THE UNIVERSITY OF TEXAS AT AUSTIN
McCOMBS SCHOOL OF BUSINESS

Making Decisions

Lecture 5

STA 371G

Decision Analysis

- A framework for analyzing decision problems that involve uncertainty

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- Smaller analyses can be done using pen and paper
- Larger ones require software

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- How early decisions affect later decisions
- 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

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 monetary values for the various outcomes.

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

A real decision

Suppose you are offered a job at a tech startup, with two compensation options:

1. Salary only: $125,000 annually
2. Salary + stock: $105,000 annually, plus 0.7% equity in the company

What factors would come into play here that would help you make your 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. (Imagine D1, D2, and D3 are different stocks we might purchase, and O1, O2, and O3 represent three possible market conditions in the future.)
- Which decision do you prefer?

Payoff Tables

We need to know the probability of each outcome to make a good decision!

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

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

Decision strategies

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- Maximax: Pick the decision that leads to the best possible best-case outcome (optimistic)
- Expected monetary value (EMV): Pick the decision that leads to the best outcome in expected value (realistic)

Maximin

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

Find the worst-case outcome for each strategy:

- D1: Worst-case outcome is $10
- D2: Worst-case outcome is −$10
- D3: Worst-case outcome is −$30

Pick decision with the least-bad worst-case outcome: D1

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Pick decision with the least-bad worst-case outcome: D1
(In this case the worst-case outcomes always came from O1, but that won't always be the case.)

Maximax

	O1	O2	O3
D1	$10	$10	$10
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Find the best-case outcome for each strategy:

- D1: Best-case outcome is $10
- D2: Best-case outcome is $30
- D3: Best-case outcome is $80

Pick decision with the best best-case outcome: D3

Maximax

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

Find the best-case outcome for each strategy:

- D1: Best-case outcome is $10
- D2: Best-case outcome is $30
- D3: Best-case outcome is $80

Pick decision with the best best-case outcome: D3

(In this case the worst-case outcomes always came from O3, but that won't always be the case.)

Expected monetary value

Treat each possible decision as its own random variable and calculate expected value:

- $E(D1) = 10$

Pick decision with the highest expected value: D3

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- $E(D1) = 10$
- $E(D2) = -10(0.3) + 20(0.5) - 30(0.2) = 13$

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Expected monetary value

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- $E(D1) = 10$
- $E(D2) = -10(0.3) + 20(0.5) - 30(0.2) = 13$
- $E(D3) = -30(0.3) + 30(0.5) + 80(0.2) = 22$

Pick decision with the highest expected value: D3

Back to the startup job dilemma

My choices:

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- You expect to work at this startup for 2 years

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- You expect to work at this startup for 2 years
- There is a 10% chance that the startup is acquired for $10M, a 5% chance that the startup is acquired for $50M, and a 1% chance that the startup is acquired for $100M

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- There is a 10% chance that the startup is acquired for $10M, a 5% chance that the startup is acquired for $50M, and a 1% chance that the startup is acquired for $100M
- In all other cases, your 0.7% stake in the company is worthless

Payoff table for the startup job dilemma

Decision	No exit 84%	$10M exit 10%	$50M exit 5%	$100M exit 1%
Salary only				
Salary + stock				

Payoff table for the startup job dilemma

Decision	No exit 84%	$10M exit 10%	$50M exit 5%	$100M exit 1%
Salary only	$250,000	$250,000	$250,000	$250,000
Salary + stock	$210,000	$280,000	$560,000	$910,000

Now let's calculate expected values:

1. Salary only: $250,000
2. Salary + stock: $241,500

So you are better off choosing the salary-only option using the EMV criterion.

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  - What if there is a chance that the company ends up being worth $1B (or more)?
  - What if you are being too optimistic about this company's chances of an exit at all?
- Even under my existing assumptions, you might still decide to choose the salary + stock option because the variance is higher—it might be worth rolling the dice!

So what really happened?

- As it turned out, the company did get acquired, for $13M
- The job seeker chose neither option—decided not to take the job at all!