

## 8.5 Random Variable and Expected Value

E.g. Production of a concert.

Does not rain : \$20,000 profit

Does rain : \$12,000 loss

Probability of rain : 0.4

$X$  : random variable that gives the profit

Find the probability distribution of  $X$  and

the expected value of  $X$ . ( $E(X)$ )

| $x$     | $p(x)$ | $x \cdot p(x)$          |
|---------|--------|-------------------------|
| 20000   | 0.6    | $(20000)(0.6) = 12000$  |
| -12,000 | 0.4    | $(-12000)(0.4) = -4800$ |

$$E(x) = 12000 - 4800 = 7200$$


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E.g. Car Insurance.

For a category of customers, the premium is \$2300

For these customers  $\left\{ \begin{array}{l} 0.007 \text{ probability of big accident.} \\ \text{insurance pays } \$100,000 \end{array} \right.$

$\left\{ \begin{array}{l} 0.015 \text{ probability of small accident.} \\ \text{insurance pays } \$30,000 \end{array} \right.$

Find the expected value of this policy from customer viewpoint?

|                | $x$    | $p(x)$                           | $x \cdot p(x)$ |
|----------------|--------|----------------------------------|----------------|
| Big accident   | 97 700 | 0.007                            |                |
| Small accident | 27 700 | 0.015                            |                |
| No accident    | -2 300 | $1 - 0.007 - 0.015$<br>$= 0.978$ |                |

$$\begin{aligned}
 E(x) &= (97\,700) \cdot (0.007) + (27\,700) \cdot (0.015) \\
 &\quad + (-2\,300) \cdot (0.978) \\
 &= -1150 \longrightarrow \text{cost to customer}
 \end{aligned}$$

1150  $\longrightarrow$  profit to insurance.