and the second expression must be greater by 50 than the first, regardless of $p$.

The advocate of nuclear disarmament might amplify his argument by inserting an extra premise, namely, that the probability of war, whatever it is, is practically the same no matter which act is performed. Thus, he might concede the existence of a deterrent effect of nuclear armament, but believe that this is almost exactly cancelled by an increased danger of accidental war. He may amend his argument in this way, but he cannot then present it as an argument which makes no assumptions about the probability matrix. In its original form, the argument was indeed invalid.

1.6 Problems

1 Train or Plane?
As far as cost and safety are concerned, train and plane provide equally good ways of getting from Las Pulgas to San Francisco. However, the trip takes 8 hours by train, and 3 hours by plane, unless the San Francisco airport proves to be fogged in, in which case the plane trip takes 15 hours. According to the weather forecast, there are 7 chances out of 10 that San Francisco will be fogged in. Draw up a probability matrix based on the weather forecast, and a desirability matrix based on the travel times (putting minus signs before the times given above, since short trips are preferred), and decide whether to take the train or plane.

2 The Point of Balance
In problem 1, what must the probability of fog be, if plane and train are to be equally good choices?

3 Beyond Matrices
Many problems are simplified if we use different sets of relevant conditions for different acts, in a way that is impossible in the usual matrix formulation. Example: the variant of problem 1 in which the conditions relevant to going by plane are still fog or not (at the airport), but the conditions relevant to going by train are quite different: snow or not (in a mountain pass). For the act of going by plane, the probability $\times$ desirability entries would be as in problem 1:

<table>
<thead>
<tr>
<th></th>
<th>Fog</th>
<th>No fog</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plane</td>
<td>.7 $\times$ -15</td>
<td>.3 $\times$ -3</td>
</tr>
</tbody>
</table>

(The desirability of going by plane is shown at the right.) But if the probability of snow in the pass is .5, and the train trip takes 10 hours or
8, depending on whether or not there is snow in the pass, the relevant information about going by train would be shown in a row of a different matrix, with different column headings:

<table>
<thead>
<tr>
<th></th>
<th>Snow</th>
<th>No snow</th>
</tr>
</thead>
<tbody>
<tr>
<td>Train</td>
<td>.5 x -10</td>
<td>.5 x -8</td>
</tr>
</tbody>
</table>

Then, in order to see that going by train is preferable, there is no need to use the standard matrix format, as below. Problem: discuss (and, if possible, overcome) the difficulties of filling in the blanks of the standard matrix with probabilities and utilities on the basis of the information given so far.

<table>
<thead>
<tr>
<th>Fog and snow</th>
<th>Fog and no snow</th>
<th>No fog but snow</th>
<th>No fog and no snow</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plane</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Train</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

4 The Heavy Smoker

In The Consumers Union Report on Smoking and the Public Interest (Consumers Union, Mt. Vernon, N.Y., 1963, p. 69), figures provided by the American Cancer Society are reproduced as follows.

Percentage of American Men Aged 35 Expected to Die before Age 65

- Nonsmokers 23%
- Cigar and pipe smokers 25%
- Cigarette smokers:
  - Less than 1/2 pack a day 27%
  - 1/2 to 1 pack a day 34%
  - 1 to 2 packs a day 38%
  - 2 or more packs a day 41%

The agent is a 35-year-old American man who has found that if he smokes cigarettes at all, he smokes 2 or more packs a day. He sees his options as these three:

- \( C = \) Continue to smoke 2 or more packs of cigarettes a day
- \( S = \) Switch from cigarettes to pipes and cigars
- \( Q = \) Quit smoking altogether

He sees the relevant conditions as these two:

- \( D = \) Die before the age of 65
- \( L = \) Live to age 65 or more