



Stockholm
University

Department of Economics

Course name: Risk and uncertainty
Course code: EC2104
Examiner: Mathias Herzing
Number of credits: 7,5 credits
Date of exam: Tuesday 28 May 2013
Examination time: 3 hours [09:00-12:00]

Write your identification number on each paper and cover sheet (the number stated in the upper right hand corner on your exam cover).

Use one cover sheet per question. Explain notions/concepts and symbols. If you think that a question is vaguely formulated, specify the conditions used for solving it. Only legible exams will be marked. **No aids are allowed.**

The exam consists of 3 questions. Each question is worth 25 points. The term paper has a maximum score of 25 points. The maximum score on the exam is 100 points in total. For the grade E 45 points are required, for D 50 points, for C 60 points, for B 75 points and for A 90 points.

Your results will be made available on your "My Studies" account (www.mitt.su.se), on Tuesday 11 June 2013 at the latest.

Good luck!

1. Short questions:

- a) Consider a principal who owns a farm and offers an agent a contract to take care of the farm. The output produced at the farm depends on the agent's effort, but also on whether a good or a bad state is realized; however, a higher level of effort will increase the probability of the good state being realized. Given that the principal does not have the time to supervise the farm, what asymmetric information problem may arise in this situation? What contract will a risk averse principal offer a risk neutral agent? (Explain in words, no formulas!)
- b) Suppose there are two types of workers in a perfectly competitive industry. Type 0 workers have productivity $\Theta_0 = 1$ and reservation wage $w_0^r = 1$. Type 1 workers have productivity $\Theta_1 = 4$ and reservation wage $w_1^r = 2$. Let the share of type 0 workers be f_0 . Assuming there is no possibility of screening and signaling, for which values of f_0 will adverse selection occur in this industry?
- c) What is "confirmatory bias"? Give a brief explanation and provide an example.
- d) Consider an economy consisting of two risk averse individuals, A and B. There are two states of the world. In the good state the sum of all the economy's resources is larger than in the bad state. It is possible for A and B to trade state-claims. State the equilibrium condition for this economy. Show how this economy can be represented by an Edgeworth box, with individual A in the lower left corner and individual B in the upper right corner and claims in the bad state measured on the horizontal axis. Indicate both individuals' certainty lines. Will the contract curve lie above or below individual A's certainty line? Will the contract curve lie above or below individual B's certainty line? Illustrate where the contract curve is located in the Edgeworth box (you are not supposed to derive it, just show where it is located approximatively).

2. Hen has the following elementary utility function: $v(c) = \ln c$, where c is consumption. Assume there are only two possible states of the world, 1 and 2, where the probability of state 1 being realized is π . Consumption in state 1 is denoted by c_1 , and consumption in state 2 is denoted by c_2 .

- a) State Hen's von Neumann-Morgenstern utility function.
- b) Derive a mathematical expression for Hen's marginal rate of substitution (MRS) between consumption in the two possible states of the world. What does the MRS measure? (Hint: $v'(c) = \frac{1}{c}$.)

Hen's endowment of state claims is given by $\bar{c}_1 = 8$ and $\bar{c}_2 = 8$, and $\pi = 0,25$. It is possible to trade state claims at prices $p_1 = 1$ and $p_2 = 2$.

- c) Which two conditions need to be satisfied to find Hen's optimal amounts of state claim 1 and state claim 2?
- d) What are Hen's optimal amounts of state claim 1 and state claim 2?
- e) Explain why the market price ratio is not actuarially fair.
- f) Given that $p_1 = 1$, what value of p_2 will make market prices actuarially fair?
- g) Now assume that it is not possible for Hen to trade state-claims directly. There exists, however, an asset market. Which conditions have to be satisfied for asset trading to be a substitute for direct trading in state-claims?

3. Two identical risk neutral countries, 1 and 2, disagree over the ownership of a gold mine, the value of which is 4. Since diplomacy does not work, the conflict will be resolved either through war or the threat thereof. Let the armament levels of the two countries be given by G_1 and G_2 , respectively, and let the cost for one unit of armament be 1. The countries first choose armament levels simultaneously and then whether to go to war or to negotiate a settlement. In case of war, the probability that country 1 wins the entire mine is determined by the following contest success function:

$$p_1(G_1, G_2) = \begin{cases} \frac{G_1}{G_1 + G_2} & \text{if } \sum_{i=1}^2 G_i > 0; \\ \frac{1}{2} & \text{otherwise.} \end{cases}$$

The probability that country 2 wins is given by $1 - p_1(G_1, G_2)$. In case a settlement is reached income from the gold mine is split according to the contest success function, such that country 1 receives the share $p_1(G_1, G_2)$ and country 2 receives the share $1 - p_1(G_1, G_2)$. Assume that war leads to no destruction. It is enough for one of the countries to choose war for war to occur.

- a) Determine the equilibrium armaments levels and the equilibrium payoffs for both countries. (Hint: $\frac{\partial p_1}{\partial G_1} = \frac{G_2}{(G_1 + G_2)^2}$.)
- b) Does it matter if the countries actually go to war over the gold mine or negotiate a deal according to the contest success function?
- c) What if both countries were risk averse? Explain what the outcome would be, war or settlement?
- d) How much would each country gain if they could agree to making no investments in guns and split the value of the gold mine equally?

Now assume that the interaction between the two countries takes place over two periods and that war is destructive. If war occurs, the winner gets 4Φ (where $\Phi < 1$) and the loser is eliminated.

- e) Provide an intuitive explanation for how the likelihood of war is affected if the conflict technology becomes more decisive. (No derivations, just words!)
- f) Provide an intuitive explanation for how the likelihood of war is affected if the valuation of the future increases. (No derivations, just words!)