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Introduction to Probability, Subtitle, Edition

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Preface

Here come the golden words

place(s),
month year

First name Surname
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Contents

Part I

Part Title

1

Chapter Heading

Definition 1.1 (Sample space). A sample space $\mathcal{S}$ is the set of all possible outcomes of an experiment.

Here *experiment* is a broad abstraction of any activity that has a set of outcomes which are unknown before the activity is performed.

Definition 1.2 (Event). An event $\mathcal{A} \subseteq \mathcal{S}$ is a subset of a sample space $\mathcal{S}$.

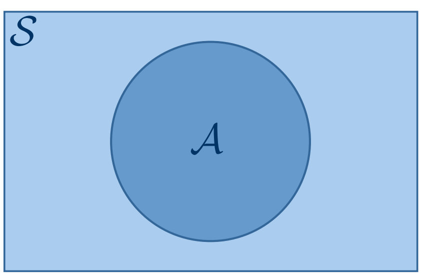

Fig. 1.1: Venn diagram representation of an event $\mathcal{A}$ residing on sample space $\mathcal{S}$

Definition 1.3 (Naive definition of probability). Assuming that

1. all outcomes are equally likely, and
2. sample space $\mathcal{S}$ is finite,

the probability that $\mathcal{A}$ occurs is given by

$$P(\mathcal{A}) = \frac{\#\text{ favorable outcomes}}{\#\text{ possible outcomes}} \tag{1.1}$$

Assumption 2 is needed otherwise all the probabilities are zero. Assumption 1 is a rather strong assumtion which is true in many cases but not all. Mostly in problems which involves some kind of *symmetry*, assumption 1 holds nice, e.g., a fair coin, a fair dice.

1.0.1 Extreme of failure of Naive definition

- The possibility of life on Neptune is $\frac{1}{2}$.
- The possibility of intelligent life on Neptune is also $\frac{1}{2}$. Should it not be strictly less than all life? Absurdity!

Always need some justification to apply naive definition. Especially, adherance to the above two assumptions.

1.1 Basic principles of counting

To be able to use the naive definition of probability, we should be able to count. Let us introduce *multiplication rule* to do this.

Proposition 1.4 (Multiplication Rule). *If there are r number of experiments and each experiment has n_i number of possible outcomes, then the overall sample space has size*

$$|\mathcal{S}| = \prod_{i=1}^{r} n_i \tag{1.2}$$

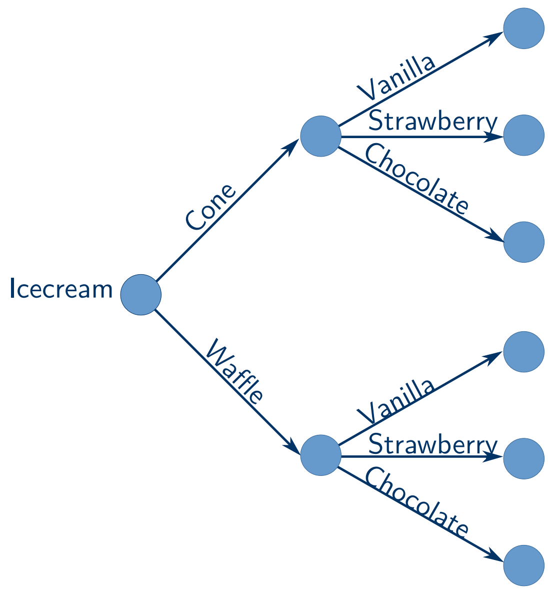

Fig. 1.2: The icecream coutning tree explanning multiplication rule

Example 1.5. The probability of a full house (e.g., three 7s and two Jacks) in a five card poker hand (without replacement, and without other players) is

$$P(\text{full house}) = \frac{13 \times \binom{4}{3} \times 12 \times \binom{4}{2}}{\binom{52}{5}} \tag{1.3}$$

Definition 1.6 (Binomial Coefficient). The binomial coefficient is given by

$$\binom{n}{k} = \begin{cases} \dfrac{n!}{(n-k)!\;k!}, & n \geq k \\ 0, & \text{otherwise.} \end{cases} \tag{1.4}$$

Theorem 1.7 (Sampling Table).

1.2 Section Heading

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1.2.1 Subsection Heading

Your text goes here.

$$\mathbf{a} \times \mathbf{b} = \mathbf{c} \tag{1.5}$$

[1] Footnote

Subsubsection Heading

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Paragraph Heading

Your text goes here.

Subparagraph Heading. Your text goes here.

Theorem 1.8. *Theorem text goes here.*

Lemma 1.9. *Lemma text goes here.*

Problems

1.1. The problem[1] is described here. The problem is described here. The problem is described here.

1.2. Problem Heading
(a) The first part of the problem is described here.
(b) The second part of the problem is described here.

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Solutions

Problems of Chapter 1

1.1 The solution is revealed here.

1.2 Problem Heading
(a) The solution of first part is revealed here.
(b) The solution of second part is revealed here.

References

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