This basic course textbook is "Probability Rules" by DeGroot & Schervish (2012), in private section of course webpage stat131-spring20-01.courses.see.ucsc.edu
(you need to log in to this webpage to access the textbook PDF)

Reading: DG ch. 1

Assessment: 10 quizzes (1/week) and 3 take-home tests (THTs)

All quizzes & THTs will be open-book, open-notes with moderate time pressure, you will upload PDF versions of your solutions to Canvas in time to meet deadlines.
This course is FAST and CUMULATIVE. Try hard not to fall behind. [Pascal]

& Fermat (1654): classical approach to probability. [Chevalier de Méré]

Equally likely model (ELM)

If you can list all the ways a random experiment can come out in such a way that no outcome is favored over another, \( P\left( A = \frac{\# \text{ of } E_0 \text{ favorable to } A}{\# \text{ total } \# \text{ of } E_0} \right) \)
Ex. single six-sided die:

dice-rolling

fair: \( \Omega = \{1, 2, \ldots, 6\} \)

are equally likely/plausible

if fair, \( P_{PF} \left( \# \text{ is at least } 5 \right) \)
\[ \frac{2}{6} = \frac{1}{3} \]

\( P_{PF} \left( \# \text{ is } \geq 5 \mid \text{ die-rolling is fair} \right) = \frac{1}{3} \]

"given"

\[ P_{PF} \left( \# \text{ is } \geq 5 \right) = \text{undefined} \]

This is one of three ways to define probability:

1. **P-F** (1654)
2. **Bayesian** (1750)
3. **Frequentist** (1825)
P(HH HHT HTH THT THH TTH THT HTT) = $\frac{1}{2}$

3. Frequentist (relative frequency)

\[ F(\text{on a single toss}) = \frac{1}{2} \]

Relative frequency = $\frac{1}{2}$

\[ F(\text{on 10 tosses}) = \frac{7}{10} \]

\[ F(\text{on 100 tosses}) = \frac{52}{100} = 0.52 \]

\[ F(\text{on 1000 tosses}) = \frac{504}{1000} = 0.504 \]

\[ F(\text{on 10000 tosses}) = \frac{5004}{10000} = 0.5004 \]

C = true/false statement

\[ \text{Not C is true, gives weight of evidence} \]

That assumption: \( A \) are true.
\[ P(C \mid A) \leq 1 \]

\[ T/F \text{ statements} \]

**ELM?**

\[ \frac{1}{2} \]

\[ P(\text{normal} \mid \text{carrier}) \]

\[ \frac{1}{4} = 25\% = 0.25 \]

\[ P(\text{carrier} \mid F, M \text{ carriers}) = \frac{2}{4} = 50\% = 0.5 \]

\[ P(\text{T-S} \mid F, M \text{ carriers}) = \frac{1}{4} = 25\% = 0.25 \]

<table>
<thead>
<tr>
<th># children</th>
<th>( P(1 \text{ or more T-S} \mid F, M \text{ carriers}) )</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.25</td>
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<td>2</td>
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population

\[
\begin{bmatrix}
1 \\
2 \\
9
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\]

of random

\[
\begin{bmatrix}
\star \\
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\( P(\text{F, is odd at random}) = \frac{2}{3} \)

\( P(A \lor B) = P(A) + P(B) \)
\[
(1 \text{ or more}) = \text{not } (T-S) \quad \text{exactly 0 or 1 of } T-S
\]

\[
P(A) = \frac{\text{not } T-S}{\text{not } T-S} \quad \text{and} \quad \frac{\text{not } T-S}{2} \quad \text{and}
\]

\[
P(A \text{ or } B)
\]

\[
\text{all possible outcomes } \Omega
\]

\[
P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B)
\]

Special case rule for \( \text{or} \) with no overlap.
\[ P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B) \]

General rule for OR

\[ (A, B \text{ no overlap}) \Rightarrow (A, B \text{ are mutually exclusive}) \]

\[ P(A \text{ and } B) = 0 \]

\[ P(A) = 1 - P(\text{not } A) \]

\[ P(A) + P(\text{not } A) = 1 \]

\[ = 100\% \]
\(\mathbb{P}(A) \uparrow \mathbb{P}(A)\)

set

\(\Rightarrow\)

T/F statement (proposition)

Stone's representation theorem