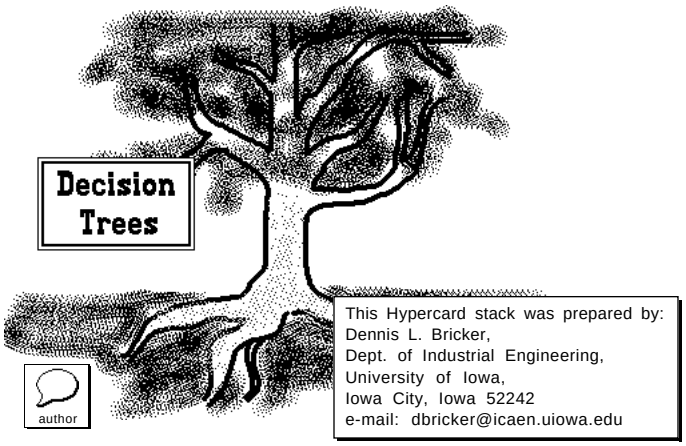

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Decision Trees

- a diagram for analyzing decisions *under risk*, i.e., when the probability dist'ns of the possible "states of nature" are known
- appropriate for a *sequence* of decisions, each of which could lead to one of several uncertain outcomes

EXAMPLES

☞ PROTRAC, Inc.

☞ AIRLINE TICKET PURCHASE

☞ OILCO

☞ INCORPORATING NEW INFORMATION

EXAMPLE PROTRAC, Inc., must decide on one of three marketing & prod'n strategies for a new line of home & garden tractors:

A: agressive
B: basic
C: cautious

The condition of the market (as yet unknown) is categorized as "Strong" or "Weak", and determines the payoff:

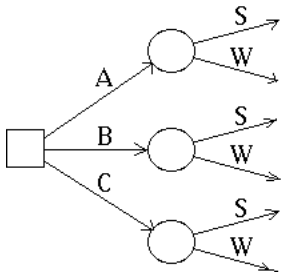
⏎

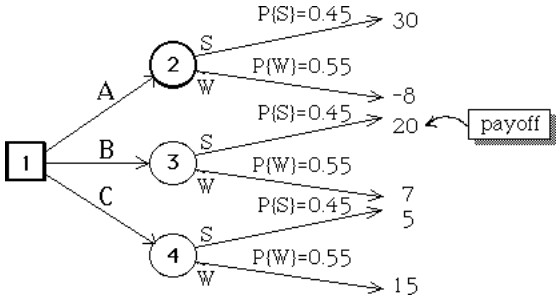
The condition of the market (as yet unknown) is categorized as "Strong" or "Weak", and determines the payoff:

	State of "Nature"	
	S: strong	W: weak
Decision	0.45	0.55
A	30	-8
B	20	7
C	5	15

Probability

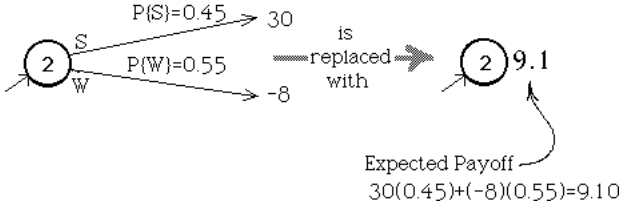
Represent the decision process as a "tree", with a SQUARE representing a decision, and a CIRCLE representing a random outcome:



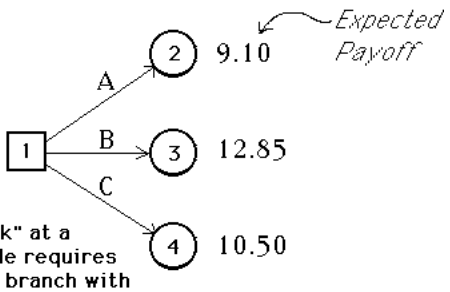


"Folding Back" Terminal Branches of the Tree

"Folding Back" at a random node requires computation of the expected payoff

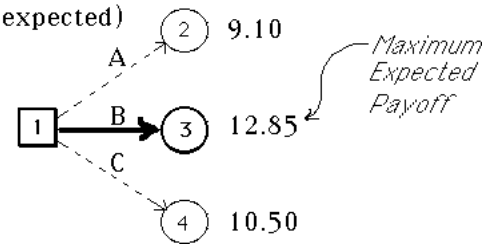


Reduced Decision Tree

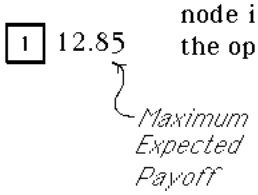


"Folding Back" at a decision node requires selection of branch with the maximum (expected) payoff (or minimum expected cost)

We now select the decision which leads to a greater (expected) payoff:



Reduced Decision Tree



When we "fold back" the tree at a decision node, the value of the node is the value of the optimal decision

EXAMPLE

Erica is going to fly to London on August 5 and return home on August 20. It is now July 1.

On July 1, she may buy a one-way ticket (for $350) or a round-trip ticket (for $660).

She may also wait until August 1 to buy a ticket.

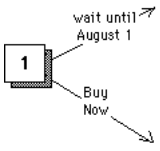
On August 1, a one-way ticket will cost $370 and a round-trip ticket will cost $730

It is possible (with probability 0.30) that between July 1 and August 1, her sister (who works for the airline) will be able to obtain a ***free*** one-way ticket for Erica.

If Erica has bought a round-trip ticket on July 1 and her sister has obtained a free ticket, she may return "half" of her round-trip ticket to the airline. In this case, her total cost will be $330 plus a $50 penalty.

Erica wishes to minimize the expected cost of obtaining round-trip transportation to London & return.

Solution



First, she must decide whether to

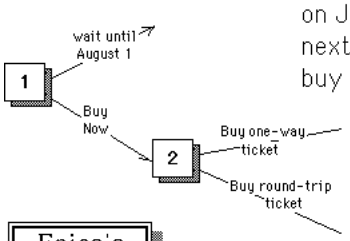
- buy a ticket now (July 1),

or

- wait until August 1

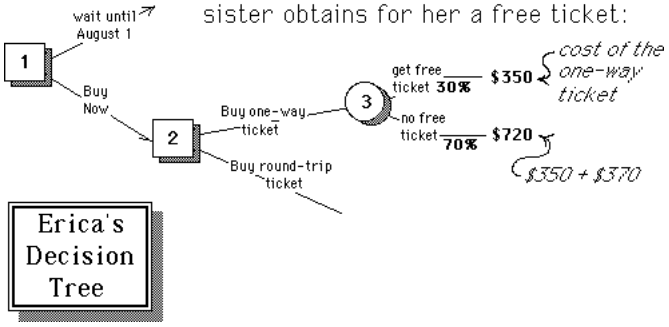
Erica's Decision Tree

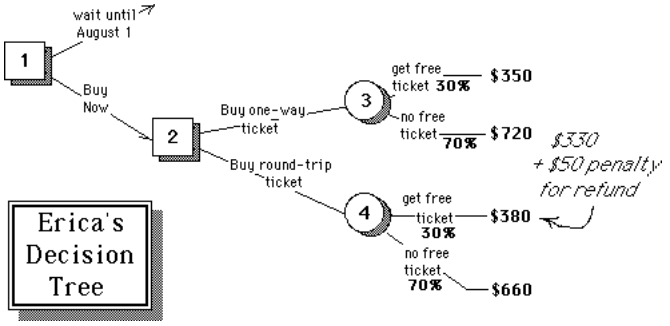
If she decides to the ticket on July 1, then she must next decide whether to buy a one-way ticket or a round-trip ticket

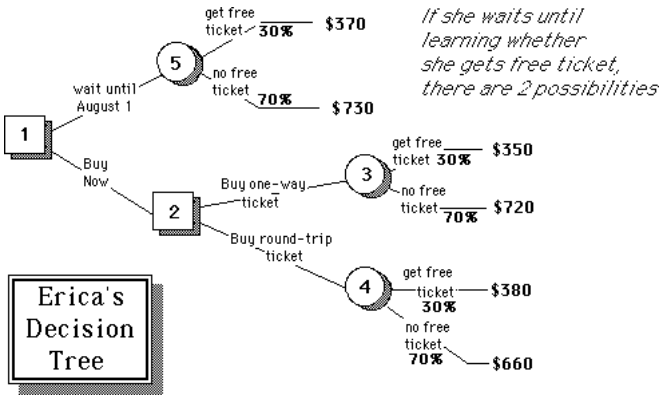


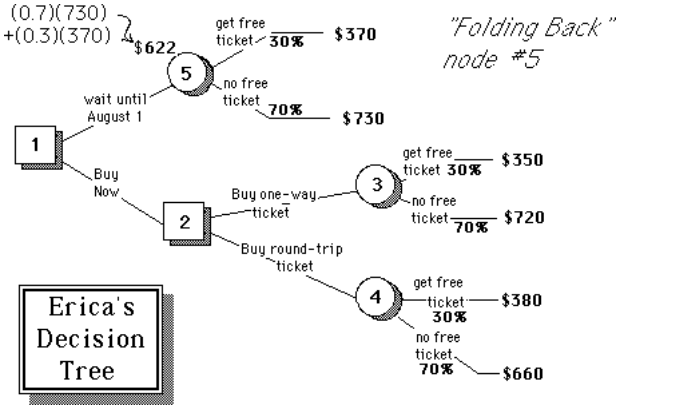
Erica's Decision Tree

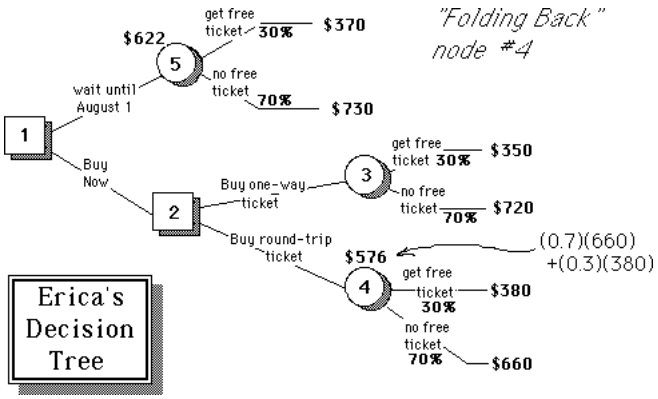
If she buys a one-way ticket, then her cost depends upon whether her sister obtains for her a free ticket:

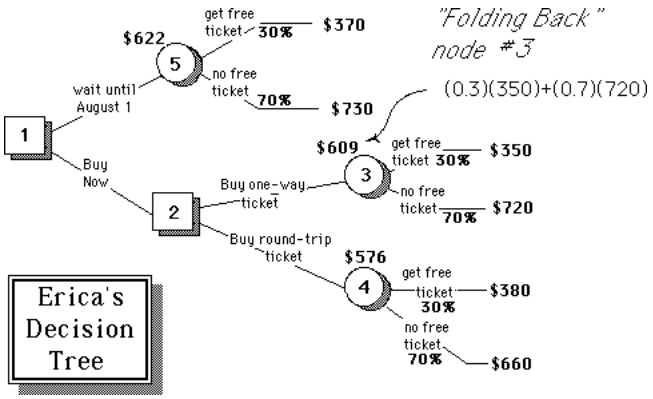


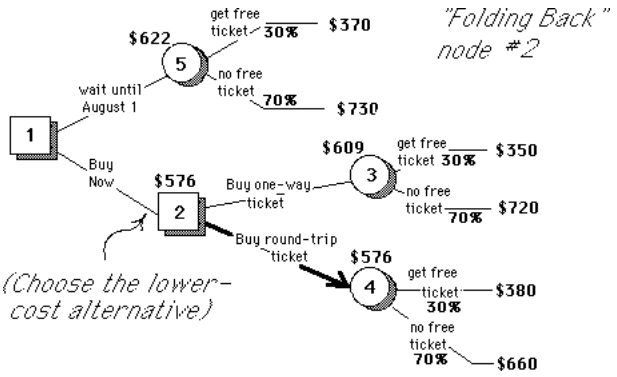


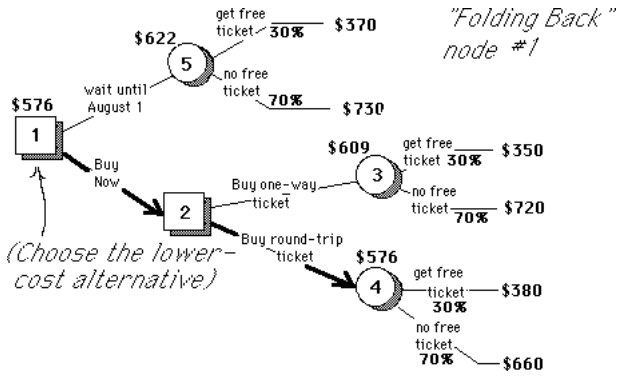












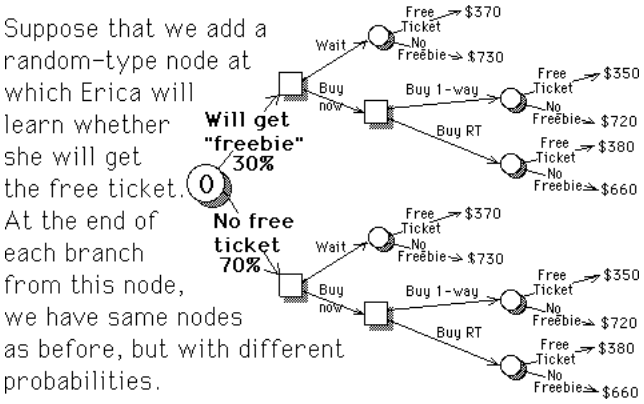
The optimal strategy is not to wait until August 1,
but to buy a round-trip ticket now.
Then, if she gets the free ticket,
she should cancel half of the round-trip ticket
which she purchased.

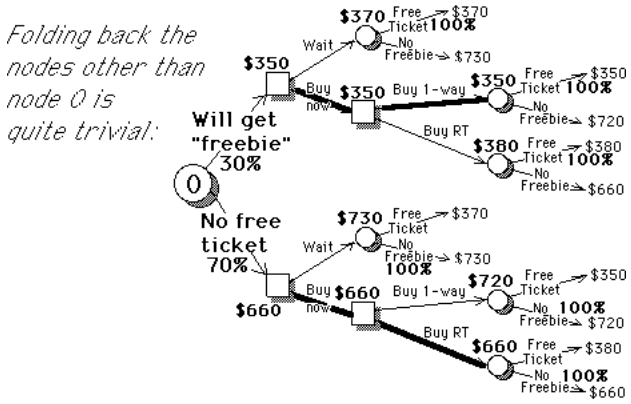
EVPI Expected Value of Perfect Information

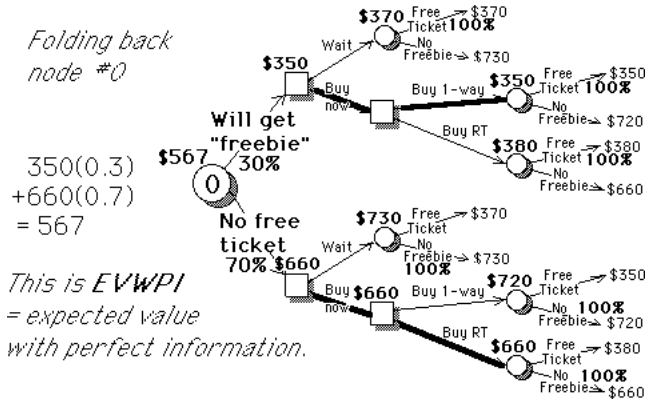
EVWOI = Expected Value Without Information

= $576 (cost)

What is EVWPI= Expected Value With Perfect Information?







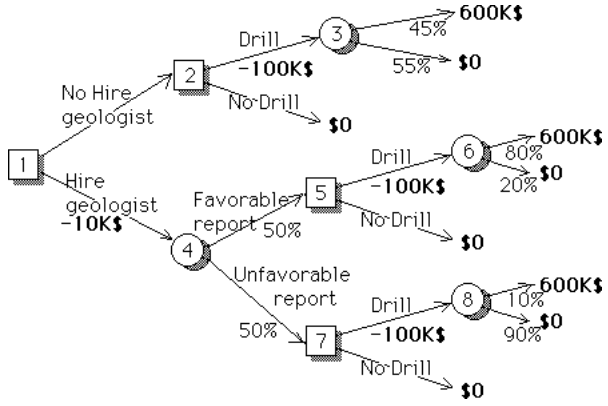
EVPI = EVWPI - EVWOI

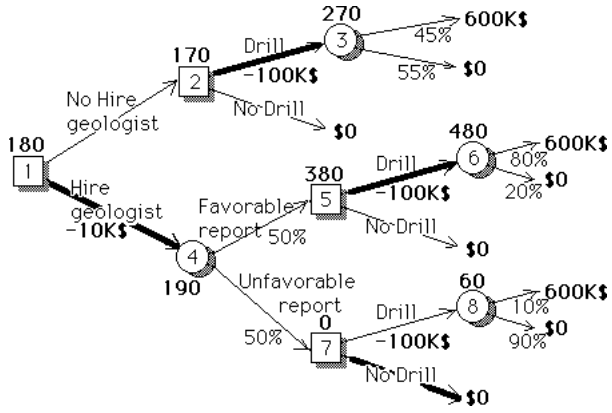
= (-$567) - (-$576)

= $9

If Erica had foreknowledge whether she would receive the free ticket, her expected cost would be reduced by $9.

- Oilco must decide whether to drill for oil in the South China Sea.
- Cost of drilling is $100,000.
- If oil is found, its value is estimated at $600,000.
- Current estimate of P{oil} is 45%.
- Before drilling, the company can hire a geologist for $10,000.
- There is 50% probability he will issue a favorable report, in which case P{oil} is 80%
- If unfavorable, P{oil} is 10%.





Solution

Oilco should hire the geologist;
if his report is favorable, they should drill,
but if not favorable, they should not drill.

What is the expected value of

- *sample information, i.e., the report of the geologist?*
- *perfect information?*

EVSI = EVWSI − EVWOI = $20,000

EVWSI = 190 K$
EVWOI = 170 K$

EVPI = EVWPI − EVWOI = $55,000

EVWPI = 500(0.45) = 225 K$
EVWOI = 170 K$