Student Information

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Answer 1

a)

The expected value of a single die roll for each color can be calculated by taking the average of the face values. For the blue die: $\frac{1+2+3+4+5+6}{6} = 3.5$. For the yellow die: $\frac{1+1+1+3+3+3+4+8}{8} = 3$. For the red die: $\frac{2+2+2+2+2+3+3+4+4+6}{10} = 3$.

b)

If you roll a single die of each color, the expected total value would be $3.5+3+3 = 9.5$. If you roll three blue dice, the expected total value would be $3 * 3.5 = 10.5$. So it would be better to choose to roll three blue dice.

c)

If it is guaranteed that the yellow die's value will be 8, then rolling a single die of each color would give an expected total value of $8 + 3.5 + 3 = 14.5$ which is higher than rolling three blue dice with an expected total value of 10.5.

d)

Let R denote that a red die was rolled and V denote that the value of the rolled die is equal to three. We want to find $P(R|V)$. Using Bayes' theorem: $P(R|V) = \frac{P(R \cap V)}{P(V)}$. We have $P(R \cap V) = P(V|R)P(R) = \frac{2}{10} * \frac{1}{3} = \frac{1}{15}$. To calculate $P(V)$, we have $P(V|R)P(R) + P(V|B)P(B) + P(V|Y)P(Y) = \frac{2}{10}\frac{1}{3} + \frac{1}{6}\frac{1}{3} + \frac{3}{8}\frac{1}{3} = \frac{89}{360}$, where $P(R) = \frac{1}{3}$, $P(B) = \frac{1}{3}$, and $P(Y) = \frac{3}{8}$. Therefore, $P(R|V) = \frac{\frac{1}{15}}{\frac{89}{360}} = \frac{24}{89}$.

e)

Let X denote the result when rolling a blue die and Y denote the result when rolling a yellow die. We want to find $P(X + Y = 5)$. Since X and Y are independent, we have:

$$P(X+Y=5) = P(X=1, Y=4) + P(X=2, Y=3) + P(X=3, Y=1) + P(X=4, Y=1)$$
$$= P(X=1) * P(Y=4) + P(X=2) * P(Y=3) + P(X=3) * P(Y=1) + P(X=4) * P(Y=1)$$
$$= \frac{1}{6}\frac{1}{8} + \frac{1}{6}\frac{3}{8} + \frac{1}{6}\frac{3}{8} + \frac{1}{6}\frac{3}{8} = \frac{5}{24}$$

So the probability that total value be 5 when a blue die and a yellow die are rolled is $\frac{25}{96}$.

Answer 2

a)

The number of distributors of company A that offer a discount on a specific day follows a binomial distribution with parameters $n = 80$ and $p = 0.025$. Let X denote this random variable. We want to find $P(X \geq 4)$. Using the cumulative distribution function of the binomial distribution, we have:

$$P(X \geq 4) = 1 - P(X < 4) = 1 - (P(X = 0) + P(X = 1) + P(X = 2) + P(X = 3))$$
$$= 1 - \text{binomcdf}(80, 0.025, 3) \approx 0.1406$$

Therefore, the probability that at least 4 distributors offer a discount on a specific day is approximately equal to 0.1406.

b)

Let Y denote the event that you can buy a phone from company A in two days and Z denote the event that you can buy a phone from company B in two days. Since these events are independent and at least one of them must occur for you to be able to buy a phone in two days, we have:

$$P(Y \cup Z) = P(Y) + P(Z) - P(Y \cap Z) \ = (1 - (1 - 0.025)^{80})^2 + (1 - (1 - 0.1)^2)$$
$$-((1 - (1 - 0.025)^{80})^2 * (1 - (1 - 0.1)^2)) \ \approx 0.442$$

Therefore, the probability that you can buy a phone in two days is approximately equal to 0.442. In this part, I used the complement rule and the independence of events to calculate the probability.

Answer 3

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My Octave Code:
{
N = 1000;
blue = [1 2 3 4 5 6];
yellow = [1 1 1 3 3 3 4 8];
red = [2 2 2 2 2 3 3 4 4 6];

option1 = zeros(N,1);
option2 = zeros(N,1);

for i=1:N
% Roll a single die of each color
option1(i) = blue(randi(6)) + yellow(randi(8)) + red(randi(10));
% Roll three blue dice
option2(i) = blue(randi(6)) + blue(randi(6)) + blue(randi(6));
```

```
end
% Calculate average total value for both options
avg_option1 = mean(option1);
avg_option2 = mean(option2);
% Calculate percentage of cases where second option is greater than first option
percentage_greater = sum(option2 > option1)/N*100;

fprintf('Average total value for first option: %.4f\n', avg_option1);
fprintf('Average total value for second option: %.4f\n', avg_option2);
fprintf('Percentage of cases where second option is greater than first:
 %.4f%%\n', percentage_greater);
}
```

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Comment: Based on the results of the simulation, the average total value for
the first option (rolling a single die of each color) was 9.621, while the
average total value for the second option (rolling three blue dice) was 10.541.
Additionally, in 54.6% of the cases, the total value of the second option was
greater than the first option.
This aligns with our theoretical calculations in Q1b, where we found that the expected
value of the second option was greater than that of the first option. It is
interesting to note that in almost half of the cases, the second option
resulted in a higher total value, indicating that it may be a more favorable
option in certain scenarios.
```

Here is my image:

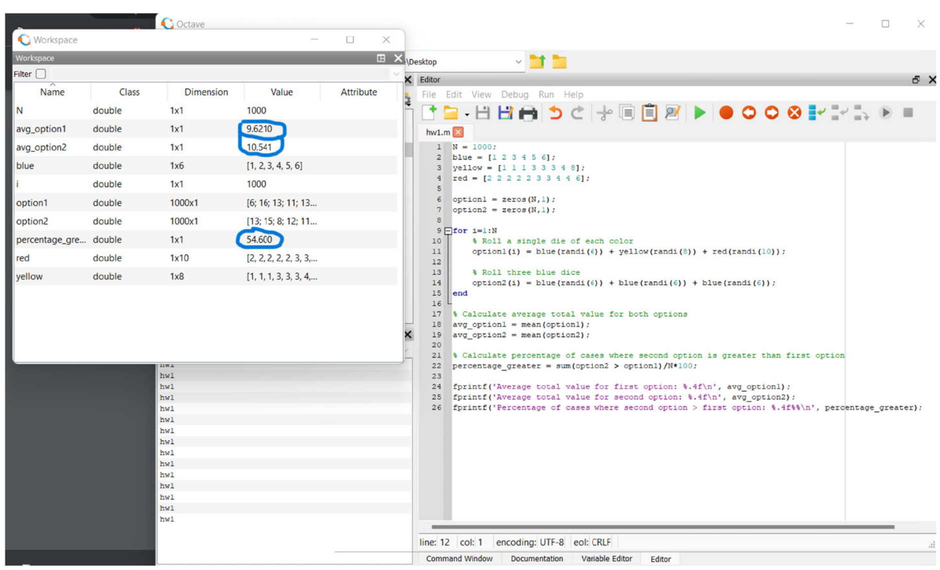

Figure 1: Screenshot of outputs