Assignment 1

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1 PROBLEM

Suppose that two cards are drawn at random from a deck of cards.Let X be the number of aces obtained.Then the value of E(X) is

1) 37/221
2) 5/13
3) 1/13
4) 2/13

2 SOLUTION

Total number of cards =52 with 4 aces,48 non-ace's and we need to select 2 cards so X can be 0 ,1 or 2

Let $A \in \{0, 1\}$ represent the random variable, where 0 represents first card being an non ace, 1 represents first card being ace.
Let $B \in \{0, 1\}$ represent the random variable, where 0 represents second card being an non-ace, 1 represents second card being ace

$\Pr(A = 0)$	48/52	$\Pr(A = 1)$	4/52
$\Pr(B = 0|A = 0)$	47/51	$\Pr(B = 0|A = 1)$	48/51
$\Pr(B = 1|A = 0)$	4/51	$\Pr(B = 1|A = 1)$	3/51

if A=1 then 3 aces left and if A=0 then 4 aces left in remaining 51 cards

Case 1: $X = 0$

$$\implies \Pr(X = 0) = \Pr(A = 0, B = 0)$$
$$= \Pr(A = 0) \times \Pr(B = 0|A = 0)$$
$$\Pr(X = 0) = 188/221$$

$$(2.0.1)$$

Case 2: $X = 1$

$$\Pr(X = 1) = \Pr(A = 1, B = 0) + \Pr(A = 0, B = 1)$$
$$\Pr(A = 1, B = 0) = \Pr(A = 1) \times \Pr(B = 0|A = 1)$$
$$\Pr(A = 1, B = 0) = 16/221$$
$$\Pr(A = 0, B = 1) = \Pr(A = 0) \times \Pr(B = 1|A = 0)$$
$$\Pr(A = 0, B = 1) = 16/221$$
$$\implies \Pr(X = 1) = \frac{32}{221}$$

$$(2.0.2)$$

Case 3: $X = 2$

$$\implies \Pr(X = 2) = \Pr(A = 1, B = 1)$$
$$= \Pr(A = 1) \times \Pr(B = 1|A = 1)$$
$$\Pr(X = 2) = 1/221$$

$$(2.0.3)$$

Now we know that E(X) denotes the average or expectation value which means that E(X) is the weighted average of all values X can take,each value being weighted by the probability of that particular event/value of X occurring
i.e E(X) is given by

$$E(X) = \sum_{i=0}^{2} X \times \Pr(X)$$

X	0	1	2
$\Pr(X)$	188/221	32/221	1/221
$X \times \Pr(X)$	0	32/221	2/221

$$\implies E(X) = \frac{32+2}{221} = \frac{2}{13}$$

Final answer E(x) = 2/13 or option 4