GSOE9210 Engineering Decisions

Problem Set 02

1. Choose either a problem of your own or one from the discussion forums and apply each of the following decision rules:

   (a) Maximin
   (b) miniMax Regret
   (c) How would you go about determining your own personal optimism index ($\alpha$) for the problem? What is your personal optimism index value? Post your optimism value on the forum.

2. For the technology start-up problem from week 1, do the following:

   (a) Determine the action chosen by each of the rules MaxiMax and Maximin
   (b) What would be the best response if the final prototype trial succeeds? Fails? What would be the miniMax Regret action?
   (c) Based on your own decision, with which of the rule(s) above were your choices compatible (with which decision rule(s) did your choice agree)? Post your answer on the forum and/or post a reply comparing your answer with someone else’s.

3. For the travelling problem in lectures, the values of outcomes based on walking distance (km) are given below:

   \[
   \begin{array}{c|cc}
   & b_L & b_P \\
   \hline
   Tr & 2 & 2 \\
   Bu & 1 & 4 \\
   \end{array}
   \]

   (a) Describe each action as a lottery.
   (b) What is the MaxiMax (MM) action for this problem?
   (c) How would this be affected if the traveller had to visit the hospital’s clinic, a further kilometre south of the hospital, afterwards?
   (d) Draw the decision table for the same problem using walking time instead, assuming a person walks at an average speed of 3km/h.
   (e) Which action is chosen under the MaxiMax rule when considering walking time?

4. Repeat the exercise above for the Maximin (Mm) rule.

5. Suppose Alice is the principal in the school fund-raising problem discussed in lectures:
(a) Represent each action as a lottery.
(b) Which action is preferred under MaxiMax and Maximin?
(c) What optimism level (i.e., value of index $\alpha$ under Hurwicz’s rule) would Alice have if she were ‘indifferent’ between (i.e., have equal preference for) the two options?
(d) Derive a general expression for the value of the optimism index $\alpha^*$ for which Alice would be indifferent between actions $A_1$ and $A_2$, with best and worst outcomes $M_1$ and $m_1$, and $M_2$ and $m_2$, respectively.
(e) Suppose there was a third option, an indoor trivia night (T), which generates profit $\$100$ regardless of the weather. How optimistic would Alice have to be to prefer the sports day over the trivia night?

6. How could you simplify Laplace’s decision rule of insufficient reason? That is, can you give an equivalent, but simpler, criterion for choosing between actions?

7. Alice has a choice of buying an investment property in either of two suburbs: A and B. In five years, house prices are likely to go up by $\$2K$ in B, and by $\$1K$ in A. However, there is an existing proposal to build a shopping centre in A in the next year. If the shopping centre is approved (a), house prices in A will increase in value over the next five years by $\$6K$.

For the problem described above:
   a) Which is the Maximin action?
   b) Which is the best action if approval from the shopping centre is granted? If approval is not granted?
   c) Which is the miniMax Regret action?
   d) Which of the two decision rules above would be most relevant for a property investor?

8. Consider the following decision table:

<table>
<thead>
<tr>
<th></th>
<th>$s_1$</th>
<th>$s_2$</th>
<th>$s_3$</th>
<th>$s_4$</th>
<th>$V$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$A_1$</td>
<td>2</td>
<td>2</td>
<td>0</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>$A_2$</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>$A_3$</td>
<td>0</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>$A_4$</td>
<td>1</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

(a) Evaluate each action under the following decision rules, and determine which action will be chosen under each rule: i. MaxiMax (MM) ii. Maximin (Mm) iii. Hurwicz’s rule for values of $\alpha = 0, \frac{3}{4}, \frac{3}{4}, 1$.
(b) Which decision rules above agree on this problem; i.e., choose the same actions?
(c) Two decision rules are said to be equivalent if they choose the same action for every possible decision problem. Which of the rules above are equivalent?

9. For the problem above, which is the $\text{miniMax Regret}$ action?

10. For the raffle problem discussed in lectures:

   (a) Draw the decision tree and table
   (b) Should you draw a ticket in the raffle?
   (c) What if you knew there were three blue tickets? Four? None?
   (d) How many blue tickets would there have to be to make it worthwhile entering?
   (e) If there were $n$ blue tickets ($0 \leq n \leq 4$), how would the value of the prize which makes it worthwhile entering depend on $n$?