $= \dfrac{\sum_{i=1}^{n} (H_i - \mu)^2}{n}$

$= \sqrt{\text{variance}}$

std $= \sqrt{\dfrac{\sum_{n=1}^{n} (H_i - \mu)^2}{n}}$

$\Rightarrow$

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Empirical vs Theoritical Probability

Estimate the probability from the data

Estime the probability using rule

prove

$P(H) = 1/2 = 0.5$

T

100, 200, 1000

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Casino Example

with replacement

→ 3 red balls & 2 Blue balls

You pick a ball, write a color and put it back in the bag.

This is done 4 times

→ If all 4 red balls drawn → Rs 150

otherwise loose Rs 10

→

Q result profit (or) loss for you?

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⇒ * How many of no red balls can expect to be drawn?

Discrete

X : no of red balls drawn

0,

1

2

3

4

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0	$\rightarrow$	4%
1	$\rightarrow$	8%
2	$\rightarrow$	32%
3	$\rightarrow$	44%
4	$\rightarrow$	12%

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75 people

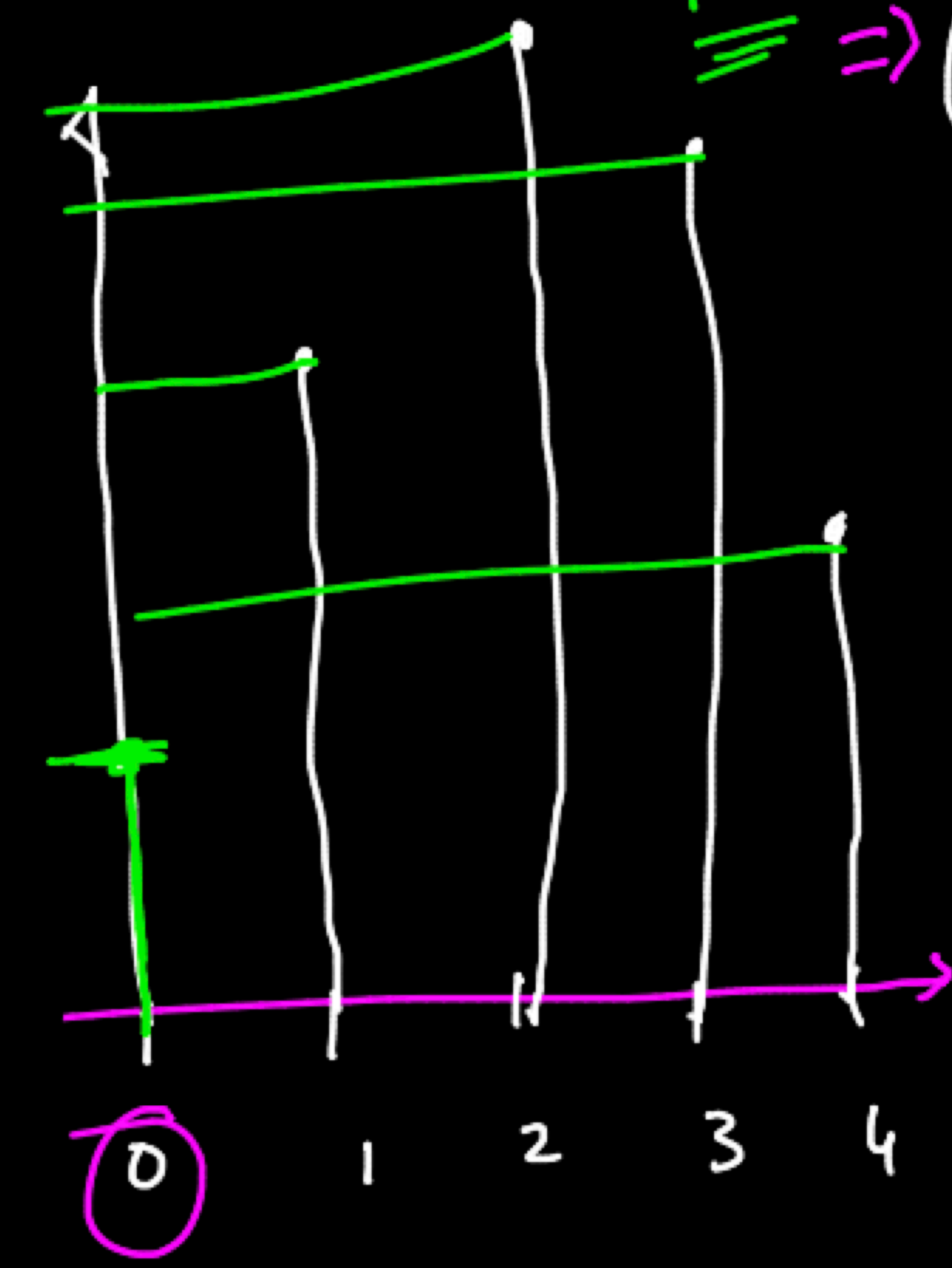
$x = 0$	2 people
$x = 1$	12
$x = 2$	26
$x = 3$	25
$x = 4$	10

fraction of people

$p(x)$

PDF $\Rightarrow$ PMF

Probability mass



$F(x) = y$

Discrete random

Empirical

$P(x=0) = 2/75$

$P(x=1) = 12/75$

$P(x=2) = \frac{26}{75}$

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$$E(x) = \frac{0 * 2 + 1(12) + 2(26) + 3(25) + 4(10)}{75}$$

$$= 2.38$$

$$= 0 * \left(\frac{2}{75}\right) + 1\left(\frac{12}{75}\right) + \text{---}$$

$$= 0 * P(x=0) + 1 * P(x=1) + 2 * P(x=2) +$$
$$3 * P(x=3) + 4 * P(x=4)$$

$$\boxed{E(x) = \sum_{i=} x_i * P(x = \cancel{X} x_i)}$$

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Theoritical Approach

3 R 2 B

$$P(R) = 3/5$$

$$P(B) = 2/5$$

$X \rightarrow$ no of Red balls draw

$\downarrow$

0

1

2

3

4

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X	Combinations		P(X)
0	$4C_0 = 1$	$\left(\frac{2}{5}\right)^4$	$\Rightarrow 4C_0 * \left(\frac{2}{5}\right)^4$
1	$4C_1 = 4$	$\boxed{\left(\frac{2}{5}\right)^3 \left(\frac{3}{5}\right)}$	$\Rightarrow 4C_1 * \left(\frac{2}{5}\right)^3 \left(\frac{3}{5}\right)$
2	$4C_2 = 6$	$\left(\frac{2}{5}\right)^2 \left(\frac{3}{5}\right)^2$	$\Rightarrow 4C_2 * \left(\frac{2}{5}\right)^2 \left(\frac{3}{5}\right)^2$
3	$4C_3 = 4$	$\left(\frac{2}{5}\right)^1 \left(\frac{3}{5}\right)^3$	$\Rightarrow 4C_3 * \left(\frac{2}{5}\right)^1 \left(\frac{3}{5}\right)^3$
4	$4C_4 = 1$	$\left(\frac{3}{5}\right)^4$	$\Rightarrow 4C_4 * \left(\frac{3}{5}\right)^4$

$$P(X=0) = 4C_0 * \left(\frac{3}{5}\right)^0 * \left(\frac{2}{5}\right)^4$$

$$P(X=1) = 4C_1 * \left(\frac{3}{5}\right)^1 * \left(\frac{2}{5}\right)^3$$

$$\boxed{P(X=K) = 4C_K * \left(\frac{3}{5}\right)^K * \left(\frac{2}{5}\right)^{4-K}}$$

$$=$$

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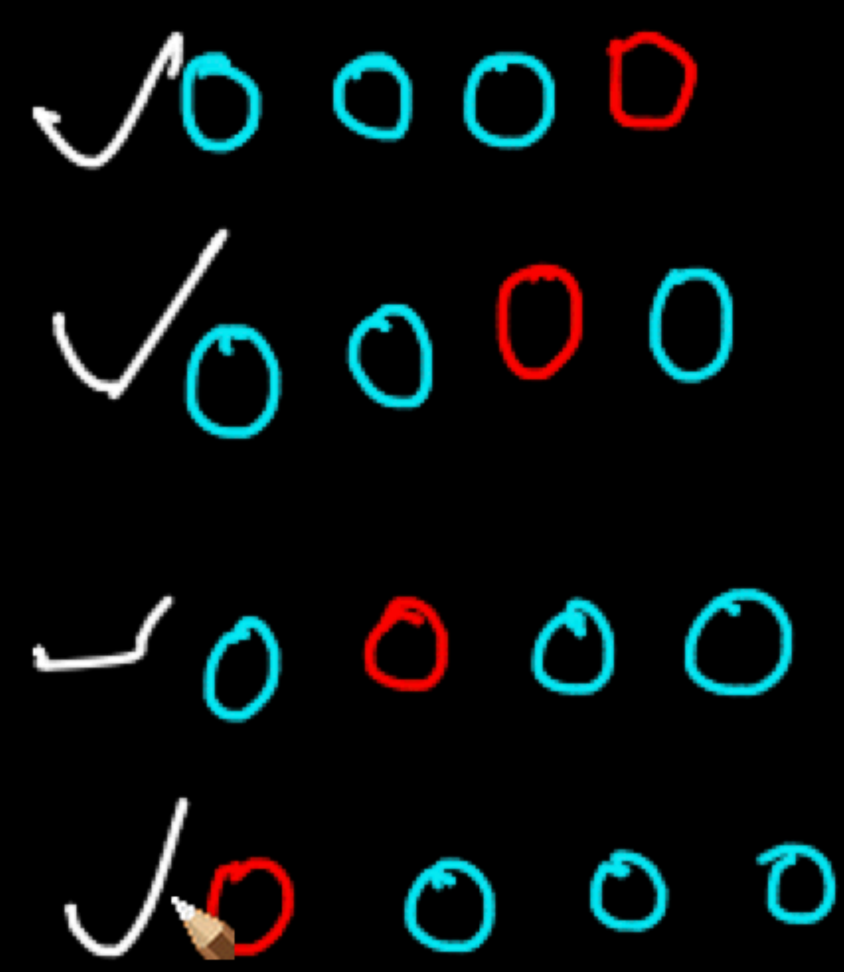
0 red

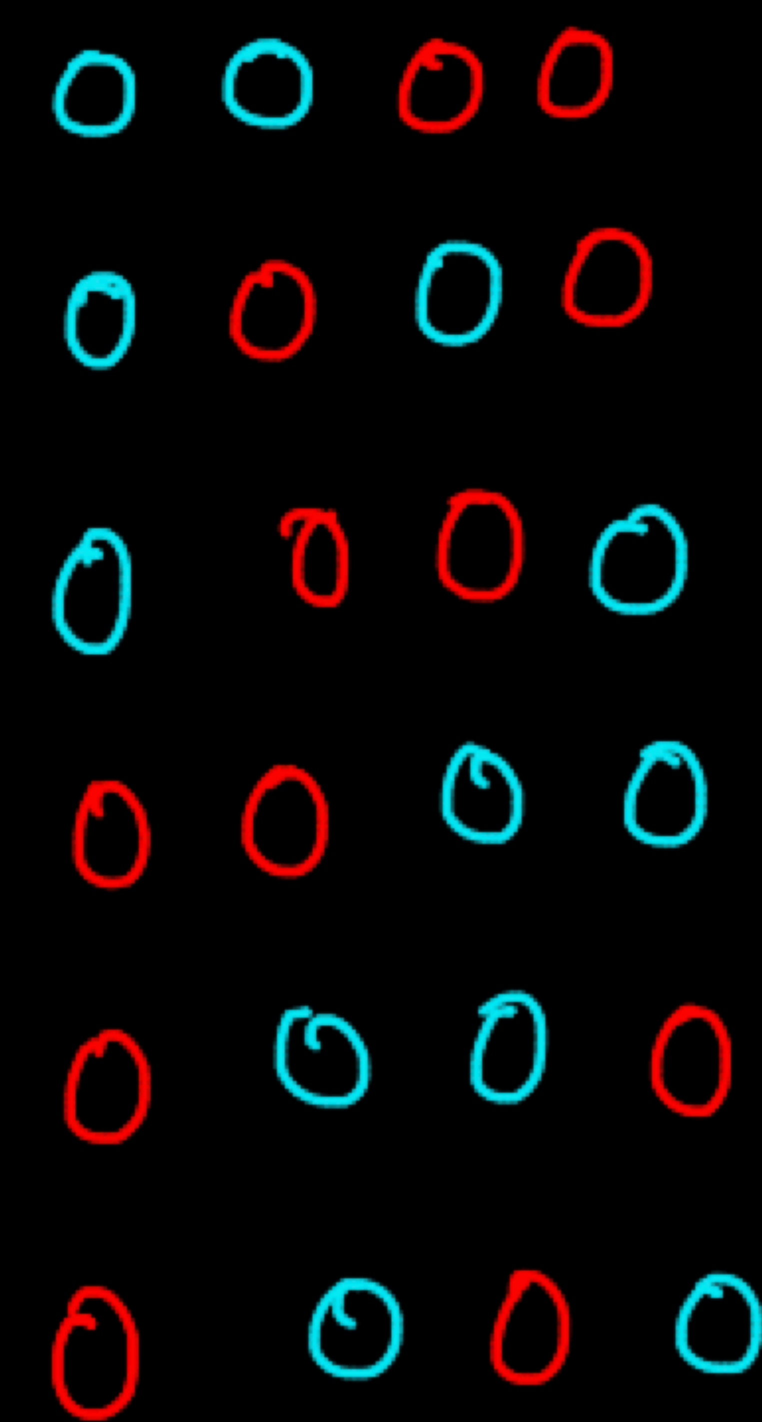
$^4C_0$

1 red



$^4C_1$

2 reds



$^4C_2$

3reds

$^4C_3$

4 reds

$^4C_4$

$P(BBBB)$

$= \frac{2}{5} * \frac{2}{5} * \frac{2}{5} * \frac{2}{5}$

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p = Success

$$P(X=K) = {}^{n}C_{K} \left(\tfrac{3}{5}\right)^{K} \left(\tfrac{2}{5}\right)^{n-K}$$

$P(R) = 3/5$

p → Sucess if you are draw red

$$P(X=K) = {}^{n}C_{K} \left(\frac{3}{5}\right)^{K} \left(\frac{2}{5}\right)^{n-K}$$

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$Y \Rightarrow$ amount of money won/lost

$Y : \{ 150, -10 \}$

R R R R +150

x x x x −10

$P(Y = 150) =$

$P(X = 4)$

$1 - P(X=4)$

$P(Y = -10)$

$\boxed{P(X=0) + P(X=1) + P(X=2) + P(X=3)}$

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150 $\quad P(X=4) \Rightarrow {}^{4}C_{4} \left(\frac{3}{5}\right)^{4} \Rightarrow 0.1296$

-10 $\quad 1 - P(X=4) \Rightarrow 0.8704$

$$E(Y) = 150 * 0.1296 + (-10) * (0.8704)$$

$$= 10.73$$

$$E(Y) = \sum Y_i * P(Y = Y_i)$$

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