University of California, Davis -- Department of Economics

ECN 103 : ECONOMICS of UNCERTAINTY Professor Giacomo Bonanno

WINTER 2024 - FINAL EXAM Version 2

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

NAME:_____ University ID:_____

- **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. [35 points] Bob lives near Lake Tahoe. His house is worth $860,000. Bob's wealth consists of the house plus the balance of his bank account, which is $250,000. The probability that there will be a forest fire near his house next year is 50%. If a forest fire occurs then the house will incur damages equal to $700,000. However, by spending $$x$ on protective measures Bob can reduce the probability that the fire will reach the house from 50% to $0.5-\frac{x}{400,000}$. Thus the more he spends, the lower the probability. Bob's utility of wealth function is $U(m)=10\ \ln(m)$ (where ln is the natural logarithm). What Bob cares about is his **entire wealth.**

(a) [3 points] Suppose first that insurance is not available. Write an expression, call it $EU(x)$, showing Bob's expected utility if he decides to spend $$x$ on prevention. [No need to simplify.]

From now on assume that the only possible values of x are 0, 100,000 and 200,000.

(b) [6 points] If insurance is not available, which value of x will he choose?

(c) [2 points] If Bob is offered a full-insurance contract with premium h, what value of x will he choose if he accepts the contract?

(d) [12 points] Suppose that Bob is offered an insurance contract with premium h = \$80,000 and deductible d = \$100,000. If he accepts the contract, what value of x will he choose?

(e) [12 points] Suppose that Bob has the following choices: (1) not insure, (2) get full insurance at premium \$150,000 and (3) get partial insurance at premium h = \$80,000 and deductible d = \$100,000. Which option will he choose?

2. [25 points] A Principal, whose vNM utility-of-money function is $U(\$m) = \sqrt{m}$, wants to hire an Agent to perform a task. The monetary outcome of the task will depend on random factors as well as on the effort that the Agent exerts, which can be either Low (*L)* or High (*H*), as shown in the following table:

outcome	\$102	\$112	\$156
probability if $e = L$	$\frac{5}{8}$	$\frac{1}{4}$	$\frac{1}{8}$
probability if $e = H$	$\frac{1}{4}$	$\frac{1}{2}$	$\frac{1}{4}$

The Agent's vNM utility depends on money (*m*) and effort (*e*) as follows:

$$V(\$m, e) = \begin{cases} \sqrt{m} - 3 & \text{if } e = L \\ \sqrt{m} - 4 & \text{if } e = H \end{cases}$$

Both Principal and Agent have zero initial wealth. The Agent's effort cannot be observed by the Principal, while the outcome is observable and verifiable. All of the above is common knowledge between Principal and Agent.

(a) Suppose that the Principal offers to give the Agent 25% of the realized outcome. Call this contract *A*. **(a.1)** [8 points] Calculate the Agent's expected utility from contract *A*.

(a.2) [3 points] Calculate the Principal's expected utility from contract *A*.

(b) Now consider the alternative contract, call it *B*, according to which the Agent gets one third of the outcome if the outcome is either \$112 or \$156, but gets nothing if the outcome is \$102. **(b.1)** [8 points] Calculate the Agent's expected utility from contract *B*.

(b.2) [3 points] Calculate the Principal's expected utility from contract *B*.

(c) [3 points] Does one of the two contracts Pareto dominate the other? Explain your answer.

3. [25 points] Imagine a world where a person's productivity is decided at birth and education has no effect on it. However, employers don't know this and believe that education increases productivity. There are three levels of productivity in the population: \$18,000, \$28,000 and \$36,000. People who are born with a productivity level of 18,000 have the following cost of acquiring education: $C_L(y) = 3{,}000\,(y-8)$ ($y \in \{8,10,14,18,21\}$ denotes the number of years of schooling). People with a productivity of 28,000 have the cost function $C_M(y) = 1{,}500\,(y-8)$ and people with productivity of 36,000 have the cost function $C_H(y) = 1{,}000\,(y-8)$. The employers' beliefs are reflected in the following wage schedule:

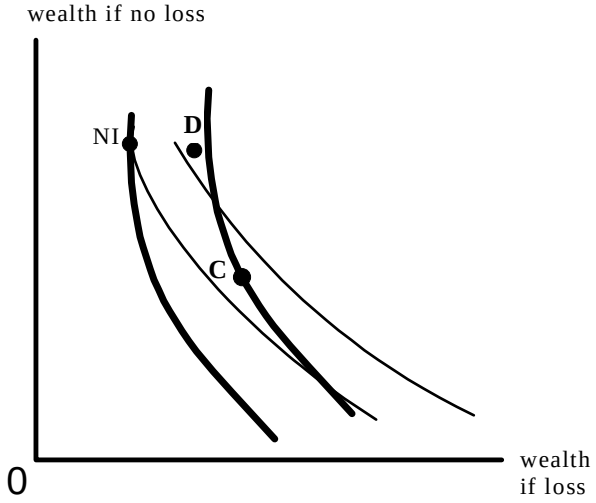
y	offered wage
8	\$18,000
10	\$18,000
14	\$28,000
18	\$28,000
21	\$36,000

(a) [20 points] Is there a signaling equilibrium? (if your answer is No, prove that there isn't one; if your answer is Yes, describe the equilibrium and justify each item). [More space on the next page.]

y	offered wage
8	\$18,000
10	\$18,000
14	\$28,000
18	\$28,000
21	\$36,000

(b) [5 points] Suppose that employers are risk-neutral. Suppose also that the population is composed as follows: 50% with productivity 18,000, 40% with productivity 28,000 and 10% with productivity 36,000. Would it be a Pareto improvement to shut down all the schools beyond 8^{th} grade and pay everybody a salary equal to the average productivity?

4. [15 points] A monopolist in the insurance industry faces two types of consumers. Both types have the same initial wealth W and face the same potential loss L. The probability of loss is: $\frac{1}{15}$ for one type and $\frac{1}{25}$ for the other type. The following figure shows two pairs of indifference curves: the thick curves belong to one type and the thin curves to the other type. NI is the no-insurance point and C and D are two insurance contracts.



Let
$W = 900$, $L = 700$, $C = (280, 520)$,
$D = (220, 880)$

There are 40 consumers of each type. The monopolist cannot tell what type each potential customer is, while each consumer knows her own type. The monopolist offers both contracts C and D and lets each consumer choose which contract (if any) she wants.

Calculate the monopolist's expected total profits.