SECTION 9.3 EXPECTED VALUE

If an experiment has numerical outcomes and it has a probability distribution,

Outcome Value of X	x_1	x_2	x_3	. . .	x_n
Probability	$p(x_1)$	$p(x_2)$	$p(x_3)$	. . .	$p(x_n)$

then the expected value of the experiment is

E = Expected Value = $x_1p(x_1) + x_2p(x_2) + x_3p(x_3) + \cdots + x_np(x_n)$

The expected value is interpreted as a long term or long run average.

If you have taken Math 10 Statistics, you may have seen this as $\mu = \Sigma\, x\, P(x)$
where the symbol μ (Greek letter "mu") stands for "mean" or "expected value"

EXAMPLE 32:
Students who live in the dormitories at a certain four year college must buy a meal plan.
They must select from four available meal plans: 10 meals, 14 meals, 18 meals, or 21 meals per week.
The Food and Housing Office has determined that 15% of students purchase 10 meal plan,
45% purchase the 14 meal plan of students, 30% purchase the 18 meal plan ,10% purchase the 21 meal plan.
X = the number of weekly meals that an individual student purchase on their meal plan

Notation: P(Event) = probability value

$P(X = 10)$ is the probability that a student purchases a meal plan with 10 meals per week
$P(X > 14)$ is the probability that a student purchases a meal plan with more than 14 meals per week
$P(X \leq 18)$ is the probability that a student purchases a meal plan at most 18 meals per week

x =Number of Meals	Probability P(x)
10	
14	
18	
21	

This table is called the PDF
Probability Distribution Function

On average, how many meals does a student purchase per week in their meal plan?

If there are 2000 students living in the dorm, how many meals do does the dining hall expect to serve each week?

EXAMPLE 33: Keisha makes and sells jewelry at crafts fairs during on summer weekends
If the weather is hot and sunny, she earns a profit of \$1000. If the weather is cool and sunny, she earns a profit of \$2000.If the weather is rainy she loses \$400 because she pays booth rental and travel costs but does not sell much jewelry in the rain. There is 30% chance the weather is hot and sunny, a 50% chance it is cool and sunny and a 20% chance that it rains. Find and interpret the expected value.

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EXAMPLE 34 :

A real estate developer is presenting plans to the Planning Commissioner for a development of houses and apartments he proposes to build. He needs to estimate the impact on the local schools so he must estimate the number of children expected to attend the schools. He hires a statistician who studies the demographics of the neighborhood and of similar housing developments; she provides the estimates in the table.

X	P(X)
0	0.30
1	0.20
2	
3	0.18
4	0.04
5	0.01
6 or more	0

Let X = the number of school age children per household.

a. Find the probability that a household has 2 school age children

b. Find the probability that a family has **at most 3** school age children.

c. Find and interpret the **expected number** of school age children per household.

d. Find the expected total number of school age children in this development if 120 housing units are built.

Extra Practice Examples: The following two examples are from the textbook. Try these questions yourself for practice and Read Section 9.3 in the textbook to see solutions to these two examples.

EXAMPLE 35 : ***Section 9.2 Example 2 from Textbook***

To sell an average house, a real estate broker spends $1200 for advertisement expenses. If the house sells in three months, the broker makes $8,000. Otherwise, the broker loses the listing. If there is a 40% chance that the house will sell in three months, what is the expected payoff for the real estate broker?

EXAMPLE 36 : ***Section 9.2 Example 4 from Textbook***

A lottery consists of choosing 6 numbers from a total of 51 numbers. The person who matches all six numbers wins $2 million. If the lottery ticket costs $1, what is the expected payoff?