

Intelligent Decisions – Intelligent Support?

A Series of Guided Discussions

Module 1 - FRI MAR07 13-16	History of <i>decision making</i>
Module 2 - THU MAR13 13-16	Theories of <i>decision making</i>
Module 3 - FRI MAR14 13-16	Models of <i>decision making</i>
Module 4 - THUMAR27 13-16	<i>Decision and automation</i>
Module 5 - FRI MAR28 13-16	<i>Time and decision making</i>
Module 6 - THU APRO3 13-16	<i>Decision situation characteristics</i>
Module 7 - FRI APRO4 13-16	<i>Tools and solutions / Case study introduction</i>
Module 8 - THU APR24 13-16	<i>Presentation and discussion of case studies</i>
Module 9 - FRI APR25 13-16	<i>Presentation and discussion of case studies; course summary</i>



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Three approaches to decision making

- ❖ Rational-comprehensive approach (root method)
 - ❖ *Homo economicus*
- ❖ Successive limited comparison (branch method)
- ❖ Muddling through.

- ❖ Each approach obviously requires its own kind of model.
- ❖ Each approach differs in the degree of realism.
- ❖ Which approach should be the basis for a support system?



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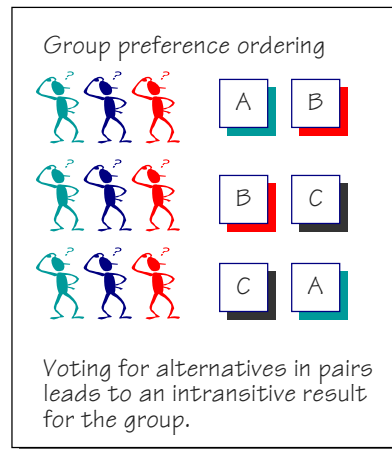
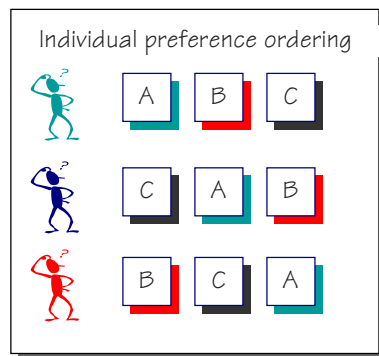
Homo Economicus

- ❖ Completely informed
 - ❖ Knowledge of all courses of action
 - ❖ Knowledge of the outcome of any action
- ❖ Infinite sensitivity
 - ❖ Characterisation of alternatives is infinitely divisible, and HE is infinitely sensitive
- ❖ Rationality
 - ❖ Weak ordering: (1) be able to determine preference between two alternatives, (2) preferences must be transitive
 - ❖ Choices are made to maximise something (utility, SEU, safety / risk, etc.)
- ❖ The assumption also requires that the HE acts alone, and that the environment is stable during the decision.



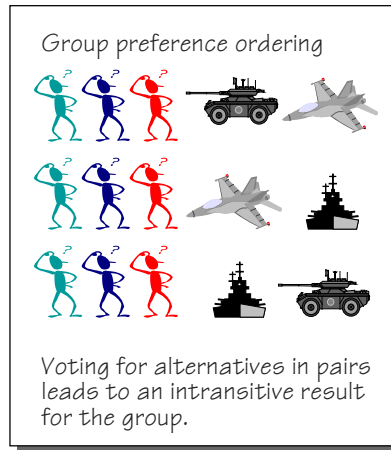
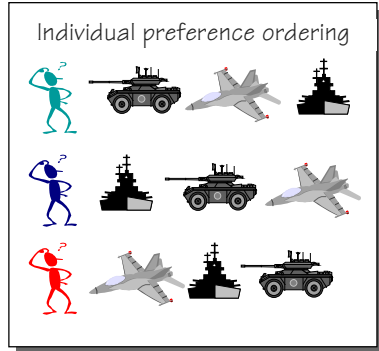
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Voter's paradox



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Commander's paradox



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Multiattribute choice

Nuclear power	Fossil power	Wind power
Clean	Clean	Clean
Reliable	Reliable	Reliable
Cheap	Cheap	Cheap

Clean Fossil < Nuclear < Wind
 Reliable Wind < Fossil < Nuclear
 Cheap Nuclear < Fossil < Wind



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Aspects of rational decisions

- ❖ Certainty
 - ❖ Each option (alternative) has a single outcome, which is known in advance.
- ❖ Rational competition
 - ❖ Any strategy that can be used by the decision can also be used by the competition.
 - ❖ The competition reasons in a similar way to “myself”.
- ❖ Risk
 - ❖ Probabilities of possible consequences of choices are known (or can be estimated). That includes responses of the competitor.
- ❖ Ignorance
 - ❖ Choices have multiple consequences, but it is unknown which might occur.



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Generalised pay-off matrix (TSD)

		Y (detect)	N (reject)	
s (signal)	Hit	V_{Y_s}	Miss	$E(Y x) \geq E(N x)$
	False alarm	$-V_{Y_n}$	Correct rejection	
n (noise)	False alarm	$-V_{Y_n}$	Correct rejection	
	Hit	V_{Y_s}	Miss	

$$E(Y|x) = V_{Y_s} p(s|x) - V_{Y_n} p(n|x)$$

$$E(N|x) = V_{N_n} p(n|x) - V_{N_s} p(s|x)$$



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Sentry's pay-off matrix

Decision alternatives	Anticipated events and outcome values	
	Foe	Friend
Categorise as "foe" and fire	Alive and highly regarded	Alive, regretful, but duty fulfilled
Categorise as "friend" and not fire	Dead or wounded	Alive, but feeling lucky and neglectful
Estimated likelihood of events	50%	50%



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USS Vincennes pay-off matrix

Decision alternatives	Anticipated events and outcome values	
	Foe	Friend
Categorise as "foe" and fire	Survive and highly regarded	Survive, regretful, but duty fulfilled
Categorise as "friend" and not fire	Attacked or killed	Survive, but possibly with some doubt
Estimated likelihood of events	p	$1-p$



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Trust in DSS output

Decision alternatives	Anticipated events and outcome values	
	Differ from expectations	Match expectations
Follow DSS "advice"	Delegating authority, feeling uncertain	Feeling highly confident
Follow own "intuition"	Taking a chance, possibly losing	
Estimated likelihood of output being correct	p	$1-p$



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NPP alarm (Inagaki)

Decision alternatives	Anticipated events and outcome values	
	False alarm	Correct alarm
Believe alarm and shut down NPP	Unnecessary shutdown, inefficient	Correct response
Distrust alarm and cancel it	Clever operator	Possibly reckless behaviour
Estimated likelihood of events	p	$1-p$



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Natural decision making

- ❖ Natural decision making often looks for *acceptable solutions*:
 - ❖ *these may be prepared in advanced of the task*
 - ❖ *mission planning, training, procedures*
- ❖ *Decision making in natural tasks is a mixture of skills, routines/procedures, and “real” decisions.*
 - ❖ *decision is one of many tasks*
 - ❖ *decisions are made when the situation requires*

