

**WINTER 2024 - SECOND MIDTERM EXAM** **Version 1**

Answer all questions. **If you don't explain (= show your work for) your answers you will get no credit.**

**CIRCLE THE NAME OF YOUR TA: Kalyani Chaudhuri or Joaquin Paleo**

If you don't know the name of your TA, then circle your Section:

**A01, Tuesday 5-6**

**A02, Tuesday 6-7**

**A03, Tuesday 7-8**

**A04, Tuesday 8-9**

- **By writing your name on this exam you certify that you have not violated the University's Code of Academic Contact** (for example, you have not copied from the work of another student and you have not knowingly facilitated cheating by another student).
- **If you submit the exam without writing your name and ID, you will get a score of 0 for this exam.**
- **If you do not stop writing when told so (at the end), a penalty of 10 points will be deducted from your score.**

1. [30 points] Walter is a wiki-chondriac (a wiki-chondriac is a person who constantly Googles or uses Wikipedia, or other internet resources, to self-diagnose his illness based on symptoms he has been experiencing). He just read that his symptoms are consistent with spendulitis, a rather uncommon disease that affects 2% of the population. He can take a blood test to check if he has the disease. The probability that the result will be **negative** if he has the disease is 1%. The probability that the result will be **positive** if he does **not** have the disease is 5%.

(a) [8 points] What is the probability that if he takes the blood test it will turn out to be positive?  
[Show the work for your answer.]

(b) [16 points] Fill in the following table (with the appropriate **numbers of individuals**), assuming that there are 10,000 individuals in the population under consideration and they all have taken the blood test. [Show the work for your answer.]

	positive blood test	negative blood test	Total
have the disease			
don't have the disease			
Total			

(c) [6 points] Use the numbers in the table of part (b) to compute the probability that Walter does **not** have spendulitis given that the result of the blood test was **positive**.

2. [40 points] Trevor's initial wealth is zero. Trevor has just received a bonus of \$1,200 from his employer. He can either put the \$1,200 in his checking account, in which case it will yield no interest, or invest it in a mutual fund which, according to recent past performance, is going to yield a net return of \$600 (that is, he will get back \$1,800 from the fund) with probability 8%, a net return of \$200 with probability 74% and a **loss** of \$500 with the remaining probability. Trevor cares about his **total wealth**.
- (a) [4 points] If Trevor decides to put the bonus in his checking account, what is his attitude to risk? [Explain your answer]
- (b) [16 points] When asked what he would choose between (1) putting the \$1,200 bonus in a certificate of deposit (CD) that yields a net return of \$200 for sure and (2) investing it in his friend's startup company that would yield - with equal probability - a net return of \$600 and a loss of \$500, he said that he would be indifferent. Furthermore, he would be indifferent between (1) putting the \$1,200 in his checking account and (2) investing it in a foreign venture that would yield a net return of \$200 with probability 96% and a loss of \$500 with the remaining probability. Assuming that Trevor prefers more money to less and focusing only on the four levels of wealth corresponding to the possible investments mentioned so far, construct Trevor's normalized von Neumann-Morgenstern utility function.

(c) [12 points] Calculate Trevor's expected utility for all the options mentioned above (checking account, mutual fund, CD, startup and foreign venture).

(d) [8 points] How would a risk neutral person rank all the options mentioned above (checking account, mutual fund, CD, startup and foreign venture)?

- 3.** [30 points] All that matters to Don is his wealth. He has to choose one of three investment strategies (denoted by  $a$ ,  $b$ , and  $c$ ) whose outcomes – which represent his total wealth – depend on the future state of the economy (one of  $s_1, s_2, s_3$  and  $s_4$ ), as shown in the following table. Don's vNM utility-of-money

function is  $U(\$m) = \sqrt{m}$ .

	$s_1$	$s_2$	$s_3$	$s_4$
$a$	\$16	\$36	\$16	\$81
$b$	\$25	\$169	\$9	\$64
$c$	\$121	\$1	\$100	\$0

- (a) [12 points] Construct the regret table.

**(b)** [6 points] Find the MinMax Regret solution.

**(c)** Let  $H(x, \frac{1}{4})$  denote the Hurwicz index of act  $x$  when the index of pessimism is  $\frac{1}{4}$ .

**(c.1)** [2 points] Calculate  $H(a, \frac{1}{4})$

**(c.2)** [2 points] Calculate  $H(b, \frac{1}{4})$

**(c.3)** [2 points] Calculate  $H(c, \frac{1}{4})$

**(d)** [6 points] If all the states are equally likely, what is the act that maximizes expected utility?