# Tutorial Sheet 3 Solutions

## Probability Mass Distributions

### Question 1

1. The probability mass function of a discrete random variable X is given in the following table:
2. Find the E[X] and Var [X].

#### **ANSWER**

The formula for the Expected value, E[X] is:

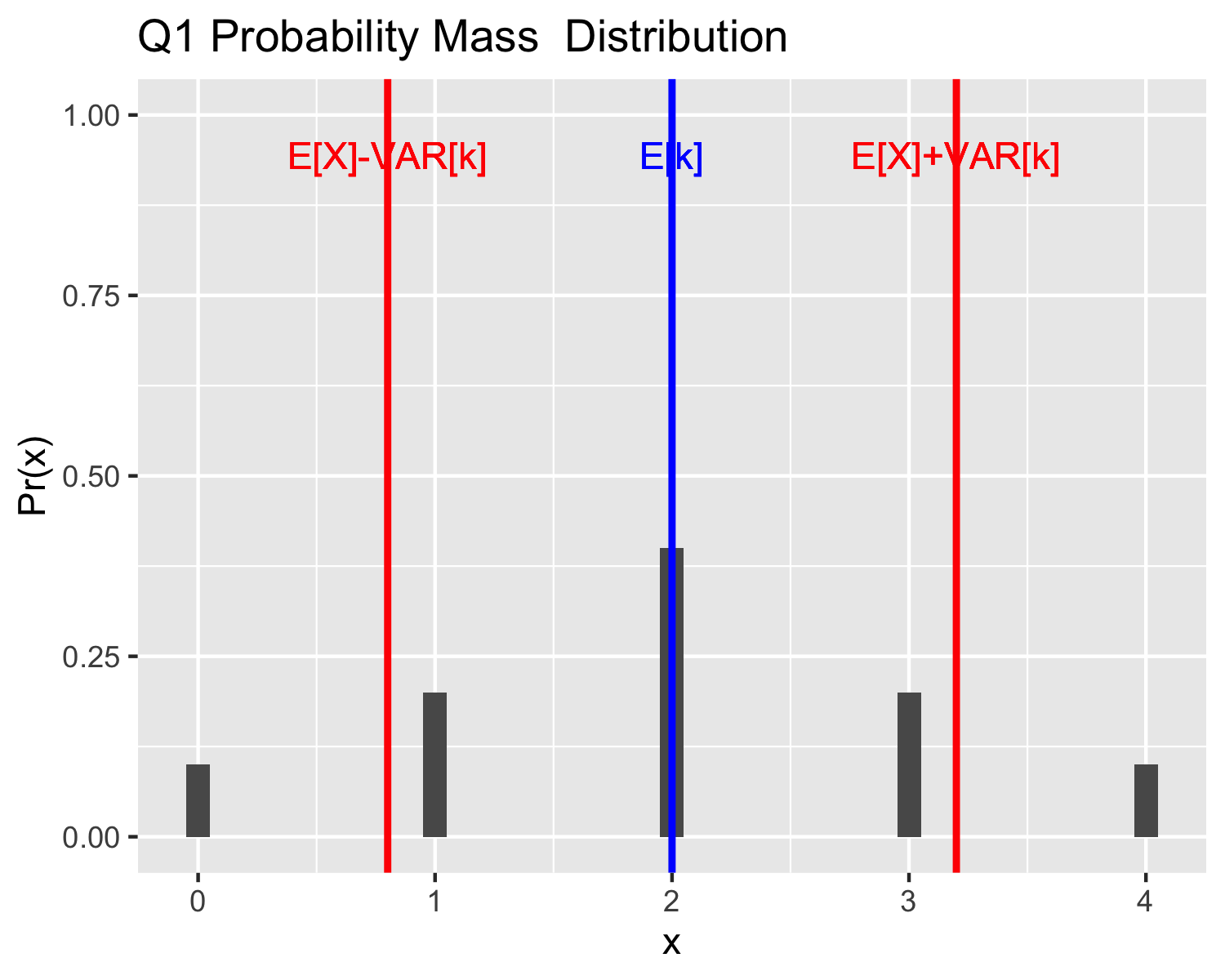
Doing the E[X] calculation in tabular form:

The expected value E[X] is 2.

The formula for the Variance value, VAR[X], is:

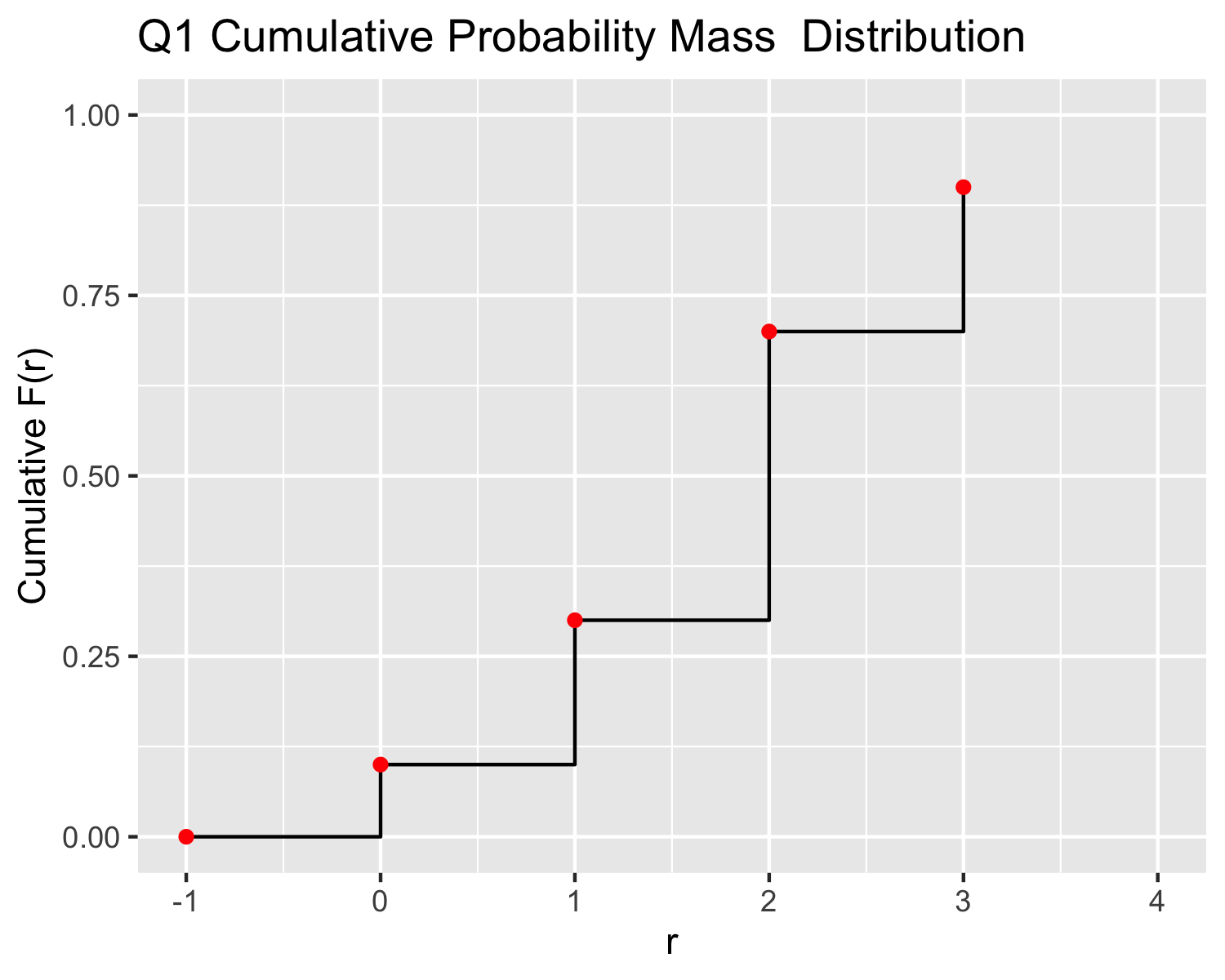
In tabular form:

The Variance value VAR[X] is 1.2.



1. The Cumulative probability mass function

The cumulative probability mass function of a discrete random variable X is given in the following table:



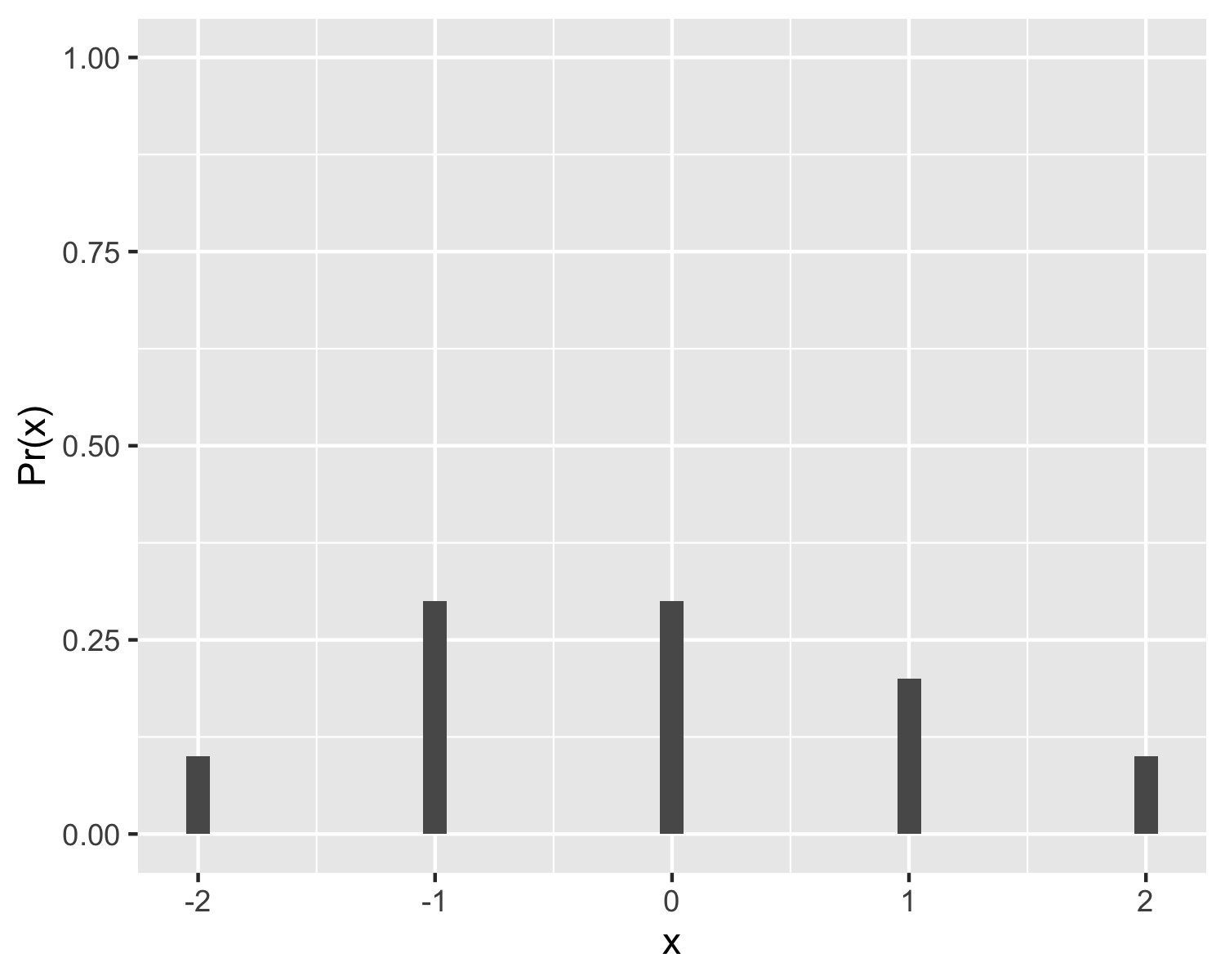
### Question 2

The probability mass function of a discrete random variable X is given in the following table:

1. Show that p3 = 0.2

#### **ANSWER**

re-arranging



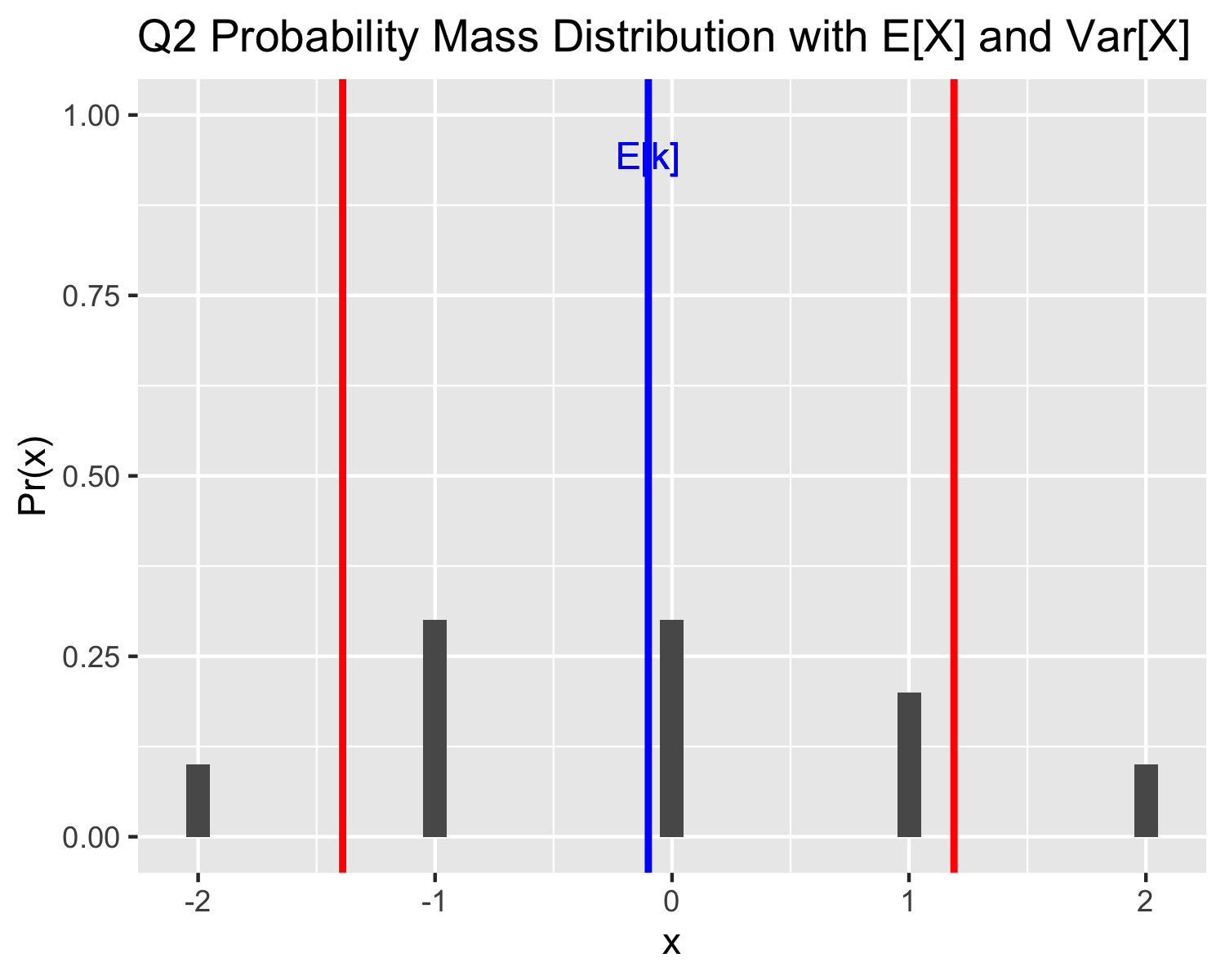
1. Calculate the E[X] and Var[X].

#### **ANSWER**

The expected value E[X] is -0.1.

Calculating the Var[X] in tabular form:

The formula for the Variance value, VAR[X], is:



### Question 3

1. 20% of the Irish population watched Ireland beat France in the Rugby World Cup. A representative from TV3 marketing was sent to Grafton Street to ask passersby their opinion of the match coverage. Let X denote the number of people need to be asked til the marketer successfully finds someone who watched the game.

i Give the Geometric probability mass function for X.

**ANSWER**

The probability of “success” is

the probability of “failure” is

This gives the general definition of the distribution as:

where k is the number of people asked by the marketer.

ii Find the probability that the marketer had to ask exactly 2 people.

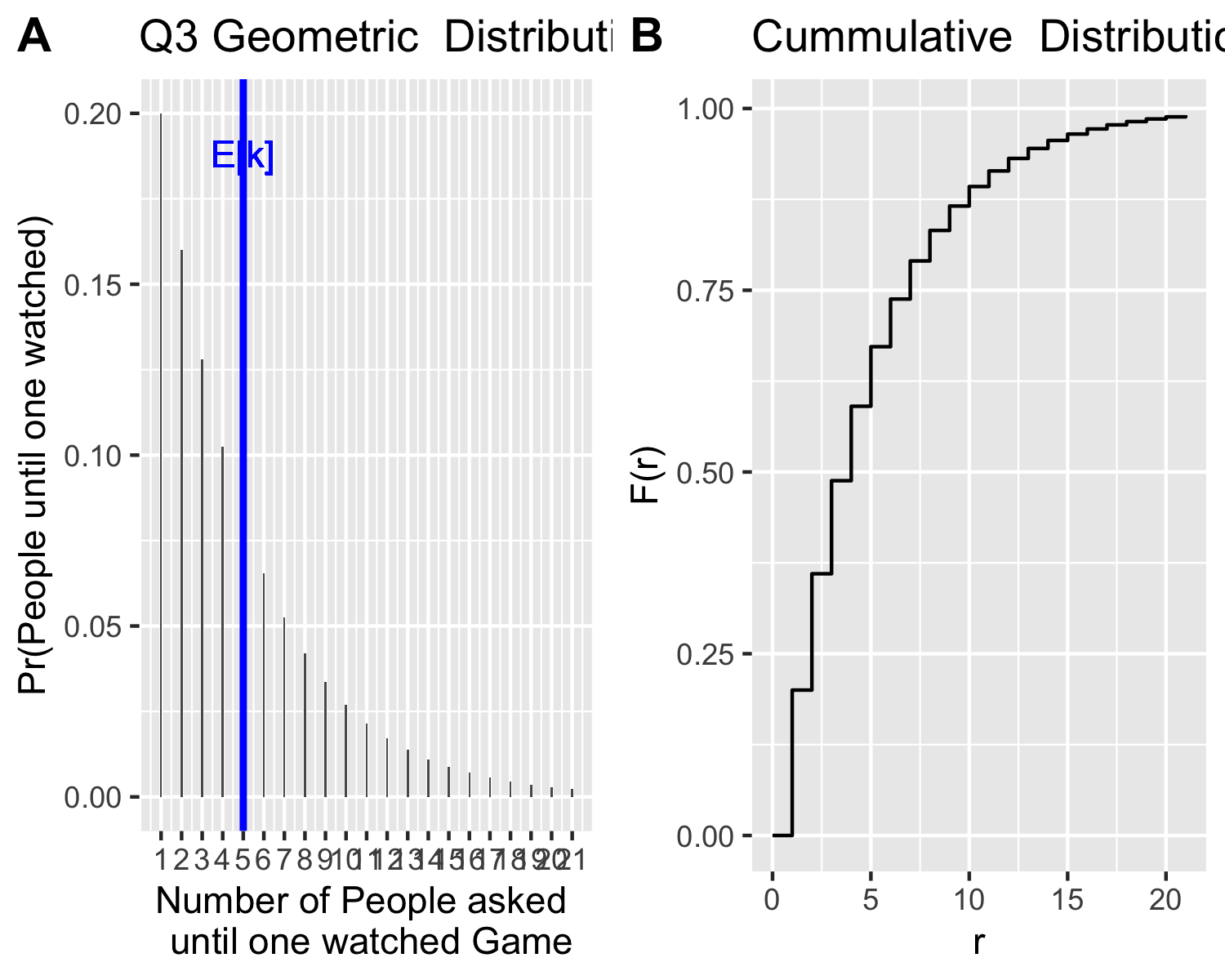
**ANSWER**

iii What is the E [X ] and V ar [X ] of the distribution.

**ANSWER**

The expected outcome of,

and variance of



### Very Optional Question 4

1. The probability mass function of a Bernoulli random variable X is given in the following table:
2. Find the mean E[X] and variance Var[X]. **Answer:**

### MCQ Question 5

Which of the following is true about a probability mass function (PMF) of a discrete random variable?

1. The PMF can take any value greater than or equal to 0.
2. The sum of all values of a PMF is 1.
3. The PMF can take negative values.
4. The PMF is defined for continuous random variables.

**Solution**

Correct Answer: B) The sum of all values of a PMF is 1.

### MCQ Question 6

The probability mass function of a discrete random variable is given in the following table:

What is the probability that X takes a value greater than -2?

1. 0.1
2. 0.2
3. 0.6
4. 0.4
5. 0.7

**Solution**

Answer: C) 0.6

### MCQ Question 7

Which of the following best describes the geometric distribution?

1. It models the number of successes before the first failure in a series of independent Bernoulli trials.
2. It models the number of trials until the first success in a series of independent Bernoulli trials.
3. It models the number of failures before the first success in a series of dependent Bernoulli trials.
4. It models the number of trials until the first success in a series of dependent Bernoulli trials.

**Solution** ANSWER: B

### MCQ Question 8

Spot three reasons why the following table cannot be a probability mass function of a discrete random variable :

**Solution**

1. Negative probability
2. Probabilities do not sum to 1
3. In wrong order (this is a bit of a weak one)

### MCQ Question 9

What is the variance of a Bernoulli random variable with success probability ?

1. 0.24
2. 0.36
3. 0.4
4. 0.6

**Answer**: **A**

### MCQ Question 10

Which statement best describes a cumulative distribution function (CDF)?

1. It gives the probability of a specific value.
2. It gives the probability that a variable is greater than a value.
3. It gives the probability that a variable is less than or equal to a value.
4. It gives the expected value of a distribution.

**Answer**: **C**

### Question 11

Write your own question for a geometric distribution.