

Lecture 6 – LaTeX Scribe Generation

Hi, i want you to generate the scribe of a lecture pdf. Using the file “L6_S1_A”, create a scribe in LaTeX format that I can use as a reference for my exams. The content should be clear, precise, accurate and the final pdf should be 2-3 pages long not more that that.

Do not change the original content in any way. Do not add information from reference files or include any additional material of your own. The goal is only to present the given content in a proper scribe format.

Make sure the output can be directly compiled in LaTeX. For now, provide only the LaTeX code.

If there is any difficulty in providing the PDF, please also include the content in the chat along with the PDF.

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Here is the LaTeX code for the lecture scribe. I have organized the content from your PDF to be concise and exam-friendly while strictly adhering to the original material.

Code snippet

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\documentclass[11pt]{article}
\usepackage[utf8]{inputenc}
\usepackage[margin=1in]{geometry}
\usepackage{amsmath, amssymb, amsfonts}
\usepackage{enumitem}
\usepackage{tcolorbox}

\title{CSE400: Fundamentals of Probability in Computing \\\large
Lecture 6: Discrete RVs, Expectation and Problem Solving}
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\date{January 22, 2025}

\begin{document}

\maketitle

\section{Introduction to Random Variables (RVs)}

[cite_start]A \textbf{random variable X} on a sample space  $\Omega$  is
a function  $X: \Omega \rightarrow \mathbb{R}$  that assigns a real number
 $X(\omega)$  to each sample point  $\omega \in \Omega$ [cite: 48].

\begin{itemize}
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[cite_start]\item \textbf{Discrete RVs:} Take values in a range that is finite or countably infinite[cite: 49].

[cite_start]\item \textbf{Distribution Visualization:} Can be represented as a bar diagram where the x-axis shows values and the height shows $\Pr[X=a]$ [cite: 104, 105, 106].

\end{itemize}

\section{Probability Mass Function (PMF)}

[cite_start]A random variable is discrete if it can take on at most a countable number of values[cite: 204].

\begin{itemize}

[cite_start]\item \textbf{Definition:} The function $P_X(x_k) = P(X = x_k)$ for $k = 1, 2, 3, \dots$ is the PMF of X [cite: 221, 222].

[cite_start]\item \textbf{Property:} The sum of all probabilities must equal 1: $\sum_{k=1}^{\infty} P_X(x_k) = 1$ [cite: 233].

\end{itemize}

\section{Bayes' Theorem Recap}

\begin{tcolorbox}

$$\Pr(B_i|A) = \frac{\Pr(A|B_i)\Pr(B_i)}{\sum_{i=1}^n \Pr(A|B_i)\Pr(B_i)}$$

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\begin{itemize}

[cite_start]\item \textbf{A priori probability:} $\Pr(B_i)$ - formed from presupposed models[cite: 291].

[cite_start]\item \textbf{Posteriori probability:} $\Pr(B_i|A)$ - calculated after observing event A [cite: 292].

\end{itemize}

\section{Independence}

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[cite_start]\item \textbf{Two Events:} A and B are independent if $\Pr(A|B) = \Pr(A)$ and $\Pr(B|A) = \Pr(B)$, implying $\Pr(A, B) = \Pr(A)\Pr(B)$ [cite: 448].

[cite_start]\item \textbf{Three Events:} A , B , and C are mutually independent if[cite: 460]:

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[cite_start]\item  $\Pr(A,B) = \Pr(A)\Pr(B)$ ,  $\Pr(B,C) = \Pr(B)\Pr(C)$ ,  $\Pr(A,C) = \Pr(A)\Pr(C)$  [cite: 462, 463].

[cite_start]\item  $\Pr(A,B,C) = \Pr(A)\Pr(B)\Pr(C)$  [cite: 463].

\end{itemize}

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\section{Types of Discrete Random Variables}


\subsection{Bernoulli Random Variable}

[cite_start]Models an experiment with only two outcomes: Success (1) or Failure (0) [cite: 535, 544].

\begin{itemize}

[cite_start]\item \textbf{PMF:}  $P_X(1) = p$  and  $P_X(0) = 1-p$ , where  $p \in (0,1)$  [cite: 556, 557].

[cite_start]\item \textbf{Examples:} Single coin toss, email spam classification [cite: 572, 574].

\end{itemize}


\subsection{Binomial Random Variable  $B(n,p)$ }

[cite_start]Models the number of successes in  $n$  independent trials, each with success probability  $p$  [cite: 597, 599].

\begin{itemize}

[cite_start]\item \textbf{PMF:}  $p(i) = \binom{n}{i} p^i (1-p)^{n-i}$  for  $i = 0, 1, \dots, n$  [cite: 612].

[cite_start]\item \textbf{Examples:} Correct answers on a test, number of defective items in a sample [cite: 626, 627].

\end{itemize}


\subsection{Geometric Random Variable}

[cite_start]Models the number of independent trials required until the first success occurs [cite: 644, 645].

\begin{itemize}

[cite_start]\item \textbf{PMF:}  $P_X(X=n) = (1-p)^{n-1} \times p$  for  $n=1, 2, \dots$  [cite: 659].

[cite_start]\item \textbf{Examples:} Tosses until first head, attempts until first sale [cite: 669, 670].

\end{itemize}

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\subsection{Poisson Random Variable}

[cite_start]A discrete RV with parameter  $\lambda > 0$ [cite: 695].

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[cite_start]\item \textbf{PMF:}  $p(i) = P\{X=i\} = e^{-\lambda} \frac{\lambda^i}{i!}$  for  $i = 0, 1, 2, \dots$ [cite: 702, 703].

[cite_start]\item \textbf{Approximation:} Used for  $B(n,p)$  when  $n$  is large and  $p$  is small such that  $n \times p$  is moderate[cite: 725, 726].

[cite_start]\item \textbf{Examples:} Misprints on a page, customers entering a post office daily[cite: 740, 744].

\end{itemize}

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