Probability

Random Variable - Examples

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Example - 01

- When a student attempts to **log on to a computer time-sharing** system, **either all ports are busy (F)**, in which case the student will **fail to obtain access**, or else there is **at least one port free (S)**, in which case the student will be successful in accessing the system. With $\mathcal{S}\{\boldsymbol{S}, \boldsymbol{F}\}$, define random variable X by $X(S) = 1, (F) = 0$

Example - 02

- Consider the experiment in which a **telephone number in a certain area code is dialed using a random number dialer** (such devices are used extensively by **polling** organizations), and define random variable Y by

$$Y = \begin{cases} 1 & \textit{if the selected number is unlisted} \\ 0 & \textit{if the selected number is listed in the directory} \end{cases}$$

Example - 03

- In an experiment in which the **number of pumps in use at each of two gas stations was determined**. Define random variable X, Y, and U by
  - X the total number of pumps in use at the two stations
  - Y the difference between the number of pumps in use at station 1 and the number in use at station 2
  - U the maximum of the numbers of pumps in use at the two stations

Example - 04

- Each of the random variables of the above examples can assume only a **finite number of possible values**. This need not be the case
- the experiment in which batteries were examined until a good one (S) was obtained. The sample space was $\mathcal{S}$ $\{S, FS, FFS, \ldots\}$. Define random variable X by

Example - 05

- The experiment of tossing a coin twice. Let X represent number of heads appearing
  - X is a random variable with values 0, 1, 2
  - $X(T, T) = 0$
  - $X(H, T) = 1$

Example - 06

- **Computer chips** often contain surface **imperfections**. For a certain type of computer chip, **9% contain no imperfections**, **22%** contain **1** imperfection, **26%** contain **2** imperfections, **20%** contain **3** imperfections, **12%** contain **4** imperfections, and the remaining **11%** contain **5** imperfections. Let Y represent the number of imperfections in a randomly chosen chip.
- What are the possible values for Y? Is Y discrete or continuous? Find $P(Y = y)$ for each possible value y.

Example - 07

- A certain type of **magnetic disk** must function in an environment where it is **exposed to corrosive gases**. It is known that **10%** of all such disks have **lifetimes less than or equal to 100 hours, 50%** have lifetimes **greater than 100 hours but less than or equal to 500 hours**, and **40%** have lifetimes **greater than 500 hours**.
- Let Z represent the number of hours in the lifetime of a randomly chosen disk. Is Z **continuous or discrete**? Find $P(Z \leq 500)$. Can we compute all the probabilities for Z? Explain.

Discrete – Continuous Random Variable

- When the probabilities pertaining to a random variable are known, we usually do not think about the sample space; we just focus on the probabilities
- There are two important types of random variables, **discrete and continuous.**
  - A **discrete random variable** is one whose possible values form a **discrete set**.
  - The possible values of a **continuous random variable** always contain an **interval**, that is, all the points between some two numbers.

Discrete – Continuous Random Variable

- Discrete
  - Finite set
  - Infinite “But counted”
- continuous
  - Interval

Probability Mass Function

- **The number of flaws in a 1-inch length of copper wire** manufactured by a certain process varies from wire to wire. Overall, **48%** of the wires produced have **no flaws**, **39%** have **one flaw**, **12%** have **two flaws**, and **1%** have **three flaws**. Let X be the number of flaws in a randomly selected piece of wire. Then
  - $P(X = 0) = 0.48$ $\quad P(X = 1) = 0.39$
  - $P(X = 2) = 0.12$ $\quad P(X = 3) = 0.01$
- The list of possible values **0, 1, 2, 3**, **along** with the **probabilities** for each, provide a **complete description of the population** from which X is drawn. This description has a name—the **probability mass function**

References

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