Q1. What is the Probability density function?

The Probability Density Function (PDF) is a fundamental concept in probability and statistics. It describes the likelihood of a continuous random variable taking on a specific value. In mathematical terms, the PDF represents the derivative of the cumulative distribution function (CDF). The PDF provides a way to understand the probability distribution of continuous random variables by showing how the probability is distributed over the range of possible values.

Q2. What are the types of Probability distribution?

There are various probability distributions, including: 1.Normal Distribution (Gaussian Distribution) 2.Binomial Distribution 3.Poisson Distribution 4.Exponential Distribution 5.Uniform Distribution 6.Chi-Square Distribution 7.Student's t-Distribution 8.F-Distribution 9.Bernoulli Distribution 9.Geometric Distribution 10.Hypergeometric Distribution 11.Beta Distribution 12.Gamma Distribution 13.og-Normal Distribution

Q3. Python function to calculate the probability density function of a normal distribution:

In [1]:
```
import numpy as np
import scipy.stats as stats

def normal_pdf(x, mean, std_dev):
    return stats.norm.pdf(x, loc=mean, scale=std_dev)

# Example usage:
mean = 2.0
std_dev = 1.0
point = 3.0
probability = normal_pdf(point, mean, std_dev)
print(f"PDF at {point} = {probability}")
```

```
PDF at 3.0 = 0.24197072451914337
```

Q4. Properties of Binomial distribution:

The Binomial distribution describes the number of successes in a fixed number of independent Bernoulli trials. Its properties include: 1.Discrete: The number of successes is a whole number (0, 1, 2, ...). 2.Two Parameters: It's defined by two parameters, n (number of trials) and p (probability of success). 3.Probability Mass Function (PMF): The PMF of the Binomial distribution gives the probability of getting exactly k successes in n trials. 4.Mean: The mean is μ = np. 5.ariance: The variance is σ^2 = np(1-p). Examples: Binomial distribution can be applied to events like: Tossing a coin (success = heads, failure = tails) multiple times and counting the number of heads. Quality control in manufacturing, where you check a sample of items for defects, and you're interested in the number of defective items.

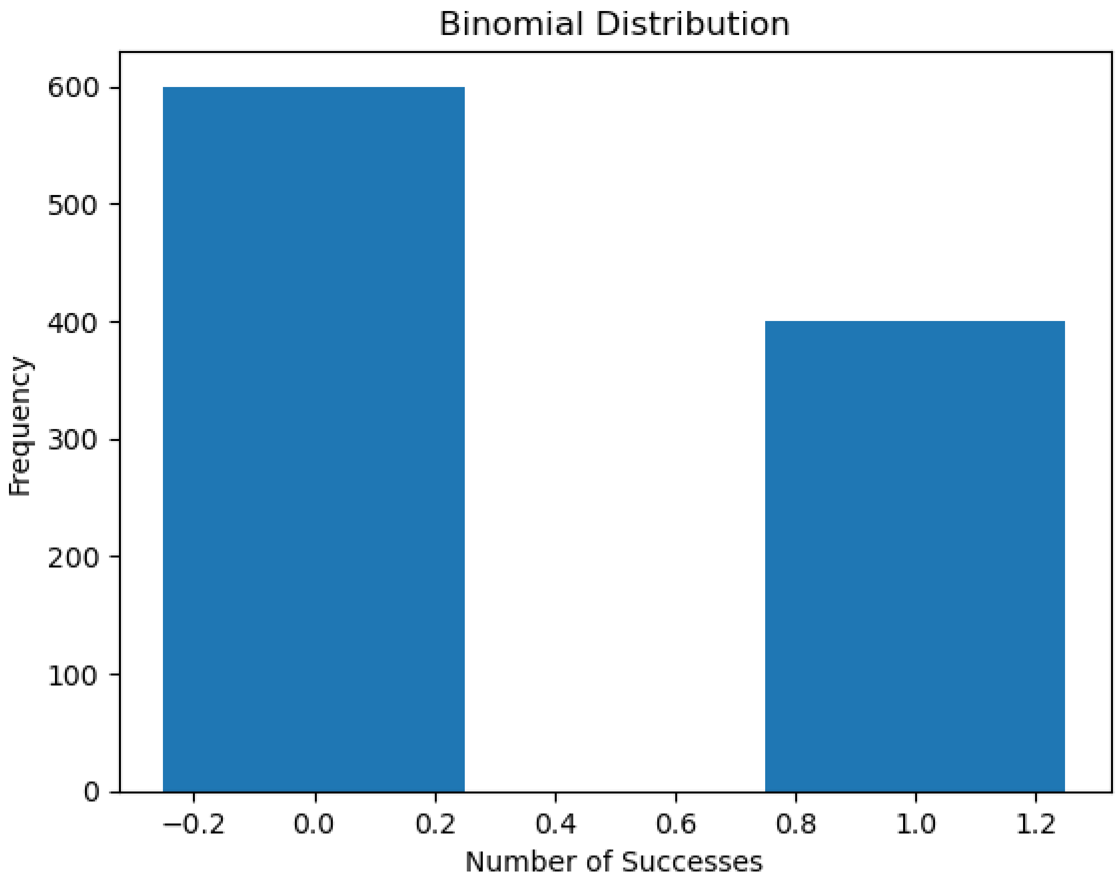
Q5. Generate a random sample from a binomial distribution and plot a histogram using matplotlib:

In [2]:
```
import numpy as np
import matplotlib.pyplot as plt

# Generate a random sample of size 1000 from a binomial distribution with p=0.4
sample = np.random.binomial(n=1, p=0.4, size=1000)

# Plot a histogram of the results
plt.hist(sample, bins=[0, 1, 2], align='left', rwidth=0.5)
```

```
plt.xlabel("Number of Successes")
plt.ylabel("Frequency")
plt.title("Binomial Distribution")
plt.show()
```



Q6. Python function to calculate the cumulative distribution function of a Poisson distribution:

In [3]:
```
import scipy.stats as stats

def poisson_cdf(k, mu):
    return stats.poisson.cdf(k, mu)

# Example usage:
mu = 5
point = 3
cumulative_probability = poisson_cdf(point, mu)
print(f"CDF at {point} = {cumulative_probability}")
```

```
CDF at 3 = 0.2650259152973616
```

Q7. How Binomial distribution is different from Poisson distribution?

Binomial Distribution is used to model the number of successes in a fixed number of trials with a constant probability of success (e.g., coin flips). Poisson Distribution is used to model the number of events occurring in a fixed interval of time or space, where the events are rare and random.

Q8. Generate a random sample from a Poisson distribution, and calculate sample mean and variance

In [4]:
```
import numpy as np

# Generate a random sample of size 1000 from a Poisson distribution with mean 5
sample = np.random.poisson(lam=5, size=1000)

# Calculate sample mean and variance
sample_mean = np.mean(sample)
sample_variance = np.var(sample)

print(f"Sample Mean: {sample_mean}")
print(f"Sample Variance: {sample_variance}")
```

```
Sample Mean: 4.954
Sample Variance: 4.703884
```

Q9. Relationship between mean and variance in Binomial and Poisson distributions:

In a Binomial Distribution, the mean (μ) is equal to np, and the variance (σ^2) is equal to np(1-p), where n is the number of trials and p is the probability of success. In a Poisson Distribution, the mean (μ) is equal to the parameter λ, and the variance (σ^2) is also equal to λ.

Q10. In normal distribution with respect to mean position, where does the least frequent data appear?

In a normal distribution, the least frequent data appears farthest from the mean. This data is found in the tails of the distribution, specifically in the tails that are farthest from the mean on both sides. The further away from the mean a data point is, the less likely it is to occur, making it the least frequent data in the distribution.