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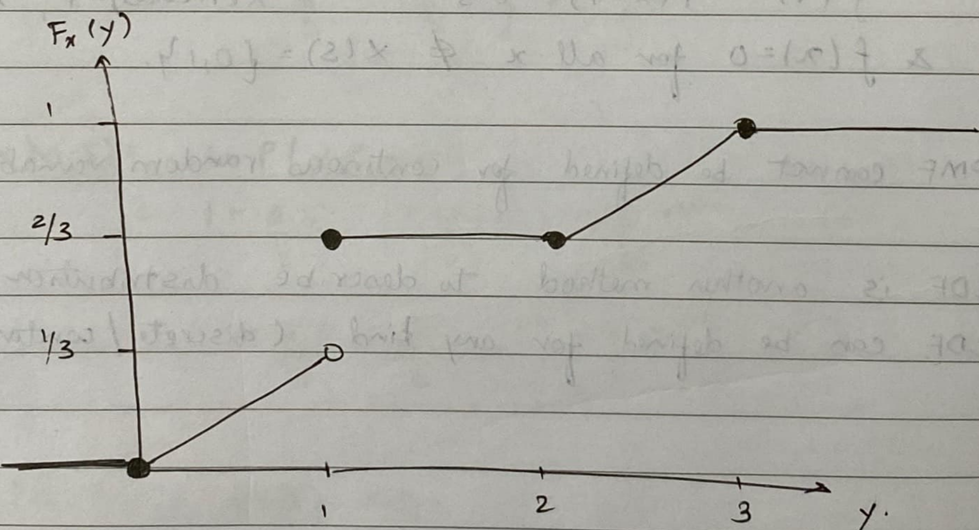
2.5 (9) (a) Binomial coefficient

52 cards in ~~de~~ pack, hand of 5 cards.
order doso not matter here
so, Combination & not permutation. i.e diff combinations of 5 cards unordered. i.e $^{52}C_5$

$$^{52}C_5 = \frac{52!}{5!\,(52-5)!} = \frac{52!}{5!\,47!}$$

3.7 (14)

$$F(y) = \begin{cases} 0 & y \le 0 \\ y/3 & y \in [0,1) \\ 2/3 & y \in [1,2] \\ y/3 & y \in [2,3] \\ 1 & y \geq 3 \end{cases}$$



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(a) $P(X > 0.5) = 1 - P(X \leq 0.5)$

$= 1 - \frac{0.5}{3} = 1 - \frac{1}{6} = \boxed{\frac{5}{6}}$

(b) $P(2 < X \leq 3) = P(X \leq 3) - P(X \leq 2)$

$= F(3) - F(2)$

$= \frac{3}{3} - \frac{2}{3} = \boxed{\frac{1}{3}}$

(c) $P(0.5 < X \leq 2.5) = \cancel{P(0.5)} \; \cancel{P(2.5)}$

$= P(X \leq 2.5) - P(X \leq 0.5)$

$= \frac{2.5}{3} - \frac{0.5}{3} = \boxed{\frac{2}{3}}$

(d) $P(X=1) = \cancel{F(1) = \frac{2}{3}} - F(1^-) = \cancel{P(X \leq 1)} - P(X<1)$

$\cancel{= \frac{2}{3} - \frac{1}{3} = \frac{1}{3}}$

$= P(X \leq 1) - P(X < 1)$

$= \frac{2}{3} - \frac{1}{3}$

$= \boxed{\frac{1}{3}}$

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4.5 (1) pmf, cdf

$X(S) = \{1, 3, 4, 6\}$ [= values that R.V can take.]

$P(X=1) = P(X=6) = 0.1$

$P(X=3) = P(X=4) = 0.4$.

(a) PMF $f(x) = P(X=x)$. [pmf is a probablity measure that gives us [p's] of possible values for a R.V.]

$f(1) = P(X=1) = 0.1$

$f(3) = P(X=3) = 0.4$

$f(4) = P(X=4) = 0.4$

$f(6) = P(X=6) = 0.1$.

[we can find prob dist of R.V(X) using pmf.]

(b) CDF. for RV X. :-

$F_X(y) = P(X \leq y)$.

~~$F_X(0) = P(X \leq 0) = 0$~~

$F_X(1) = P(X \leq 1) = P(X=0) + P(X=1)$

$= 0 + 0.1 = \underline{0.1}$

$F_X(3) = P(X \leq 3) = P(X = 0 \text{ or } 1 \text{ or } 3)$

$= P(0) + P(1) + P(3)$

$= 0 + 0.1 + 0.4$

$= \underline{0.5}$.

$F_X(4) = P(X \leq 4) = P(0) + P(1) + P(3) + P(4)$

$= 0.5 + 0.4$

$= \underline{0.9}$.

$F_X(6) = P(X \leq 6) = 0.9 + P(6) = P(6) + P(X \leq 5)$

$= 0.9 + 0.1$

$= \underline{\underline{1}}$.

(b) CDF.

$$F_x(y) = P(X \le y).$$

$$F_x(y) = \begin{cases} 0 & -\infty < y < 1 \\ 0.1 & 1 \le y < 3 \\ 0.5 & 3 \le y < 4 \\ 0.9 & 4 \le y < 6 \\ 1 & 6 \le y < \infty \end{cases}$$ [from below].

$y < 1$: $P(\cancel{k}) = 0$

$1 \le y < 3$: $P(1) + P(3) = 0.1$

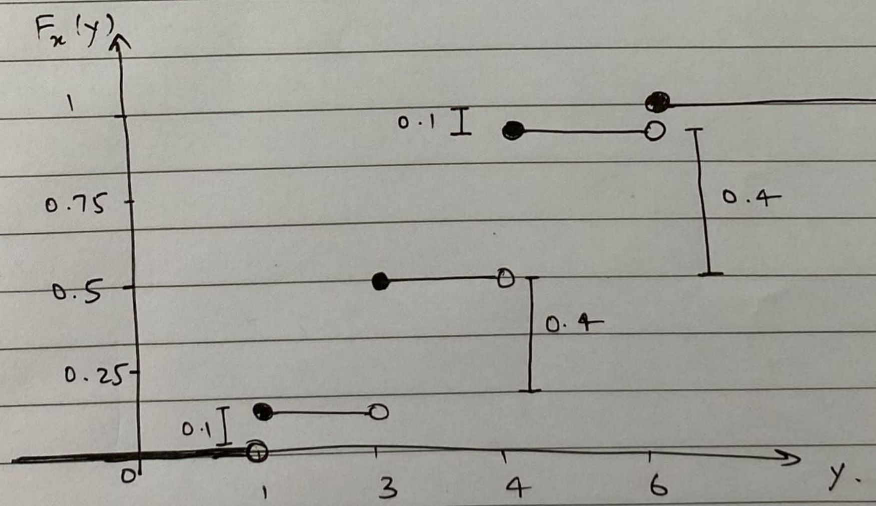
$3 \le y < 4$: $P(1) + P(3) + P(4) = 0. + 0.1 + 0.4 = 0.5$

$4 \le y < 6$: $P(1) + P(3) + P(4) + \cancel{P(6)} = \quad = 0 + 0.1 + 0.4 + 0.4 = 0.9$

$6 \le y < \infty$: $P(1) + P(3) + P(4) + P(6) \quad = \cancel{0 + 0.1}\ 0.9 + 0.1 = 1$

Here, $P(x)$ means $P(X = x)$

i.e $P(6) = P(X = 6) = 0.1$.



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QTP 1) $n(\text{Ghosts}) = 10$

$n(\text{Ghostbusters}) = 10.$

game will start with 3 ghostbusters & 5 ghosts.
here order does not matter for selection hence using combination.

choose 3 Ghostbusters + 10 AND Choose 5 ghosts from 10.

i.e $\cancel{{}^{3}C_{10} \times {}^{5}C_{10}}$ $\underline{{}^{10}C_3 \times {}^{10}C_5}.$

$$= \frac{10!}{3! \times 7!} \times \frac{10!}{5!\,5!}.$$

QTP 2) $n(\text{questions}) = 20$

3 choices i.e $p(\text{correct}) = \frac{1}{3}.$

Y = no of questions he/she guesses correctly.

i.e Y is the collection of multiple events.
where they are. E_1 = 1^{st} answer correct
E_2 = 2^{nd} answer correct
E_3 = 3^{rd} answer correct
$\vdots$
E_{20} = 20^{th} answer correct

$$\left[Y = \sum_{i=1}^{20} X_i \right]$$

where they will have Random variables $X_1, X_2, X_3, \ldots X_{20}$ respectively.

where in each R.V can be either success or failure
i.e $X_i = \{0, 1\}. = \{\text{success, failure}\}.$

(a) Since Y is associated with multiple ~~Bernoulli~~ random variables ($x_1, x_2, \ldots x_{20}$) where each of them follow Bernoulli distribution ($\because x_n = \{0, 1\}$) and each of the sub events are mutually independent. we can say that Y follows Binomial Distribution.

hence probablity of answering n questions correctly will be.

$$P(Y = x) = \cancel{A}\ {}^{n}C_{x}\, p^{x} (1-p)^{n-x}$$

$p = \frac{1}{3}$, $n = 20$ $\quad\therefore X \sim \text{Binomial}(p = 1/3, n = 20)$

$$\therefore P(Y = x) = {}^{20}C_{x} \left(\frac{1}{3}\right)^{x} \left(\frac{2}{3}\right)^{20-x} = \cancel{\text{choose}(20,}$$

(b) $P(Y = 6) = {}^{20}C_{6} \left(\frac{1}{3}\right)^{6} \left(\frac{2}{3}\right)^{20-6}$

R command [dbinom(6, 20, 1/3)]

OR choose(20, 6)x((1/3)^6)x((3/4)^4)

$= \underline{0.1821288}$.

(c) $P(Y \leq 6) = P(Y = 6) + P(Y = 5) + P(Y = 4) + P(Y = 3) + P(Y = 2) + P(Y = 1) + P(Y = 0)$.

$$= \sum_{i=0}^{6} \left({}^{20}C_{i}\right) \left(\frac{1}{3}\right)^{i} \left(\frac{2}{3}\right)^{20-i}$$

[pbinom(6, 20, 1/3)]

$= \underline{0.4793427}$.

(d) $P(Y > 6) = 1 - P(Y \leq 6)$

$= 1 - 0.4793427$

$\doteq \underline{0.5206573}$

[pbinom(6, 20, 1/3, lower.tail = FALSE)]

$= \underline{0.5206573}$.