Homework 04, Isaac Hancock, ST371

Import Section

In [34]:
```
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
import pandas as pd
import stemgraphic as stg
import statistics
from scipy.stats import binom
```

Problem 29

Part A

$$E(x) = \mu_x = \sum_x x \cdot p(x) = 1(0.05) + 2(0.1) + 4(0.35) + 8(0.4) + 16(0.1) = 6.45$$

Part B

$$V(x) = \sum_x (x-\mu)^2 p(x) = (1-6.45)^2(0.05) + (2-6.45)^2(0.1) + (4-6.45)^2(0.35)$$
$$+ (8-6.45)^2(0.4) + (16-6.45)^2(0.1) = 15.6475$$

Part C

$$\sigma = \sqrt{V(x)} = \sqrt{15.6475} = 3.955692$$

Part D

$$V(x) = E(X^2) - \mu^2 \rightarrow E(X^2) = 1^2(0.05) + 2^2(0.1) + 4^2(0.35) + 8^2(0.4) + 16^2(0.1)$$
$$= 57.25 \rightarrow V(x) = 57.25 - 6.45^2 = 15.6475$$

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Problem 32

Part A

$$E(x) = \mu_x = \sum_x x \cdot p(x) = 16(0.2) + 18(0.5) + 20(0.3) = 18.2$$

$$E(X^2) = 16^2(0.2) + 18^2(0.5) + 20^2(0.3) = 333.2$$

$$V(x) = E(X^2) - \mu^2 = 333.2 - (18.2^2) = 1.96$$

Part B

Compute the new values for P where $P = 70X - 650$
$70(16) - 650 = 470 \rightarrow 70(18) - 650 = 610 \rightarrow 70(20) - 650 = 750$

P	470	610	750
p(x)	0.2	0.5	0.3

Find μ_P: $\mu_P = \sum_x x \cdot p(x) = 470(0.2) + 610(0.5) + 750(0.3) = 624$

Also could be found by doing $\mu_p = 70(\mu_x) - 650 = 750(18.2) - 650 = 624$

Part C

$E(P^2) = 470^2(0.2) + 610^2(0.5) + 750^2(0.3) = 398,980$
$V(x) = E(X^2) - \mu_p^2 = 398,980 - (624)^2 = 9,604$

Part D

This can be calculated by passing in the mean of X.
$\mu_h = \mu_x - 0.008(\mu_x)^2 = 18.2 - 0.008(18.2)^2 = 15.550$

Problem 38

Part A

Calculate $E(X)$ and after that $E(5 - X)$

$$E(x) = \mu_x = \sum_x x \cdot p(x) = 1(0.15) + 2(0.35) + 3(0.35) + 4(0.15) = 2.5$$

$$E(5 - X) = 5 - \mu_x = 5 - 2.5 = 2.5$$

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Part B

We have to calculate the new Values of X such that $X_{new} = \frac{150}{5-X}$

$X_1 = \frac{150}{5-1} = 37.5 \; X_1 = \frac{150}{5-2} = 50 \; X_1 = \frac{150}{5-3} = 75 \; X_1 = \frac{150}{5-4} = 150$

X	37.5	50	75	150
p(x)	0.15	0.35	0.35	0.15

$$E(x) = \mu_x = \sum_x x \cdot p(x) = 37.5(0.15) + 50(0.35) + 75(0.35) + 150(0.15) = 71.875$$

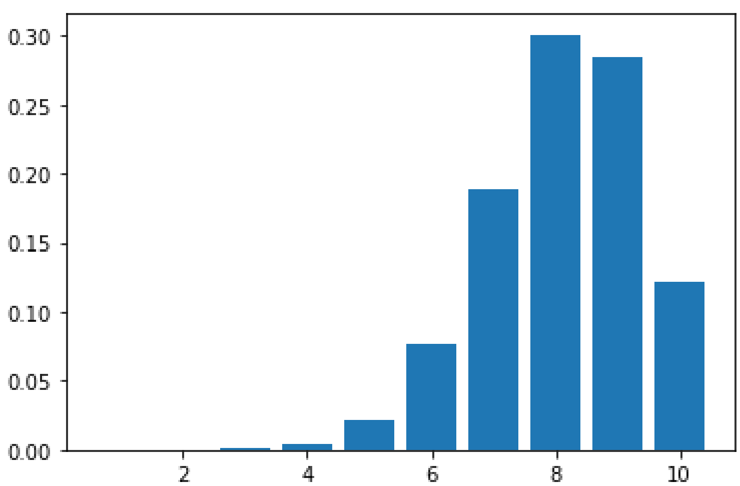
Given this information it would be better to charge a flat fee of $75

Problem 57

Plot the binomial distribution for our datat set. We need to find the probability that at least 9 will work so $P(9 \leq X)$ or $P(X = 9) + P(X = 10)$. We also know that the probability for 1 flashlight working is the probability that both batterys are at the correct voltage. Thus, this can be calculated as such: $0.9 * 0.9 = 0.81$. We will use these assumptions to create a binomial distribution

In [35]:
```
dist = binom.pmf(k=range(1,11), n=10,p=0.81)
plt.bar(range(1,11),dist)
```

Out[35]: <BarContainer object of 10 artists>



In [36]:
```
p = sum(dist[-2:])
print("The probability of at least 9 working is %0.5f" % (p))
```

```
The probability of at least 9 working is 0.40676
```

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Problem 60

The probability of our car being a passenger car is $P(X_P) = 0.6$. The probability of it not being a passenger car is $P(X_N) = 0.4$.

$$E(X_P) = \mu_x = \sum_x x \cdot p(x) = 25(0.6) = 15$$

$$E(X_N) = 25 - X = 25 - E(X_P) = 25 - 15 = 10$$

Thus the total revenue $1.00 \cdot E(X_P) + 2.5 \cdot E(X_N) = 1(15) + 2.5(10) = 40$

The exepcted toll revenue is 40 dollars

```
In [ ]:
```