Introduction to Statistics and Data Science using *eStat*

Chapter 5 Probability Distribution

5.3 Discrete Random Variable – Geometric Distribution –

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5.3 Discrete Random Variable

5.3.3 Geometric Distribution

- **Examples of Geometric Distribution**

  - A candidate has a 40 percent approval rating in an election. When interviewing voters to hear opinions from those who oppose, what is the probability of finding someone who disagrees to meet at the fifth trials?

  - Defect rate in a factory-produced product is said to be about 5%. If you continue to inspect the product until you find a defect product to investigate the cause, what is the probability of finding it in 10th trials?

- If we call one outcome of interest is 'success' and the other is 'failure', the experiment is the repetition of Bernoulli trials until we have one 'success'. ⇨ Geometrical random variable
  Geometric distribution

5.3.3 Geometric Distribution

- When the probability of 'success' in a Bernoulli trial is p and X is the number of Bernoulli trials until the first success, the probability distribution of X is called a geometric distribution
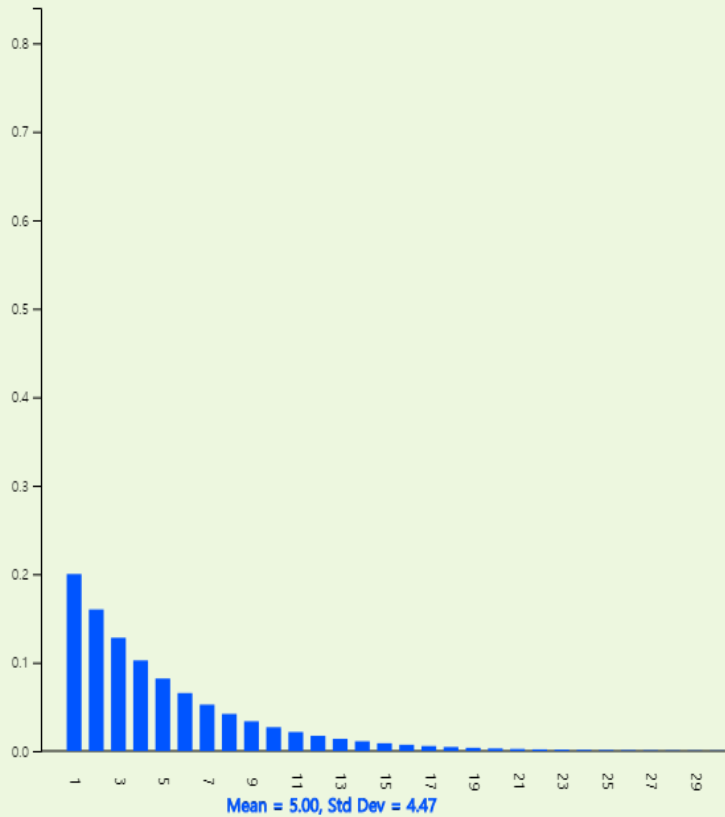
$$f(x) = p \, (1-p)^{x-1} \ , \quad x = 1, 2, \dots$$

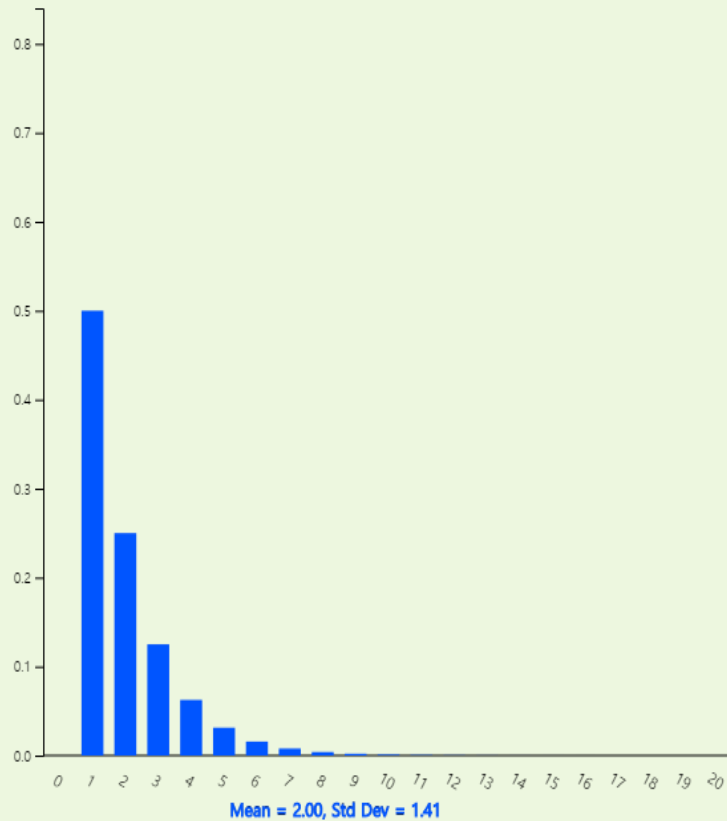$$E(X) \ \frac{1}{p} \ , \quad V(x) = \frac{1-p}{p^2}$$

5.3 Discrete Random Variable
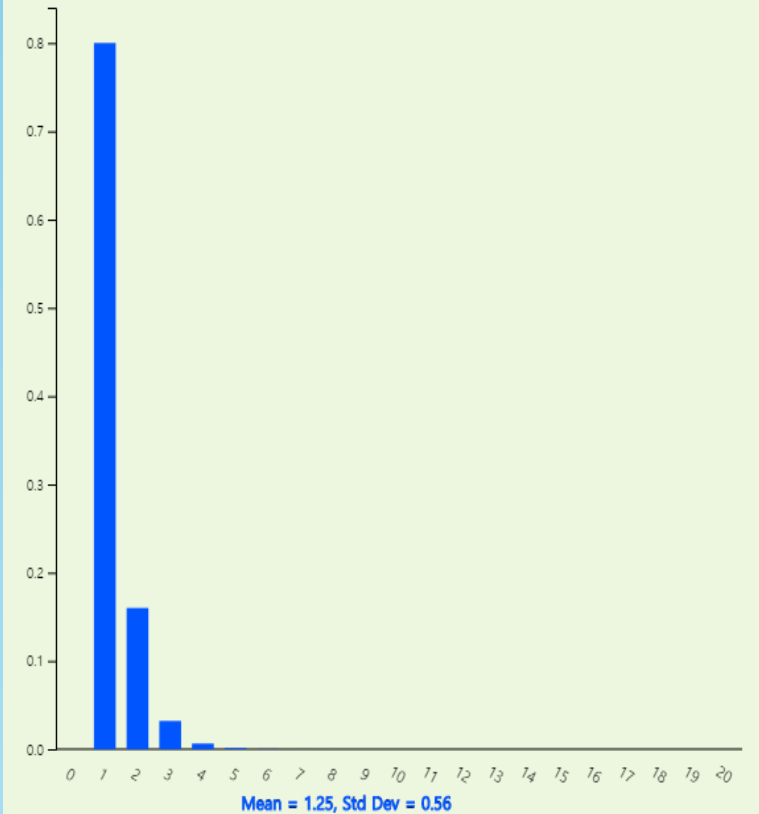
5.3.3 Geometric Distribution

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[Example 5.3.10] A candidate has 60% approval rating in an election. When interviewing voters to hear the opinions of those who oppose the candidate, calculate the following probabilities.

1) What is probability of finding someone who is opposed in the first interview?
2) What is probability of finding someone who is opposed in the fifth interview?

⟨Answer⟩
- Let X be the geometric random variable with p = 0.4.
  1) P(X = 1) = f(1) = $(1 - 0.4)^{1-1} \times 0.6$ = 0.4
 2) P(X = 5) = f(5) = $(1 - 0.4)^{5-1} \times 0.6$ = 0.0518

[Ex 5.3.11] Defect rate in a factory is 5 %. Use 『eStatU』 to obtain the following probabilities when continuing to inspect the product until it finds a defective product to investigate cause of defective.

1) What is probability of finding a defective product at the third inspection
2) What is the probability of finding defective products at the third or after?

⟨Answer⟩
1) P(X=3) = 0.0451.
2) P(X ≥ 3) = 1 − P(X ≤ 2)
        = 1 − 0.0975 = 0.9025

Geometric Distribution p = 0.05

Mean = 20.00, Std Dev = 19.49
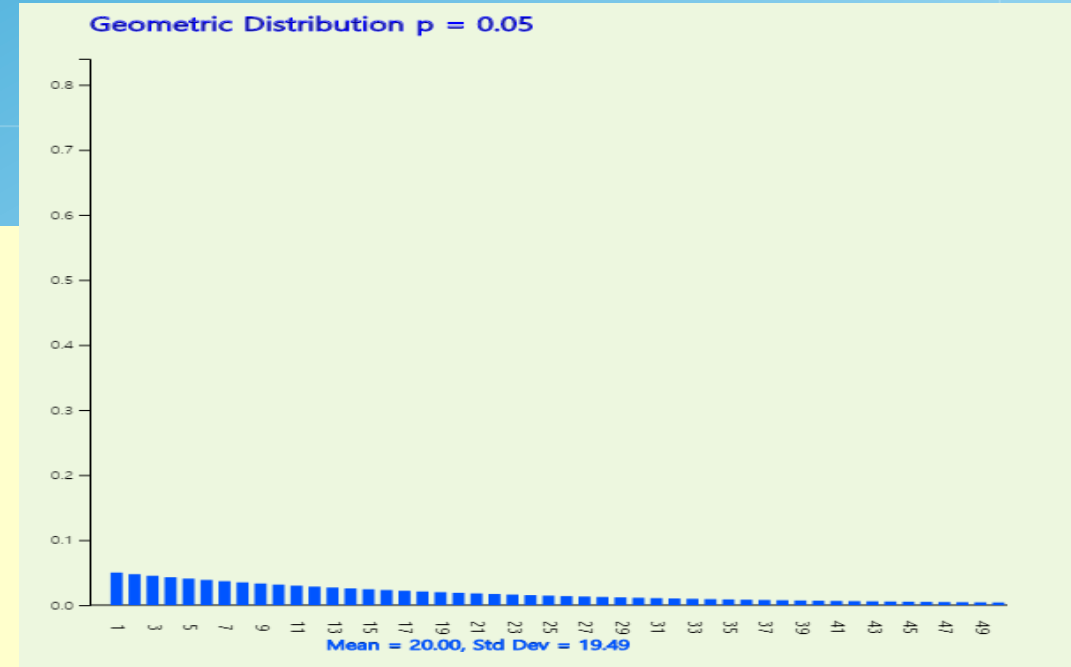
p = 0.05			
x	P(X = x)	P(X x)	P(X x)
1	0.0500	0.0500	1.0000
2	0.0475	0.0975	0.9500
3	0.0451	0.1426	0.9025
4	0.0429	0.1855	0.8574
5	0.0407	0.2262	0.8145

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Thank you