# College Mathematics IV
## §2.1 Sample Space

Sichuan University, Spring 2026

# Observation & Experiment

- Statistics is concerned with chance outcomes in studies or scientific experiments.
- For instance:
  - Numbers of monthly traffic accidents in Chengdu.
  - Number of A, B, C, D, F grades at courses at Sichuan Univ..

### Definition

Any recording of information is called an observation.

### Definition

Any process that generates a set of data is called an experiment.

# Sample Space

## Definition

The set of all possible outcomes at a statistical experiment is called the sample space and is denoted $S$.

## Example (Flipping a Coin)

- The only possible outcomes are head ($H$) or tail ($T$).
- The sample set then is

$$S = \{H, T\}.$$

### Example (Tossing a Die)

- If we are interested in the number on the top face, then the sample set is

$$S_1 = \{1, 2, 3, 4, 5, 6\}.$$

- If we are interested only on whether the number is even or odd, then the sample set is

$$S_2 = \{\text{even}, \text{odd}\}.$$

# Sample Space – Examples
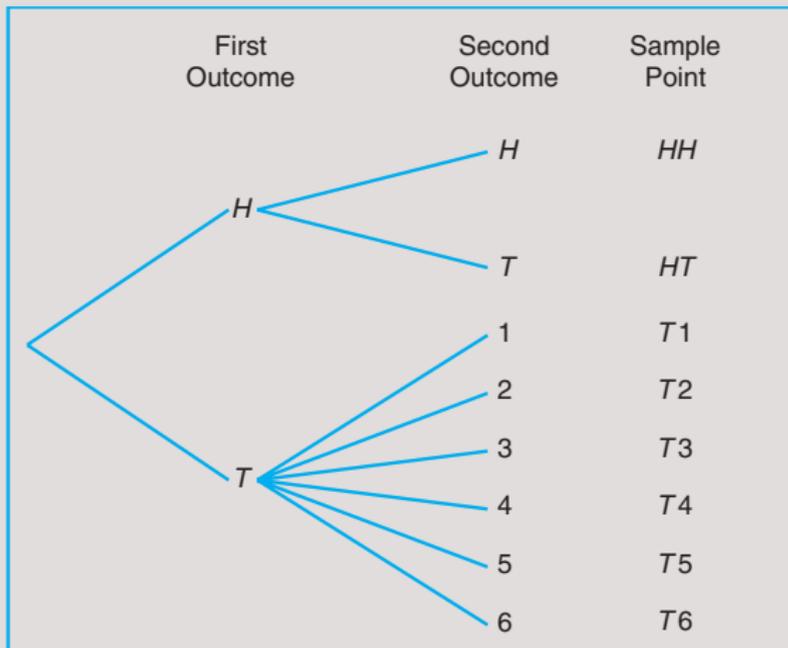
## Example (Flipping and Tossing)

- We flip a coin.
- If we have a head we flip it again.
- If we have a tail, we toss a die.
- The sample space then is

$$S = \{HH, HT, T1, T2, T3, T4, T5, T6\}.$$

# Tree Diagrams

## Remark

It is sometimes convenient to use a tree diagram:

# Tree Diagrams

### Example (Manufacturing Process)

- We randomly select items in a manufacturing process.
- 2 possible outcomes:

    defective ($D$) or non-defective ($N$).

- The process is performed three times.
- The sample space then is

    $S = \{DDD, DDN, DND, DNN, NDD, NDN, NND, NNN\}.$

# Tree Diagrams

## Example (Continued)



First Item · Second Item · Third Item · Sample Point

| | | | |
|---|---|---|---|
| D | D | D | DDD |
| | | N | DDN |
| | N | D | DND |
| | | N | DNN |
| N | D | D | NDD |
| | | N | NDN |
| | N | D | NND |
| | | N | NNN |