MATH 141

Basic Rules of Probability

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What proportion of the Earth's surface is covered with water?

- Our only resource is this inflatable globe and 5 minutes of time.
- How could we develop a guess for this proportion based on this **random process**?

Probability

- the proportion of times an outcome would occur if the **random process** was observed an infinite number of times
- Probabilities are between 0 and 1

How does probability relate to the "Inflatable Globe" problem?

- *Law of large numbers* - As more observations are collected, the sample proportion $\hat{p}$ converges to the probability p.
- For the "Inflatable Globe" problem,
  - $p = \mathbb{P}(water) = 0.71$
  - $1 - p = \mathbb{P}(land) = 0.29$
  - $\hat{p}$ is our observed proportion of "Water!" out of our n observations of the random process

- Recall Plicker question 1 about tossing two dice

Sum of two dice

- Define givens
- Solve the problem
- **General Addition Rule** - Let A and B be events.

$$\mathbb{P}(A \text{ or } B) = \mathbb{P}(A) + \mathbb{P}(B) - \mathbb{P}(A \text{ and } B)$$

Addition Rule for Disjoint Outcomes

Disjoint events

- *Event* - a set of outcomes
- *Disjoint events* - events that have no outcomes in common
  - no common elements in their sets

One dice toss

- Let event D correspond to the number of pips on one roll of a die
- Let $W = \{1\}$ and $Z = \{2, 4\}$
- Are W and Z disjoint events?
  - Yes, they have no outcomes in common / no overlap
- Let $E = \{1, 3\}$ and $F = \{\text{even result}\}$. What's $\mathbb{P}(E \text{ or } F)$?
  - $2/6 + 3/6 = 5/6$
- **Addition Rule for Disjoint Outcomes** - Let A_1 and A_2 be disjoint events.

$$\mathbb{P}(A_1 \text{ or } A_2) = \mathbb{P}(A_1) + \mathbb{P}(A_2)$$

- Special case of **General Addition Rule** where $\mathbb{P}(A_1 \text{ and } A_2) = 0$

Probability Distribution

- A table of all disjoint events in a sample space along with their probabilities
- **Inflatable Globe**

Event	**Probability**
water	0.71
land	0.29

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- **Roll of a Die**

Event	1	2	3	4	5	6
Probability	1/6	1/6	1/6	1/6	1/6	1/6

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