Probability Methods in Engineering
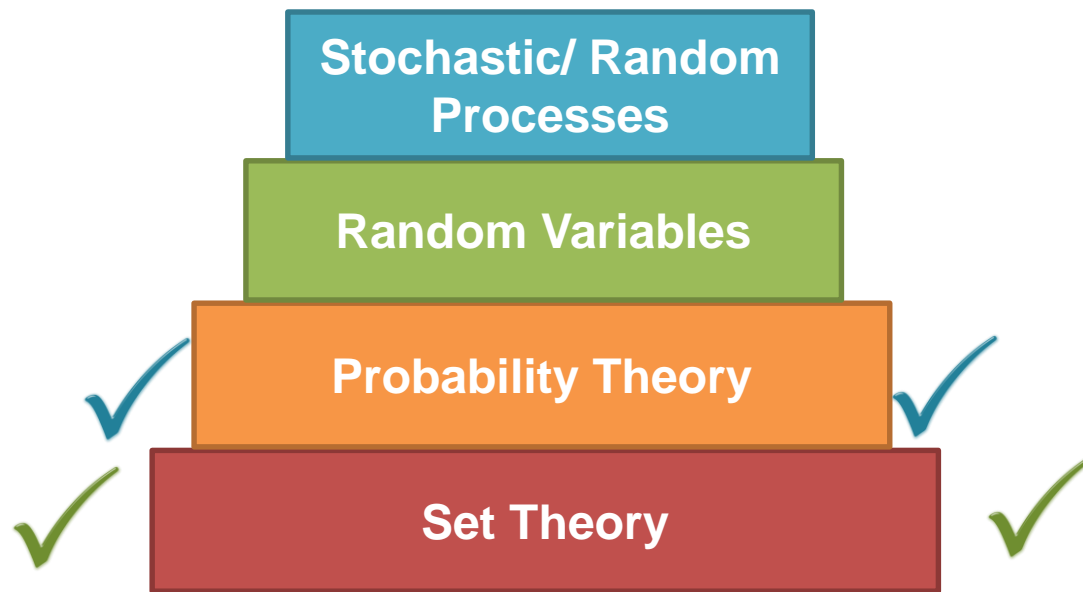
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Lecture 12

Random Variable
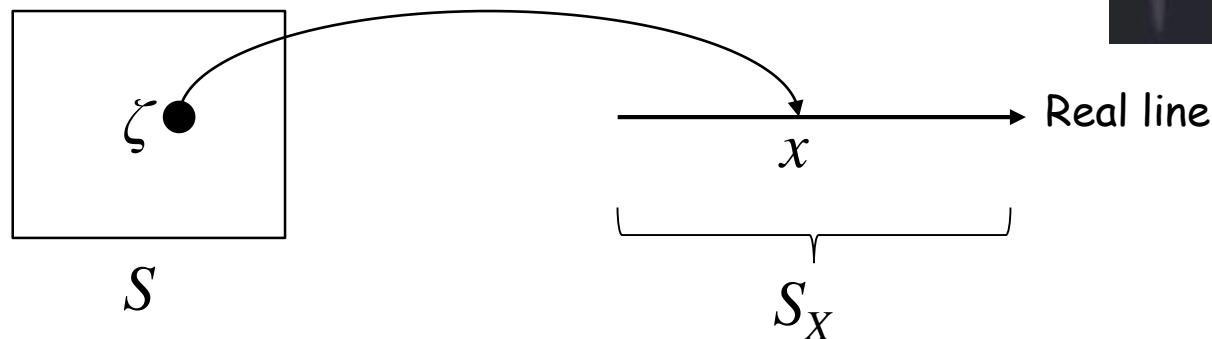
➢ Random Variable or RV

➢ "A function for assigning a number (numerical value) to each outcome of a random experiment"

➢ Outcome of random experiment not always a number
➢ Outcome has some measurement or numerical attribute
  ❑ Interest in number related to outcome, called **value**

➢ Notations
  ❑ Capital letters for RVs $(X, Y, …)$
  ❑ Small letters for values $(x, y, …)$

➤ RV X assigns number $X(\zeta) = x$, to each outcome ζ in the sample space of a random experiment

ζ

S

x

Real line

S_X

➤ A random variable either has an associated probability distribution (Discrete Random Variable), or a probability density function (Continuous Random Variable)

➢ A coin is tossed three times and the sequence of heads and tails is noted. The sample space for this experiment is S = {HHH, HHT, ... , TTT}. Let X be the number of heads in the three tosses. X assigns each outcome ζ in S a number from the set S_X. Find S_X.

➤ A coin is tossed three times and the sequence of heads and tails is noted. The sample space for this experiment is $S =$ {HHH, HHT, ... , TTT}. Let X be the number of heads in the three tosses. Let Y be the number of points obtained for each outcome such that 8 points are awarded for three heads, 1 point for two heads and no point otherwise. Find S_Y.
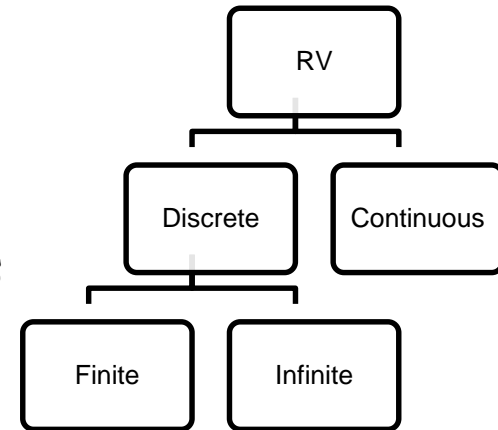
Examples (cont.)

➤ Consider a hockey player, Y = the number of goals the player has scored during the season. Find S_Y.

➤ Survey a group of 10 hockey players; Z = the average number of goals scored by the players during the season. Find S_Z.

➤ Throw two dice, X = the sum of the numbers facing up. Find S_X.

➤ Throw one die over and over until you get a six, F = the number of throws. Find S_F.

Discrete and Finite RVs

- ➤ Discrete RV has only specific, isolated numerical values
  - ❑ Finite discrete RV has finite possible values
    - ○ E.g. outcome of roll of a dice
  - ❑ Infinite discrete RV has unlimited number of values
    - ○ E.g. number of stars in universe
- ➤ Continuous RV can have any values within a continuous range or an interval
  - ❑ E.g. temperature in lab 1, height of a person in cm

Examples (cont.)

➢ Discrete or continuous?

❑ Flip a coin three times; X = the total number of heads

❑ Count the number of restaurants in a city; X = the number of restaurants in a city

❑ Measure the height of a table; X = its height in cm

Examples (cont.)

> ## Discrete or continuous?

- ❑ Throw two dice over and over until you roll a double six; X = the number of throws

- ❑ Take a true-false test with 100 questions; X = the number of questions you answered correctly

- ❑ Invest Rs. 10,000 in stocks; X = the rounded value of your next investment after a year

- ❑ Select a group of 50 people at random; X = the exact average height (in m) of the group

Source: *http://www.zweigmedia.com/RealWorld/Summary6.html*