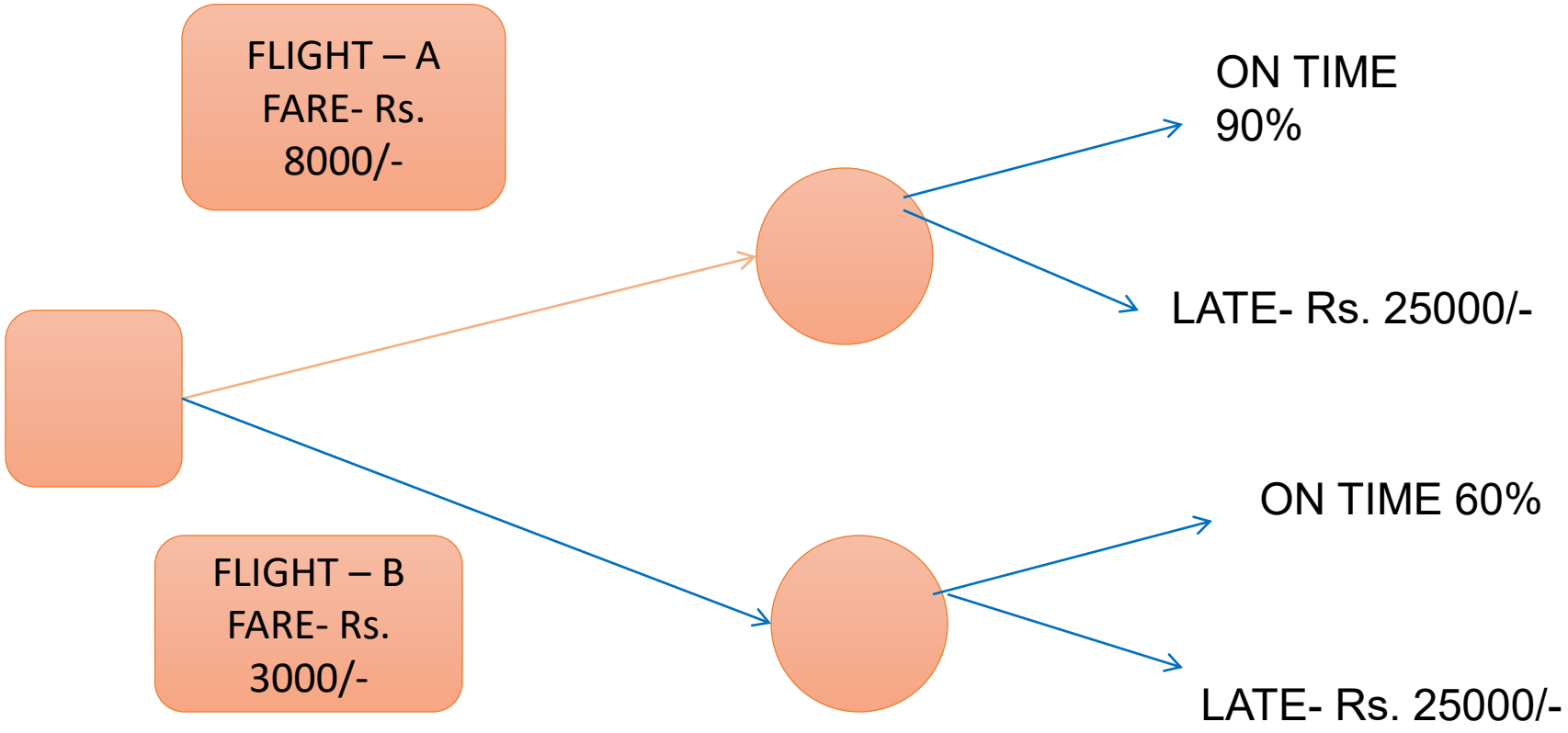
Decision Tree Analysis

Decision tree analysis

- Decision trees are used to support selection of the best of several alternative courses of action.
- Alternative paths through the project are shown in the decision tree using branches representing different decisions or events, each of which can have associated costs and related individual project risks (including both threats and opportunities).
- The end-points of branches in the decision tree represent the outcome from following that particular path, which can be negative or positive.
- The decision tree is evaluated by calculating the expected monetary value of each branch, allowing the optimal path to be selected. An example decision tree is shown in following figure.

Decision Tree Analysis- Example 1:

- Mr. Kumar has to fly to Mumbai to attend an important event. Considering the data provided below, which flight Mr. Kumar should take and what is the EMV of his decision?



Solution-

- If Mr. Kumar looks at the cost, he will choose Flight B because of cheaper fares. However, the flights have different on-time arrival rates.
- So Mr. Kumar performs EMV Analysis-

Flight A= (10% X 25000)+(90%X0)+8000

= 0.1X25000+0+8000

= Rs. 10500/-

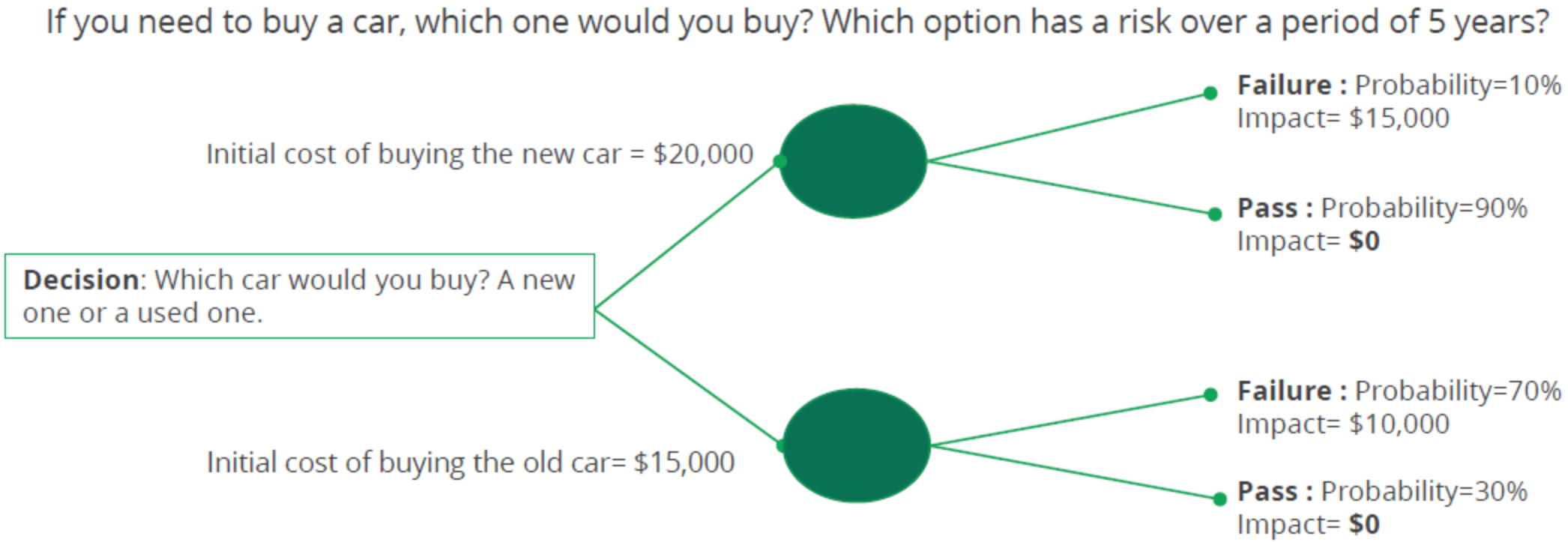
Flight B= (40%X25000)+(60%X0)+3000

= 0.4X25000+0+3000

= Rs. 13000/-

Mr. Kumar should choose Flight A due to less EMV of Rs. 10500/-

Decision Tree Analysis- Example 2:



Risk Exposure = Probability * Impact

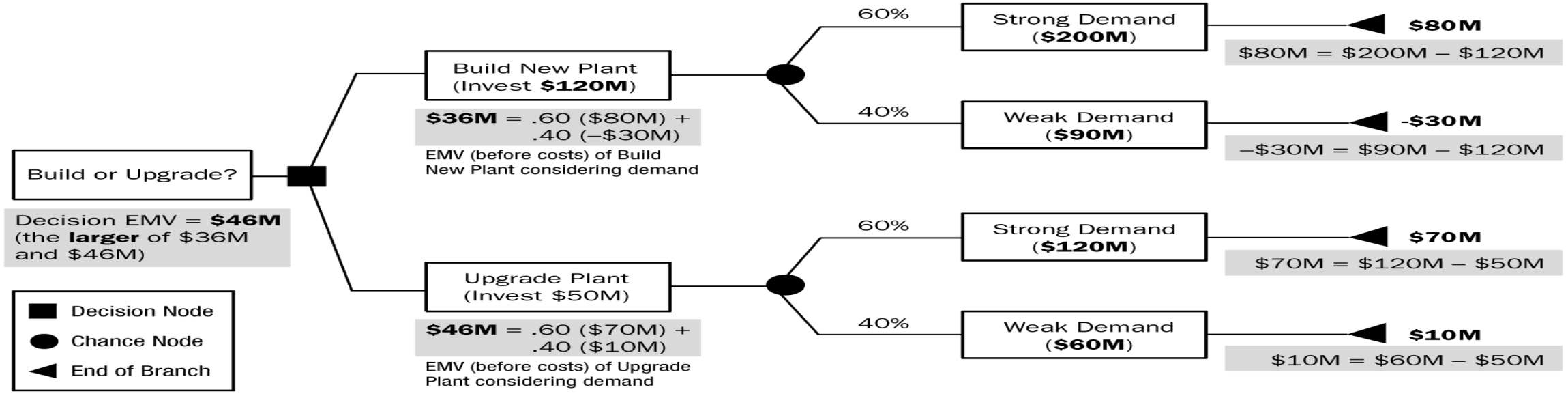
Risk associated with the new car is $20,000 + ($15,000 * 10%) + ($000*90%) = $21,500

Risk associated with the old car is $15,000 + ($10,000*70%) + ($000*30%) = $22,000

Decision Tree Analysis

Diagrams that show the sequence of interrelated decisions and the expected results of choosing one alternative over the other.

Decision Definition	Decision Node	Chance Node	Net Path Value
Decision to be Made	**Input:** Cost of Each Decision **Output:** Decision Made	**Input:** Scenario Probability, Reward if it Occurs **Output:** Expected Monetary Value (EMV)	**Computed:** Payoffs minus Costs along Path



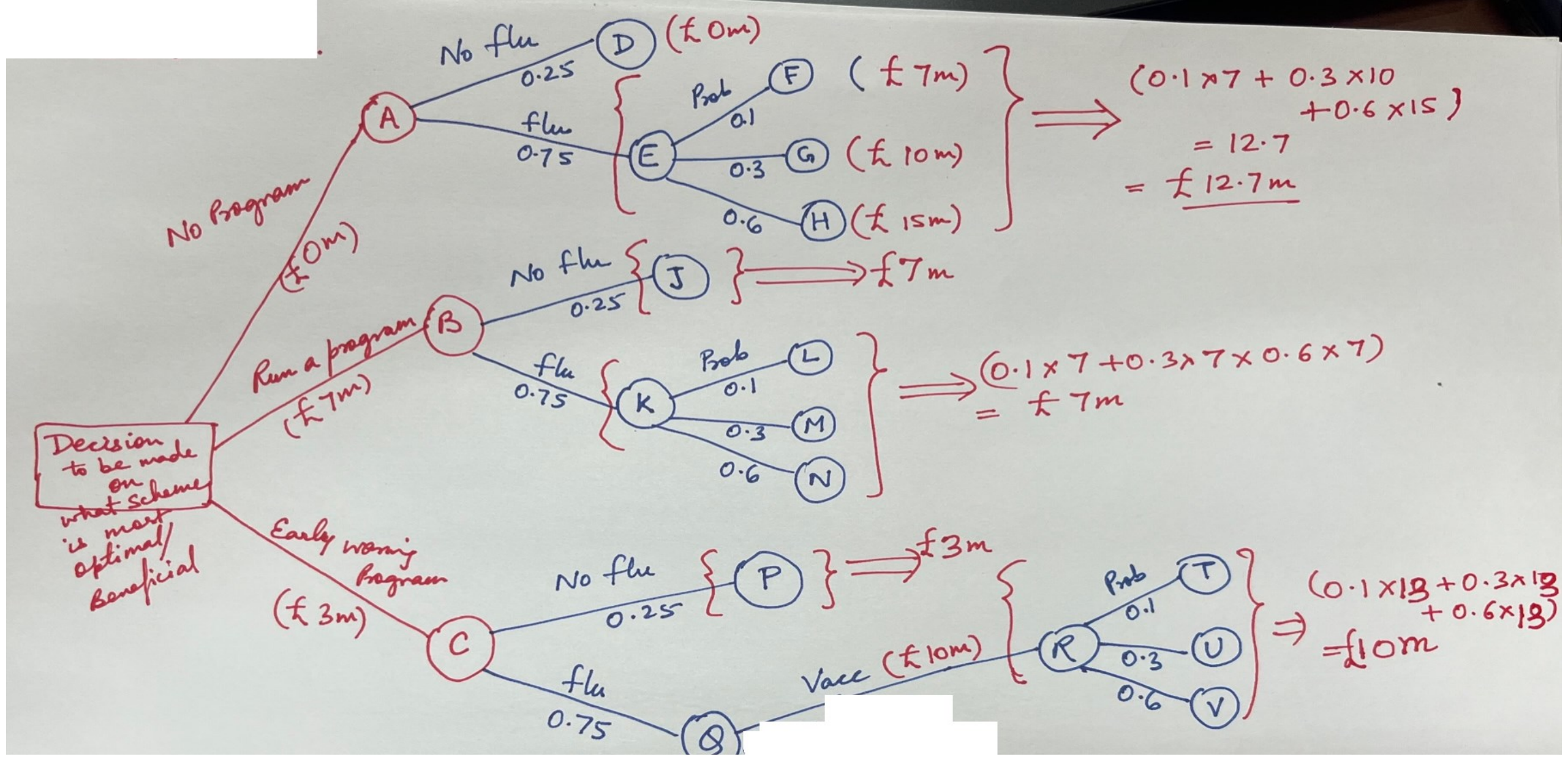
Note 1: The decision tree shows how to make a decision between alternative capital strategies (represented as "decision nodes") when the environment contains uncertain elements (represented as "chance nodes").

Note 2: Here, a decision is being made whether to invest $120M US to build a new plant or to instead invest only $50M US to upgrade the existing plant. For each decision, the demand (which is uncertain, and therefore represents a "chance node") must be accounted for. For example, *strong* demand leads to $200M revenue with the new plant but only $120M US for the upgraded plant, perhaps due to capacity limitations of the upgraded plant. The end of each branch shows the net effect of the payoffs minus costs. For each decision branch, all effects are added (see shaded areas) to determine the overall Expected Monetary Value (EMV) of the decision. Remember to account for the investment costs. From the calculations in the shaded areas, the upgraded plant has a higher EMV of $46M – also the EMV of the overall decision. (This choice also represents the lowest risk, avoiding the worst case possible outcome of a loss of $30M).

A government committee is considering the economic benefits of a program of preventative flu vaccinations. If vaccinations are not introduced then the estimated cost to the government if flu strikes in the next year is £7m with probability 0.1, £10m with probability 0.3 and £15m with probability 0.6. It is estimated that such a program will cost £7m and that the probability of flu striking in the next year is 0.75.

One alternative open to the committee is to institute an "early-warning" monitoring scheme (costing £3m) which will enable it to detect an outbreak of flu early and hence institute a rush vaccination program (costing £10m because of the need to vaccinate quickly before the outbreak spreads).

- What recommendations should the committee make to the government if their objective is to maximise expected monetary value (EMV)?
- The committee has also been informed that there are alternatives to using EMV. What are these alternatives and would they be appropriate in this case?



At node C, there is a chance of occurrence of flu is 0.75 and if flu spreads gov has to start a vaccination program spending 10 million euro, there is no chance left for not vaccinating.

EMV at (A) = 0.25 x 0 + 0.75 x 12.7

= £9.525m (Expenditure of gov. funds)

EMV at (B) = 0.25 x 7 + 0.75 x 7

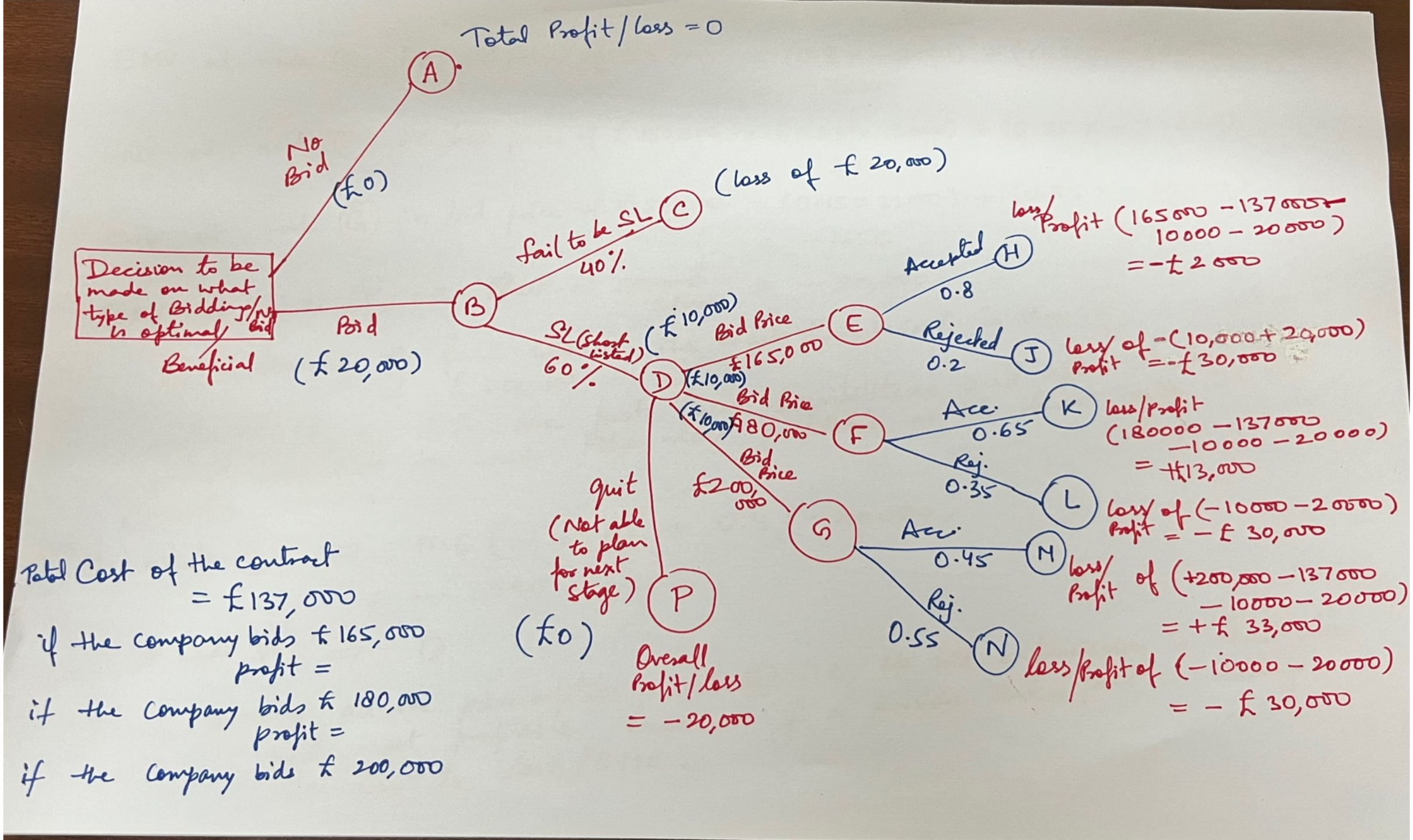
= £7m (expenditure of gov. funds)

EMV at (C) = 0.25 x 3 + 0.75 x 10

= £8.25m. (expenditure of gov. funds)

Minimum espenditure is for program B hence B will be the best decision.

A firm is suppose to take the decisions on submitting the bid for a contract, they decided to estimate the benefits and cost involved in putting the bid. So, they estimated that only preparing the bid will cost £20,000. If their company bid then they estimate that there is a 60% chance that their submission of quotation will be considered, 40% chance that their quotation will be rejected. Once "under consideration" the company will be asked to provide other details (the estimate of this process is £10,000). After analysis, their quotation will either be accepted or rejected. The company estimated the total cost associated (direct + indirect costs) with this contract as £137,000. They are considering three possible prices to quote, viz. £165,000, £180,000 and £200,000. They estimated the probability of these bids being accepted (once they have been "under consideration") is 0.80, 0.65 and 0.45 respectively. What should the company do and what is the expected monetary value of your suggested course of action? Discuss all the possibilities in detail.


Total Profit/loss = 0
A
No Bid
(£0)
Decision to be made on what type of Bidding/No Bid is optimal/ Beneficial
Bid
(£20,000)
B
fail to be SL
40%
C
(loss of £20,000)
SL (short listed)
60%
(£10,000)
D
Bid Price
£165,000
(£10,000)
E
Accepted
0.8
H
loss/Profit (165000 − 137000 − 10000 − 20000)
= −£2000
Rejected
0.2
J
loss/Profit of −(10,000 + 20,000)
= −£30,000
Bid Price
£180,000
(£10,000)
F
Acc.
0.65
K
loss/Profit (180000 − 137000 − 10000 − 20000)
= +£13,000
Rej.
0.35
L
loss/Profit of (−10000 − 20000)
= −£30,000
Bid Price
£200,000
G
Acc.
0.45
M
loss/Profit of (+200,000 − 137000 − 10000 − 20000)
= +£33,000
Rej.
0.55
N
loss/Profit of (−10000 − 20000)
= −£30,000
quit (Not able to plan for next stage)
(£0)
P
Overall Profit/loss
= −20,000
Total Cost of the contract
= £137,000
if the company bids £165,000
profit =
if the company bids £180,000
profit =
if the company bids £200,000

EMV at node (E) i.e bid price of £165,000 $= (0.8 \times -2000) + (0.2 \times -30000)$
$= -7600$

EMV at node (F) i.e bid price of £ 180,000 $= (0.65 \times 13000) + (0.35 \times -30000)$
$= -2050$

EMV at node (G) i.e bid price of £ 200,000 $= (0.45 \times 33000) + (0.55 \times -30000)$
$= -1650$

EMV at node (P) i.e Quit at second stage $= -20,000$

Among the four choices, the most beneficial is the (G) i.e bid price of £ 200,000.

nodes (E), (F), (G) & (P) are just four possibilities and after checking the overall profit/loss on each, the most profitable or the least costly will be really chosen.

EMV at node (B) $\Rightarrow$ $0.6(-1650) + 0.4(-20000)$
$= -8990$

EMV at node (A) $\Rightarrow$ 0

Hence among all the possibilities node (A) i.e, No bid submission is least loss and most profitable. because if a person takes part in bidding he has to lose £8990.