



Decision Tree Analysis


Decision Trees, used to help with decision making in business (and many other areas), are a form of diagrammatic analysis. They are used as a tool for helping managers to choose between several courses of action. They provide an effective and clear structure for presenting options and within decision trees the probabilities and financial outcomes of these options can be measured. They also help to form a balanced picture of the risks and potential financial rewards associated with each possible course of action. In many business decision making situations chance (or probability) plays an important role, and the use of decision trees helps build probability into the decision making process.

Drawing a Decision Tree


The component parts of a decision tree are:

 Square decision nodes

 Circular chance nodes

 Lines representing a decision, or probability

 Values of outcomes in £

 Probability of outcomes in % or decimal point

When drawing a Decision Tree we start with a decision that the business needs to make. The decision we are presented with in business studies is often a choice between 2 or more projects, or a proposal/order acceptance or refusal. This first choice to be made by the business is represented by a decision node, a small square drawn on the far left of the decision tree. Decision nodes represent points at which the company has to make a choice of one alternative from a number of possible alternatives. From this decision node we draw out lines towards the right for each possible option or choice, and write the descrip-

tion of that option along the line.

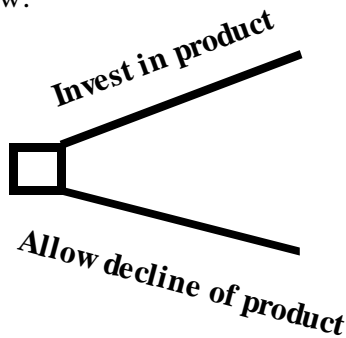
At the end of each line, we consider the likely outcome of a decision. If the result of taking that decision is uncertain, we draw a small circle - a chance or probability node. Chance nodes represent points at which chance, or probability, plays a dominant role and reflect alternatives over which the company has (effectively) no control. So we could say that one of the options a business has is to launch a new product, and the possible outcomes of the launch are excellent sales, good sales, and poor sales. The chance or probability node allows us to represent these alternative outcomes. Each probability is based on judgement and research evidence, so this gathering of evidence may indicate that there may be a probability of 40% good sales occurring. Probabilities are normally presented as a proportion of 1, so 40% = 0.4. When the probabilities from each chance node are added together they always total 1. After all, one of, excellent sales, good sales, and poor sales has to be right!

One decision being made can lead to the need to make another decision, so for example the initial decision might be to launch a new product, the second decision might be to go for a national or regional launch. If there is another decision that needs to be made, draw another square, decision node. Remember that squares represent decisions, and circles represent uncertain outcomes. Write the decision or factor above the square or circle. The process is repeated until all decisions and probabilities are represented on the Decision Tree Diagram.

Within business studies questions it will be clear what the choices are, and the likelihood of outcomes, in fact in exams it is quite likely that the decision tree will be already constructed. The candidate is then required to calculate the appropriate values and make a decision based on these values.

Example. A business is choosing whether to invest in updating a product, or whether to let the product go into decline.

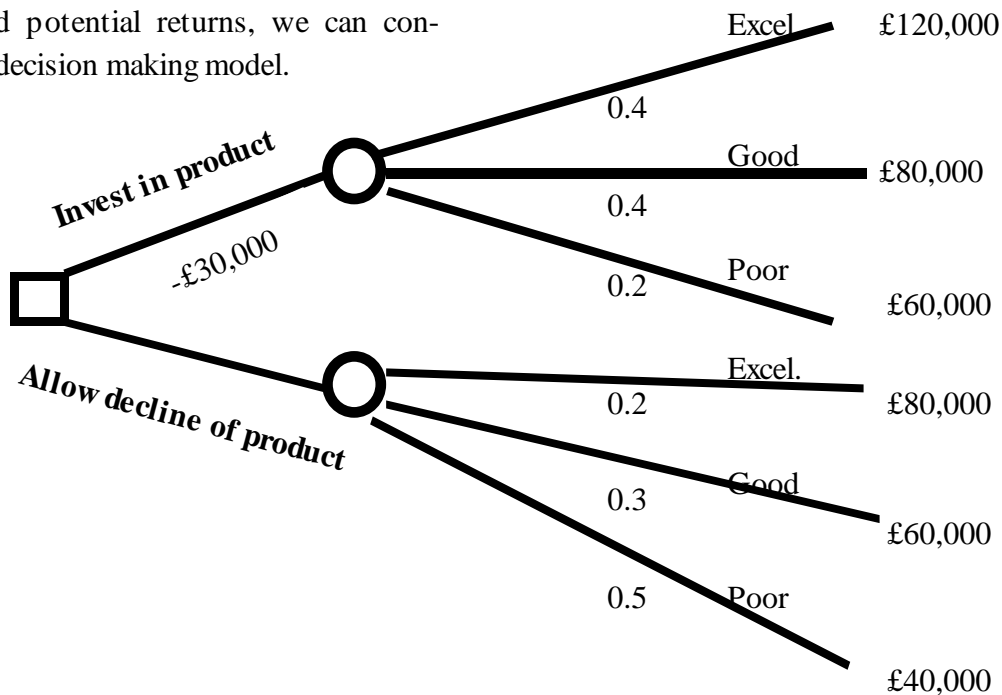
This choice can be represented in a decision tree as shown below.



The cost of investment in the product is £30,000, we can add this to the tree. Also the firm has calculated certain probabilities and likely levels of return that could result from either decision, these are shown in the table below. Again we can add this information to the decision tree.

Future sales	Poor	Good	Excellent
Invest in	0.2	0.4	0.4
Total Return	£60,000	£80,000	£120,000
Allow	0.5	0.3	0.2
Total return	£40,000	£60,000	£80,000

On their own these 2 options do not help a great deal in the decision making process, but if we now add information regarding costs of choices, potential results of the choices, and potential returns, we can construct an effective decision making model.



The decision tree above now shows the 2 initial choices, the probabilities of the 3 possible outcomes of the two choices, and the likely return to the company, if an individual outcome were to occur.

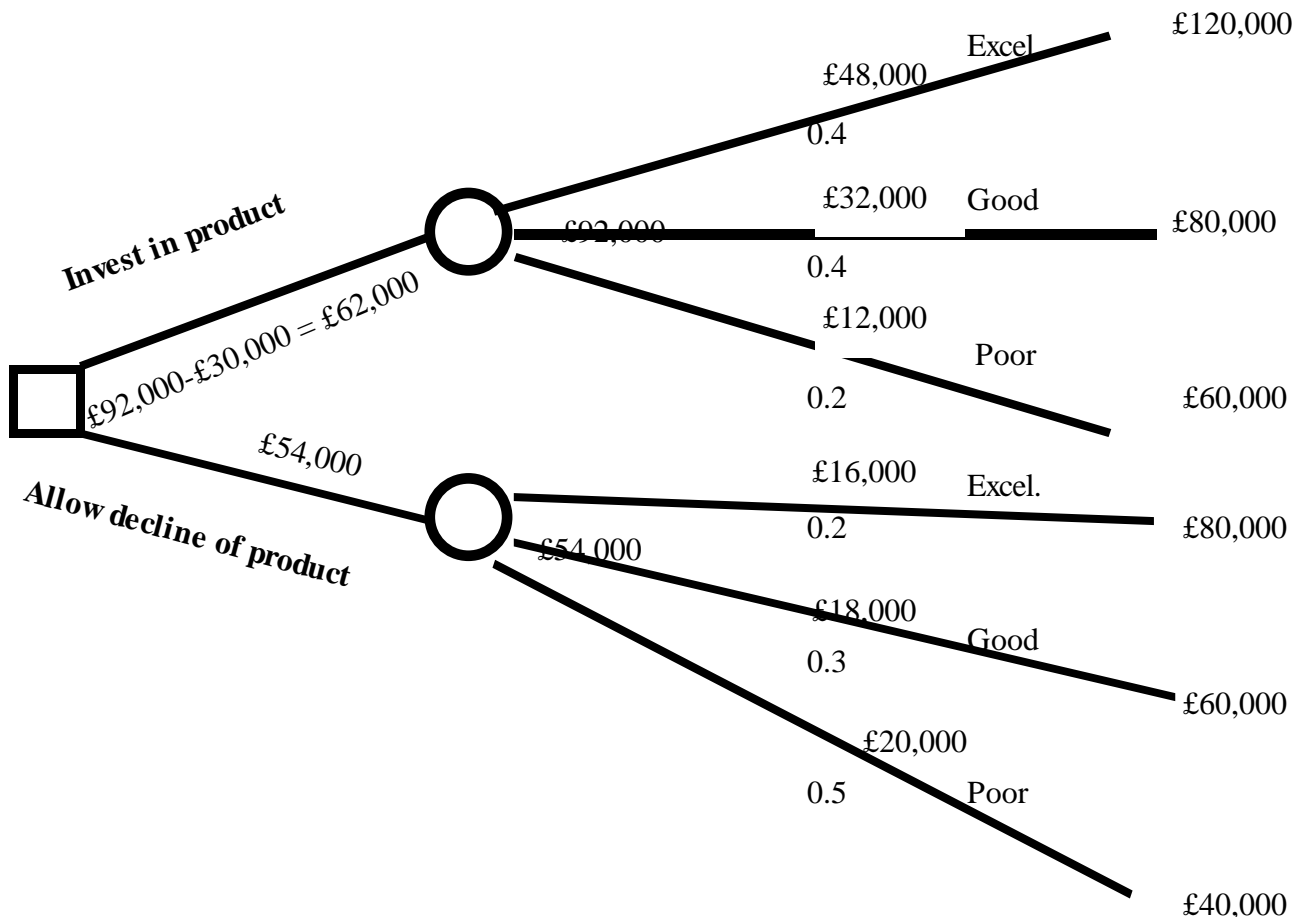
So for example, if the firm were to decide to invest in the product, there would be a probability of 0.4, or 40%, that this decision would lead to a return of £120,000. Alternatively if the firm decided to allow the product to decline, there is probability of 0.5, or 50%, that this would lead to a return of £40,000.

We have also recorded the cost of the potential investment on the decision tree, -£30,000.

The next stage is to calculate a value for each decision allowing for probabilities. We start on the far right top. Here we have a probability or chance of 0.4 of a return of £120,000. To give a value to this branch of the tree, we simply multiply. £120,000 by 0.4, giving an answer of £48,000. We place this value on the branch. We continue in the same way for each branch from each chance node. So 0.4 times £80,000 gives £32,000, and 0.2 times £60,000 gives £12,000.

We then total every one of the possible outcomes from the chance node, this gives us a value of £48,000 + £32,000 + £12,000 = £92,000. We place this total next to the chance node. We repeat the process for each chance node. The totals for the second node are shown. Once this is done we simply transfer the figure to the previous branch of the decision tree, but remember to take away any costs indicated. The figure we are left with is the likely financial value of each option or decision.

On purely financial terms the option with the highest value is selected. Which in this case would be, invest in product, which gives a probable return of £62,000 against the decline option which gives a probable return of £54,000



We see then that the use of Decision Trees allows both measures of financial outcomes and the probability of outcomes occurring, to be used within a single business decision making tool.

We can therefore say that, decision trees provide an effective method of decision-making because they:

- clearly lay out the problem so that all options can be challenged
- allow us to analyse fully the possible consequences of a decision
- provide a framework to quantify the values of outcomes and the probabilities of achieving them
- help us to make the best decisions on the basis of existing information and best guesses.

As with all decision-making methods, Decision Tree Analysis should be used in conjunction with common sense - decision trees are just one important part of an business decision-making tool kit. So other quantitative decision making methods could be used, (or at least considered in your answers), and qualitative factors will also have an influence on the decision made. In the previous example, we might consider the effects of decisions on workforce, training costs, recruitment, capacity management, suppliers etc, before a final decision is made – all qualitative factors.

Notes