MA 120 Probability and Statistics

Prob.

Uncertainty
Randomness

Prob. uses statistics to make predictions or decisions in uncertain scenarios.

Stats.

Summary of info.
└ Avg. height of students in this class
Max.
Min.
⋮

Quantitative

Bar Chart

 Pie Chart

Qualitative

Probability

$2+3=5$
$4\times 3=12$
Force = Mass × Acceleration
Distance = Speed × Time
Pure
Perfect measurement → Water will boil at 100°C.

Deterministic Experiments

What will be the result of a coin toss? < H / T

Real world is noisy.

$y = f(x) + \text{noise}$

noise: uncertainty, randomness.

Random Experiment

Is a coin toss really random?

- If you understand & control the Physics of the coin toss, its not random.
- Randomness is an acknowledgement of our ignorance.
- Human coin toss is random. It is too complex to understand & control.

  is considered to be random. ← - says nothing about reality.
  - a phenomenon might be actually random or it might be deterministic (but too complex).
  - If it is too complex, we will deal with it under the framework of randomness.
  - best approximation is to consider it to be random.
  - randomness is a convenient term to express our ignorance of complex phenomena.
    └ Sub-atomic

Randomness vs. Chaos

- Chaos is when nothing can be predicted. Most extreme form of randomness.
- Usually, randomness is less extreme. "Some" predictions can be made.
- Randomness, just like Physics, has its own set of laws. Its own terminology.

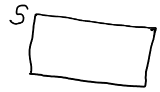
Probability deals with such laws.

Terminology

① Random Experiment
- └ Exp. with uncertain output
- └ Trial

② Sample space (set of all possible outcomes)

Venn Diagram



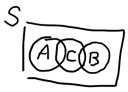
$S = \{H, T\}$

$S = \{1, 2, 3, 4, 5, 6\}$

2 coins $S = \{HH, HT, TH, TT\}$

③ Event

Outcomes that we are interested in.



$A = \{H\}$

$A = \{2, 4, 6\}$

$A = \{HH, HT\}$ disjoint
$B = \{TH, TT\}$

$C = \{HT, TT\}$

$A^c = \{1, 3, 5\}$ ← event

$B \cup C = \{TH, TT, HT\}$ ← event

$B \cap C = \{TT\}$ ← event

④ Event Occurrance

$A = \{2, 4, 6\}$

"A occurs" means one of the elements of A was the outcome of the experiment.

P (event) = likelihood of event

How to assign P(events)?

1. Empirical Approach
2. Counting Approach
3. Measuring "
4. Independence