Lecture 1:

Introduction to Decision Making Theory

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BIS4435

Choice Problem and Preference Relations

Utility Function

Multicriteria Decision Making

Complexity and Uncertainty

The Structure of Decisions

The Three Phases of Decision Making

Supporting Decisions in Business

THE CHOICE PROBLEM and PREFERENCE RELATION

- Suppose you have a set (a choice set):

$$\{\text{Apple}, \text{Orange}\}$$

What would be your choice? Why?

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Definition

The preference relation $\gtrsim$ is a binary relation that is

1. *Total*: defined for all elements of the set
2. *Transitive*: If $a \gtrsim b$ and $b \gtrsim c$, then $a \gtrsim c$

Indiference $a \sim b$, when $a \gtrsim b$ and $b \gtrsim a$

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The preference relation can help us to order the set

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Utility is a function $u : A \to \mathbb{R}$ that assigns a number (priority) to each element of the choice set such that if the utility is higher, then the object is preferred

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Example

You have two job offers: Job1 with a salary $\$18K$ and Job2 with $\$30K$. Most of us would choose Job2 because:

$$u(\text{Job2}) = \$30,000 > u(\text{Job1}) = \$18,000$$

MULTICRITERIA DECISION MAKING

Let Job1 be in City1 and Job2 be in City2. Suppose now that City1 is located near the sea, has a good climate, nice restaurants, cheap food and your girl/boy–friend lives there. And let City2 has none of these.

MULTICRITERIA DECISION MAKING

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- What will be your decision?
- How many objectives you considered?
- Has learning new information changed your decision?

MULTICRITERIA UTILITY

Cars (price vs quality)

MULTICRITERIA UTILITY
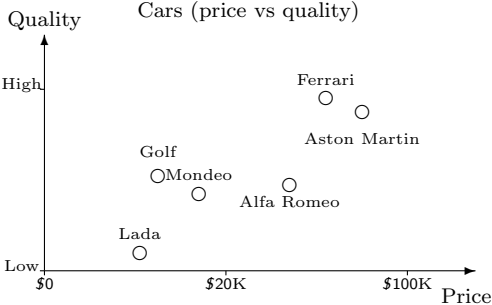
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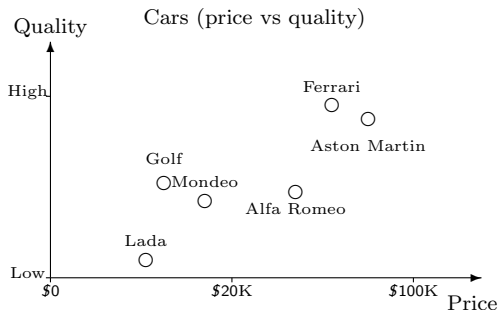
We could use the following utility:

$$U = \frac{\text{Quality}}{\text{Price}}$$

How to choose between Mondeo and Aston Martin?

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- Multiplicative utility

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$$+ W_1 W_2 \cdots W_n U_1 U_2 \cdots U_n$$

PROBLEMS WITH RATIONAL APPROACH

Suppose your friend offers you a choice of an apple and an orange. Which one would you choose?

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What is the utility value of your decision?

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- Psychologists showed that people match the probability of a reward in their choice behaviour.
- Nevertheless, people do not always choose what seems rational

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Consider a chess game.

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- What if you plan 10 steps ahead?

THE STRUCTURE OF DECISIONS

Herbert Simon introduced the idea of **structured** (programmable) and **unstructured** (nonprogrammable) decisions.

Structured	Semi–structured	Unstructured
goals defined	$\cdots$	the outcomes are uncertain
procedures are known	$\cdots$	appear in unique context
information is obtainable and manageable	$\cdots$	the resources are hard to assess

THE THREE PHASES OF DECISION MAKING
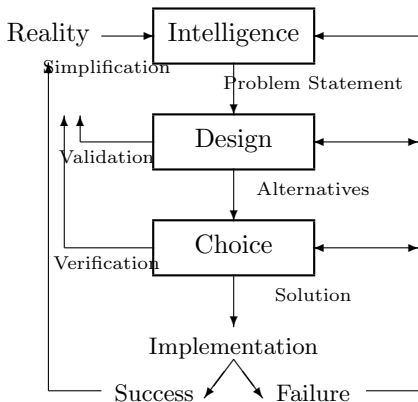
Simon (1977)

DECISIONS IN BUSINESS

Economy is hard to predict, but there are some trends and cycles.
If we can detect them, then we shall be able to make better
decisions (better than our competitors). Thus, DSS should provide
us with:

- More information (knowledge) of the domain (market,
  resources)
- Better definition of the utility (objectives of the decision)
- A set of alternative actions (solutions)
- Prediction of the possible outcomes of the solutions (expected
  utilities)

SUPPORTING THE INTELLIGENCE PHASE

According to three main sources of information:

Internal using DBMS, MIS and custom built data retrieval

External using external DBs (online, from gov–nt, etc)

Personal more specific (relevant) set of parameters

The tools for analysis and visualisation of data are very important (statistical analysis, pattern recognition, self–organising maps, etc).

SUPPORTING THE DESIGN PHASE

The solution to a problem (or a set of alternative solutions) can be proposed using various techniques:

- Analytical solutions (maths)
- Decision trees
- Expert systems (rule or case–based, fuzzy, etc)
- Optimisation (e.g. genetic algorithms)
- Models and simulations

SUPPORTING THE CHOICE PHASE

The proposed solutions may have problems:

- Not palatable
- None of the solutions seem to have clear advantage
- The world (situation) has already changed

Final decision must be made and documented.