MAT2013: Probability and Statistics [1] [2] **Spring 2017**

Lecture 3: Distributions: Ideal Models

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3.1 Introduction

Within the probabilistic framework, the ensemble, or aggregate behavior of the random phenomenon in question is characterized by its **"probability distribution function"** $f(x)$, or equivalently distribution function $F(x)$. In much the same way that theoretical mathematical models are derived from 'first-principles' [3] for deterministic phenomena, it is also possible to derive these theoretical PDFs as ideal models that describe our knoweledge of the underlying random phenomena.

Third of the lecture, 'Distributions', is fully focused on developing and analyzing ideal probability models, or equivalently distributions, of random variability. We do this in each case by starting with all the relevant information about the phenomenological mechanism behind the specific random variable, says X, and we derive the expression for the PDF $f(x)$ appropriate to the random phenomenon in question.

3.2 Ideal Models of Discrete R.V.

3.2.1 The Discrete Uniform Random Variable

3.2.1.1 Basic Characteristics

3.2.1.2 Model Development

3.2.1.3 Mathematical Characteristics

3.2.2 The Bernoulli Random Variable

3.2.2.1 Basic Characteristics

3.2.2.2 Model Development

3.2.2.3 Mathematical Characteristics

3.2.3 The Binomial Random Variable

3.2.3.1 Basic Characteristics

3.2.3.2 Model Development

3.2.3.3 Mathematical Characteristics

3.2.4 The Negative Binomial Random Variable

3.2.4.1 Basic Characteristics

3.2.4.2 Model Development

3.2.4.3 Mathematical Characteristics

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3.2.5 The Geometric Random Variable

3.2.5.1 Basic Characteristics

3.2.5.2 Model Development

3.2.5.3 Mathematical Characteristics

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3.2.6 The Poisson Random Variable

3.2.6.1 Basic Characteristics

3.2.6.2 Model Development

3.2.6.3 Mathematical Characteristics

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3.3 Ideal Models of Continuous R.V.

3.3.1 The Ratio Familly: The Uniform Random Variable

3.3.1.1 Basic Characteristics

3.3.1.2 Model Development

3.3.1.3 Mathematical Characteristics

3.3.2 The Gamma Familly: The Exponential Random Variable

3.3.2.1 Basic Characteristics

3.3.2.2 Model Development

3.3.2.3 Mathematical Characteristics

3.3.3 The Gaussian Familly: The Gaussian Random Variable

3.3.3.1 Basic Characteristics

3.3.3.2 Model Development

3.3.3.3 Mathematical Characteristics

References

[1] Youngstown State University G. Jay Kerns. *Introduction to Probability and Statistics Using R.* `http://ipsur.org/index.html`. G. Jay Kerns, 2010.

[2] Babatunde A. Ogunnaike. *Random Phenomena: Fundamentals of Probability and Statistics for Engineers.* CRC Press, 2009.

[3] *WIKI, First Principles.* `https://en.wikipedia.org/wiki/First_principle`. Accessed: 2017-04-17.