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### **Introduction**

In many problems chance (or probability) plays an important role. Decision analysis is the general name that is given to techniques for analyzing problems containing risk/uncertainty/probabilities. E.g., decision trees are a specific tool of decision analysis. For the following example draw the decision tree and solve it:

### **Example MDG**

The Metal Discovery Group (MDG) is a company set up to conduct geological explorations of parcels of land in order to ascertain whether significant metal deposits (worthy of further commercial exploitation) are present or not. Current MDG has an option to purchase outright a parcel of land for £4m.

If MDG purchases this parcel of land then it will conduct a geological exploration of the land. Past experience indicates that for the type of parcel of land under consideration geological explorations cost approximately £2m and yield significant metal deposits as follows:

- gold 1.01% chance
- silver 0.6% chance

Only one of these two metals is ever found (if at all), i.e. there is no chance of finding two or more of these metals and no chance of finding any other metal.

If gold is found then the parcel of land can be sold for £320m and if silver is found the parcel of land can be sold for £160m.

MDG can, if they wish, pay £250k for the right to conduct a three-day test exploration before deciding whether to purchase the parcel of land or not. Such three-day test explorations can only give a preliminary indication of whether significant metal deposits are present or not and past experience indicates that three-day test explorations cost £250k. If Ag is present (in reality but unknown), test exploration will indicate significant metal deposits with a probability of 83,33%; in case of Au the probability will be 99,01%; if no deposits are present test explorations are inaccurate and will indicate significant metal deposits with probabilities of 49,29%.

Compute the probability that a test exploration indicates significant metal deposits (it should be closely to 50% - round it to 50%). Compute the conditional probabilities that Ag, Au or no deposits are present under the conditions that test explorations

- indicates significant metal deposits or
- do not indicate significant metal deposits, respectively.

Draw the decision tree and solve the decision problem by backward recursion.