

## 14.123 Microeconomics III—Problem Set 1

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**Instructions.** You are encouraged to work in groups, but everybody must write their own solutions. Each question is 33 points. Good Luck!

1. Exercise 2.1 in lecture notes.
2. Consider the set of lotteries  $(p_x, p_y, p_z)$  on the set of outcomes  $\{x, y, z\}$  where  $p_x$ ,  $p_y$ , and  $p_z$  are the probabilities of  $x$ ,  $y$ , and  $z$ , respectively.
  - (a) For each (partial) preference below, determine whether it is consistent with expected utility maximization. (If yes, find a utility function; if so, show that it cannot come from an expected utility maximizer.)
    1.  $(0, 1, 0) \succ (1/8, 6/8, 1/8)$  and  $(7/8, 0, 1/8) \succ (6/8, 1/8, 1/8)$
    2.  $(1/4, 1/4, 1/2) \succ (3/4, 0, 1/4) \succ (5/6, 1/6, 0) \succ (1/2, 1/3, 1/6)$
  - (b) For each family of indifference curves below, determine whether it is consistent with expected utility maximization. (If yes, find a utility function; if so, show that it cannot come from an expected utility maximizer.)
    1.  $p_y = c - 2p_x$  (where  $c$  varies)
    2.  $p_y = c(p_x + 1)$  (where  $c$  varies)
    3.  $p_y = c - 2\sqrt{p_x}$  (where  $c$  varies)
  - (c) Find a complete and transitive preference relation on the above lotteries that satisfies the independence axiom but cannot have an expected utility representation.
3. Under the assumptions P1-P5, prove or disprove the following statements.
  - (a) If  $A_1 \succeq B_1$ ,  $A_2 \succeq B_2$ , and  $A_1 \cap A_2 = \emptyset$ , then  $A_1 \cup A_2 \succeq B_1 \cup B_2$ .
  - (b) For any given event  $D$ , define " $\succeq$  given  $D$ " by  $A \succeq B$  given  $D$  iff  $A \cap D \succeq B \cap D$ . The relation  $\succeq$  given  $D$  is a qualitative probability.
  - (c) For any two partitions  $(A_1, \dots, A_n)$  and  $(B_1, \dots, B_n)$  of  $S$  with  $A_1 \dot{\sim} \dots \dot{\sim} A_n$  and  $B_1 \dot{\sim} \dots \dot{\sim} B_n$ , we must have  $A_1 \dot{\sim} B_1$ .

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14.123 Microeconomic Theory III  
Spring 2015

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