THE UNIVERSITY OF TEXAS AT AUSTIN
McCOMBS SCHOOL OF BUSINESS

Decision Trees - Part 1

Lecture 20

STA 371G

Making Better Decisions

Decision making is the only way that individuals can purposely exercise any control over thier lives, careers, or their surroundings.
- Ralph Keeney, Making Better Decision Makers, Decision Analysis, vol. 1 No:4, 2004

Decision Analysis

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- Larger ones require software

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- How early decisions affect decisions make later
- How a decision maker can quantify the value of information
- How attitudes toward risk and uncertainty can affect the analysis

Elements of a Decision Analysis

Although decision making under uncertainty occurs in a wide variety of contexts, all problems have three common elements:

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Although decision making under uncertainty occurs in a wide variety of contexts, all problems have three common elements:

- The decisions available to the decision maker
- The possible outcomes and the probabilities of these outcomes
- A value model that provides values (in monetary units usually) for the various outcomes

Once these elements are defined, the decision maker can find an optimal decision.

Payoff Tables

A payoff table lists the payoff for each decision outcome pair

- Positive values are gains and negative values are losses

	O1	O2	O3
D1	$10	$10	$10
D2	-$10	$20	$30
D3	-$30	$30	$80

- This table shows three possible decisions (D1, D2, and D3) and three possible outcomes (O1, O2, and O3) for each.
- Which decision do you prefer?

Payoff Tables

But we need probabilities for the outcomes to make a good decision

	O1	O2	O3
D1	\$10	\$10	\$10
D2	-\$10	\$20	\$30
D3	-\$30	\$30	\$80

- Probabilities: P(O1) = 0.3, P(O2) = 0.5, P(O3) = 0.2
- Now which decision do you prefer?

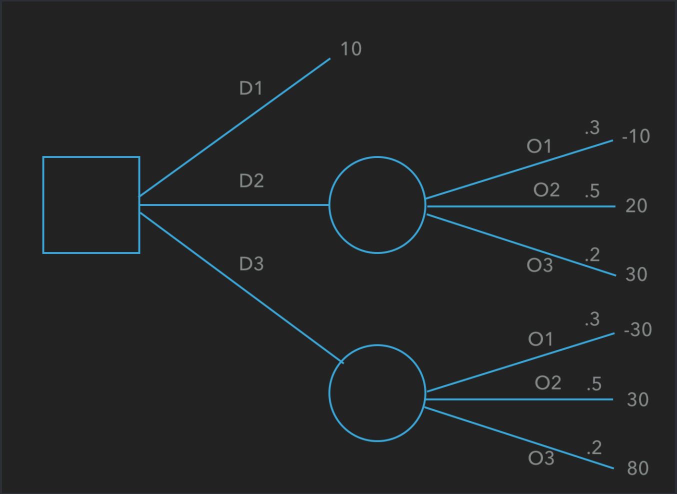
Expected Value - Remember this?

- EV is a weighted average of the possible payoffs for the decision, weighted by the probabilities of the outcomes
- D1: EV = 10
- D2: EV = -10(0.3) + 20(0.5) - 30(0.2) = 13
- D3: EV = ?

Decision Trees

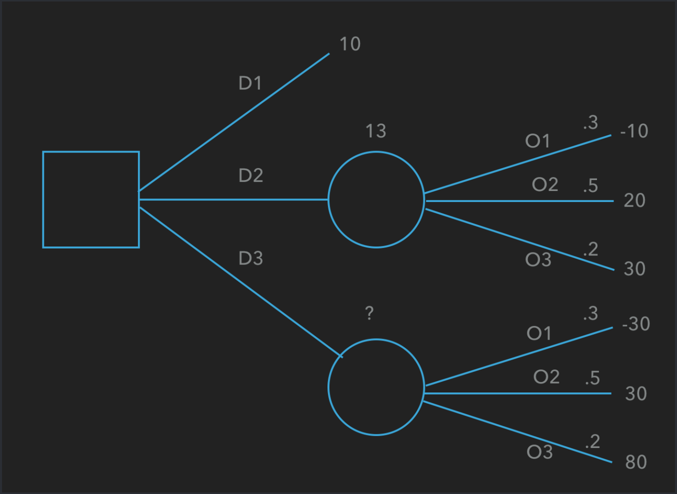
- Time proceeds from left to right.
- Branches leading out of a decision node represent the possible decisions
- Probabilities are listed on probability branches. The probabilities are conditional on the events that have already been observed.
- Monetary values are shown to the right of the end nodes.
- EVs are calculated through a “rolling-back” process.

Decision Tree For Our Simple Example



Rollback Procedure

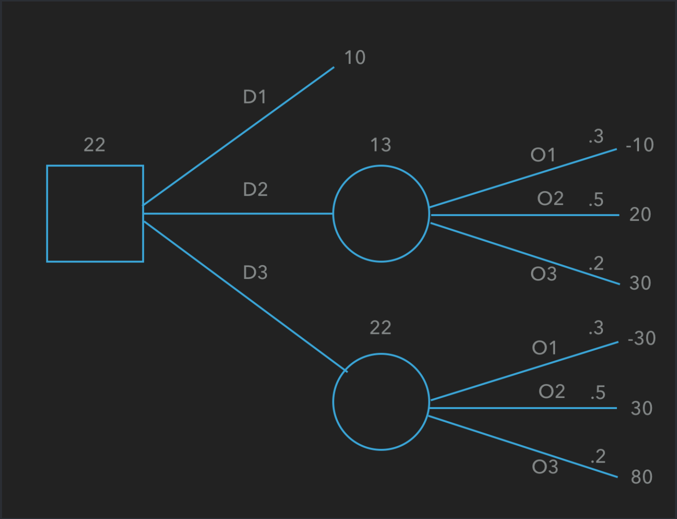
Calculate the expected value at each probability node



EV = .3(-10) + .5(20) + .2(30) = 13

Rollback Procedure

Calculate the maximum at each decision node



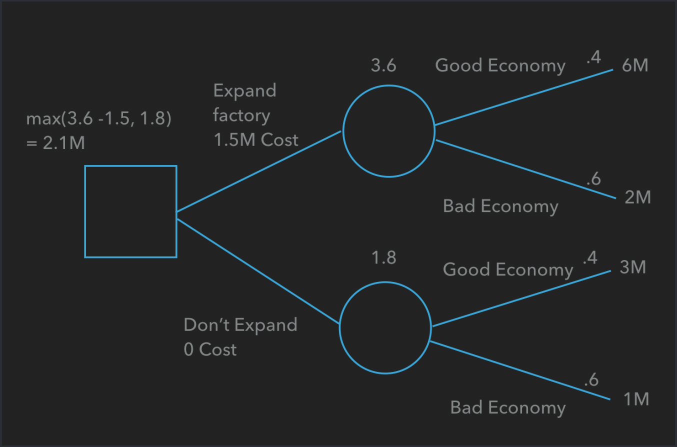
22 is the maximum out of of 10, 13, and 22

Sally Ann Soles' Shoe Factory

Sally Ann Soles manages a sucessful shoe factory. She is wondering whether to expand her factory this year. The cost of the expansion is 1.5M USD is 1.5M USD.
If she does nothing and the economy stays good, she expects to earn 3M in revenue, but if the economy is bad, she expects only 1M.
If she expands the factory, she expects to earn 6M if the economy is good and 2M if it is bad.
She also assumes that there is a 40 percent chance of a good economy and a 60 percent chance of a bad economy.

Should she expand?

Shoe Factory Expansion Decision Tree



EV(Expand) = (.4(6) + .6(2)) - 1.5 = 2.1M

EV(No Expand) = (.4(3) + .6(1)) = 1.8M,

2.1M > 1.8M, so she should expand!

Shoe Factory Expansion Decision Tree With An Option

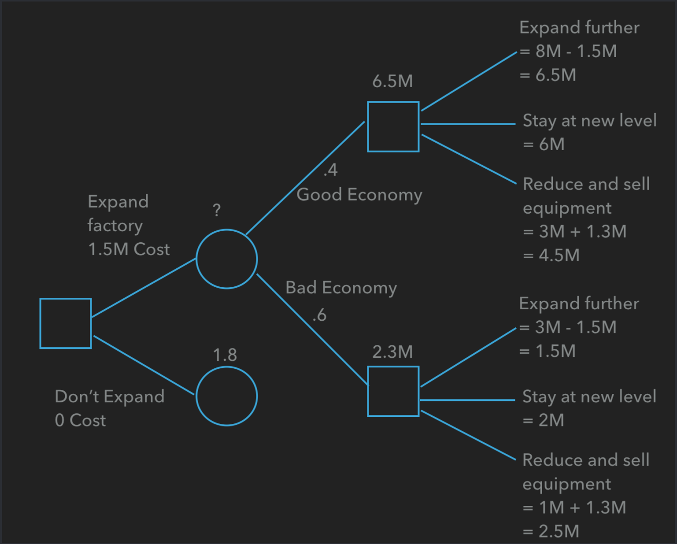
A few days later, she was told that if she expands, she can opt to either
(a) expand the factory further, which costs 1.5M and will yield an extra 2M in profit if the economy is good, but 1M if it is bad,
(b) abandon the project and sell the equipment she original bought for 1.3M,
or (c) do nothing.

How has the decision changed?

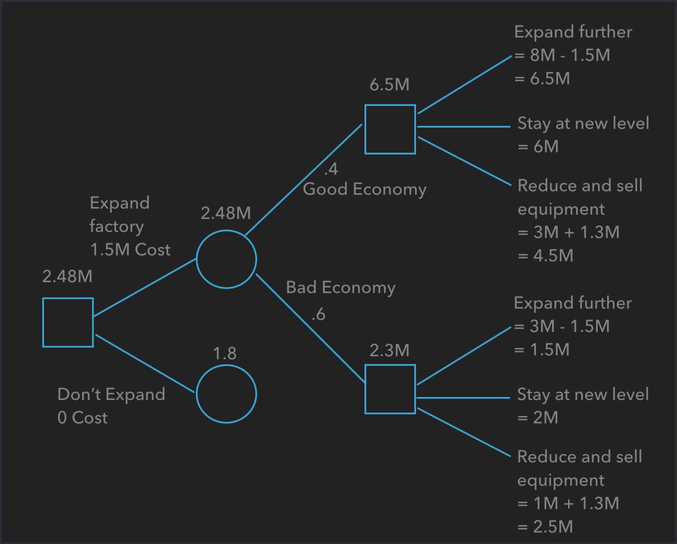
What is the value of this option before the state of the economy is known?

Intuitively, it might increase the value of the initial expansion.

A Sequential Decision



What Is The Second Expansion Option’s Value?



EV of the Project

The EV of Expanding is now [.4(6.5) + .6(2.3)] - 1.5M = 2.48M

Therefore the value of the option is:

new EV - old EV = 2.48M - 2.1M = 380,000 USD

Does This Look Familiar?

This method of valuing real optionw is used by corpotate strategists, management consultants, and bankers. A further refinement is to take time value of money into account and present value the cashflows.

More on Valuing Information Next Time...

- Don’t forget to do your Time Series homework!
- The TAs are still working on grading the test.

https://www.yahoo.com/news/analysis-trump-weight-worlds-problems-220503380.html