4.1 Probability Distributions Function (PDF) for a Discrete Random Variable

Vocabulary	Examples
A *variable* is a characteristic or attribute that can assume different values. Variables are usually denoted with a capital letter.	• X = the number of miles a student lives from this campus • X = the blood type of a randomly selected army inductee
A *random variable* is a variable whose values are always determined by chance.	• X = a card drawn from a standard 52-card deck • X = a roll of a 6-sided die • X = a randomly selected 25-year old female's number of driving accidents within one year
A *discrete variable* is a variable whose values can be counted.	• X = the number of 911 phone calls received after a road accident • X = the number of tails occurring in 3 coin tosses
A *continuous variable* is a variable whose values can be any real number in a given interval.	• X = the weight of a newborn baby • X = the winning times of a horse race

Twenty-five army inductees were given a blood test to determine their blood type. The data set is as follows:

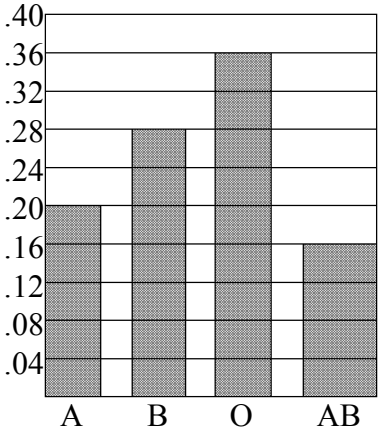
A	B	B	AB	O
O	O	B	AB	B
B	B	O	A	O
A	O	O	O	AB
AB	A	O	B	A

Frequency Distribution

Class	Tally	Frequency	Rel. Freq.
A	||||	5	.20
B	|||| ||	7	.28
O	|||| ||||	9	.36
AB	||||	4	.16

Notice the values in this column have a sum of 1.

Histogram



And now compare:

Below is the sample space of the probability experiment of a coin being tossed 3 times:

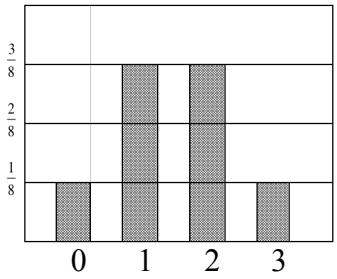
TTT	HTT
TTH	HTH
THT	HHT
THH	HHH

Probability Distribution

No. of Heads X	Tally	Frequency	Probability $P(X)$
0	|	1	$\frac{1}{8}$
1	|||	3	$\frac{3}{8}$
2	|||	3	$\frac{3}{8}$
3	|	1	$\frac{1}{8}$

Notice the values in this column have a sum of 1.

Probability Histogram



The preceding is an example of a discrete probability distribution within the category of theoretical (classical) probability.

A *discrete probability distribution* is a formula, table, or graph that gives the possible values of a random variable X, and the probability $P(X)$ associated with each value of X.

If we change the column headings in the frequency distribution of the army inductee blood types to X for Class and $P(X)$ for relative frequency, we will have a discrete probability distribution within the category of empirical probability.

Probability Distribution

X	Tally	Frequency	$P(X)$
A	||||	5	.20
B	|||| ||	7	.28
O	|||| ||||	9	.36
AB	||||	4	.16

Example 1: Construct a probability distribution and histogram for the probability experiment of tossing two coins where X = the number of heads.

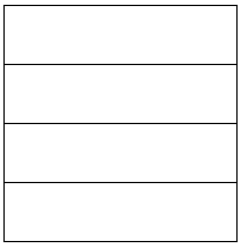
Sample Space

Sample space of the probability experiment of a coin being tossed 2 times:

Probability Distribution

No. of Heads X	Tally	Frequency	Probability $P(X)$
0			
1			
2			

Probability Histogram



Example 2: Construct a probability distribution and histogram for the number of hours 80 students stayed in the math lab during the past week.

Number of hours stayed	Frequency
1	32
2	29
3	15
4	4

Here, the sample space is taken from the sign-in sheet at the lab. The data was tallied from the sign-in sheets and organized in the table above. From this we can construct the probability distribution and histogram.

Probability Distribution

Number of hours stayed X	Frequency	$P(X)$
1	32	
2	29	
3	15	
4	4	

Probability Histogram