01204312
Probability Theory and Random Processes

Department of Computer Engineering, Faculty of Engineering,
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Course Summary

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Course Summary

- Lecture #1 Introduction to Probability and Set Theory
  - Intro to probability
  - Experiment → procedure and observation
  - Probability definition
- Lecture #2 Conditional Probability and Independent
  - Axiom
  - Conditional probability
  - Law of Total Probability
  - Independent Event (independent & disjoint)
  - Sequential Experiments
  - Counting method

Course Summary

- *Lecture #3 Discrete Random Variable*
  - *Random variable*
  - *Probability mass function*
  - *Useful discrete random variable*

Course Summary

- *Lecture #4 Discrete Random Variable (Part II)*
  - Cumulative Distribution Function (CDF)
  - Expected Value
  - Derived Random Variable
  - Variance & Standard Deviation

Discrete RV Summary

Uniform Equiprobable outcomes	$\begin{cases} 1/(j-k+1) & x = k,k+1,k+2,..,j \\ 0 & \textit{Otherwise} \end{cases}$	$E[X] = \frac{(j+k)}{2}$
Bernoulli Pass/Fail	$\begin{cases} 1 - p & x = 0 \\ p & x = 1 \\ 0 & \textit{Otherwise} \end{cases}$	$E[X] = p$
Geometric # tests until fail	$\begin{cases} p(1 - p)^{x-1} & x = 1,2,3,\ldots \\ 0 & \textit{Otherwise} \end{cases}$	$E[X] = 1/p$

Discrete RV Summary

Binomial # fails in n tests	$\begin{cases} \binom{n}{x} p^x(1-p)^{n-x} & x=1,2,\ldots,n \\ 0 & \textit{Otherwise} \end{cases}$	E[X] = np
Pascal # tests until k fails	$\begin{cases} \binom{x-1}{k-1} p^k(1-p)^{x-k} & x = k,k+1,\ldots \\ 0 & \textit{Otherwise} \end{cases}$	E[X] = k/p
Poisson occurrence in a period	$\begin{cases} \dfrac{(\lambda T)^x e^{-(\lambda T)}}{x!} & x = 0,1,2\ldots \\ 0 & \textit{Otherwise} \end{cases}$	$E[X] = \alpha$ $\alpha = \lambda T$

Course Summary

- *Lecture #5 Multiple Discrete Random Variable*
  - Joint PMF
  - Marginal PMF
  - Covariance
- *Lecture #6 Multiple Discrete Random Variable II*
  - Correlation Coefficient
  - Conditional Joint PMF by an Event

Course Summary

- *Lecture #7* *Continuous Random Variable*
  - Probability Density Function (PDF)
  - Useful continuous random variable
    - Uniform
    - Exponential
    - Gaussian

Course Summary

- *Lecture #8*
  Continuous Random Variable Part II
  - Gaussian Random Variable
    - Standard Normal CDF
    - Standard Normal Complementary CDF
  - Mixed Random Variable
    - Delta Function : $\delta(x)$
    - Unit Step Function

Course Summary

- *Lecture #9 – 1 Mixed Random Variable*
  - Derived Random Variable
  - Conditioning a continuous RV
- *Lecture #9 – 2 Multiple Random Variables*
  - Joint CDF
  - Marginal PDF
  - Functions of 2 RVs

Course Summary

- *Lecture #10*
  Multiple Random Variables – II
  - Expected Value
  - Conditioning Joint PDF by Event
  - Jointly Gaussian Random Variable

Course Summary

- *Lecture #11 Stochastic Process – I*
  - Stochastic Process
  - Counting Process
  - Poisson Process
  - Brownian Motion Process
  - Autocovariance and Autocorrelation
- *Lecture #12 Stochastic Process – II*
  - Random Sequence
  - Stationary Process
  - Wide-sense Stationary Process

Course Summary

- *Lecture #13 Law of large number & Central limit theorem*
  - Law of Large Numbers
    - Weak law
    - Strong law
  - Central Limit Theorem