Risk Profiles

A business woman who is organising an exhibition in a provincial town has to choose between two venues:

- the Luxuria Hotel
- the Maxima Centre.

To simplify her problem, she decides to estimate her potential profit at these locations on the basis of two scenarios:

- high attendance
- low attendance.

If she chooses the Luxuria Hotel, she reckons that she has a:

- 60% chance of achieving a high attendance and a profit of £30,000
- 40% chance that attendance will be low and profit will be just £11,000.

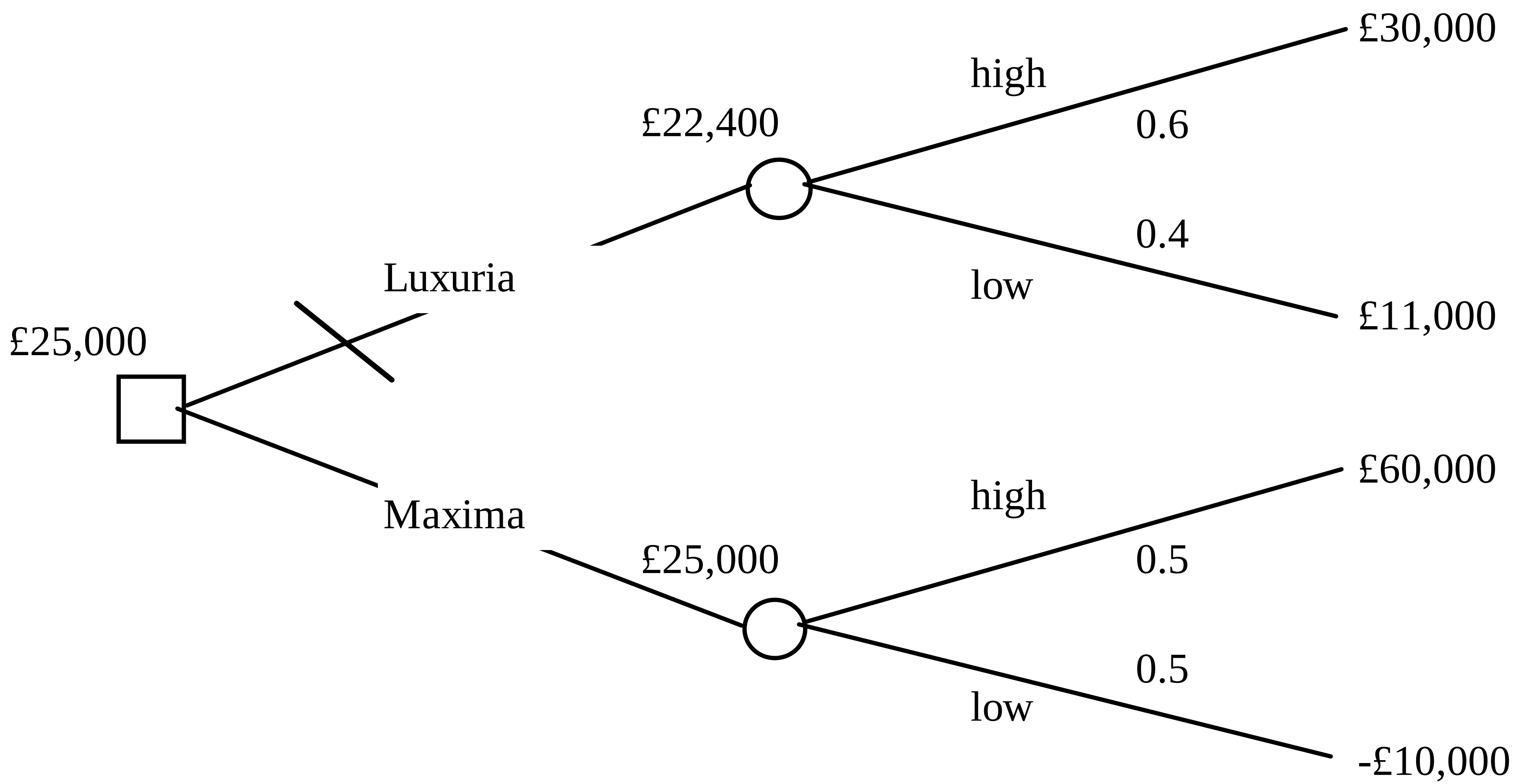
If she chooses the Maxima Centre, she reckons she has a:

- 50% chance of high attendance and a profit of £60,000
- 50% chance of low attendance leading to a loss of £10,000.

The business woman’s expected profit is:

- £22,400 if she chooses the Luxuria Hotel
- £25,000 if she chooses the Maxima Centre.

By the EMV criterion she should choose the Maxima Centre:



However, choosing the Maxima Centre is the riskier option:

- offers high rewards if things go well
- possible to make a loss if things go badly

The alternative action, choosing the Luxuria Hotel:

- leads to a guaranteed profit
- many (if not most) people would opt for this option.

The problem with the EMV criterion is that:

it does not make the risks of the different possible outcomes explicit.

The expected values, which are used for comparing different strategies:

are rarely actual outcome values.

In this case the profit would never be £22,400 or £25,000.

When the decision problem can justifiably be regarded as

one of a sequence of many identical problems, then

choosing the outcome with the best expected value would lead to

the greatest overall payoff (taken over the whole sequence)

But when the problem is a "one-off" one is on shakier ground with EMV.

One can show the risk associated with a particular strategy in graphical form, using a **probability distribution graph**, or **risk profile**.

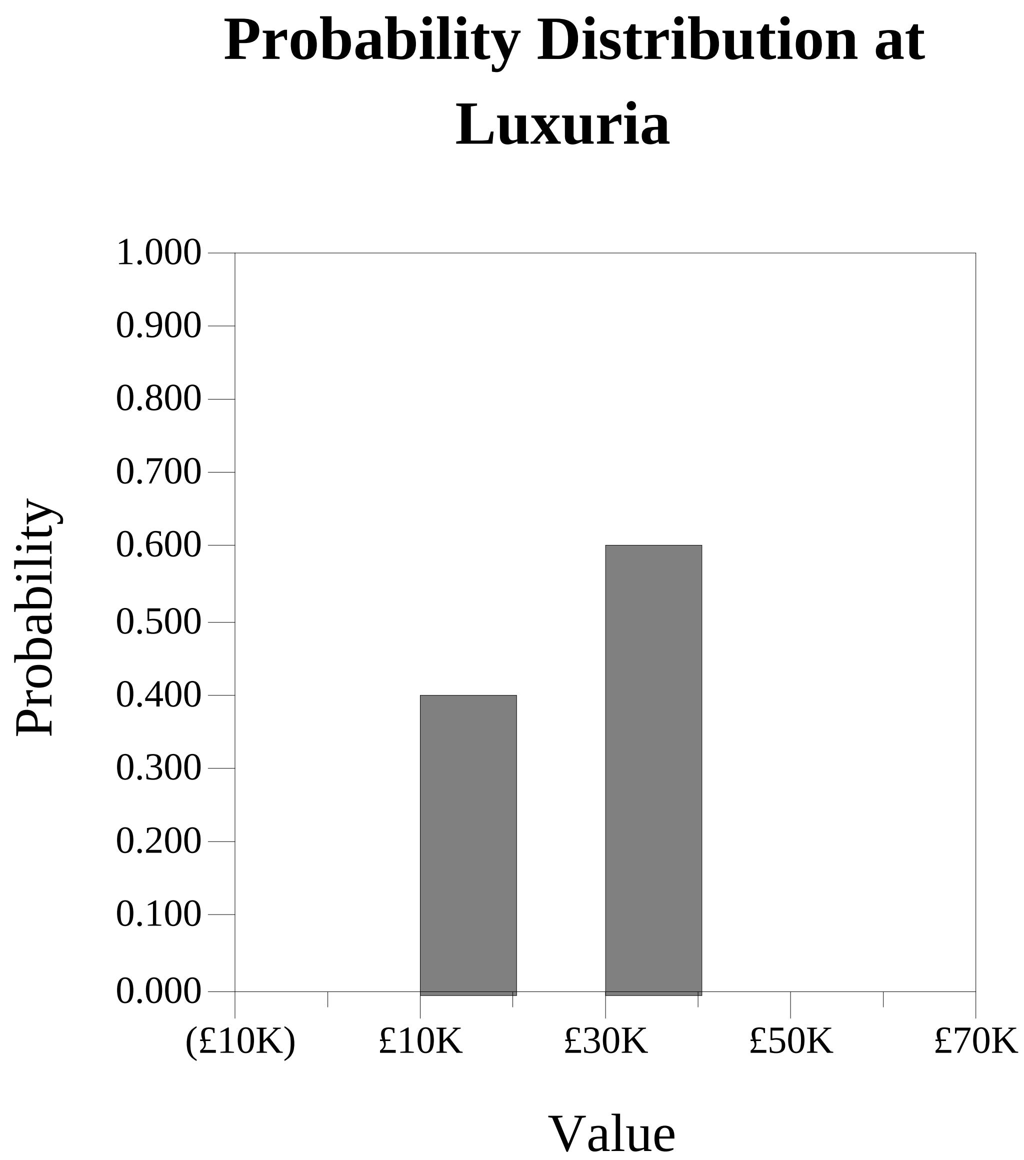
This is a column chart, which displays the:

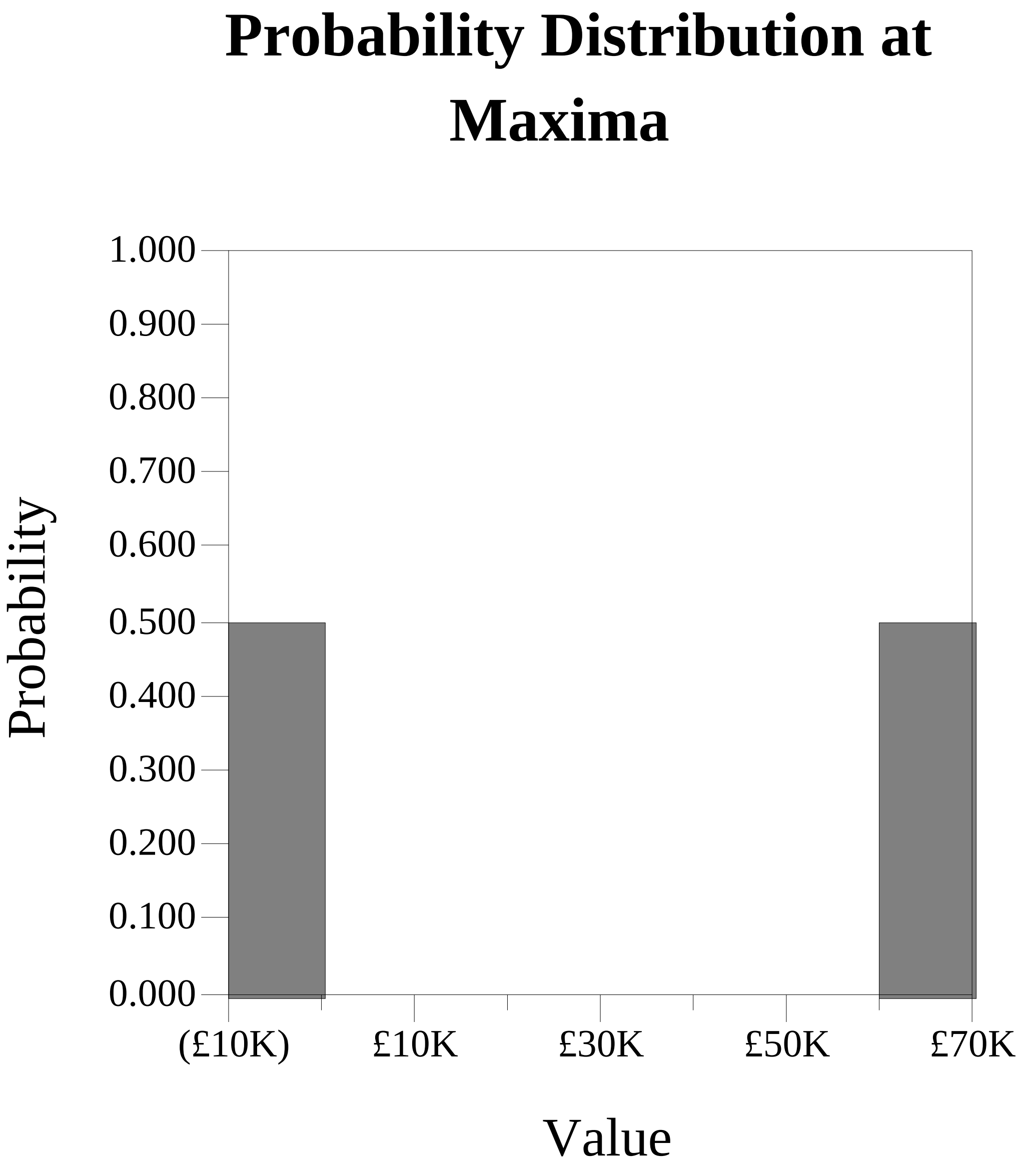
- dispersion of possible outcomes
- probabilities associated with those outcomes.

In a decision tree with several outcomes the

extent to which the bars are clustered or dispersed around the mean

provides a graphical indicator of the risk of the decision.


Probability Distribution at
Luxuria
1.000
0.900
0.800
0.700
0.600
0.500
0.400
0.300
0.200
0.100
0.000
Probability
(£10K)
£10K
£30K
£50K
£70K
Value



These risk profiles show clearly how much riskier the Maxima choice is.

A risk profile bar graph can also be displayed **cumulatively**.

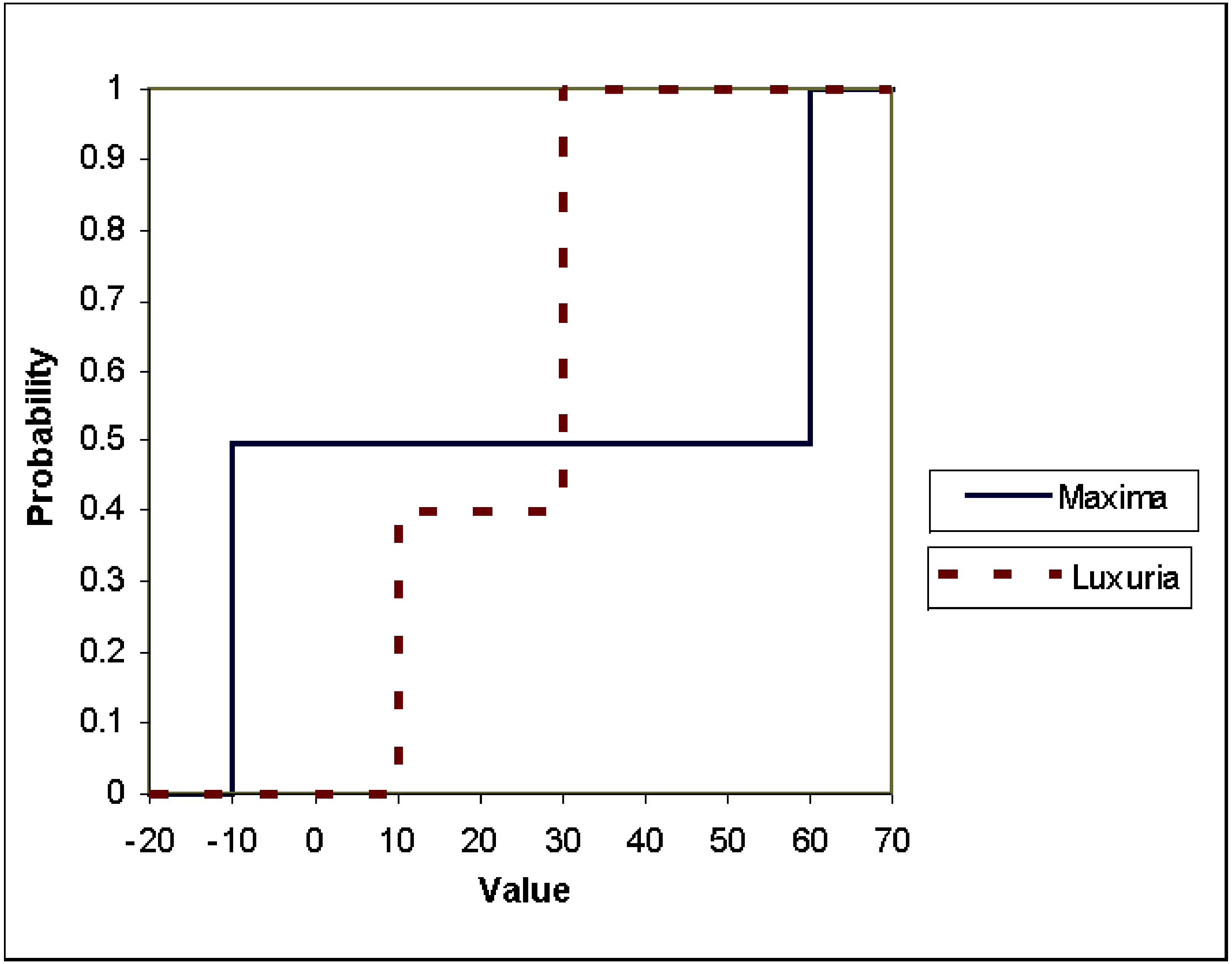
Rather than using discrete bars to indicate the probability of an outcome within a specific range of values

the cumulative graph shows a continuous series of bars.

The top of each bar indicates the

probability of an outcome at or below a particular value.

Possible to display several cumulative distributions together on a single graph:



Such comparative cumulative risk profiles are

particularly useful in showing when one strategy **dominates** another.

Deterministic dominance occurs when

one strategy always offers a better outcome than the alternative.

Not only does it have a higher expected value, but

its worst outcome (if there is any uncertainty)

is preferable (or at least equal) to

the best outcome of the alternative.

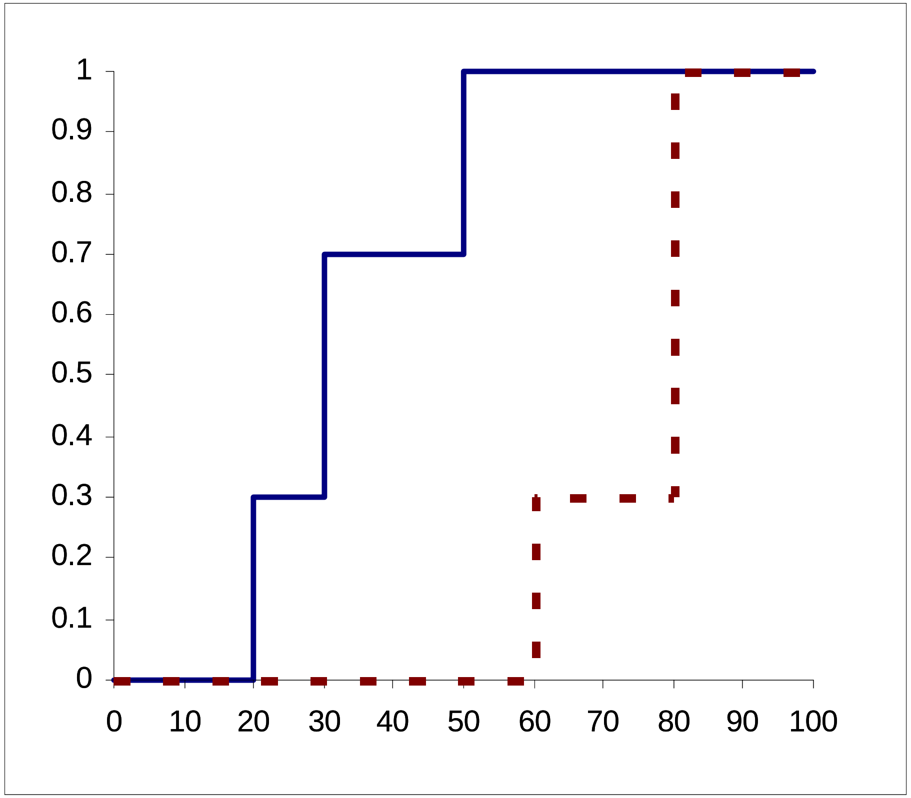
In a comparative cumulative risk profile graph,

the entire plot of the dominating alternative either

lies to the right of the line representing the other strategy,

or

its worst outcome will be equal to the best outcome of the alternative.



Stochastic (or **probabilistic**) **dominance**

involves more complex rules of interpretation.

Stochastic dominance can be inferred if

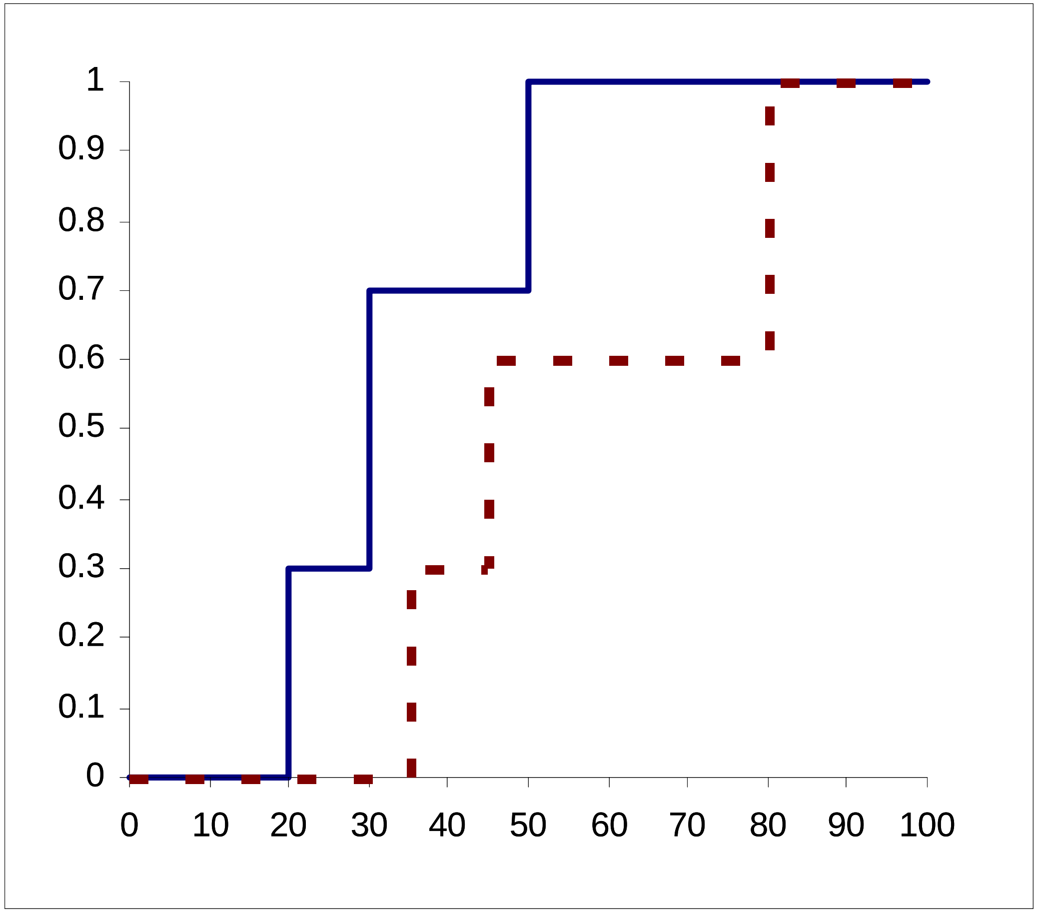
the line describing the dominating strategy is

never to the left of

the alternative's line and is

to the right and / or below it

in at least one location.

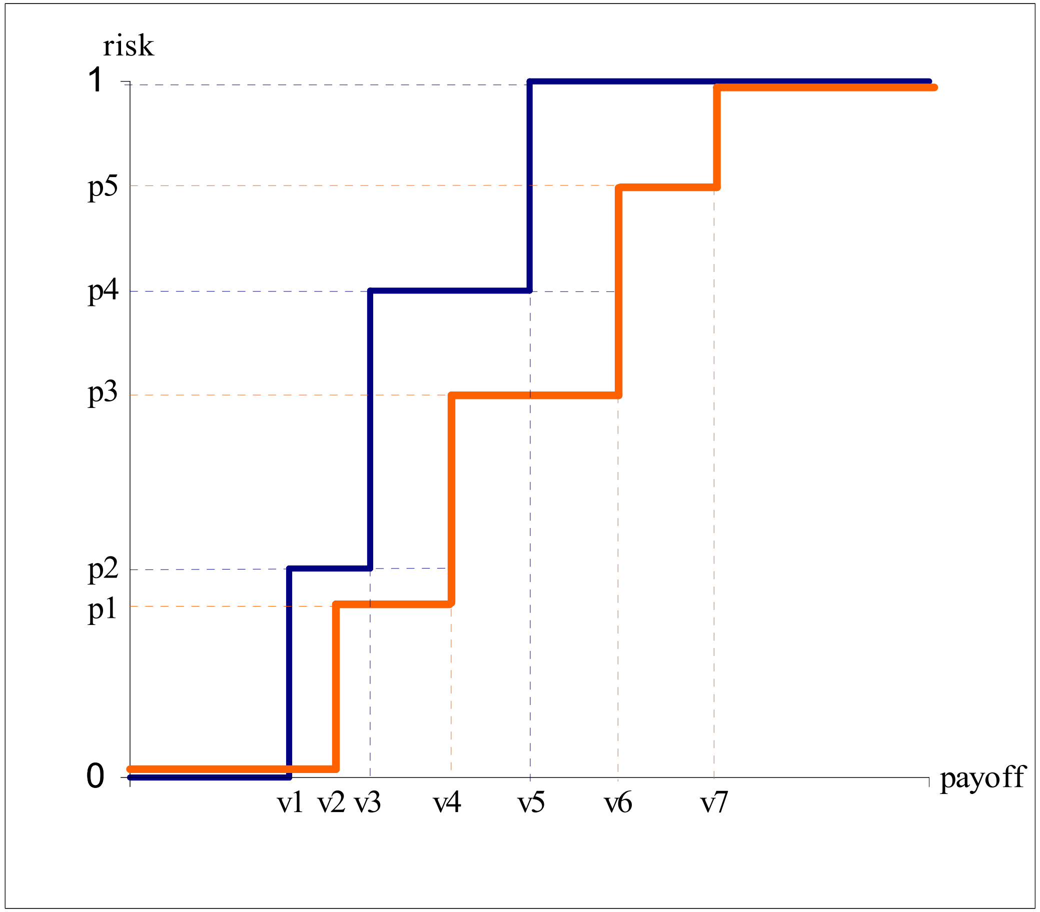


The cause of stochastic dominance can often be seen in the dominating strategy as

better probabilities,
better payoffs, or a
combination of both.

An Example of Stochastic Dominance

Orange stochastically dominates blue:



The two solutions offer combinations of payoffs at various levels of risk:

	payoff	
risk	**blue**	**orange**
p1	v1	v2
p2 - p1	v1	v4
p3 - p2	v3	v4
p4 - p3	v3	v6
p5 - p4	v5	v6
1 - p5	v5	v7

For each of the various levels of risk, the orange solution offers a higher payoff, and so is to be preferred.

In situations where there is no clear dominance, the lines of the strategies being compared will cross at one or more points in the graph, as in the Luxuria / Maxima example.

In such situations it becomes much harder to make strong statements about which strategy is better.

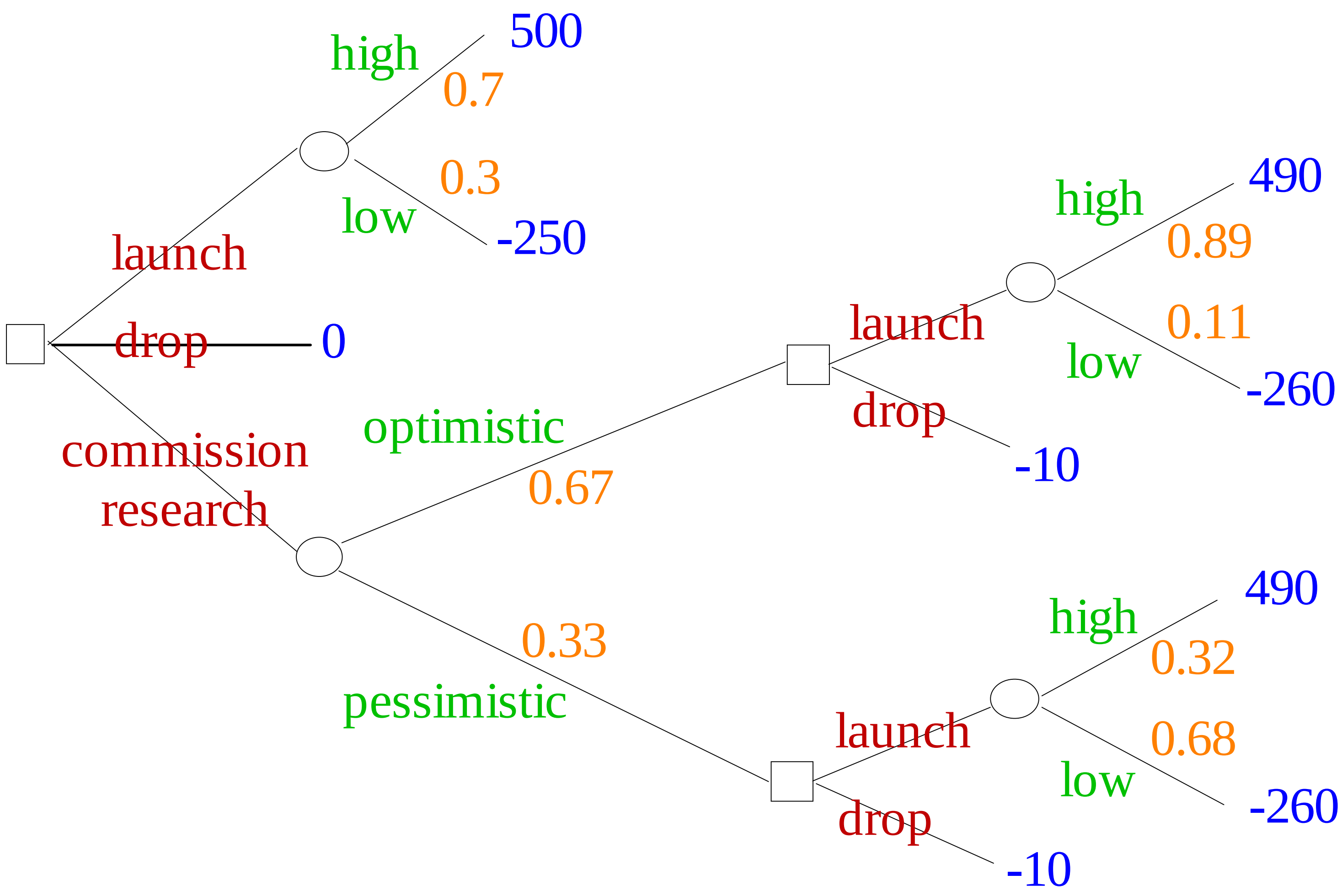
In general, if one strategy has a much higher expected value, there may be a good argument to choose it.

If the expected values are very similar, one must decide whether to choose the strategy with less risk or the strategy that offers the possibility of greater upside outcomes.

Yet, when it is possible to demonstrate dominance, you have a far less blunt instrument for eliminating inferior strategies than by simply comparing expected monetary values.

In the venture analysis example, the cost of marketing research information was £10,000 , but its value turned out to be only £3,500.

We take the cost of the marketing research information taken into account:



From the tree, we can identify a set of six distinct strategies (only some sensible):

1. Launch immediately

2. Drop immediately

3. Commission research,
   then launch, regardless of research result

4. Commission research,
   then drop, regardless of research result

5. Commission research,
   launch if optimistic research result,
   then drop if pessimistic research result

6. Commission research,
   launch if pessimistic research result,
   then drop if optimistic research result

We can work out the risks for the different strategies:

1. Launch immediately:

Payoff	Risk
500	0.7
-250	0.3

2. Drop immediately:

Payoff	Risk
0	1.0

3. Commission research,
then launch, regardless of research result:

Payoff	Risk
490	0.67*0.89 + 0.33*0.32 = 0.7
-260	0.67*0.11 + 0.33*0.68 = 0.3

4. Commission research,
then drop, regardless of research result:

Payoff	Risk
-10	0.67 + 0.33 = 1.0

5. Commission research,
launch if optimistic research result, drop if pessimistic research result:

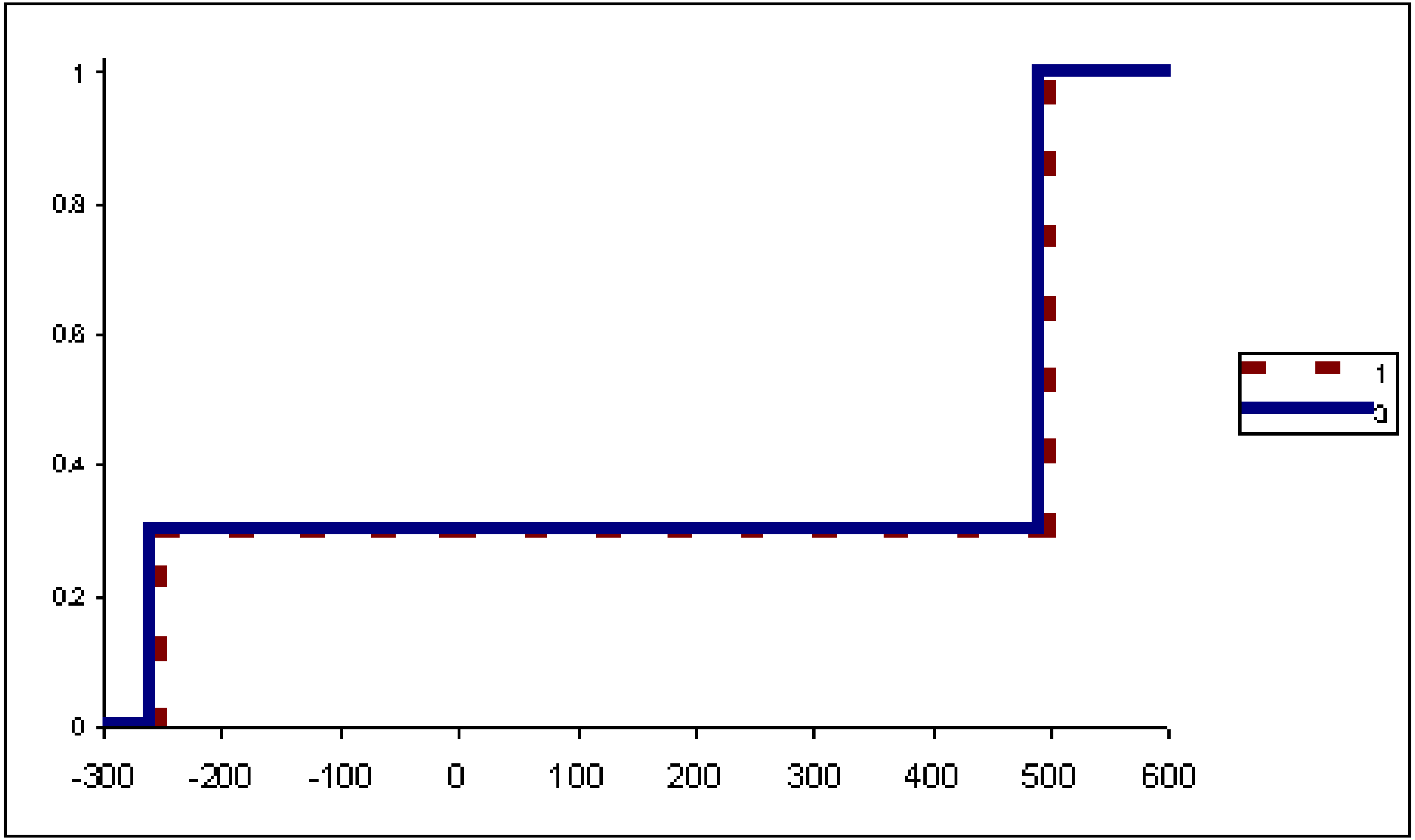
Payoff	Risk
490	0.67*0.89 = 0.595
-10	0.330
-260	0.67*0.11 = 0.075

6. Commission research,
launch if pessimistic research result, drop if optimistic research result:

Payoff	Risk
490	0.33*0.32 = 0.105
-10	0.670
-260	0.33*0.68 = 0.225

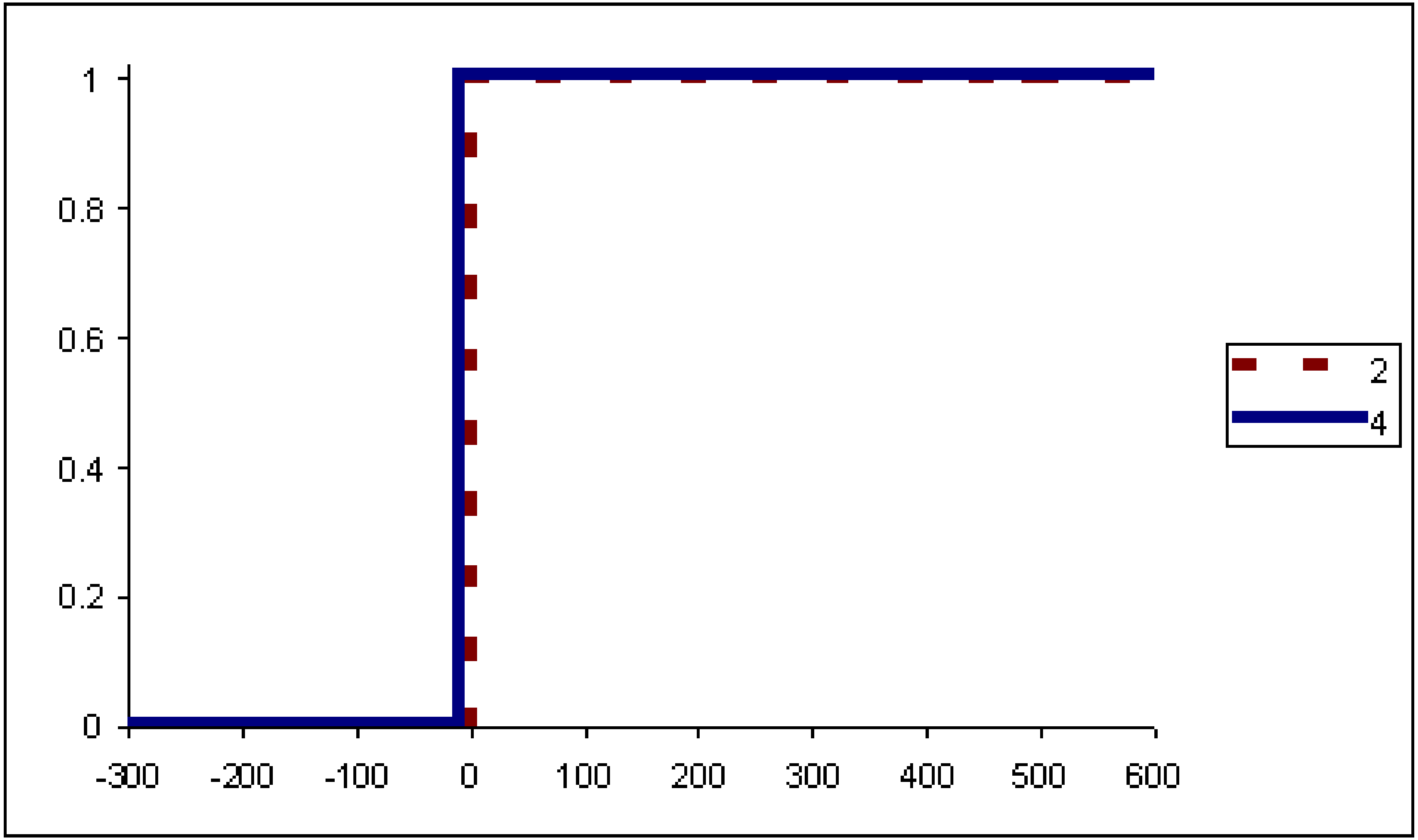
Comparing strategy 1 with strategy 3, we see that

strategy 1 stochastically dominates strategy 3 (just):



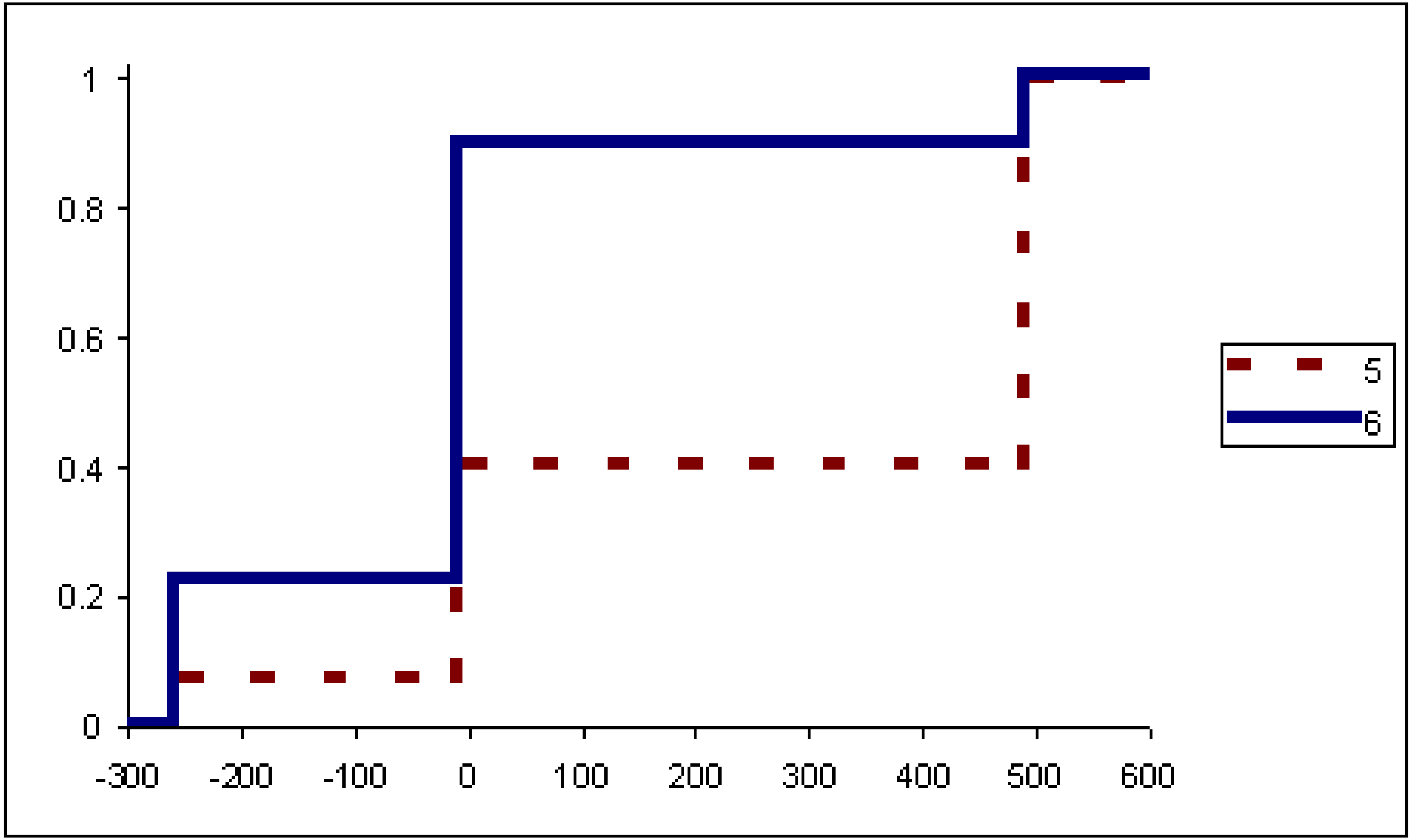
Comparing strategy 2 with strategy 4, we see that

strategy 2 deterministically dominates strategy 4 (just):

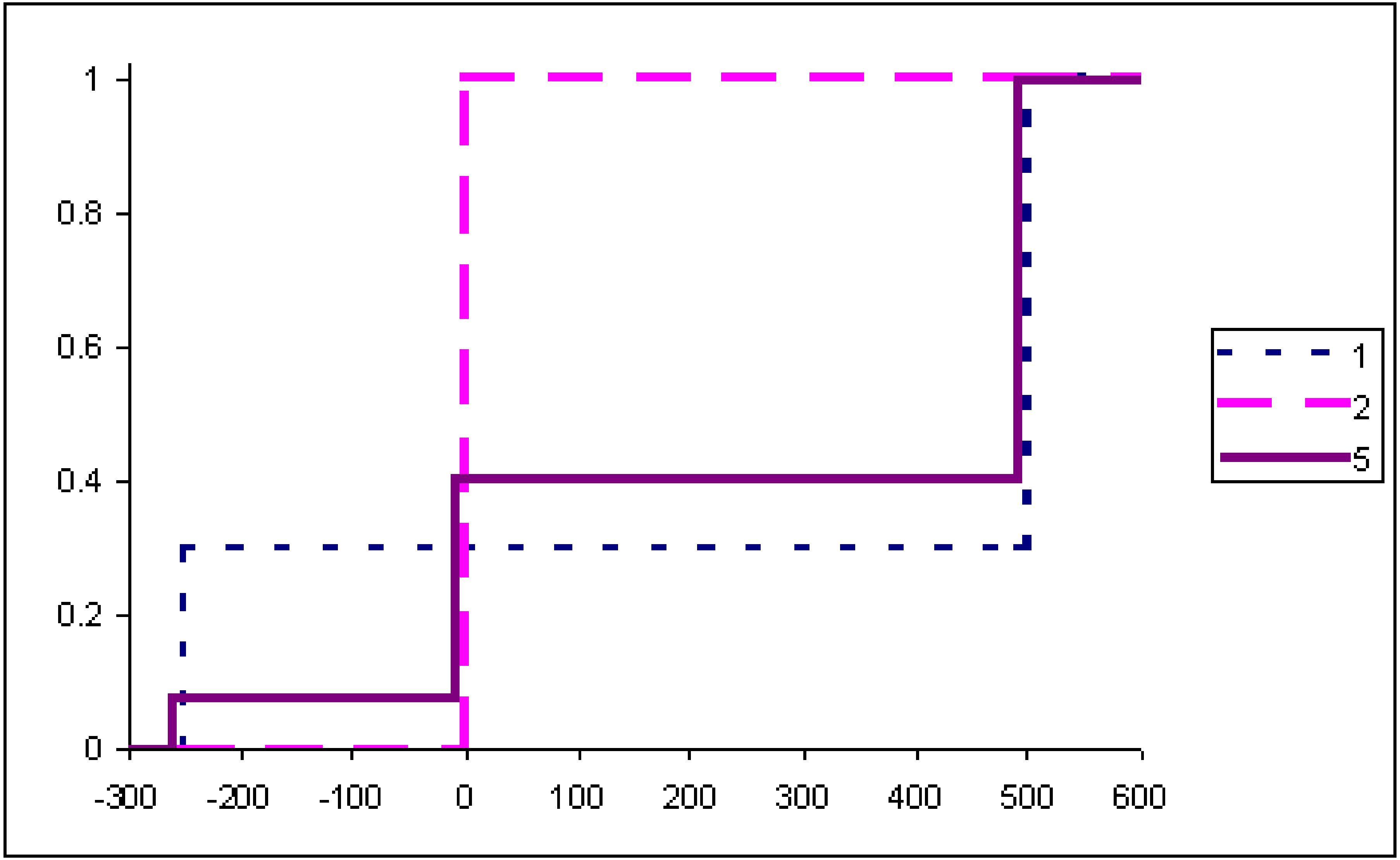


Comparing strategy 5 with strategy 6, we see that

strategy 5 stochastically dominates strategy 6:



So, we can eliminate strategies 3, 4 and 6 and need only compare the other three:



From this comparative cumulative risk profile chart, we can see that

- strategy 2 is the safest
- strategy 1 the riskiest
- strategy 5 the one that seems to offer

  the best combination of reward

  yet only moderate risks.

Notice that this choice runs

runs counter to the conclusion reached when using the EMV criterion

in which

strategy 1 is the preferred choice

with an EMV of £275K

compared to £268.5K for strategy 5 and £0K for strategy 2.