

MATH 130: STUDY GUIDE FOR QUIZ 2

THINGS TO KNOW

- **Concepts.** Be able to explain in ordinary language the meaning of core probability concepts like independence, averages, and conditional probability.
- **Fundamentals.** Know how to calculate probabilities when all outcomes are equally likely. Be able to use concepts like disjointness and complements in your calculations. Know how to determine and use independence.
- **Averages.** Know how to determine means, medians, and modes. Know how to use the additivity of mean (= expected value) in calculations.
- **Conditional probability.** Know how to compute conditional probabilities. Know how to apply Bayes's theorem.

NOTE SHEET AND CALCULATOR

For the quiz you are allowed a single sheet of paper (standard 8.5 by 11 size, front and back) for notes to reference during the quiz. Here's some suggestions for what to put on your note sheet.

- Any definitions you don't feel you have confidently memorized.
- The formulas for different calculations: independence, mean, conditional probability, Bayes's theorem.
- Outlines of any algorithms or processes.
- A reminder that you've got this and will ace the quiz.

You also are allowed a calculator for the quiz. It is written so that a calculator is not necessary for any problem, but if you want one you can bring one. I cannot allow phones, laptops, and other electronic devices which function as more than just a calculator.

SAMPLE QUESTIONS

See the unit 2 worksheets for examples of the sorts of questions to expect. Here are a few more. Unless otherwise stated, in all questions all atomic outcomes are equally likely.

- (1) If you roll two six-sided dice how likely is it that they are the same?
- (2) If you flip four coins how likely is it there are the same number of heads as tails?
- (3) Same question but six coins.
- (4) You pick a six-digit PIN at random. How likely is it that a digit is repeated?
- (5) Determine whether the following two events are independent, both in the context of a random trial of flipping four coins: "there are at least two heads" and "there are at least two tails".
- (6) Determine whether the following two events are independent, both in the context of a random trial of flipping four coins: "there are an equal number of heads and tails" and "the first flip is a heads".

- (7) A random variable can take on the following values, each with equal probability. Determine its mean, median, and mode.

4, 5, 5, 6, 10, 10, 10, 12, 14, 20, 21

- (8) A coin is biased so that it comes up heads 60% of the time. If you flip it once, what is the expected number of heads to see? What if you flip it 10 times? 20 times?
- (9) You roll a six-sided die one hundred times and calculate that the mean roll was 4.6. Based on this result, give an argument for why or why not the die is unfair.
- (10) Suppose you are rolling two six-sided dice. Calculate the probability that highest die is a 6 conditioned on knowing that the first die rolled a 4.
- (11) Suppose you are rolling two six-sided dice. Knowing that the first die rolled a 6 calculate the conditional probability that the sum is at least 10.
- (12) Your professor deploys an automated system for checking for AI use in assignments. The system boasts a 90% true positive rate and only a 10% false positive rate. If 70% of students use AI in their assignments, what is the probability that a student really did use AI if the system accuses them?