

Make a lecture scribe that is designed to strictly prepare students to exams. Only the given context of Lecture 5 should be used. No other outside knowledge, assumption, interpretation, or additional explanations should be utilized besides the provided textbook materials and lectures. Provide only those definitions as given, all assumptions as made, all statements of theorems and propositions, and proofs, derivations, and examples worked out, which appear within the given context. Do not add new examples, descriptions, deductions, and other logical processes. give the proper latex format. the following structure is

```
\documentclass[11pt]{article} %  
===== PACKAGES  
=====  
\usepackage[a4paper,margin=1in]{geometry}  
\usepackage{amsmath,amssymb} \usepackage{enumitem}  
\usepackage{fancyhdr} \usepackage{xcolor} %  
===== HEADER & FOOTER  
===== \pagestyle{fancy}  
\fancyhf{} \lhead{CSE 400: Fundamentals of Probability in Computing} \rhead{Homework Assignment-1}  
\cfoot{\thepage} % =====  
CUSTOM COMMANDS =====  
\newcommand{\solution}{\vspace{0.5cm}  
\noindent\textbf{\textcolor{blue}{Solution:}}}  
\vspace{0.2cm} % --- STUDENT: TYPE YOUR SOLUTION  
BELOW THIS LINE --- \vfill } %  
===== TITLE  
===== \title{ \normalsize School  
of Engineering and Applied Science (SEAS), Ahmedabad  
University \\ \vspace{0.2cm} \textbf{CSE 400: Fundamentals  
of Probability in Computing} \\ \Large Homework  
Assignment-1 Submission } \author{} \date{}  
\begin{document} \maketitle \vspace{-2cm} \begin{center}  
\begin{tabular}{ll} \textbf{Name:} & {Rushi Moliya}  
\hspace{2.5in} & [1.5ex] \textbf{Enrollment No:} &  
{AUXXXXXXX} \hspace{2.5in} [1.5ex] \textbf{Email:} &  
\end{tabular}
```

{rushi.m@ahduni.edu.in \hspace{2.1in}} \\ [1.5ex]
 \textbf{Date of Submission:} & {January
 10\textsuperscript{th}, 2026 (11:59 PM) \hspace{1.2in}}
 \end{tabular} \end{center} \hrule \vspace{0.5cm} %
 ====== QUESTIONS &
 SOLUTIONS =====
 \begin{enumerate}[label=\textbf{Question-\arabic\*}, leftmargin=\*] % --- QUESTION 1 --- \item A total of 28 percent of American males smoke cigarettes, 7 percent smoke cigars, and 5 percent smoke both cigars and cigarettes. \begin{enumerate}[label=(\alph\*)] \item What percentage of males smokes neither cigars nor cigarettes? \item What percentage smokes cigars but not cigarettes? \end{enumerate} \solution % TYPE SOLUTION HERE \newpage % --- QUESTION 2 --- \item In how many ways can 8 people be seated in a row if: \begin{enumerate}[label=(\alph\*)] \item there are no restrictions on the seating arrangement? \item persons A and B must sit next to each other? \item there are 4 men and 4 women and no 2 men or 2 women can sit next to each other? \item there are 5 men and they must sit next to one another? \item there are 4 married couples and each couple must sit together? \end{enumerate} \solution \newpage % --- QUESTION 3 --- \item A class in probability theory consists of 6 men and 4 women. An examination is given, and the students are ranked according to their performance. Assume that no two students obtain the same score. \begin{enumerate}[label=(\alph\*)] \item How many different rankings are possible? \item If the men are ranked just among themselves and the women just among themselves, how many different rankings are possible? \end{enumerate} \solution \newpage % --- QUESTION 4 -- - \item A committee of 5 is to be selected from a group of 6 men and 9 women. If the selection is made randomly, what is the probability that the committee consists of 3 men and 2 women? \solution \newpage % --- QUESTION 5 --- \item In order to play a game of basketball, 10 children at a playground divide themselves into two teams of 5 each. How many different divisions are possible? \solution \newpage % --- QUESTION 6 --- \item Prove that: \[ \binom{n+m}{r} = \binom{n}{0}\binom{m}{r} + \binom{n}{1}\binom{m}{r-1} + \dots + \binom{n}{r}\binom{m}{0} \]
 \textit{Hint: Consider a group of \$n\$ men and \$m\$}

women. How many groups of size  $r$  are possible?}

\solution \newpage % --- QUESTION 7 --- \item Suppose that 10 fish are caught at a lake that contains 5 distinct types of fish. \begin{enumerate}[label=(\alph\*)] \item How many different outcomes are possible, where an outcome specifies the numbers of caught fish of each of the 5 types? \item How many outcomes are possible when 3 of the 10 fish caught are trout? \item How many when at least 2 of the 10 are trout? \end{enumerate} \solution \newpage % --- QUESTION 8 --- \item An art collection on auction consisted of 4 Dalis, 5 van Goghs, and 6 Picassos. At the auction were 5 art collectors. If a reporter noted only the number of Dalis, van Goghs, and Picassos acquired by each collector, how many different results could have been recorded if all of the works were sold?

\solution \newpage % --- QUESTION 9 --- \item A board has 16 squares (arranged in a  $4 \times 4$  grid). Out of these 16 squares, two squares are chosen at random. The probability that they have no side in common is:

\solution \newpage % --- QUESTION 10 --- \item A multiple choice examination has 5 questions. Each question has three alternative answers, of which exactly one is correct. The probability that a student will get 4 or more correct answers just by guessing is:

\solution \newpage % --- QUESTION 11 --- \item In the game of bridge, the entire deck of 52 cards is dealt out to 4 players (13 cards each). What is the probability that:

\begin{enumerate}[label=(\alph\*)]

\item one of the players receives all 13 spades?

\item each player receives 1 ace?

\end{enumerate}

\solution \newpage % --- QUESTION 12 --- \item You have a fair six-sided die and a fair coin. You roll the die and flip the coin simultaneously. If the coin shows heads, you record the number on the die. If the coin shows tails, you roll the die again and record the sum of the two rolls. What is the probability that the recorded number is an even number greater than 6?

\solution \newpage % --- QUESTION 13 --- \item The coefficients  $a, b, c$  in the quadratic equation  $ax^2 + bx + c = 0$  are chosen from the set  $\{1, 2, 3, 4, 5, 6\}$ . If the probability that this equation has one real root bigger than the other is  $p$ , then the value of  $216p$  is:

\solution \newpage % --- QUESTION 14 --- \item A bag contains 4 red and 6 black balls. A ball is drawn at random from the bag, its colour is

observed, and this ball along with two additional balls of the same colour are returned to the bag. If now a ball is drawn at random from the bag, then the probability that this drawn ball is red is: \solution \newpage % ---  
QUESTION 15 --- \item A student appears for a quiz consisting of only true–false type questions. The student knows the answers of some questions and guesses the answers for the remaining questions. \begin{itemize} \item Whenever the student knows the answer, he gives the correct answer. \item The probability of the student giving the correct answer, given that he has guessed it, is \$1/2\$. \item The probability of the answer being guessed, given that the student's answer is correct, is \$1/6\$. \end{itemize} Then the probability that the student knows the answer of a randomly chosen question is: \solution \end{enumerate} \bigskip \hrule \vspace{0.2cm} \begin{center} \small \textit{End of Submission} \end{center} \end{document} instead of questions insert the contents from the lectures only

Got it. Below is a **strict exam-oriented lecture scribe for Lecture 5 only**, converted **exactly into your provided LaTeX structure**, with:

- **ONLY content from Lecture 5**
  - **No external explanations**
  - **No added intuition, deductions, or examples**
  - **All definitions, propositions, formulas, and worked examples exactly as in slides**
  - **Questions removed and replaced by lecture content**
  - **Proper LaTeX formatting suitable for exam preparation**
- 

latex

 Copy code

```
\documentclass[11pt]{article}
```

```
% ====== PACKAGES ======
\usepackage[a4paper,margin=1in]{geometry}
\usepackage{amsmath,amssymb}
\usepackage{enumitem}
\usepackage{fancyhdr}
```

```

\usepackage{xcolor}

% ===== HEADER & FOOTER =====
\pagestyle{fancy}
\fancyhf{}
\lhead{CSE 400: Fundamentals of Probability in Computing}
\rhead{Lecture 5 Scribe}
\cfoot{\thepage}

% ===== TITLE =====
\title{
\normalsize School of Engineering and Applied Science (SEAS), Ahmedabad University
\vspace{0.2cm}
\textbf{CSE 400: Fundamentals of Probability in Computing} \\
\Large Lecture 5: Bayes' Theorem, Random Variables, and PMF
}
\author{}
\date{}

\begin{document}
\maketitle
\vspace{-2cm}

\begin{center}
\begin{tabular}{ll}
\textbf{Instructor:} & {Dhaval Patel, PhD} \\
\textbf{Date:} & {January 20\textsuperscript{th}, 2026}
\end{tabular}
\end{center}

\hrule
\vspace{0.5cm}

% ===== LECTURE CONTENT =====
\begin{enumerate}[leftmargin=*]

% -----
\item \textbf{Bayes' Theorem: Weighted Average of Conditional Probabilities}

Let  $A$  and  $B$  be events. We may express  $A$  as
\[
A = AB \cup AB^c
\]

```

for, in order for an outcome to be in  $\$A\$$ , it must either be in both  $\$A\$$  and  $\$B\$$

As  $\$AB\$$  and  $\$AB^c\$$  are mutually exclusive, by Axiom 3,

$$\begin{aligned} \Pr(A) &= \Pr(AB) + \Pr(AB^c) \\ &= \Pr(A \mid B)\Pr(B) + \Pr(A \mid B^c)[1 - \Pr(B)] \end{aligned}$$

The probability of event  $\$A\$$  is a weighted average of the conditional probabilities

% -----  
\item \textbf{Bayes' Theorem: Learning by Example}

\textbf{Example 3.1 (Part 1)}

An insurance company believes that people can be divided into two classes: those who

\textbf{Solution:}

Let  $\$A_1\$$  denote the event that the policyholder has an accident within a year, a

$$\begin{aligned} \Pr(A_1) &= \Pr(A_1 \mid A)\Pr(A) + \Pr(A_1 \mid A^c)\Pr(A^c) \\ &= (0.4)(0.3) + (0.2)(0.7) = 0.26 \end{aligned}$$

% -----  
\item \textbf{Bayes Formula: Learning by Example}

\textbf{Example 3.1 (Part 2)}

Suppose that a new policyholder has an accident within a year of purchasing a pol

\textbf{Solution:}

$$\begin{aligned} \Pr(A \mid A_1) &= \frac{\Pr(A \cap A_1)}{\Pr(A_1)} \\ &= \frac{(0.4)(0.3)}{0.26} = 0.5769 \end{aligned}$$

```

= \frac{\Pr(A)\Pr(A_1 \mid A)}{\Pr(A_1)}
\]
\[
= \frac{(0.3)(0.4)}{0.26} = \frac{6}{13}
\]

% -----
\item \textbf{Law of Total Probability}

If  $B_1, B_2, \dots, B_n$  are mutually exclusive and exhaustive events, then
\[
\Pr(A) = \sum_{i=1}^n \Pr(A \cap B_i)
\]

```

This is known as the **Law of Total Probability** (Formula 3.4).

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\item \textbf{Bayes Formula (Proposition 3.1)}


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Using

```

\[
\Pr(A \cap B_i) = \Pr(B_i \mid A)\Pr(A)
\]

```

we obtain the Bayes Formula:

```

\[
\Pr(B_i \mid A) = \frac{\Pr(A \mid B_i)\Pr(B_i)}{\sum_j \Pr(A \mid B_j)\Pr(B_j)}
\]

```

Here,

```

\begin{itemize}
\item  $\Pr(B_i)$  is the a priori probability
\item  $\Pr(B_i \mid A)$  is the a posteriori probability
\end{itemize}

```

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% -----
\item \textbf{Bayes Formula: Card Example}


```

Three cards are mixed: one red-red, one black-black, and one red-black. A card is

Let  $RR$ ,  $BB$ , and  $RB$  denote the three cards. Let  $R$  denote the event that th

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\[

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\Pr(RB | R) =
\frac{\Pr(R | RB)\Pr(RB)}{\Pr(R | RR)\Pr(RR) + \Pr(R | RB)\Pr(RB) + \Pr(R | BB)\Pr(BB)}
\]

\[

= \frac{(1/2)(1/3)}{(1)(1/3) + (1/2)(1/3) + (0)(1/3)} = \frac{1}{3}

\]

% -----
\item \textbf{Random Variables: Motivation and Concept}

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A random variable is a real-valued function defined on the sample space.

Values are determined by the outcomes of an experiment.

Probabilities are assigned to possible values of random variables.

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% -----
\item \textbf{Random Variable Example}

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Suppose an experiment consists of tossing 3 fair coins. Let  $Y$  denote the number

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\[

\Pr(Y=0)=\frac{1}{8}, \quad
\Pr(Y=1)=\frac{3}{8}, \quad
\Pr(Y=2)=\frac{3}{8}, \quad
\Pr(Y=3)=\frac{1}{8}

\]

```

Since  $Y$  must take one of the values  $0, 1, 2, 3$ ,

```

\[

\sum_y \Pr(Y=y)=1

\]

```

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% -----
\item \textbf{Probability Mass Function}

```

A random variable that can take on at most a countable number of possible values

Let  $X$  be a discrete random variable with range

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\[

X = \{x_1, x_2, x_3, \dots\}

```

\]

The function

```
\[
p(x_k) = \Pr(X = x_k)
\]
```

is called the **Probability Mass Function (PMF)** of  $X$ .

Since  $X$  must take one of the values  $x_k$ ,

```
\[
\sum_k p(x_k) = 1
\]
```

```
\end{enumerate}
```

```
\bigskip
\hrule
\vspace{0.2cm}

\begin{center}
\small \textit{End of Lecture 5 Scribe}
\end{center}

\end{document}
```

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If you want, next I can:

- Convert this into **exact exam-answer formatting**
- Create **Lecture-wise exam cheat sheets**
- Do **Lecture 6+ in the same strict style**

Just say the word.

