

Probability

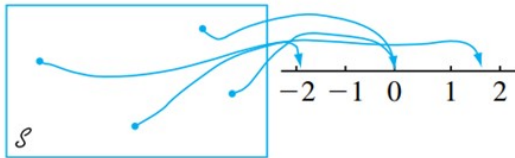
Random Variable

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Intro...

- In many situations, it is desirable to **assign a numerical value to each outcome of an experiment**.
- Such an assignment is called a **random variable (rule of association)**



| Random Variable

- Such a **rule of association** is called a **random variable**
 - **Variable** because different numerical values are possible and
 - **Random** because the observed value depends on which of the possible experimental outcomes results
- Random variables are customarily denoted by **uppercase letters**
- The notation $X(s) = x$ means that x is the value associated with the outcome s by the random variable X

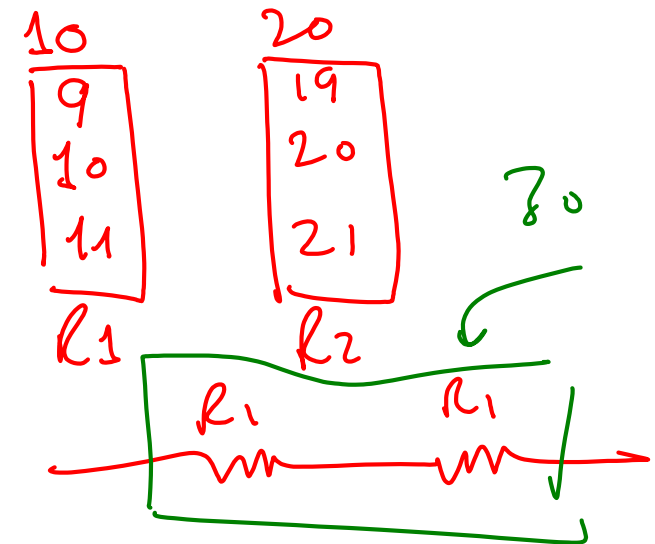
X, Y, Z

$P(X=7)$
↓
 x

Example - 01

- Suppose that an electrical engineer has on hand six resistors. Three of them are labeled 10 Ω and the **other three** are labeled **20 Ω** . The engineer **wants to connect a 10 Ω resistor and a 20 Ω resistor** in series, to **create a resistance of 30 Ω** . Now suppose that in fact the **three resistors labeled 10 Ω** have actual resistances of **9, 10, and 11 Ω** , and that the **three resistors labeled 20 Ω** have actual resistances of **19, 20, and 21 Ω** .

The process of **selecting one resistor of each type** is an experiment whose **sample space consists of nine** equally likely outcomes



Out Come	probability
9, 19	$1/9$
9, 20	$1/9$
9, 21	$1/9$
10, 19	$1/9$
10, 20	$1/9$
10, 21	$1/9$
11, 19	$1/9$
11, 20	$1/9$
11, 21	$1/9$

Outcome	Sum X	probability
9, 19	28	$\frac{1}{9}$
9, 20	29	$\frac{1}{9}$
9, 21	30	$\frac{1}{9}$
10, 19	29	$\frac{1}{9}$
10, 20	30	$\frac{1}{9}$
10, 21	31	$\frac{1}{9}$
11, 19	30	$\frac{1}{9}$
11, 20	31	$\frac{1}{9}$
11, 21	32	$\frac{1}{9}$

$$\underline{X=29} \Rightarrow \text{Sum} = 29$$

$$\downarrow \{ (9, 20), (10, 19) \}$$

$$P(X=29) = P(\{ (9, 20), (10, 19) \})$$

$$= \frac{2}{9}$$

Example - 02

- List the possible values of the random variable X , and find the probability of each of them.

Outcome	Sum X	probability
9, 19	28	$1/9$
9, 20	29	$1/9$
9, 21	30	$1/9$
10, 19	29	$1/9$
10, 20	30	$1/9$
10, 21	31	$1/9$
11, 19	30	$1/9$
11, 20	31	$1/9$
11, 21	32	$1/9$

x	$P(X=x)$
28	$1/9$
29	$2/9$
30	$3/9$
31	$2/9$
32	$1/9$
	<u>1</u>

possible values
 $28, 29, 30, 31, 32$
 x

$X \Rightarrow \text{Sum}$

$$P(X=28) = 1/9$$

$$P(X=c) = 0$$

| References

- Statistics for Engineers and Scientists, Fourth Edition, William Navidi
Colorado School of Mines
- Khan Academy