

Problem Description:

The management of HiTek Research Institute has learned that Noshiba Corp is interested in marketing a new type of very high capacity DVD-ROM technology. Noshiba does not have research people of its own available to develop the new disk, so the company is going to subcontract the development to an independent research firm. Noshiba has offered a fee of £2,500,000 for developing the new DVD-ROM disk and has asked for proposals from various research firms. The contract is *not* to be awarded on the basis of price (fixed at £2,500,000), but on the basis of both the technical plan shown in the proposal and the reputed technical competence of the firm submitting the proposal.

HiTek Research Institute is considering submitting a proposal to Noshiba to develop the new DVD-ROM technology. HiTek Research management believe that some preliminary general research will have to be undertaken in order to prepare a credible proposal and estimates that this will cost about £500,000. Further, they estimate that the chances are about 50/50 that they will be awarded the contract.

However, HiTek Research engineers are uncertain about how they will develop the new DVD-ROM technology if they are awarded the contract. They are aware of three alternative approaches that could be tried. The first approach is based on *high density read/write mechanisms*, with a cost of £1,200,000. The engineers are certain they can develop a successful model with this approach. A second approach involves the use of *multiple layers*. The engineers estimate that it will cost only £500,000 to develop a DVD-ROM using the multiple layer approach, but that there is only a 50% chance that the results will be satisfactory. A third approach involves the use of *file compression*; the cost of developing a high capacity DVD-ROM using this approach will be £800,000, with a 70% chance of success.

HiTek Research has sufficient time to try only two approaches. Thus, if they try either the multiple layer or file compression method and it fails, the second attempt will have to use the high density read/write method in order to guarantee success.

Required:

- a Assuming that HiTek management are risk neutral, advise them about how to take all the above information into account in making an immediate decision about whether to spend £500,000 to develop a proposal to send to Noshiba.

- b HiTek were not absolutely certain about the levels of cost they might incur. The following table gives reasonable upper and lower bounds for the four types of cost:

Costs:	base value	lower bound	upper bound
Prepare proposal	500,000	200,000	1,000,000
Use High Density Method	1,200,000	900,000	2,500,000
Use Multiple Layers Method	500,000	400,000	800,000
Use File Compression Method	800,000	500,000	1,000,000

- (i) Produce a tornado chart illustrating the sensitivity of the first decision (whether or not to prepare a proposal) to the four types of cost.
 - (ii) Conduct a one-way sensitivity analysis of the expected payoff from the various possible strategies to the cost of using the high density method.
- c Although HiTek are absolutely certain that the High Density method will succeed, they are not so confident about the probability of being awarded the contract or of the probability levels of the other two methods succeeding.
- (i) Produce a one-way sensitivity analysis of expected payoffs of their initial choice to the probability of being awarded the contract.
 - (ii) Conduct a two-way sensitivity analysis of the various possible strategies to the probability levels of the multiple layers and file compression methods succeeding.
- d On further investigation, it seems that HiTek management may not be risk neutral after all. Indeed, when offered a fifty-fifty lottery with payoffs of £1,500,000 and -£500,000, they decide that they are indifferent between the lottery and £200,000 for certain.

Assume that they have an exponential utility function for money of the form:

$$U(X) = A - B * \exp(-R * X)$$

where risk coefficient, R, determines the curvature and depends on HiTek 's attitude to risk, and parameters A and B determine vertical and horizontal scaling.

- (i) Derive the values of A, B and R.
- (ii) Assuming that HiTek are comfortable with all the probability and cost figures given in the problem description, what would your advice to HiTek be now?
- (iii) Investigate the sensitivity of the recommended strategy to a change in the certainty equivalent of the fifty-fifty lottery with payoffs of £1,500,000 and -£500,000.

NB: Use a spreadsheet program to help carry out the more complicated sensitivity analyses and to carry out any other difficult computations not easily done using a calculator. Include printouts of your spreadsheet models with your report.