Decision Making

(for Financial Engineering & Risk Management program)

Prof. DrSc. Nguyen Dinh

Department of mathematics
INTERNATIONAL UNIVERSITY, VNU-HCM

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Introduction to Decision Making

Chapter 1. Introduction to Decision Making

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1. What is Decision Making

"Decision-making can be regarded as a problem-solving activity yielding a solution deemed to be optimal, or at least satisfactory. It is therefore a process which can be more or less rational or irrational and can be based on explicit or tacit knowledge and beliefs. Tacit knowledge is often used to fill the gaps in complex decision making processes. Usually both of these types of knowledge, tacit and explicit, are used together in the decision-making process."
[Wikipedia]

[UMass Dartmouth]

"Decision making is the process of making choices by identifying a decision, gathering information, and assessing alternative resolutions."

"Using a step-by-step decision-making process can help you make more deliberate, thoughtful decisions by organizing relevant information and defining alternatives. This approach increases the chances that you will choose the most satisfying alternative possible."

Decision making - Optimization 1, 2

2. Seven steps to effective decision making

"A major part of decision-making involves the analysis of a finite set of alternatives described in terms of evaluative criteria. Then the task might be to rank these alternatives in terms of how attractive they are to the decision-maker(s) when all the criteria are considered simultaneously. Another task might be to find the best alternative or to determine the relative total priority of each alternative (for instance, if alternatives represent projects competing for funds) when all the criteria are considered simultaneously. Solving such problems is the focus of multiple-criteria decision analysis (MCDA). This area of decision-making, although very old, has attracted the interest of many researchers and practitioners and is still highly debated as there are many MCDA methods which may yield very different results when they are applied on exactly the same data ... [Wikipedia]

2. Seven steps to effective decision making

[This part is taken from UMass Dartmouth]

Step 1: Identify the decision

You realize that you need to make a decision. Try to clearly define the nature of the decision you must make. This first step is very important.

Step 2: Gather relevant information

Collect some pertinent information before you make your decision: what information is needed, the best sources of information, and how to get it. This step involves both internal and external work. Some information is internal: you'll seek it through a process of self-assessment. Other information is external: you'll find it online, in books, from other people, and from other sources.

Step 3: Identify the alternatives

As you collect information, you will probably identify several possible paths of action, or alternatives. You can also use your imagination and additional information to construct new alternatives. In this step, you will list all possible and desirable alternatives.

Step 4: Weigh the evidence

Draw on your information and emotions to imagine what it would be like if you carried out each of the alternatives to the end. Evaluate whether the need identified in Step 1 would be met or resolved through the use of each alternative. As you go through this difficult internal process, you'll begin to favor certain alternatives: those that seem to have a higher potential for reaching your goal. Finally, place the alternatives in a priority order, based upon your own value system.

Step 5: Choose among alternatives

Once you have weighed all the evidence, you are ready to select the alternative that seems to be best one for you. You may even choose a combination of alternatives. Your choice in Step 5 may very likely be the same or similar to the alternative you placed at the top of your list at the end of Step 4.

Step 6: Take action

You're now ready to take some positive action by beginning to implement the alternative you chose in Step 5.

Step 7: Review your decision & its consequences

In this final step, consider the results of your decision and evaluate whether or not it has resolved the need you identified in Step 1. If the decision has not met the identified need, you may want to repeat certain steps of the process to make a new decision. For example, you might want to gather more detailed or somewhat different information or explore additional alternatives.

Example.

Martin Hans (who) is a bright high school student, has received full academic scholarship from three institutions: UA (University of A), UB and UC.

To select one university, Martin specifies two main criteria:

- location and
- academic reputation.

Martin's judgement: Academic reputation is FIVE times as important as location. This gives

- Weight to location: 17 % (approximately),
- Weight to Academic reputation: 83 % .

Using a systematic analysis (to be clarified later), Martin ranks the three universities as follows:

Table 1

	Percent weight estimates for		
Criterion	UA	UB	UC
Location	12.9	27.7	59.4
Reputation	54.5	27.3	18.2

Note: • The sum of each row in the previous table is 100 (%).

• The structure of the decision problem is given in the Table 1.

• This problem has a single hierarchy (level) with two criteria (location and reputation) and three decision alternatives (UA, UB, UC).

Composite weight for each university is computed as:

$$\begin{aligned} UA &: .17 \times .129 + .83 \times .545 = .4743 \\ UB &: .17 \times .277 + .83 \times .273 = .2737 \\ UC &: .17 \times .594 + .83 \times .182 = .2520 \end{aligned}$$

One has

	Percent weight estimates for		
Criterion	UA	UB	UC
Location	12.9	27.7	59.4
Reputation	54.5	27.3	18.2
Composite weight	0.4743	0.2737	0.2520

Based on these calculations, UA has the highest weight, and hence, **UA is the best choice for Martin.**

More...

Consider again the Martin's decision making problem. Suppose further that Martin's twin sister, Jane, also was accepted with full fellowship to the three mentioned universities. However, their parents stipulate that they both must attend the same university.

The end of lecture

[Note: Example in the next page]

Example for the last learning outcome: Transportation problem

Model of Linear Programming (LP)

Transportation problems 1

destinations / supplies	80	140	100	80	u
100	2 **80**	5 **20**	4	6	0
200	8	4 **120**	3 **80**	8	-1
100	5	1	4 **20**	5 **80**	0
v	2	5	4	5	

Cost: 1460

Transportation problems 2

Tableau 11

destinations / supplies	80	140	100	80	u
100	2 **80**	5	4	6 **20**	0
200	8	4 **100**	3 **100**	8	2
100	5	1 **40**	4	5 **60**	-1
v	2	2	1	6	

Optimal solution with Cost: 1320

In practice:

- Not balance problem (One assumption is violated)
- The "need" with "minimum" and "Maximum"
- The case with "large possible cost" (M-method) - or impossible to distribute.

TABLE 8.10 Water resources data for Metro Water District

	Cost (Tens of Dollars) per Acre Foot				
	Berdoo	**Los Devils**	**San Go**	**Hollyglass**	**Supply**
Colombo River	16	13	22	17	50
Sacron River	14	13	19	15	60
Calorie River	19	20	23	—	50
Minimum needed	30	70	0	10	(in units of 1
Requested	50	70	30	∞	million acre feet)