15-259/559: Probability and Computing **Homework 3**
Due Friday 09/12/2025 at 12:50PM

Show all your work. Work through the problems carefully and **do not use online references, mathematical solvers, or GenAI** as a shortcut for finding the solutions. You will regret it in the quizzes and examinations.

Part I

Exercises 3.8, 3.10, 3.12, 4.5, 4.11, 4.12, 4.13, 4.15, 4.16, 4.18 in the textbook.

Part II

In class, we discussed Simpson's paradox. Consider again Table 4.4 from the textbook.

	Drug A	Drug B
small kidney stones	≈ **90% Effective** (90/100 Successes)	≈ 80% Effective (800/1000 Successes)
large kidney stones	≈ **60% Effective** (600/1000 Successes)	≈ 50% Effective (50/100 Successes)
aggregate mix	≈ 63% Effective (690/1100 Successes)	≈ **77% Effective** (850/1100 Successes)

Based on our clinical trial data, Drug A is more effective than Drug B on small stones, and Drug A is also more effective than Drug B on large stones. But if we mix the groups, Drug A is less effective than Drug B, a misleading conclusion given the per-stone data.

(a) Explain the so-called paradox in the above table using the law of total probability for $\Pr[E \mid A]$ and $\Pr[E \mid B]$, where E is the event that the drug is effective, and A and B are events for Treatments A and B, respectively. Identify the expressions in your equations that have no relevance to the drug itself, and are purely artifacts of how the trial was conducted.

(b) How would you design a clinical trial to avoid Simpson's paradox?