

Decision Analysis

Tutorial Problem 4

In the solution to Tutorial Problem 3:

An “ice cream man” finds that the demand for his ice cream depends on the weather, which is very variable, but can be either “moderate” or “warm”, with equal frequency.

On warm days the total demand is for 2, 3 or 4 “freezersful”, with corresponding probabilities 0.2, 0.4 and 0.4, respectively.

On moderate days the total demand is for 2, 3 or 4 freezersful, with corresponding probabilities 0.4, 0.4 and 0.2, respectively.

Each freezerful sold yields a profit of 2. Unsold freezersful of ice cream must be dumped, and involve a loss 1.

- (i) *Based on the above information, how many freezersful of ice cream should the man prepare, for sale each day?*

The local radio station broadcasts a weather forecast, which has a record of predicting moderate or warm weather with 80% reliability.

- (ii) *Should the ice cream man take note of the forecast, and, if so, what should be his strategy?*

it was found that three strategies had very similar expected monetary values:

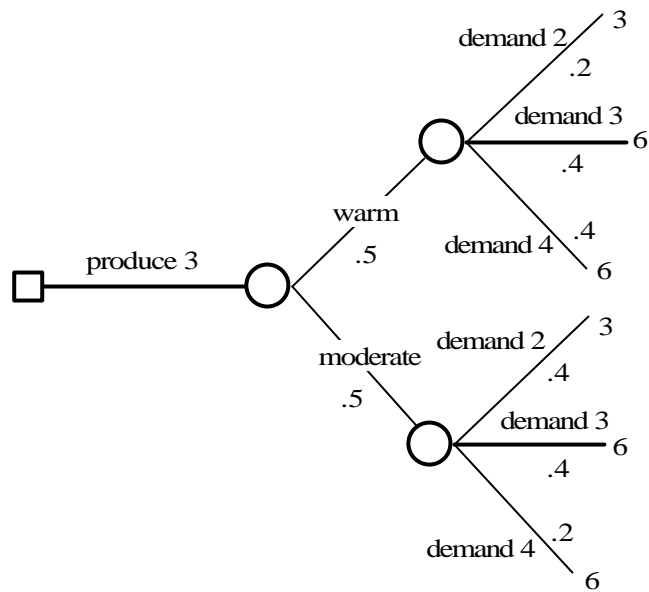
- produce three freezersfull (5.1)
- produce four freezersfull (5.0)
- listen to forecast and produce three freezersfull if the forecast is moderate but four if the forecast is warm (5.14)

Compare the risk profiles of the three strategies in order to make a recommendation.

Decision Analysis

Solution to Tutorial Problem 4

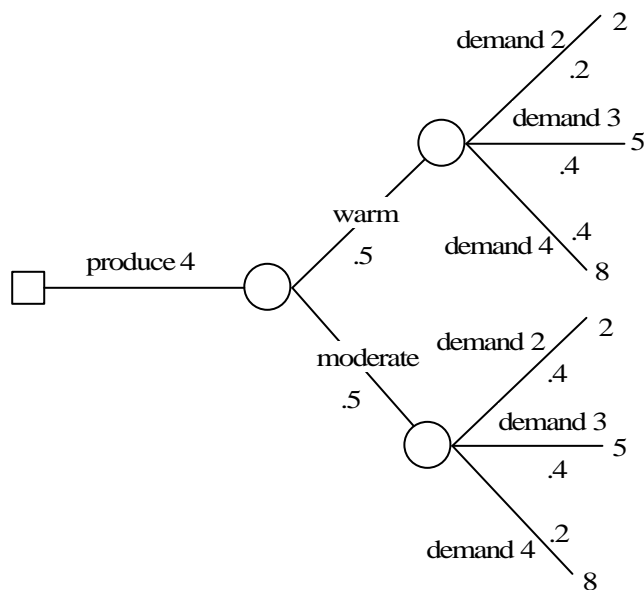
The part of the decision tree corresponding to the strategy "produce three freezersfull" is:



We can see that the probability distribution for the net profit is:

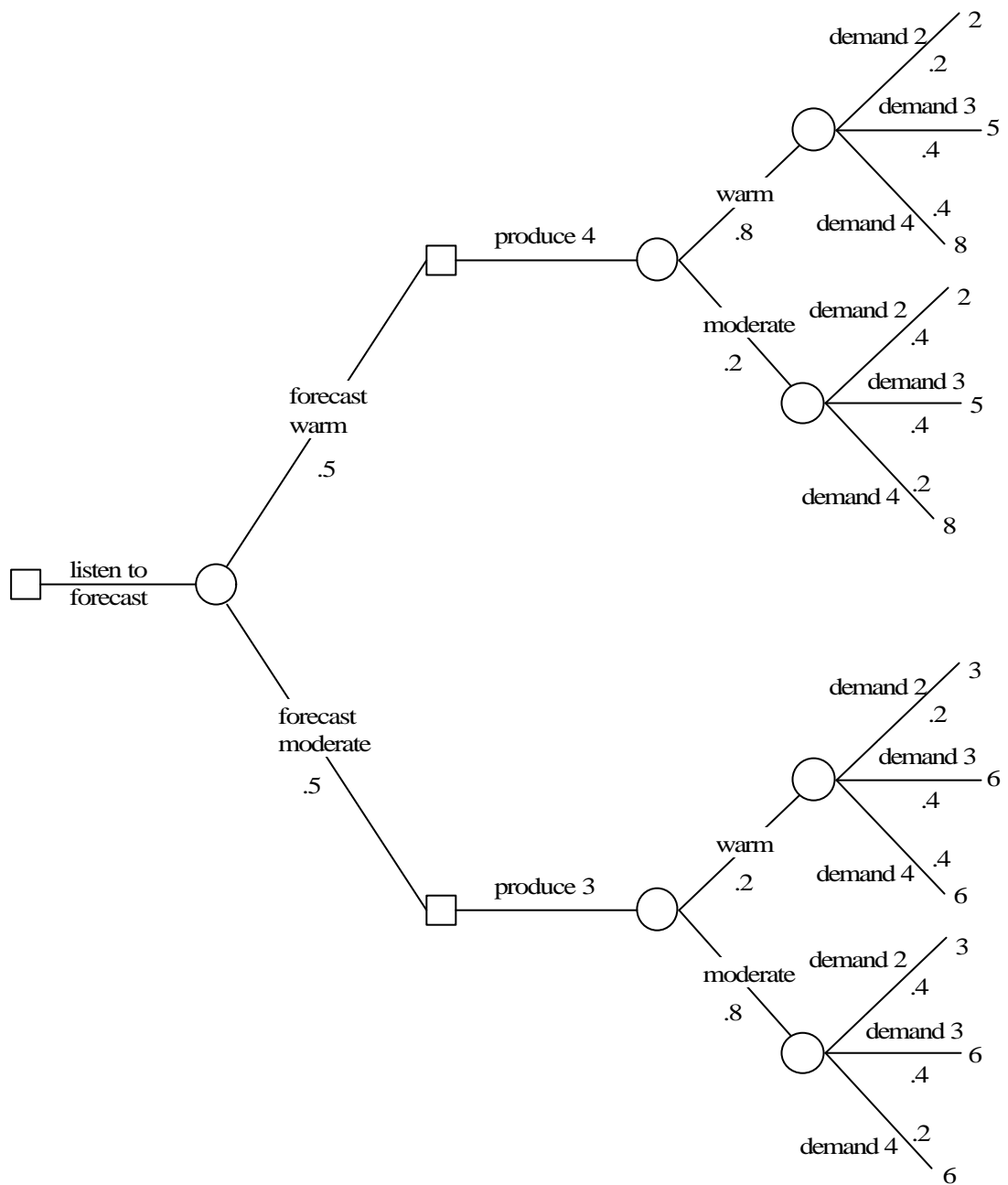
| Net Profit | Probability | Cumulative Probability |
|------------|---|------------------------|
| 3 | $(.5 \cdot .2 + .5 \cdot .4 =)$ 0.3 | 0.3 |
| 6 | $(.5 \cdot .4 + .5 \cdot .4 + .5 \cdot .2 =)$ 0.7 | 1.0 |

For the strategy "produce four freezersfull" the tree segment and profit distribution are:



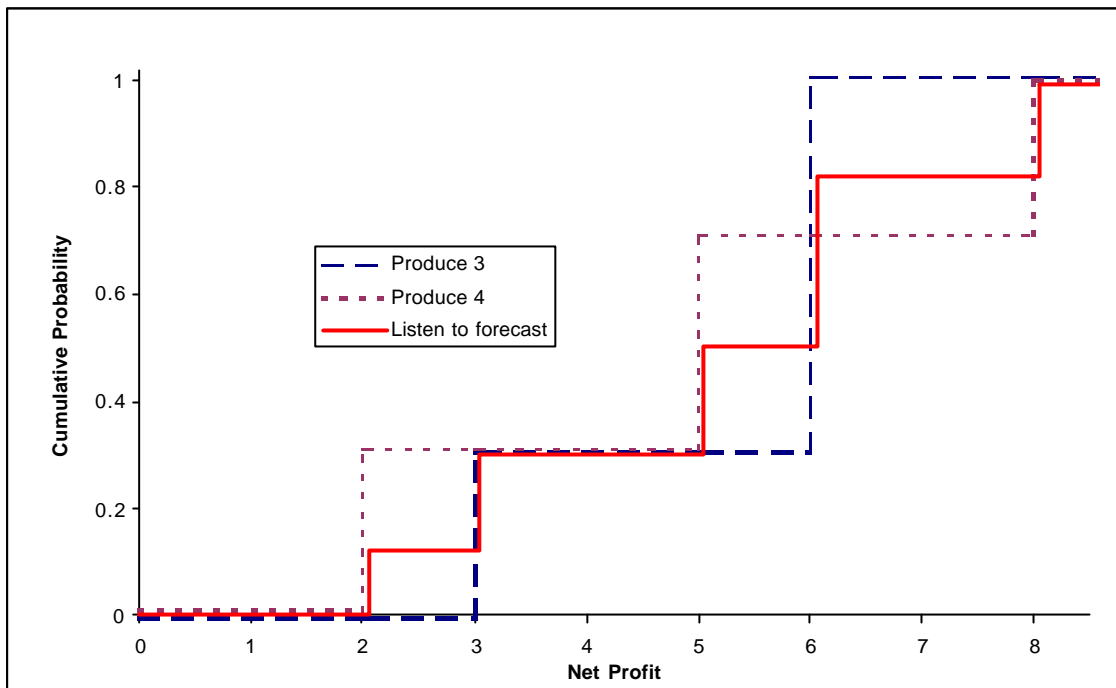
| Net Profit | Probability | Cumulative Probability |
|------------|---|------------------------|
| 2 | $(.5 \cdot .2 + .5 \cdot .4 =)$ 0.3 | 0.3 |
| 5 | $(.5 \cdot .4 + .5 \cdot .4 =)$ 0.4 | 0.7 |
| 8 | $(.5 \cdot .4 + .5 \cdot .2 =)$ 0.3 | 1.0 |

Lastly, for the strategy "listen to forecast and produce three freezersfull if the forecast is moderate but four if the forecast is warm" the tree segment and profit distribution are:



| Net Profit | Probability | Cumulative Probability |
|------------|--|------------------------|
| 2 | $(.5 \cdot .8 \cdot .2 + .5 \cdot .2 \cdot .4 =)$ 0.12 | 0.12 |
| 3 | $(.5 \cdot .2 \cdot .2 + .5 \cdot .8 \cdot .4 =)$ 0.18 | 0.30 |
| 5 | $(.5 \cdot .8 \cdot .4 + .5 \cdot .2 \cdot .4 =)$ 0.20 | 0.50 |
| 6 | $(.5 \cdot .2 \cdot .4 + .5 \cdot .2 \cdot .4 + .5 \cdot .8 \cdot .4 + .5 \cdot .8 \cdot .2 =)$ 0.32 | 0.82 |
| 8 | $(.5 \cdot .8 \cdot .4 + .5 \cdot .2 \cdot .2 =)$ 0.18 | 1.00 |

The comparative cumulative risk profile chart is shown overleaf.



None of the three strategies is dominated. We can see that producing four freezersfull (the dotted line) is slightly riskier than producing three freezersfull (the dashed line) as there is a chance of only getting a net profit of 2. On the other hand, there is a chance of getting a net profit of 8.

Listening to the forecast (the solid line) seems midway, in terms of riskiness, between the two other strategies. There is less chance of only getting a net profit of 2 (compared to the produce four freezersfull strategy), but there is also less chance of getting a net profit of 8. It would seem to be a reasonable compromise between the other two strategies.