

Due: Wednesday, February 23 at 10:59pm (submit via Gradescope).

Policy: Can be solved in groups (acknowledge collaborators) but must be written up individually

Submission: Your submission should be a PDF that matches this template. Each page of the PDF should align with the corresponding page of the template (page 1 has name/collaborators, question 1 begins on page 2, etc.). **Do not reorder, split, combine, or add extra pages.** The intention is that you print out the template, write on the page in pen/pencil, and then scan or take pictures of the pages to make your submission. You may also fill out this template digitally (e.g. using a tablet.)

First name	
Last name	
SID	
Collaborators	

For staff use only:

Q1.	Probability Review	/30
	Total	/30

Q1. [30 pts] Probability Review

This question is meant to review part of the probability prerequisite. It might be helpful to look into resources under **General Resources** at <https://piazza.com/berkeley/spring2022/cs188/resources>.

Let A, B, C, D be four random variables.

(a) What is the smallest set of independence or conditional independence relationships we need to assume for the following scenarios?

(i) [1 pt] $P(A, B) = P(A|B)P(B)$

(ii) [1 pt] $P(A, B) = P(A)P(B)$

(iii) [2 pts] $P(A, B, C) = P(A|B)P(B|C)P(C)$

(iv) [3 pts] $P(A, B, C) = P(A)P(B|C)P(C)$

(v) [3 pts] $P(A, B, C) = P(A)P(B)P(C)$

(b) Simplify the following expressions to one probability expression. Please show your work.

(i) [3 pts] $\frac{P(A, B)}{\sum_a P(a, B)}$

(ii) [3 pts] $\frac{P(A, B, C, D)}{\sum_a \sum_b P(a, b, C, D)}$

(iii) [4 pts] $\frac{P(A, C, D|B)}{P(C, D|B)}$

(iv) [4 pts] $\frac{P(A|B)}{\sum_c P(c|B)}$

(v) [6 pts] $\frac{\sum_b P(A, b|C)P(D|A, b, C)}{P(A|B, C)}$, given $A \perp\!\!\!\perp B|C$