CSE 312 : Practice Quiz 1

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Instructions

- You have twenty-five minutes to complete this exam.
- You are permitted one piece of 8.5x11 inch paper with handwritten notes (notes are allowed on both sides of the paper). You should also get a provided formula sheet (in section it'll be on different colored paper separate from the exam; if you take the exam with DRS it will be the last page of your exam).
- You may not use a calculator or any other electronic devices during the exam.
- We will be scanning your exams before grading them. Please write legibly, and avoid writing up to the edge of the paper.
- If you run out of room, you may also use the last page for extra space, but tell us where to find your answer if it's not right below the problem.
- Since you don't have a calculator, you are generally free to **not** simplify expressions (though you may if you think it will be helpful).
- In general, you should show us the work you used to get to an answer, and explanations will help us reward partial credit, but we do **not** expect explanations at the level we usually require on homeworks.

Advice

- Writing a few words about where an expression came from is often very helpful for awarding partial credit.
- Remember to take deep breaths.

Question	**Max points**
Counting	22
Bayes	17
Multiple Choice	6
Total	**45**

1. (Counting) Clothing [22 points]

Your wardrobe consists of 10 different tops, 10 different jackets, and 10 different pairs of shoes.

(a) How many of the following are there? [3 points each]

- Outfits consisting of one top, one jacket, and one pair of shoes?

- Laundry loads consisting of exactly 10 clothing items?

- Ways in which you can wear your tops, one per day, for the next 5 days without repetition?

(b) How many laundry loads consisting of exactly 10 clothing items that contain at least two tops are there? [3 points]

(c) Assume that for each item of clothing 5 out of the 10 items are formal. An outfit consists of one top, one jacket, and one pair of shoes. A formal outfit is an outfit where either the jacket and the shoes are formal or where the top and the shoes are formal. How many formal outfits do we have? [5 points]

(d) Packing for a trip, you have room in your suitcase for exactly 16 clothing items. You plan to pack exactly 5 tops, 5 jackets, and 5 pairs of shoes, while the 16th item can be either a top, a jacket, or a pair of shoes. How many different options do you have for the set of clothes that you pack? [5 points]

2. (Bayes) Check this box to say you're a human [17 points]

You are designing a CAPTCHA system (a system that checks that users are humans, rather than bots). You know that 80% of the submissions to your system come from bots. If a submission comes from a bot, the bot fails the test 99% of the time; while humans pass the test 75% of the time.

Let H be the event the submission comes from a human, B be the event the submission comes from a bot. Let P be the event the test is passed, and F be the event the test is failed.

(a) Give the notation and fill in the value for "the probability a test is failed, given that the submission came from a human." **be sure to fill in both blanks.** [4 points]

$$\mathbb{P}(\_\_\_\_\_) = \_\_\_\_\_$$

(b) What is the probability a test is failed? [4 points]

(c) You wish to ban the IP addresses of submitters that you think are bots, but you want to be sure they're really bots. What is the probability a submission came from a bot, given that the test failed. [6 points]
You may use b to represent "the correct answer from part b"

(d) Suppose that a human gets frustrated after failing a test once, and so when you show the same human a second test, they have only a 50% change of succeeding. What is the probability of a human failing two consecutive tests? [3 points]

3. Small Questions [6 points]

(a) There are m houses in a suburban neighborhood. Suppose we need to pave a (direct) path between every possible pair of houses. How many paths need to be paved? (Once paved, a path can be used in both directions). [3 points]

◯ m^2 paths
◯ $\frac{m(m-1)}{2}$ paths
◯ $\frac{m}{2}$ paths
◯ $m(m-1)$ paths
◯ None of the above.

(b) Your friend attempts to count the number of "two pair" hands. Two pair hands contain:

- Two cards of one value (e.g., two aces or two 8's)
- Two cards of a **different** value
- A fifth card of another different value.

For a standard 52 card deck (13 values, 4 suits), your friend says the number of two pair hands is

$$13\binom{4}{2} \cdot 12\binom{4}{2} \cdot 11\binom{4}{1}.$$

Which best describes their response? [3 points]

◯ It overcounts—you need to divide by $5!$ for all possible reorderings.
◯ It overcounts—you need to divide by $2!$ for reordering the "first pair" compared to the "second pair"
◯ It undercounts—you need to multiply by $5!$ for all possible reorderings.
◯ It undercounts—you need to multiply by $2!$ for reordering the "first pair" compared to the "second pair"