1)

The function generate\_geometric generates a list of random variables following a geometric distribution. Here's an explanation of the parameters and the function:

1. **p:** This parameter represents the probability of success on each trial in the geometric distribution. In a geometric distribution, the random variable represents the number of trials needed to achieve the first success.
2. **size:** This parameter determines the number of random variables to generate. The function will produce a list/array of random variables, and 'size' indicates how many elements this list should contain.

The function uses NumPy's random.geometric function, which generates random variables following a geometric distribution. It takes 'p' as the probability of success and 'size' as the number of random variables to generate. The resulting list contains integers representing the number of trials needed to achieve the first success in a series of independent Bernoulli trials.

2)

The function geometric\_pmf calculates the probability mass function (PMF) for a geometric distribution. The geometric distribution models the number of trials needed to achieve the first success in a sequence of independent Bernoulli trials, where each trial has a probability of success pp. Here's an explanation of the parameters and the logic used in the function:

1. **x:** This parameter represents the number of trials needed to achieve the first success. In a geometric distribution, xx is a positive integer greater than or equal to 1.
2. **p:** This parameter is the probability of success in each trial. It represents the likelihood of the event being a success in each individual trial.

The probability mass function (PMF) for a geometric distribution is given by:

P(X=x)=(1−p)x−1⋅pP(X=x)=(1−p)x−1⋅p

where:

* P(X=x)P(X=x) is the probability that the first success occurs on the x-th trial.
* (1−p)x−1(1−p)x−1 is the probability of having x−1x−1 consecutive failures followed by a success.
* p is the probability of success on the x-th trial.

3)

The function geometric\_cdf calculates the cumulative distribution function (CDF) for a geometric distribution. The geometric distribution models the number of trials needed to achieve the first success in a sequence of independent Bernoulli trials, where each trial has a probability of success p. Here's an explanation of the parameters and the logic used in the function:

1. **x:** This parameter represents the number of trials needed to achieve the first success. In a geometric distribution, xx is a positive integer greater than or equal to 1.
2. **p:** This parameter is the probability of success in each trial. It represents the likelihood of the event being a success in each individual trial.

The cumulative distribution function (CDF) for a geometric distribution is given by:

P(X≤x)=1−(1−p)xP(X≤x)=1−(1−p)x

where:

* P(X≤x)P(X≤x) is the probability that the first success occurs on or before the xx-th trial.
* (1−p)x(1−p)x is the probability of having xx consecutive failures before the first success.
* 1−(1−p)x1−(1−p)x is the cumulative probability up to the xx-th trial.

4)

The function geometric\_expectation calculates the expected value (or mean) of a geometric distribution. The geometric distribution models the number of trials needed to achieve the first success in a sequence of independent Bernoulli trials, where each trial has a probability of success p. Here's an explanation of the parameter and the logic used in the function:

1. **p:** This parameter is the probability of success in each trial. It represents the likelihood of the event being a success in each individual trial.

The formula for the expected value of a geometric distribution is given by:

E(X)=1pE(X)=p1​

where:

* E(X)E(X) is the expected value of the geometric distribution.
* p is the probability of success in each trial.

In simple terms, the expected value represents the average number of trials needed to achieve the first success in the sequence of independent trials.

5)

1. **PMF Calculation:** The function computes the Probability Mass Function (PMF) values for a geometric distribution with parameter pp (probability of success) for a range of unique values.
2. **Visualization:** It uses Matplotlib to create a bar plot and scatter plot of the PMF values, showing the probability of each unique value. The x-axis represents the number of trials until the first success, and the y-axis represents the probability.
3. **Title and Labels:** The function sets appropriate labels and a title for the plot, including the specified probability of success (pp), and then displays the plot.

6)

1. **CDF Calculation:** The function calculates the Cumulative Distribution Function (CDF) values for a geometric distribution with parameter pp (probability of success) for a range of unique values.
2. **Visualization:** Using Matplotlib, it creates a step plot of the CDF values, illustrating the cumulative probability up to each unique value. The x-axis represents the number of trials until the first success, and the y-axis represents the cumulative probability.
3. **Title and Labels:** The function sets appropriate labels and a title for the plot, indicating the specified probability of success (pp), and then displays the plot.