Machine Learning - Assignment 1 (Week ending 31st August)   
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1. Total Sample Spaces (possible outcomes) = 36  
   Total possible outcomes of dice landing on same numbers = 6  
   Hence, Probability of Rolling Doubles,  
    **P(X) = 6/36 = 1/6**
2. Given, P[X,Y] = 0.2, P[X] = 0.5  
   Independent Random variable, by formula,  
    P[X,Y] = P[X] \* P[Y]  
    **P[Y] = 0.5/0.2 = 2.5**
3. Let P(F) be the probability of step taken forward and P(B) be the probability of step taken backward. Now, we are given  
    P(F) = 0.6 and P(B) = 0.4  
   After 10 steps, the drunkard will be at the starting point since he will take 5 steps forward and 5 steps backward in no particular order. Therefore, probability of him being at the starting point,  
    **P(X) = => 0.000796**
4. Given that, X, Y, Z are three random variables. X & Y are independent of each other.  
   Also, E[X] = 2, var[X] = 1, E[Y] = 3,   
   Now, Variance of a random variable is given by, E iable is given by, ch other.re bility ofsince he will take 5 steps forward and 5 steps backward in no particular order.Solving the RHS and Substituting the values in the formula,

Since,

**E[Z] = 5 \* 3 = 15**

1. Given numbers : 1, 6, -1, 4, 10  
   **Mean, X’ = [1 + 6 + (-1) + 4 + 10] / 5 => 4**Sorting the numbers in ascending order,  
   **Median of -1, 1, 4, 6, 10 => 4**Now, according to the formula,  
   **Variance** =   
      
   = => **14.8**
2. Let P(W) be the probability of winning = 20% = 1/5  
   Let P(L) be the probability of losing = 80% = 4/5  
   Amount each time the gambler wins = $ 10  
   Amount each time the gambler loses = $ 5  
   Hence, his expected gain can be calculated using the formula,  
    E[Gain] = [P(W) \* 10] + [P(L) \* (-5)]  
    = (1/5 \* 10) + (4/5 \* -5)  
    = 2 – 4 = -2  
   If the gambler plays ‘n’ games, the total expected gain will be = **-2n**
3. Total no. of cards in a deck = 52  
   Total no. of spades = 13  
   Let event X = (1 spade drawn) & P(Y) be the probability of second card drawn be spade  
   No. of cards left = 51  
   No. of spades left = 12  
   Hence, **P(Y) = 12 / 51**
4. Urn 1 contains balls – 2 White and 7 Black  
   Urn 2 contains balls – 5 White and 6 Black  
   Let P(H) be the probability of Heads as outcome of toss  
   Let P(W1) & P(W2) be the probabilities of White ball drawn from Urns 1 & 2 resp.  
   Now, P(H) = ½  
   P(W1 | H) = 2/(2+7) = 2/9  
   P(W2 | H) = 5/(5+6) = 2/9  
   P(W) = P(H) \* P(W1 | H) + P(H) \* P(W2 | H)  
    = (1/2 \* 2/9) + (1/2 \* 5/11) = 67 / 198  
   Now, using Bayes Rule, probability of Heads given that a White ball was selected,  
   P(H | W) = [P(W | H) \* (P(H)] / P(W)  
    = (2/9 \* 1/2) / (67/198) = **22 / 67**
5. Probability of getting a Head in each toss, *p* =1/2  
   Probability of Heads more than 6 off 10 can be calculated using Binomial Distribution  
    Solving, P(X > 6) = **0.17 = 17%**
6. Probability of winning a bet = *p*Probability of winning for the first time after *n* bets can be calculated by **Geometric Distribution**.