Value-Driven Portfolios

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Start with "portfolio"

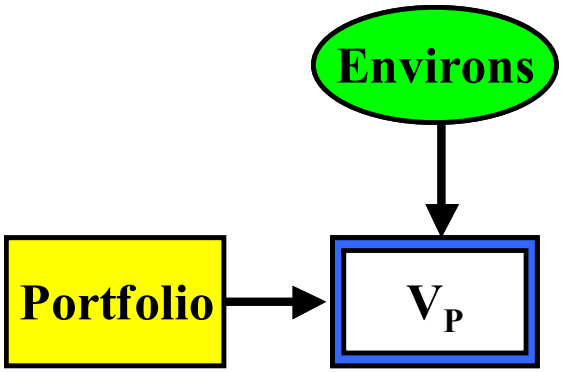
Let's start with a few basic questions:

- **What is a portfolio?**
  - A collection of things (assets)
- **Why do we care about them?**
  - $v(\mathrm{A} \cup \mathrm{B}) \neq v(\mathrm{A}) + v(\mathrm{B})$
- **How do you know if one's any good?**
  - *hmmm…? Maybe this should be linked to the notion of* ***value****?*

Consider the underlying models

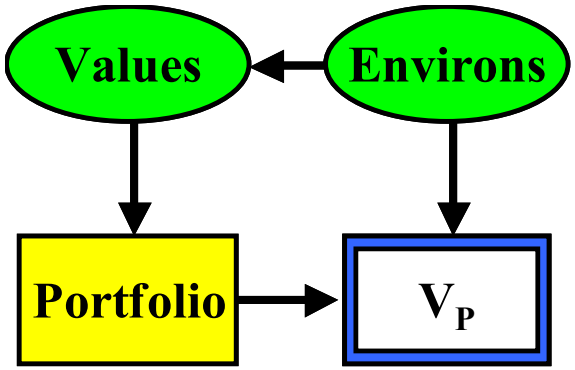
Typical model:

- Independent portfolio decisions
- Unbounded search (optimize)
- $V_P = f(P,E)$



Value-driven model:

- Dependent portfolio decisions
- Bounded search (maximize)
- $V_P = f(P,V,E)$



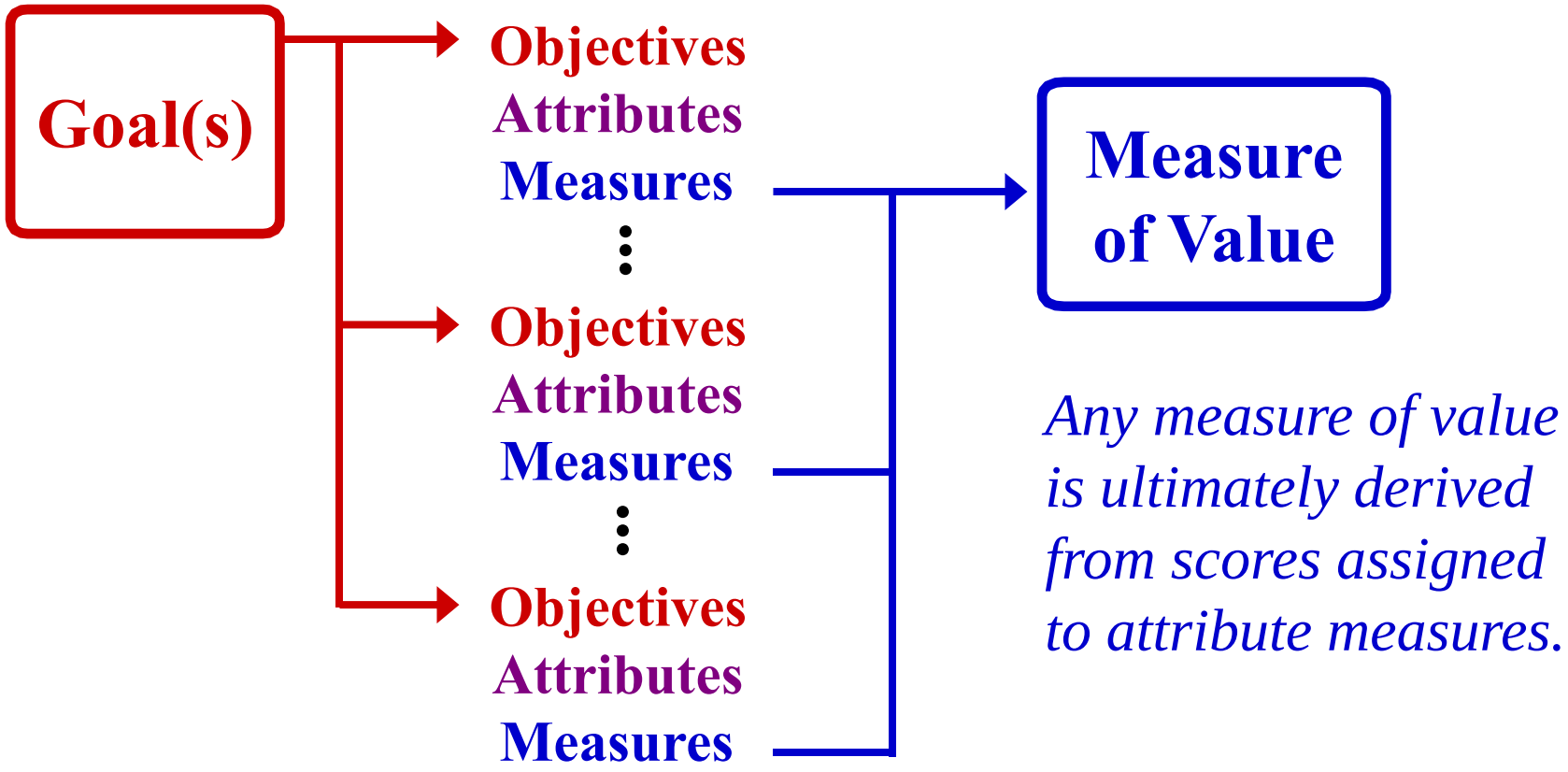
How do we measure "value"

We need to answer three fundamental questions:

- **What's important?**
- **How important is it?**
- **How much is enough?**

What is important?

Defining “value”



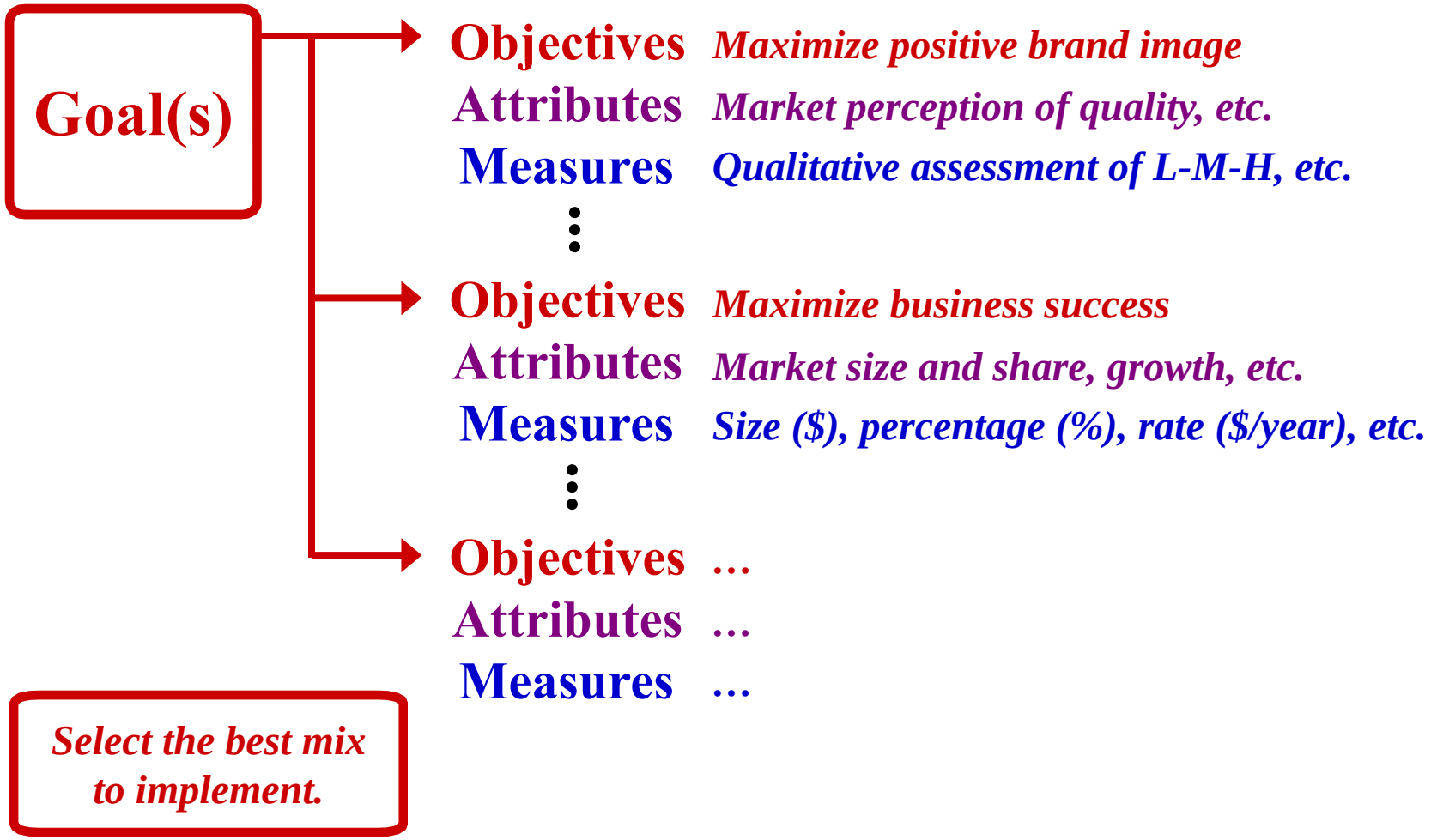
Defining “value”

Value is to large extent determined by goals, context and operational environment.

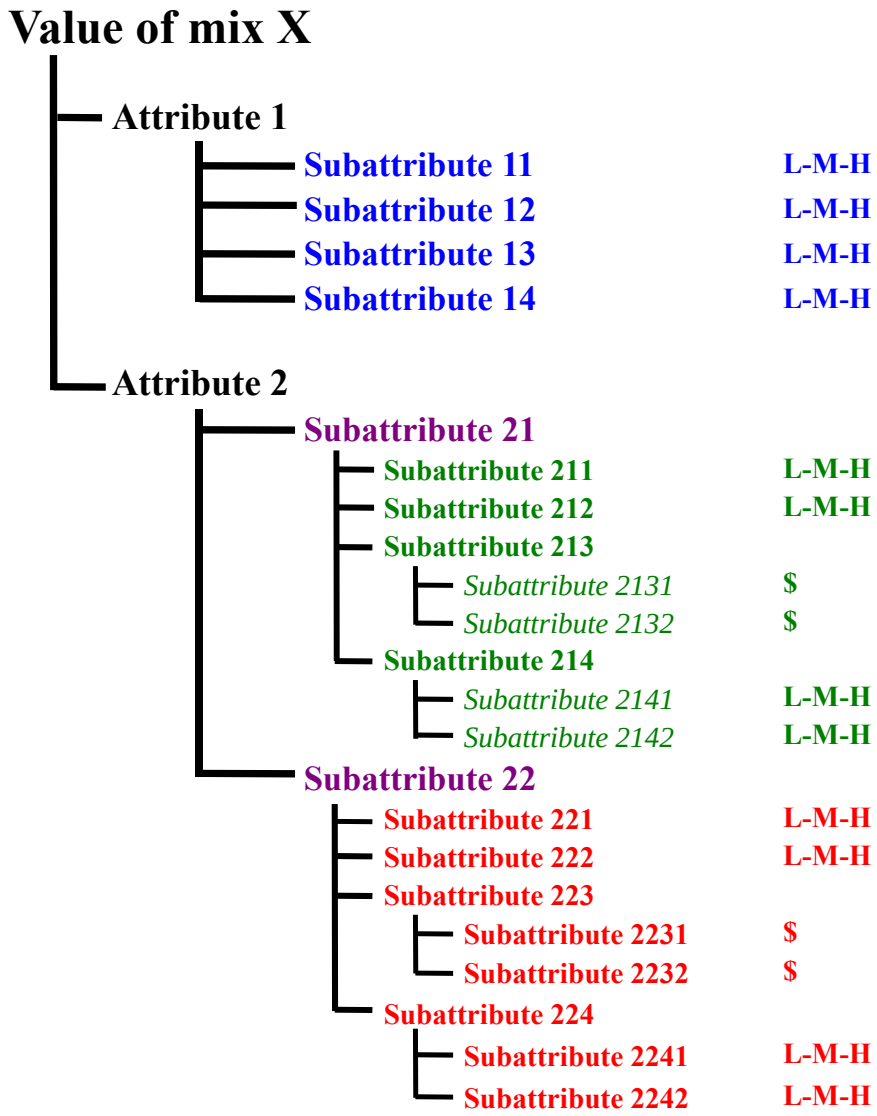
Situation:

I have to choose from a set of potential products those few that maximize the overall value of my business.

Defining “value”



A value-based hierarchy

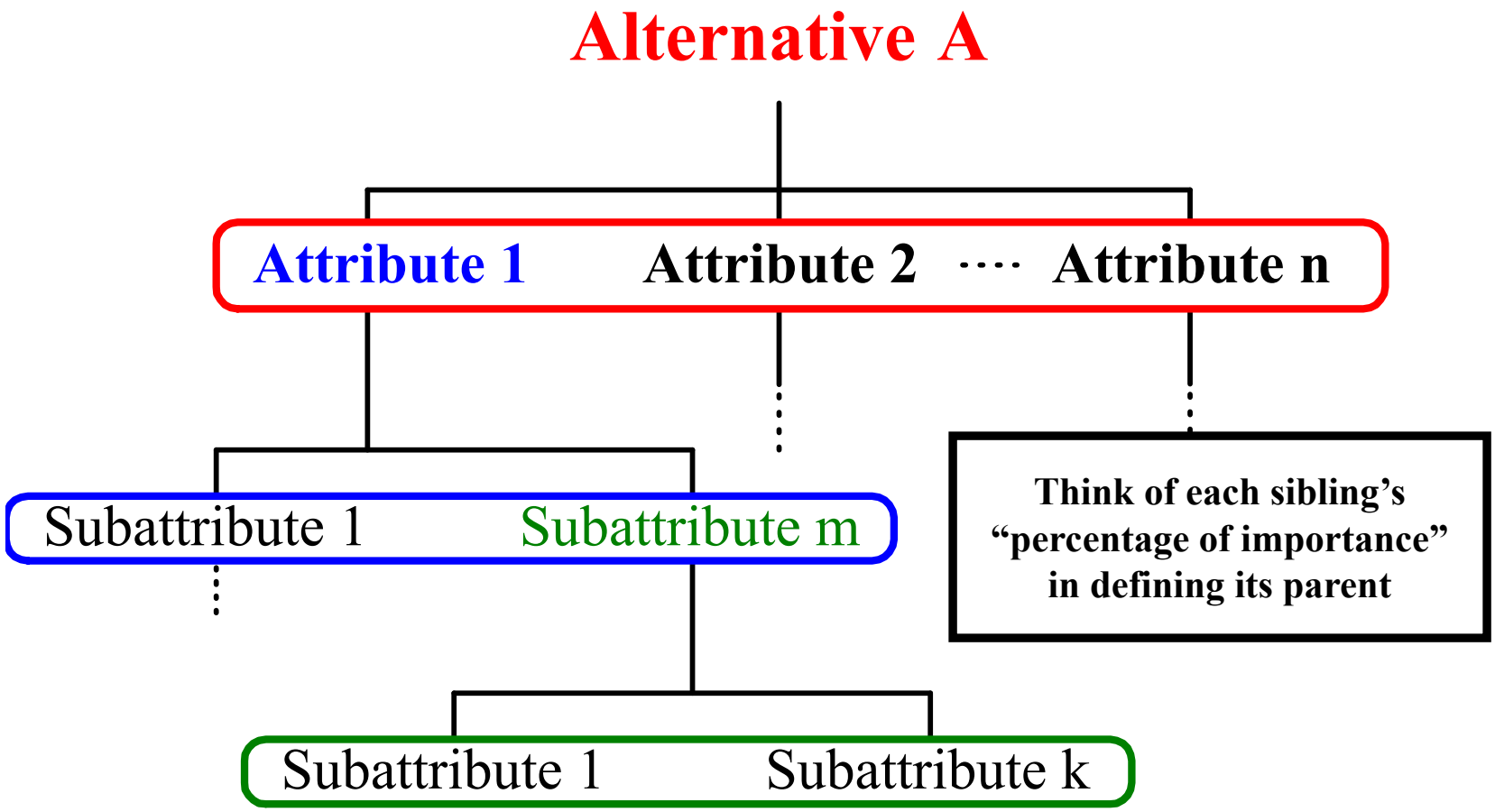


So, what's the value of mix X?

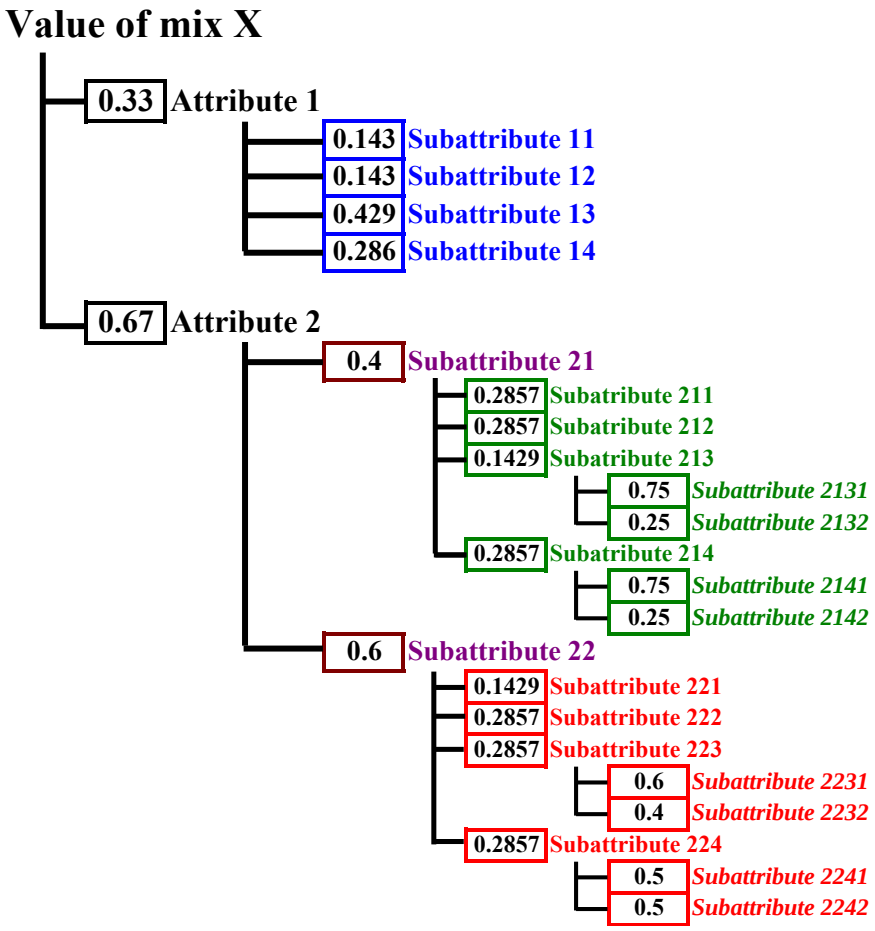
That depends on the subattribute scores and how important each is to the overall mix…

How important is it?

The “importance” of attributes



A weighted hierarchy



Weights can be determined a number of different ways:

- Direct assessment
- Pairwise comparisons
- Rank-reciprocal
- Swing weights

How much is enough?

We need a "value function"

We need a notion of value function to deal with:

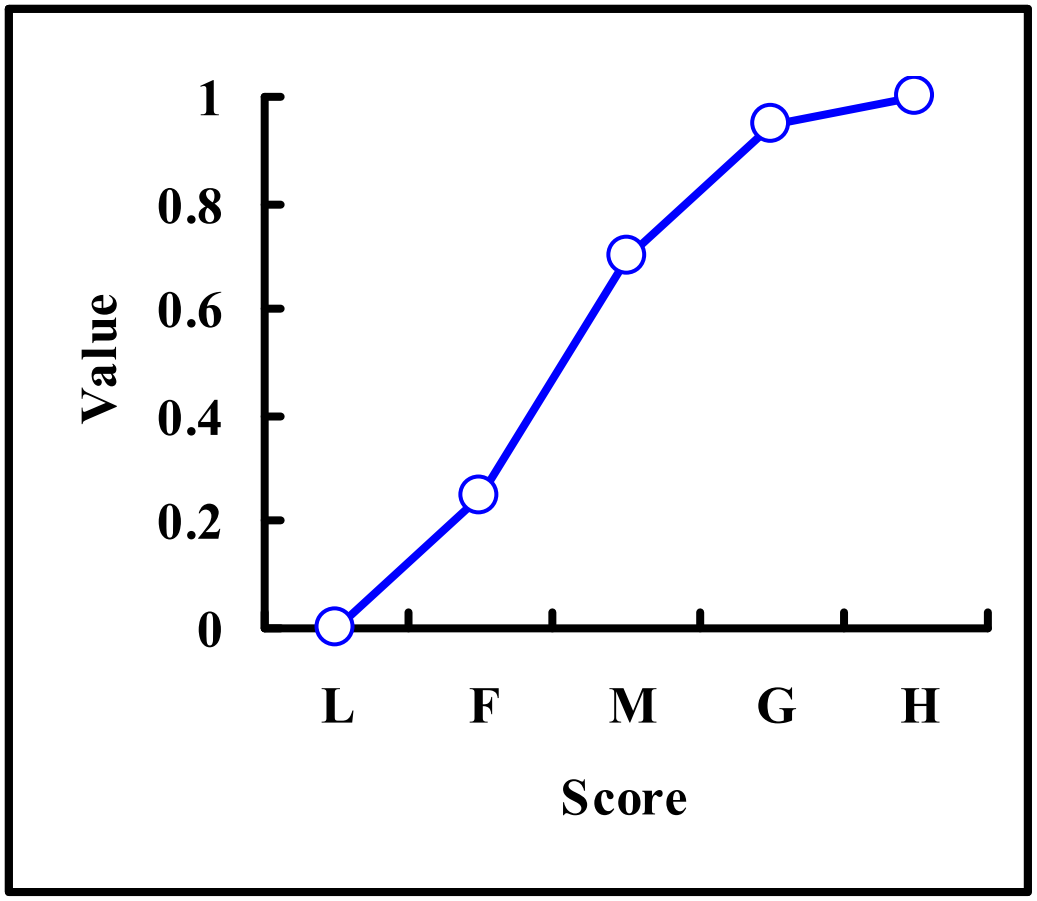
1. the problem of different attribute measures
   (*How do we compare H/M/L with dollars?*)

2. the decision maker's preferences for marginal changes in attribute scores.
   (*Is an increase from L to M worth the same as an increase from M to H?*)

Value scales over attribute scores

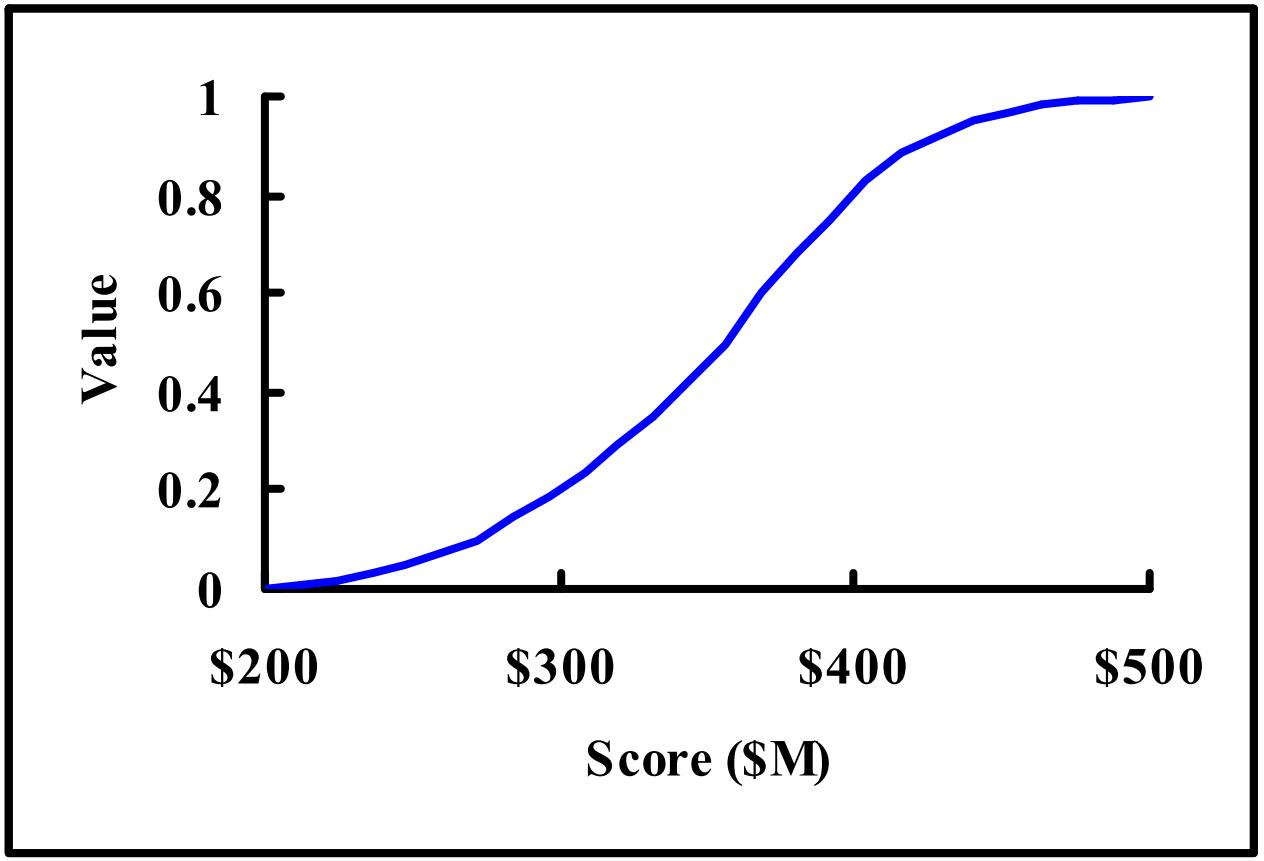
Perception of quality ("more is better")

L	0
F	0.25
M	0.7
G	0.95
H	1



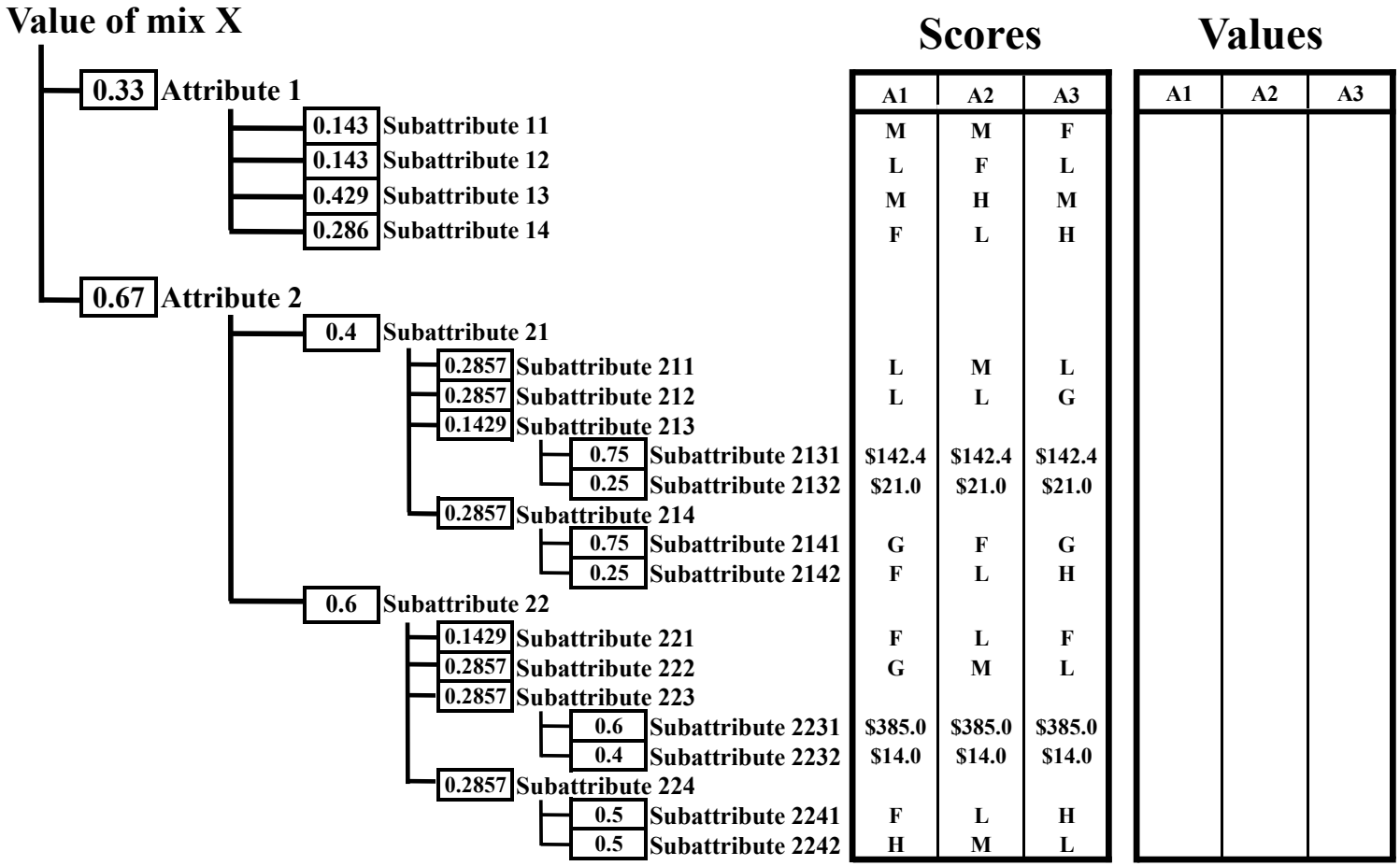
Value scales over attribute scores

Existing market size ("more is better")



Putting it all together

Calculating value



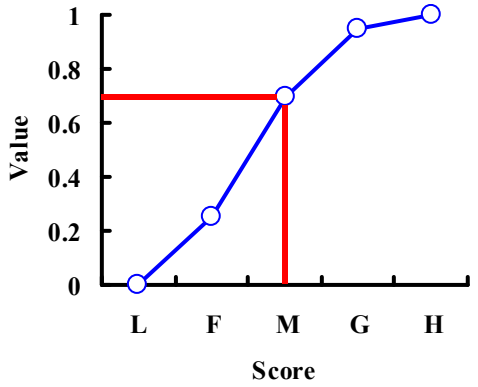
Scores

A1	A2	A3
M	M	F
L	F	L
M	H	M
F	L	H
L	M	L
L	L	G
$142.4	$142.4	$142.4
$21.0	$21.0	$21.0
G	F	G
F	L	H
F	L	F
G	M	L
$385.0	$385.0	$385.0
$14.0	$14.0	$14.0
F	L	H
H	M	L

Values

A1	A2	A3

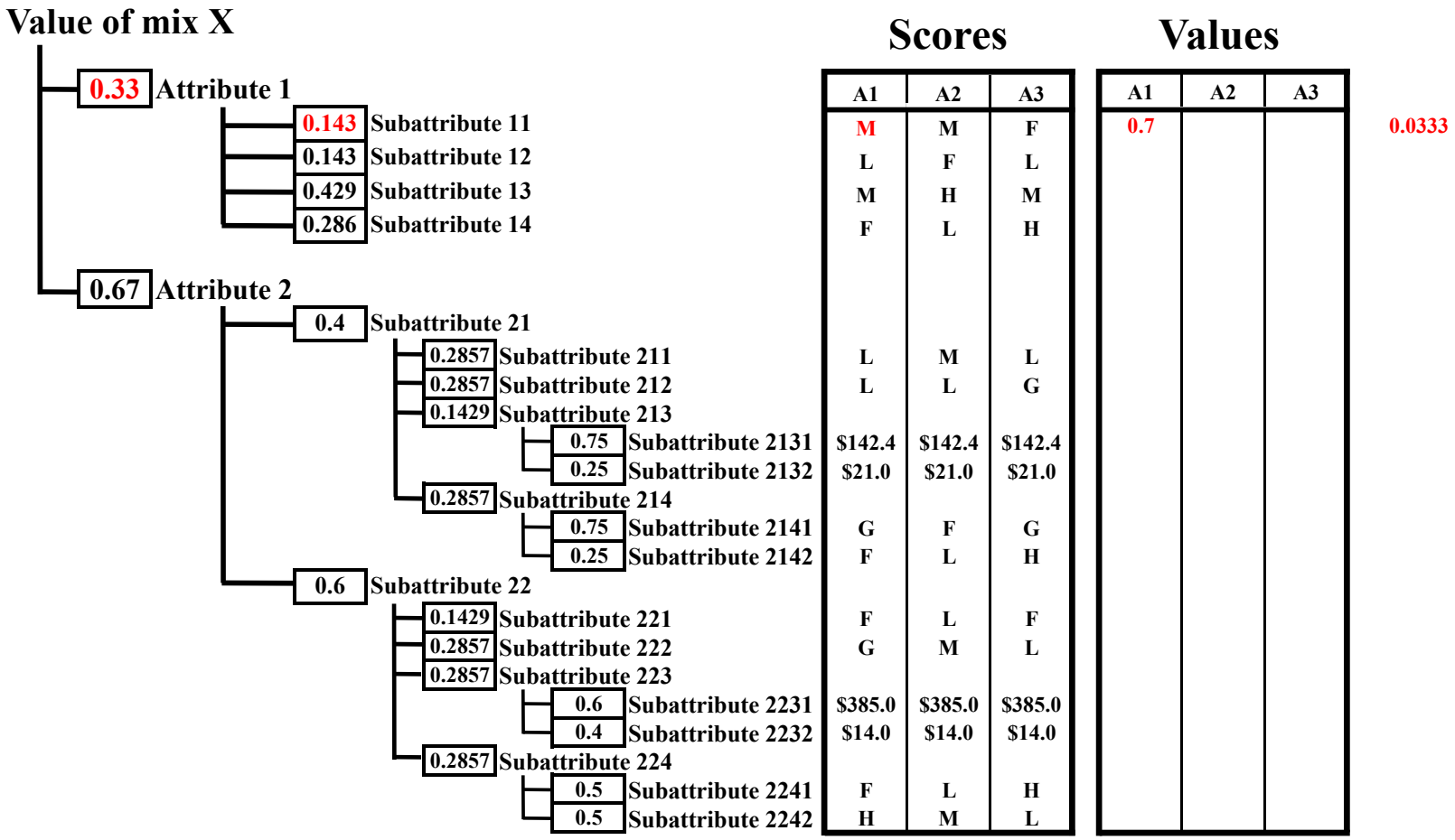
Calculating value



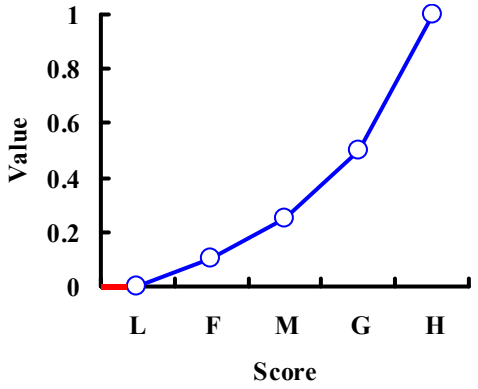
Value of mix X

		Scores			Values		
			A2	A3		A2	A3
0.33	Attribute 1						
0.143	Subattribute 11	M	M	F	0.7		0.0333
0.143	Subattribute 12	L	F	L			
0.429	Subattribute 13	M	H	M			
0.286	Subattribute 14	F	L	H			
0.67	Attribute 2						
0.4	Subattribute 21						
0.2857	Subattribute 211	L	M	L			
0.2857	Subattribute 212	L	L	G			
0.1429	Subattribute 213						
0.75	Subattribute 2131	$142.4	$142.4	$142.4			
0.25	Subattribute 2132	$21.0	$21.0	$21.0			
0.2857	Subattribute 214						
0.75	Subattribute 2141	G	F	G			
0.25	Subattribute 2142	F	L	H			
0.6	Subattribute 22						
0.1429	Subattribute 221	F	L	F			
0.2857	Subattribute 222	G	M	L			
0.2857	Subattribute 223						
0.6	Subattribute 2231	$385.0	$385.0	$385.0			
0.4	Subattribute 2232	$14.0	$14.0	$14.0			
0.2857	Subattribute 224						
0.5	Subattribute 2241	F	L	H			
0.5	Subattribute 2242	H	M	L			

Calculating value



Calculating value



Value of mix X

- 0.33 Attribute 1
  - 0.143 Subattribute 11
  - 0.143 Subattribute 12
  - 0.429 Subattribute 13
  - 0.286 Subattribute 14
- 0.67 Attribute 2
  - 0.4 Subattribute 21
    - 0.2857 Subattribute 211
    - 0.2857 Subattribute 212
    - 0.1429 Subattribute 213
      - 0.75 Subattribute 2131
      - 0.25 Subattribute 2132
    - 0.2857 Subattribute 214
      - 0.75 Subattribute 2141
      - 0.25 Subattribute 2142
  - 0.6 Subattribute 22
    - 0.1429 Subattribute 221
    - 0.2857 Subattribute 222
    - 0.2857 Subattribute 223
      - 0.6 Subattribute 2231
      - 0.4 Subattribute 2232
    - 0.2857 Subattribute 224
      - 0.5 Subattribute 2241
      - 0.5 Subattribute 2242

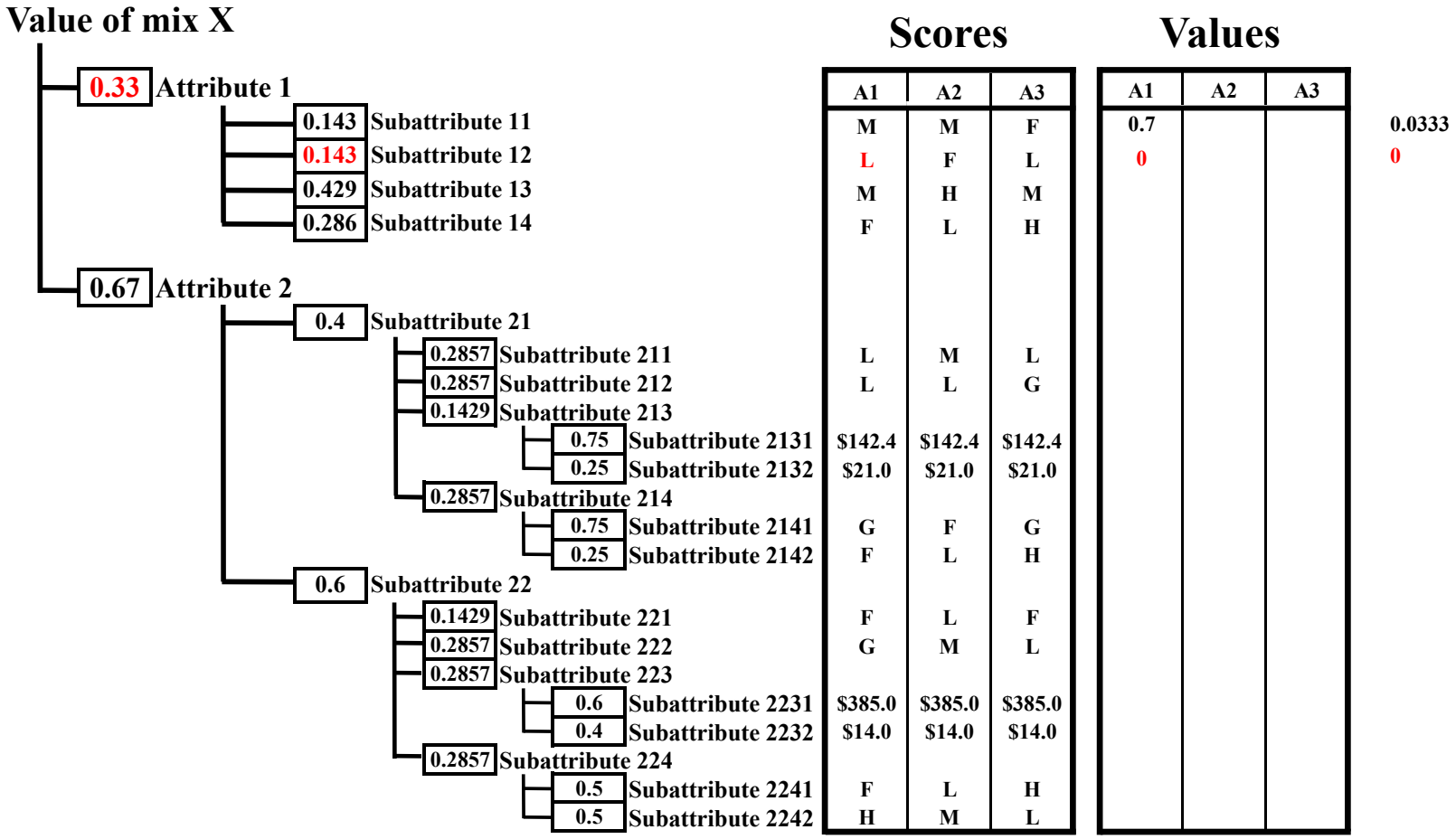
Scores

	A2	A3
	M	F
L	F	L
M	H	M
F	L	H
L	M	L
L	L	G
$142.4	$142.4	$142.4
$21.0	$21.0	$21.0
G	F	G
F	L	H
F	L	F
G	M	L
$385.0	$385.0	$385.0
$14.0	$14.0	$14.0
F	L	H
H	M	L

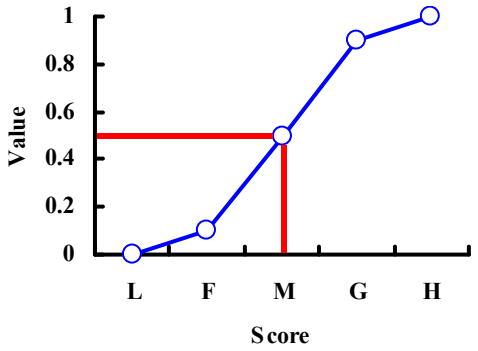
Values

	A2	A3	
			0.0333
0			0

Calculating value



Calculating value



Value of mix X

- 0.33 Attribute 1
  - 0.143 Subattribute 11
  - 0.143 Subattribute 12
  - 0.429 Subattribute 13
  - 0.286 Subattribute 14
- 0.67 Attribute 2
  - 0.4 Subattribute 21
    - 0.2857 Subattribute 211
    - 0.2857 Subattribute 212
    - 0.1429 Subattribute 213
      - 0.75 Subattribute 2131
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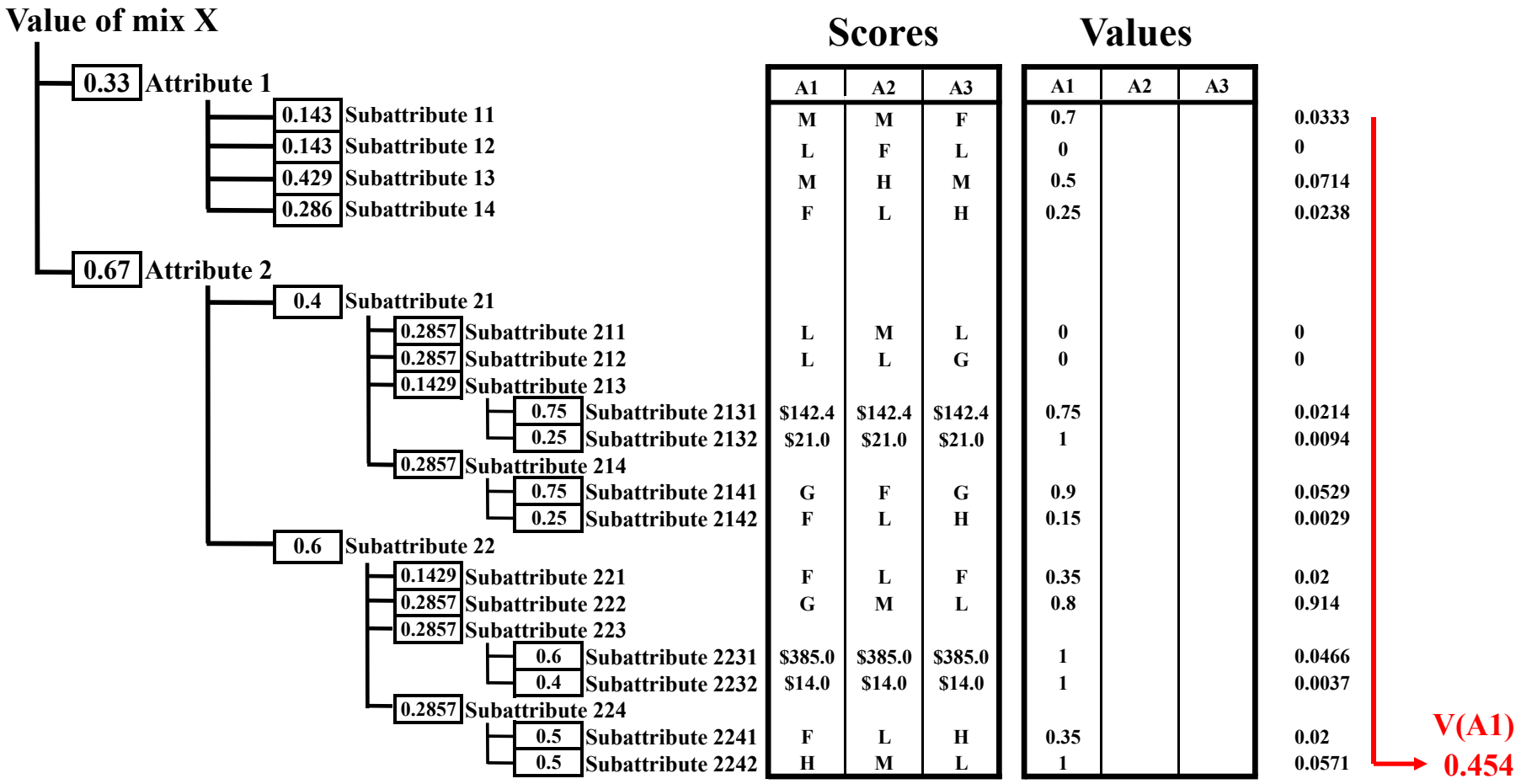
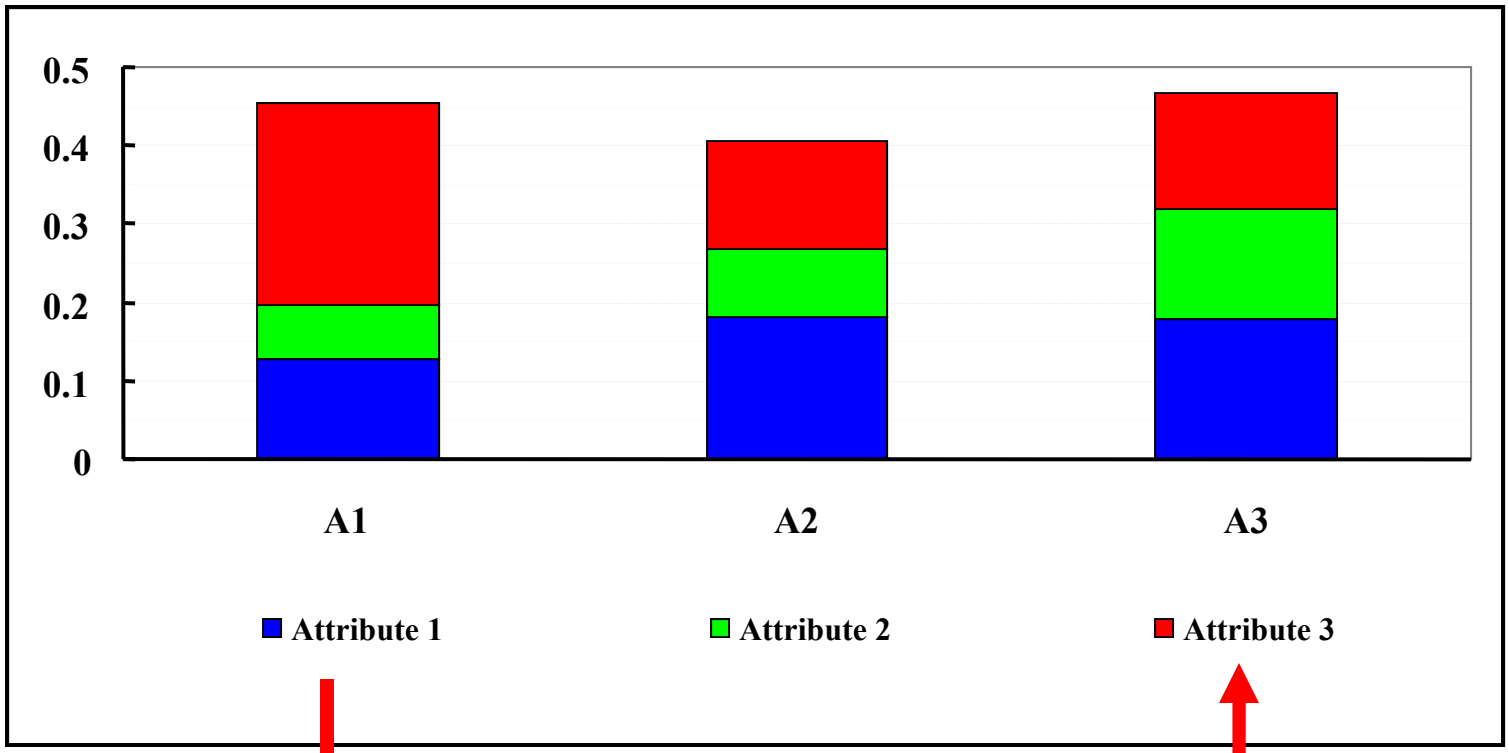
      - 0.75 Subattribute 2141
      - 0.25 Subattribute 2142
  - 0.6 Subattribute 22
    - 0.1429 Subattribute 221
    - 0.2857 Subattribute 222
    - 0.2857 Subattribute 223
      - 0.6 Subattribute 2231
      - 0.4 Subattribute 2232
    - 0.2857 Subattribute 224
      - 0.5 Subattribute 2241
      - 0.5 Subattribute 2242

Scores A1	A2	A3	Values A1	A2	A3	
	M	F				0.0333
	F	L				0
M	H	M	0.5			0.0714
F	L	H				
L	M	L				
L	L	G				
$142.4	$142.4	$142.4				
$21.0	$21.0	$21.0				
G	F	G				
F	L	H				
F	L	F				
G	M	L				
$385.0	$385.0	$385.0				
$14.0	$14.0	$14.0				
F	L	H				
H	M	L				

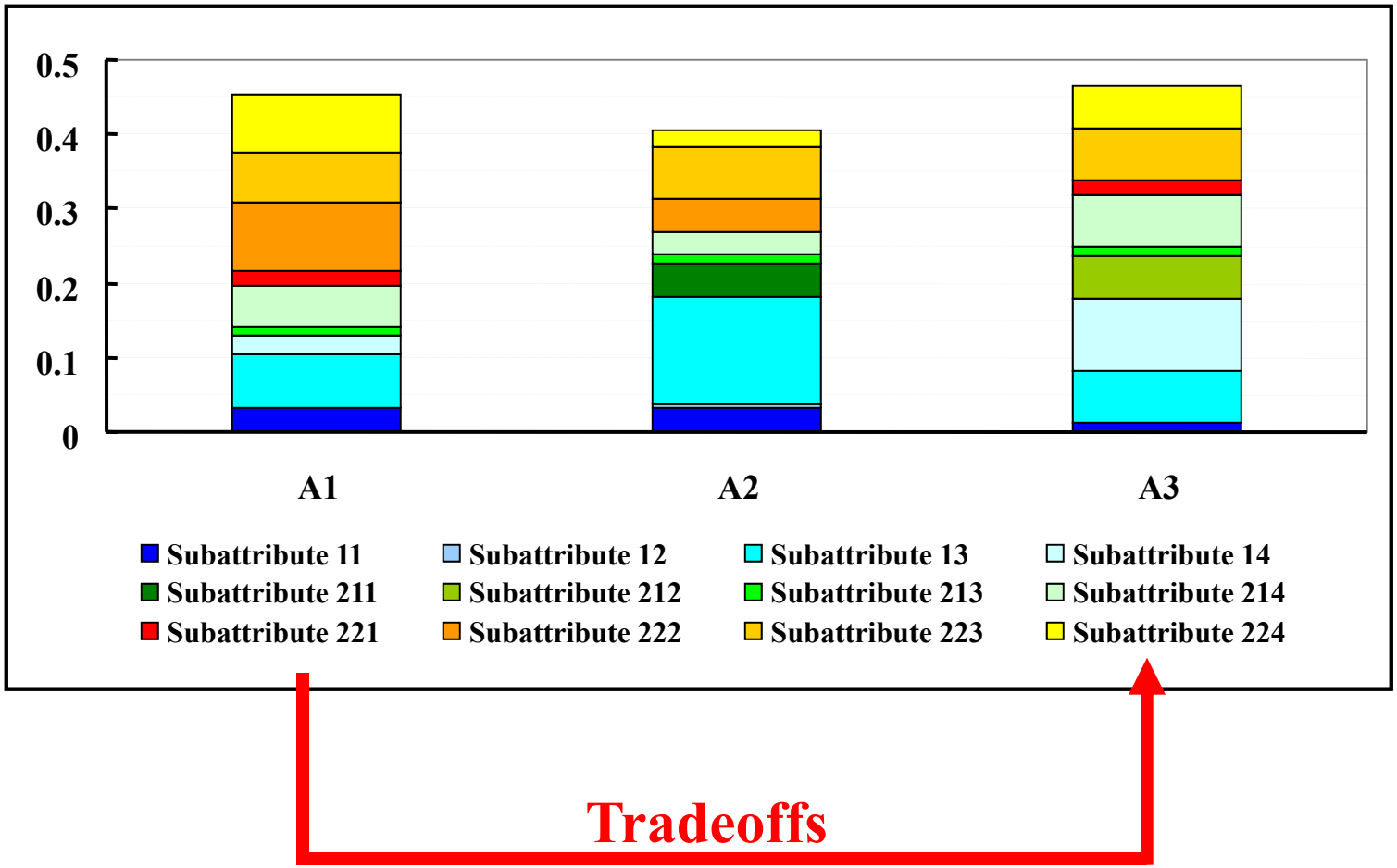
Calculating value



The elements of value



The elements of value



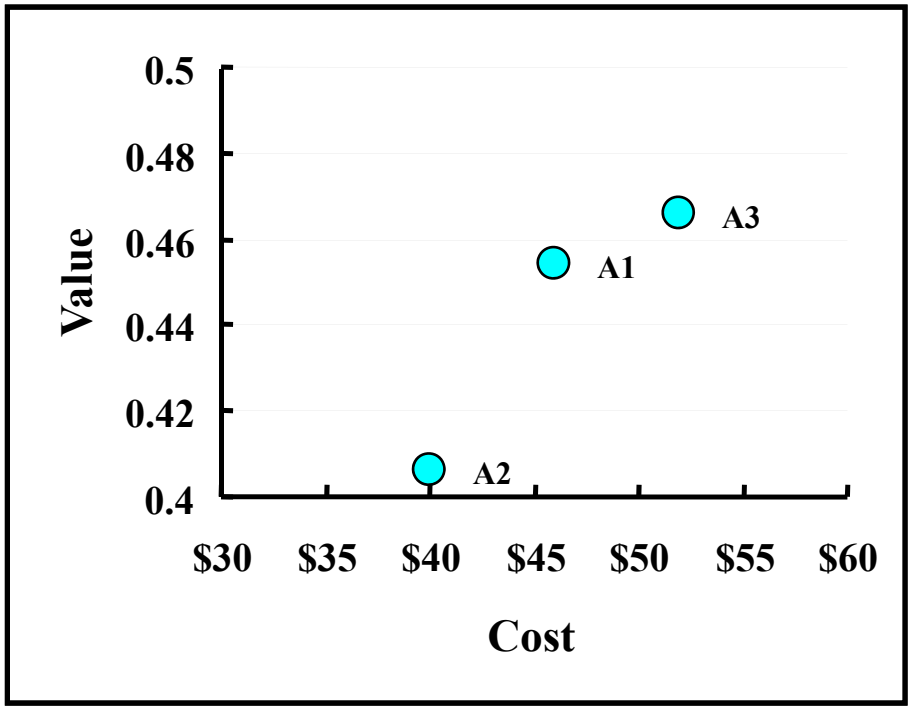
Bringing in cost

The cost-value tradeoff

What about cost?

	Cost	MOV
A1	$46	0.45396
A2	$40	0.40634
A3	$52	0.46587

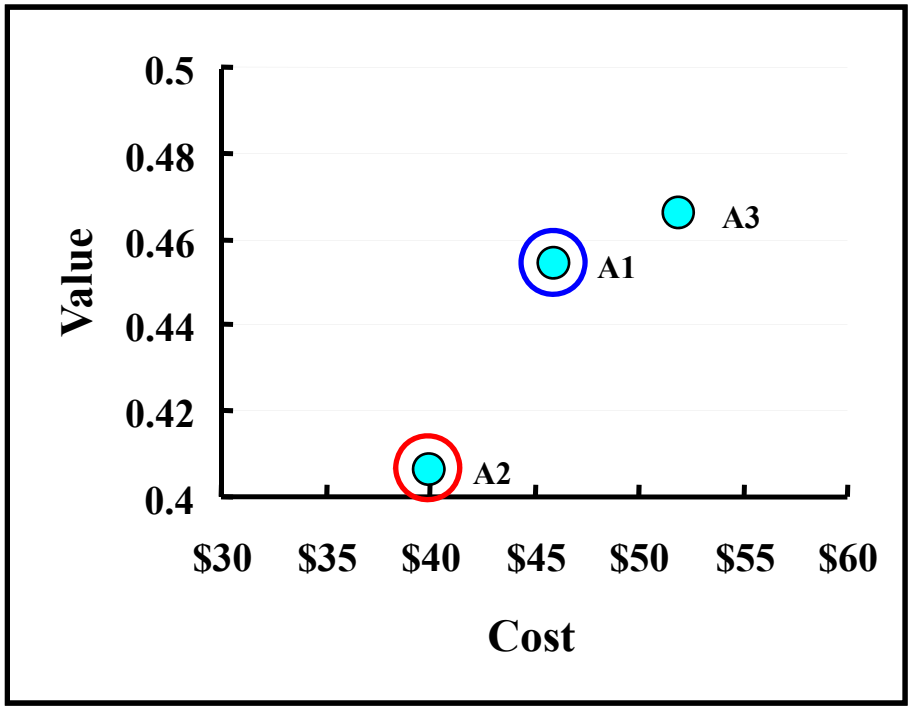
Which do you want first?



The cost-value tradeoff

What about cost?

	Cost	MOV	MOV/C
A1	$46	0.45396	0.00987
A2	$40	0.40634	0.01016
A3	$52	0.46587	0.00896



Which do you want first?

And next?

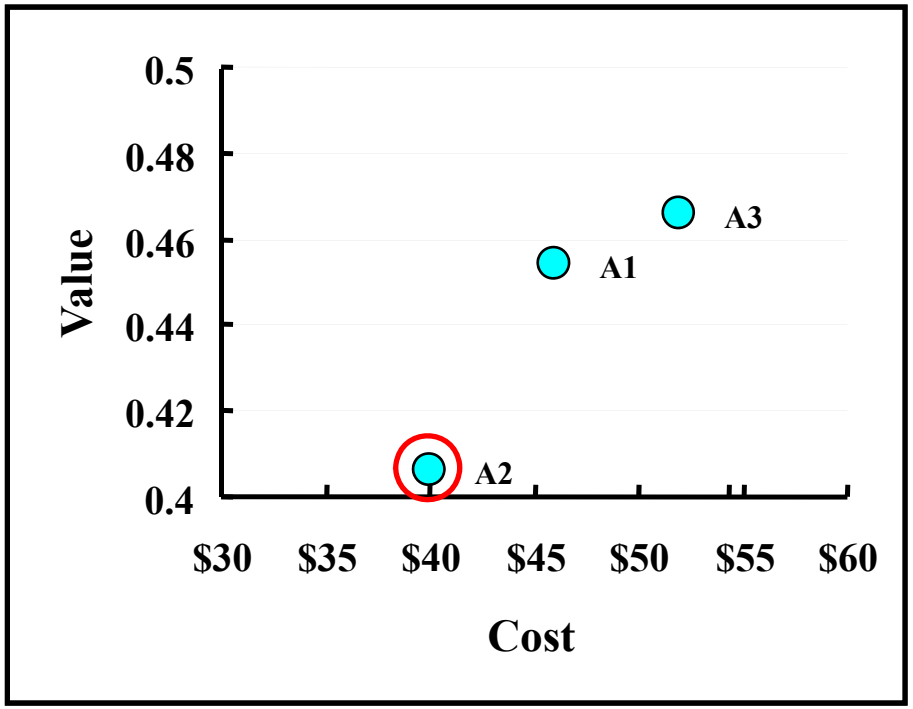
If we only had $100 to spend, we'd "buy" A1 and A2? Right…?

The cost-value tradeoff

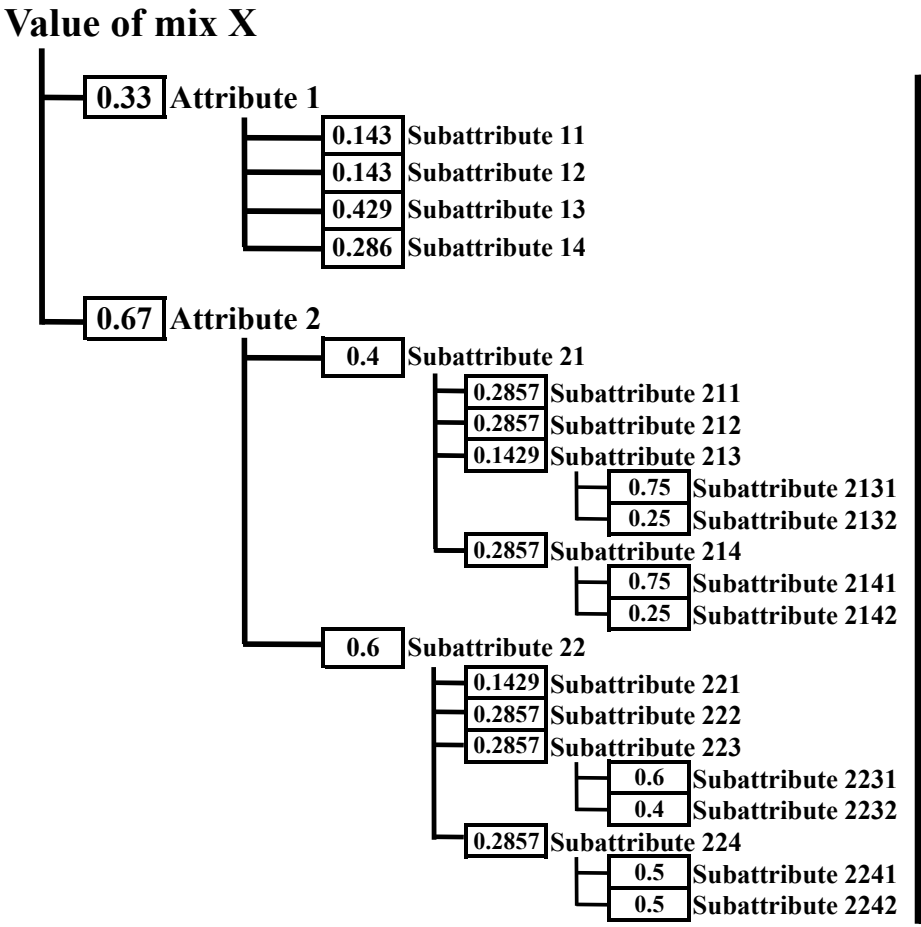
What about cost?

	Cost	MOV	MOV/C
MO1	$46	0.45396	0.00987
MO2	$40	0.40634	0.01016
MO3	$52	0.46587	0.00896

Maybe we should instead ask what we actually gain by spending the additional $46 on A1?



The cost-value tradeoff



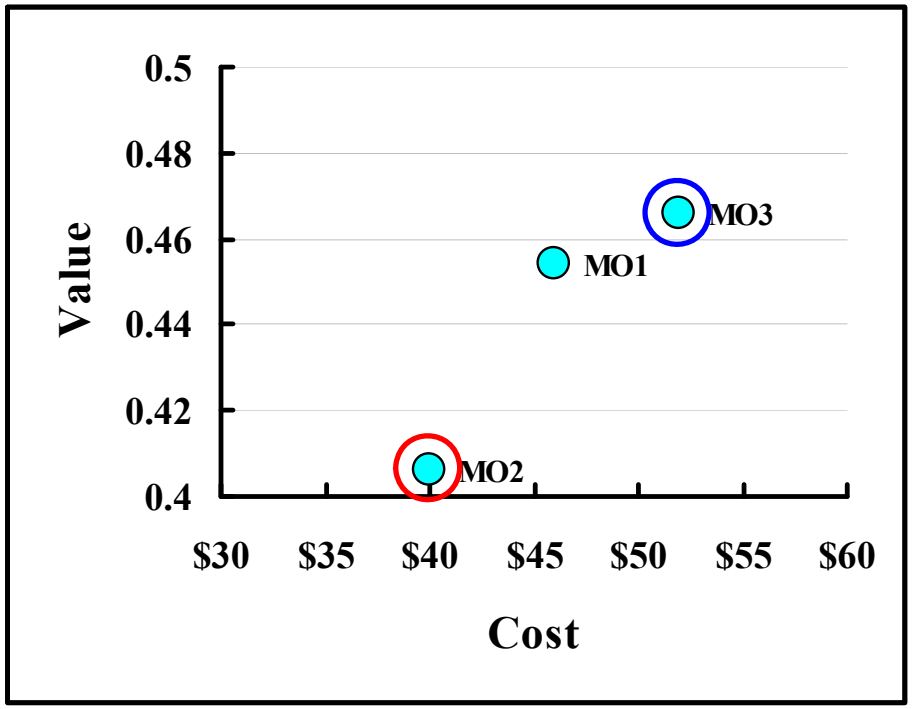
				Marginal Gain			Marginal Value		
	A1	A2	A3	A2	A1	A3	A2	A1	A3
Subattribute 11	M	M	F	M	-	-	0.7	-	-
Subattribute 12	L	F	L	F	-	-	0.1	-	-
Subattribute 13	M	H	M	H	-	-	1	-	-
Subattribute 14	F	L	H	L	L→F	L →H	0	0.25	1
Subattribute 21									
Subattribute 211	L	M	L	M	-	-	0.6	-	-
Subattribute 212	L	L	G	L	-	L →G	0	-	0.75
Subattribute 213									
Subattribute 2131	$142.4	$142.4	$142.4	$142.4	-	-	0.29	-	-
Subattribute 2132	$21.0	$21.0	$21.0	$21.0	-	-	0.5	-	-
Subattribute 214									
Subattribute 2141	G	F	G	F	F →G	F → G	0.5	0.4	0.4
Subattribute 2142	F	L	H	L	L →F	L →H	0	0.15	1
Subattribute 22									
Subattribute 221	F	L	F	L	L →F	L →F	0	0.35	0.35
Subattribute 222	G	M	L	M	M →G	-	0.4	0.4	-
Subattribute 223									
Subattribute 2231	$385.0	$385.0	$385.0	$385.0	-	-	0.68	-	-
Subattribute 2232	$14.0	$14.0	$14.0	$14.0	-	-	0.5	-	-
Subattribute 224									
Subattribute 2241	F	L	H	L	L →F	L →H	0	0.35	1
Subattribute 2242	H	M	L	M	M →H	-	0.4	0.6	-
								0.1695	0.2714
								$46	$52
								0.0037	0.0052

The cost-value tradeoff

But what about cost?

	Cost	MOV	MOV/C
MO1	$46	0.45396	0.00987
MO2	$40	0.40634	0.01016
MO3	$52	0.46587	0.00896

…so we should "buy" A3 next given the benefits we have already derived from A2!



The portfolio game

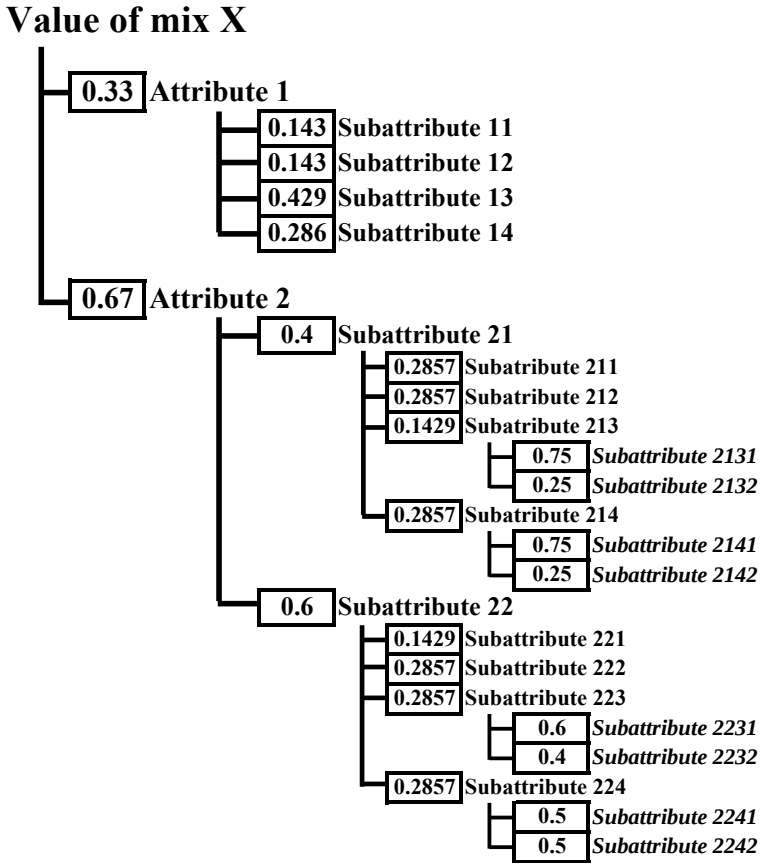
Building an incremental portfolio

We can construct our portfolio by incrementally adding the most cost-valuable assets. The important issues to consider are:

- The attribute weights
- The attribute value functions
- The reference point for marginal improvement
- The pesky issue of convexity

Building an incremental portfolio

Consider the following example…

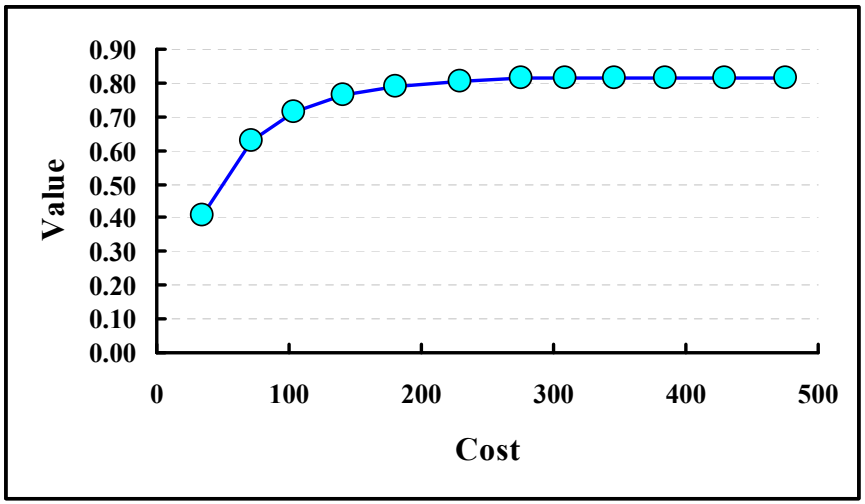


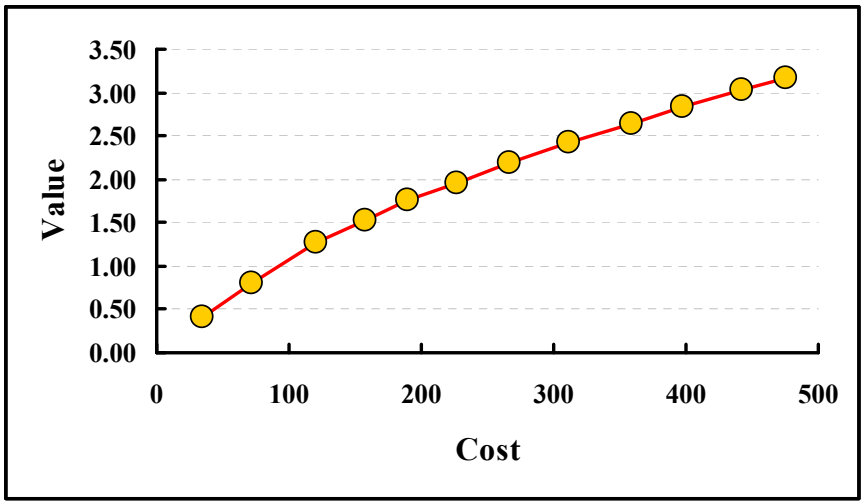
MO1	MO2	MO3	MO4	MO5	MO6	MO7	MO8	MO9	MO10	MO11	MO12
L	L	L	L	L	L	F	F	F	H	M	L
H	L	L	F	L	L	M	F	F	L	L	H
F	L	L	F	L	F	F	M	M	G	G	L
F	F	M	M	L	L	L	L	L	L	F	H
F	L	L	L	F	M	M	L	L	L	G	L
M	F	F	L	L	F	L	L	L	L	F	L
$141	$141	$141	$141	$141	$141	$141	$141	$141	$141	$141	$141
$30	$30	$30	$30	$30	$30	$30	$30	$30	$30	$30	$30
L	M	L	F	F	G	F	L	L	L	F	G
F	L	L	L	L	L	F	L	L	L	F	L
L	F	M	G	F	L	F	L	H	F	F	F
L	L	L	L	L	L	L	L	F	G	M	H
$243	$243	$243	$243	$243	$243	$243	$243	$243	$243	$243	$243
$19	$19	$19	$19	$19	$19	$19	$19	$19	$19	$19	$19
L	M	M	L	L	L	L	F	L	H	L	L
F	L	M	G	L	M	L	F	L	L	G	L
$40	$37	$47	$37	$34	$32	$45	$38	$45	$34	$49	$38

Building an incremental portfolio

Suppose our budget is reduced to $275. We can no longer afford to "buy" everything. Now we must choose not only which order, but which assets.

			Marginal		Absolute	
ALT	Abs	Marg	TC	TV	TC	TV
A1	7	5	181.00	0.7875	267.00	2.1878
A2	6	9	346.00	0.8151	227.00	1.9622
A3	9	12	476.00	0.8151	359.00	2.6491
A4	4	4	141.00	0.7656	158.00	1.5339
A5	12	8	309.00	0.8151	476.00	3.1692
A6	5	3	104.00	0.7142	190.00	1.7519
A7	11	11	429.00	0.8151	442.00	3.0331
A8	10	10	384.00	0.8151	397.00	2.8332
A9	8	7	275.00	0.8151	312.00	2.4206
A10	1	1	34.00	0.4094	34.00	0.4094
A11	3	6	230.00	0.8066	121.00	1.2797
A12	2	2	72.00	0.6266	72.00	0.8026

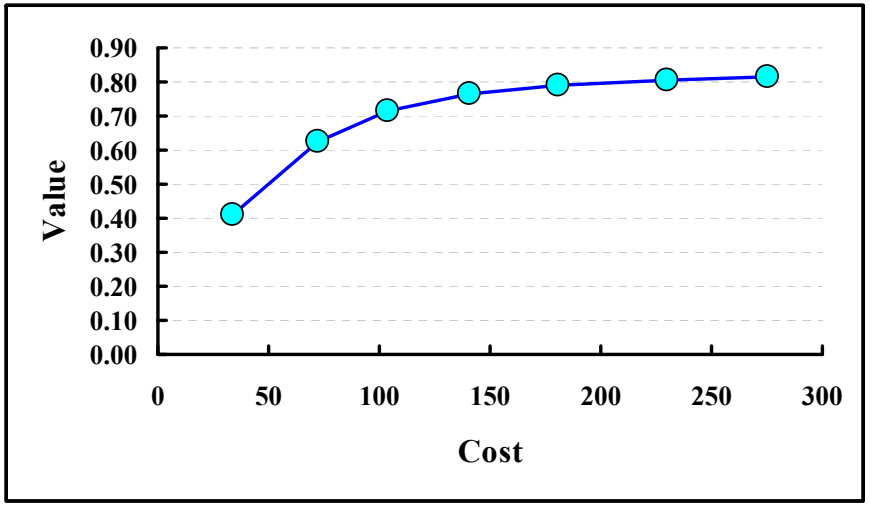


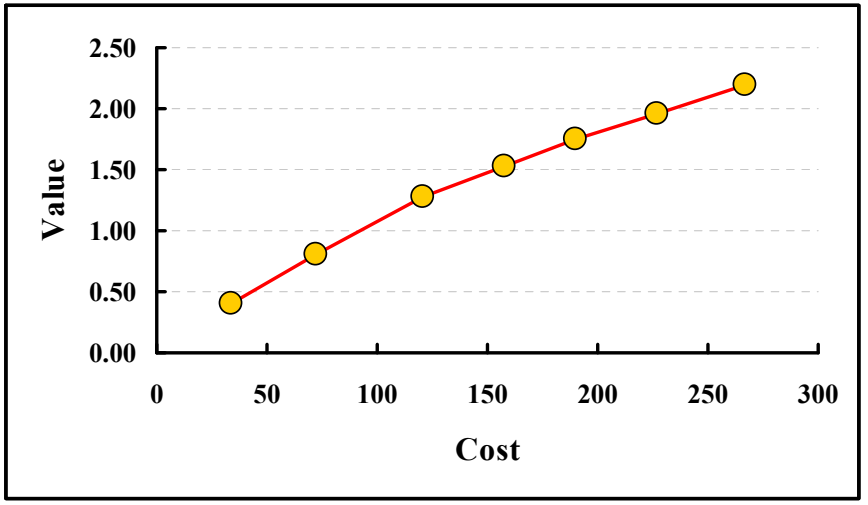


Building an incremental portfolio

Suppose our budget is reduced to $185. The number of "affordable" assets varies with the acceptance criterion. Is "more" better? What are the opportunity costs?

			Marginal		Absolute	
ALT	Abs	Marg	TC	TV	TC	TV
A1	7	5	181.00	0.7875		
A2	6				227.00	1.9622
A3						
A4	4	4	141.00	0.7656	158.00	1.5339
A5						
A6	5	3	104.00	0.7142	190.00	1.7519
A7						
A8						
A9		7				
A10	1	1	34.00	0.4094	34.00	0.4094
A11	3	6	230.00	0.8066	121.00	1.2797
A12	2	2	72.00	0.6266	72.00	0.8026





Building an incremental portfolio

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			Marginal		Absolute	
ALT	Abs	Marg	TC	TV	TC	TV
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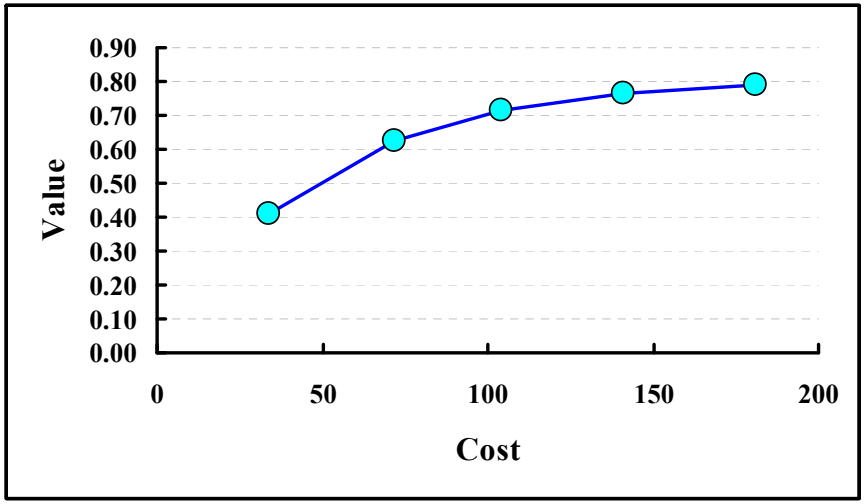
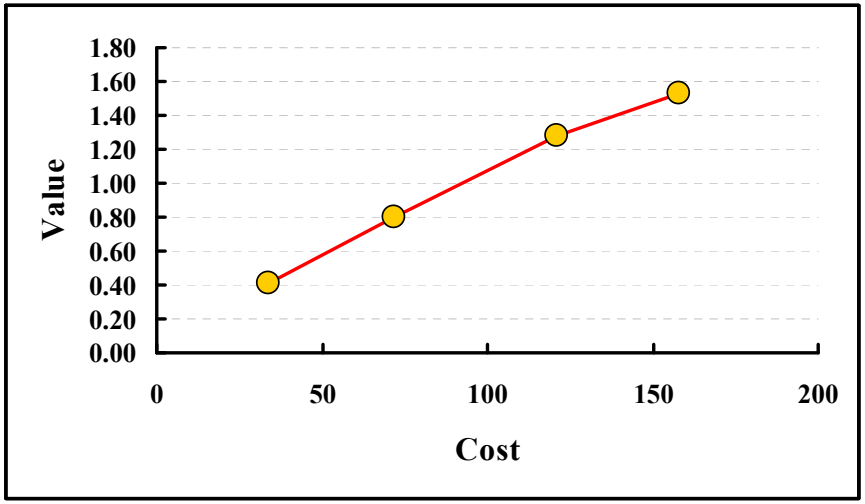
A2						
A3						
A4	4	4	141.00	0.7656	158.00	1.5339
A5						
A6		3	104.00	0.7142		
A7						
A8						
A9						
A10	1	1	34.00	0.4094	34.00	0.4094
A11	3				121.00	1.2797
A12	2	2	72.00	0.6266	72.00	0.8026





So what?

There are two main points:

- The value of a portfolio derives from the objectives underlying and the environment surrounding its creation.
- The value of the n^{th} asset added to a portfolio should depend on the n-1 assets already included.

Final notes

This construct assumes…

- … an **optimization** rather than satisficing frame,
- … that assets are **independent** and **separable**,
- … complete **fungibility** of assets and costs,
- … the **criteria for adding an element** to the portfolio (marginal overall value to marginal cost) is valid.

What happens when…

- … the DM changes?
- … the information state changes?
- … the scenario changes?

Are these necessarily "bad" things?

The end…?

Reconsider the issue

Typical model: