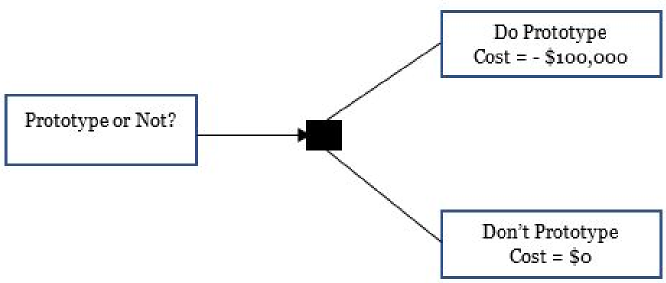
Decision Trees and Expected Monetary Value (EMV)

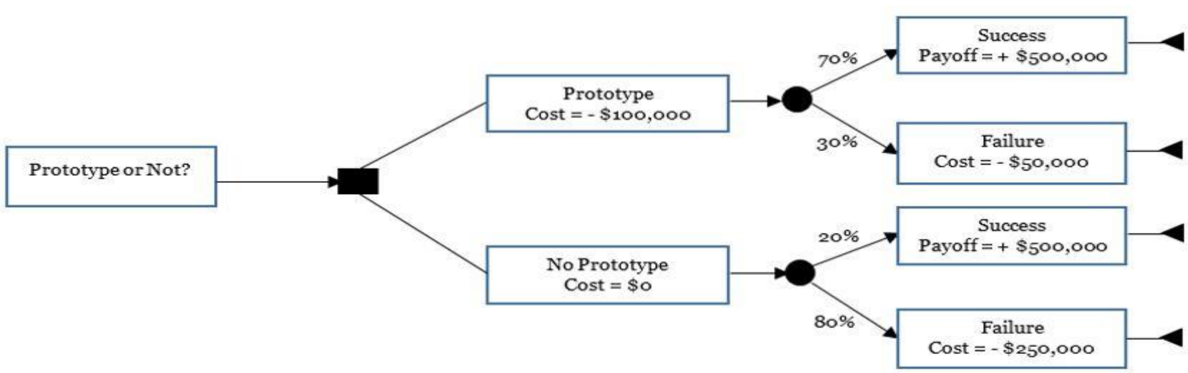
Scenario 01

You're doing a prototype for your project, but you're not sure whether to proceed with this prototype. If you do the prototype, it will cost you $100,000; and, of course, if you don't pursue it, there will be no cost. If you do the prototype, there is 30 percent chance that the prototype might fail, and for that the cost impact will be $50,000. However, if the prototype succeeds, the project will make $500,000. If you do not do any prototype, you're already taking a risk, the chance of which is 80 percent with a failure impact of $250,000. But, again, without a prototype, should you succeed, the project will make the same money as mentioned before. What should you do?

Answer:



Each option will lead to two events or chances — success or failure — branching out from the chance nodes. Taking the first option, if it fails, which has a 30 percent chance, the impact will be $50,000. If it succeeds (a 70 percent chance), there's no cost, but there is a payoff of $500,000. These are noted on the arrows. Similarly, for the second decision, "Don't Prototype":



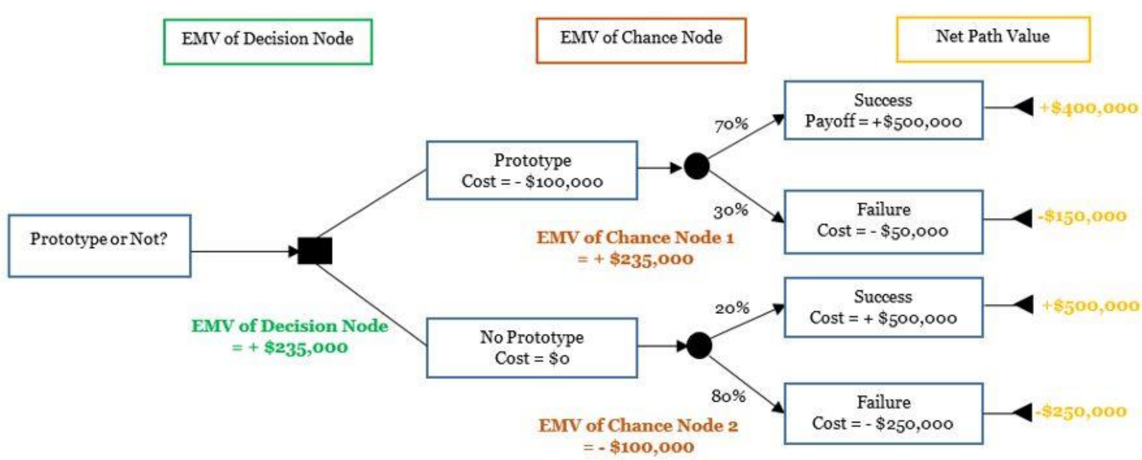
By looking at it, can you conclude anything? I can't. So let's do the EVM analysis. To calculate, as noted before, you move from right to left. First, calculate the net path value along each branch of the decision tree. The net path value for a path over the branch is the difference between payoff minus costs. Next, at every chance node, calculate the EMV. From these EMVs, we can find out the EMV of at the decision node. The decision giving the highest positive value or lowest negative value is selected.

EMV for Chance Node 1, the first circle:

The net path value for the prototype with 70 percent success = Payoff – Cost:
= +$500,000 – $100,000
= +$400,000
The net path value, for the prototype with a 30 percent failure = Payoff – Cost:
= -$50,000 – $100,000
= -$150,000
*EMV of chance node 1 = [70% * (+$400,000)] + (30% * (-$150,000)]*
= +$280,000 – $45,000
= +$235,000

EMV for Chance Node 2 (the second circle):

The net path value for the prototype with a 20 percent success = Payoff – Cost:
= +$500,000 – $0
= +$500,000
The net path value for the prototype with 80 percent failure = Payoff – Cost:
= -$250,000 – $0
= -$250,000
*EMV of chance node 2 = [20% * (+$500,000)] + (80% * (-$250,000)]*
= +$100,000 – $200,000
= -$100,000
These results are shown in this figure:



Look at the EMV of the decision node (the filled-up square). That's +$235,000. With the other option — no prototyping — you're losing money.

Hence, you should go for the prototype.

Scenario 02

Suppose you are a project manager of a power plant project and there is a penalty in your contract with the main client for every day you deliver the project late. You need to decide which sub-contractor is appropriate for your projects critical path activities. But while selecting a sub-contractor, you should take into consideration the costs and delivery dates.

- Sub-contractor 1 bids Rs 250,000. You estimate that there is a 30% possibility of completing 60 days late. As per your contract with the client, you must pay a delay penalty of Rs 5,000 per calendar day for every day you deliver late.

- Sub-contractor 2 bids Rs 320,000. You estimate that there is a 10% possibility of completing 20 days late. As per your contract with the client, you must pay a delay penalty of Rs 5,000 per calendar day for every day you deliver late.

You need to determine which sub-contractor is appropriate for your projects critical path activities. Both sub-contractors promise successful delivery and high-quality work.

Answer:

Sub-contractor 1 EMV : 340,000

Sub-contractor 2 EMV : 330,000

Hence, you should go for the Sub-contractor 2

Scenario 03

We are the prime contractor and there is a penalty in our contract with the main client for every day we deliver late. We need to decide which sub-contractor to use for a critical activity. Our aim is to minimize our expected cost. It is often difficult to argue for using the higher-priced sub-contractor, even if that one is known to be reliable.

The lower-bidding sub-contractor also promises a successful delivery, although we suspect that he cannot do so reliably. A rigorous analysis of this decision using a simplified decision tree structure that minimizes our expected cost is shown below:

One sub-contractor is lower-cost ($110,000 bid). We estimate however that there is a 50% chance that this contractor will be 90 days late and our contract with the main client specifies that we must pay a delay penalty of $1,000 per calendar day for every day we deliver late.

The higher-cost sub-contractor bids $140,000. We know this contractor and assess that it poses a low 10% chance of being late, and only 30 days late at that. Of course, our customer will impose on us the same $1,000 delay penalty per day for late delivery.

Answer: