

# Info-gap: a user's perspective

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# The task: to avoid catastrophes



<http://cte.jhu.edu/techacademy/fellows/Thomas/webquest/explosion.gif&imgrefurl>

**NASA 1985:** *'the risk of catastrophic failure is 1 in 100,000 launches'*



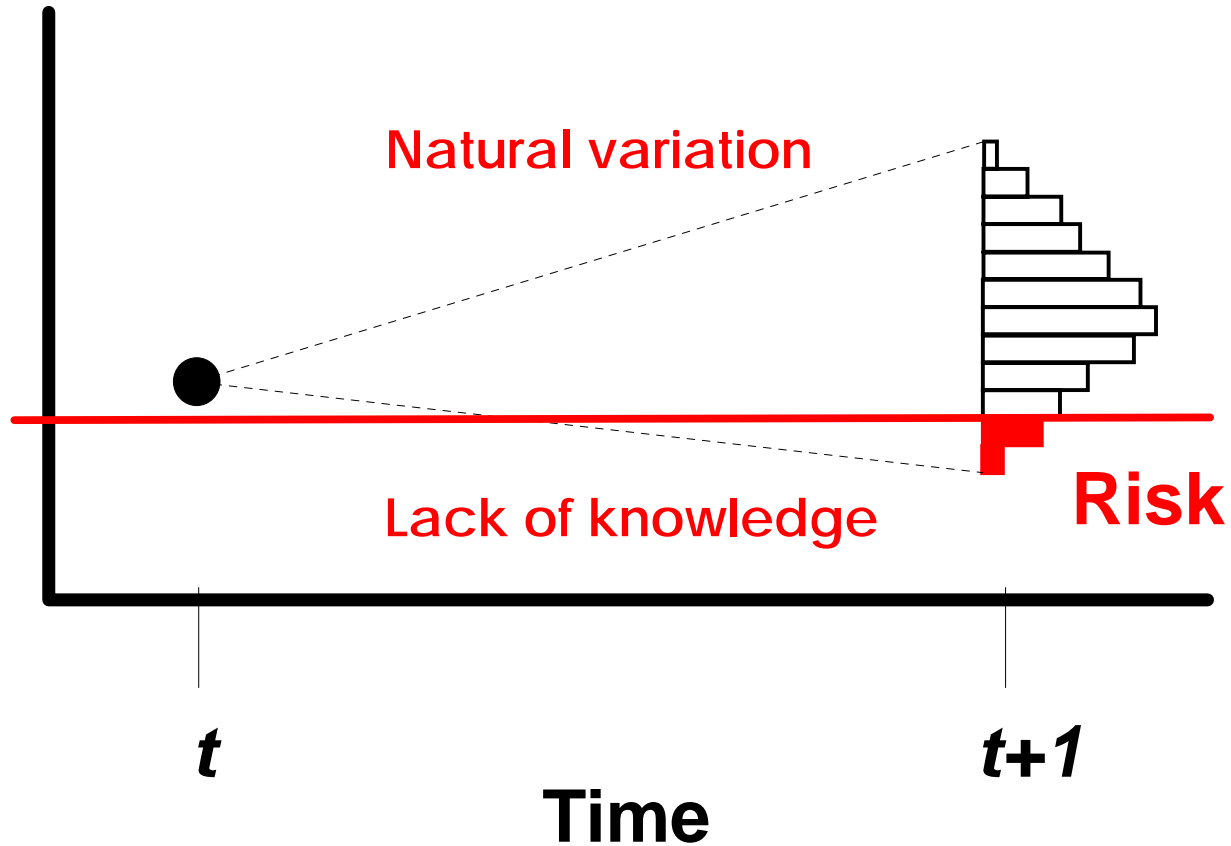
<http://www.agdepartment.com/images/NoseArea.jpg>



[www.agf.gov.bc.ca/cropprot/tfipm/fireblyt.htm](http://www.agf.gov.bc.ca/cropprot/tfipm/fireblyt.htm)

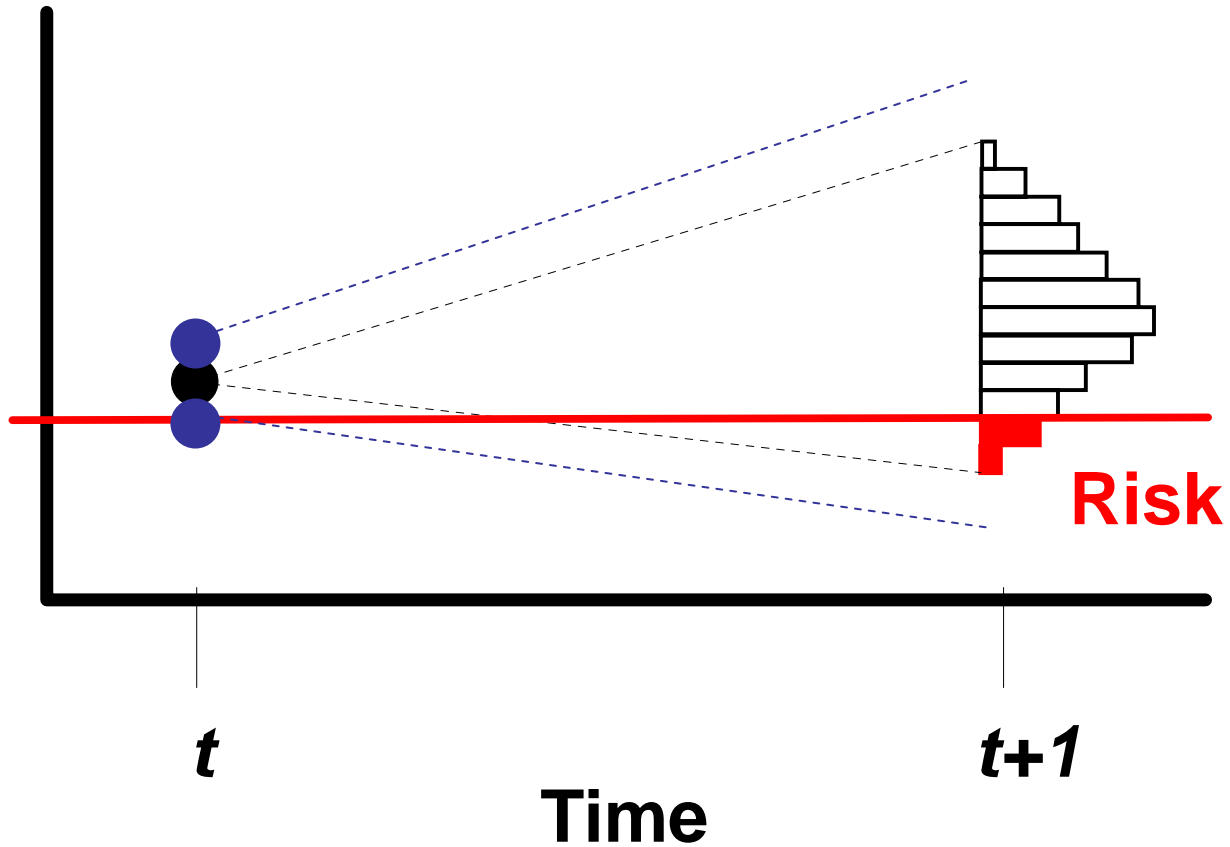


<http://fireflyforest.net/images/firefly/2006/July/cane-toad-2.jpg&imgrefurl>



Probability arithmetic, 'classical' decision theory, Monte Carlo

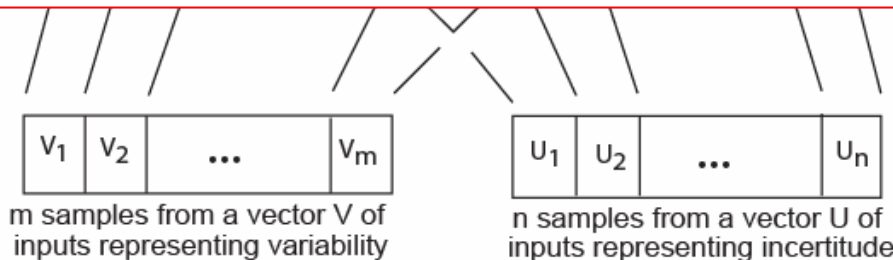
# Sensitivity analysis



Uncertainty in output due to incertitude

Uncertainty in output due to variability

- depend on unjustifiable assumptions
- can't deal with non-statistical uncertainty
- deal poorly with dependencies
- can't do back-calculations
- deals with a subset of uncertainty
- We just don't have the data



Likelihood	Consequence Severity				
	Low	Minor	Moderate	Major	Critical
Almost Certain	High	High	Extreme	Extreme	Extreme
Likely					
Possible					
Unlikely	Low	Low	Moderate	High	Extreme
Rare	Low	Low	Moderate	High	High

Lack transparency, objectivity, repeatability



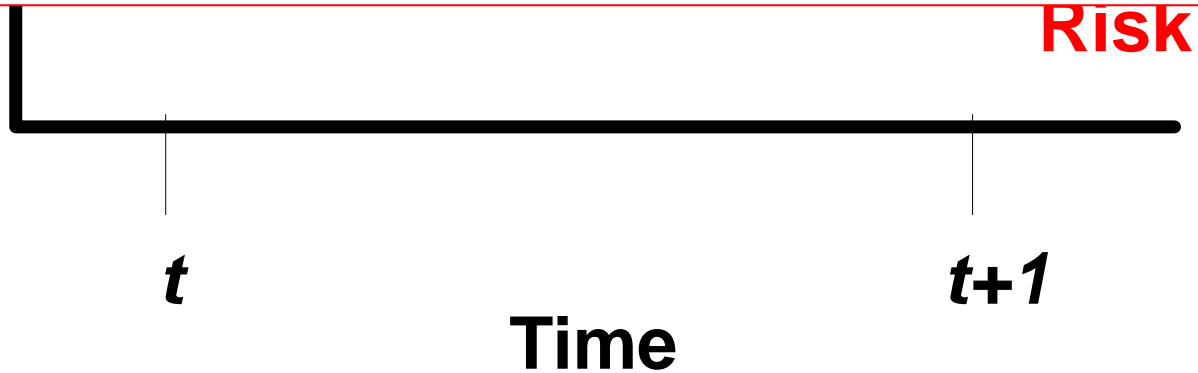
*'The chance of a ship collision is **low**'*

*'The risk of gene transfer is **remote**'*

*The risk of the disease spreading is **'very low'***

# The right question...

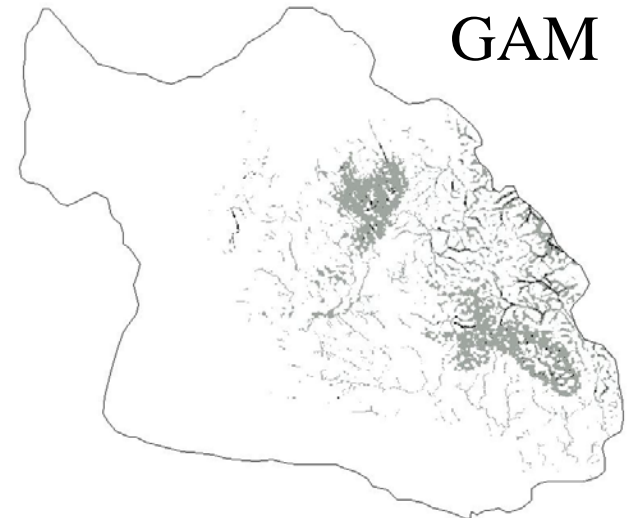
How wrong can this model be  
before I should change my decision?

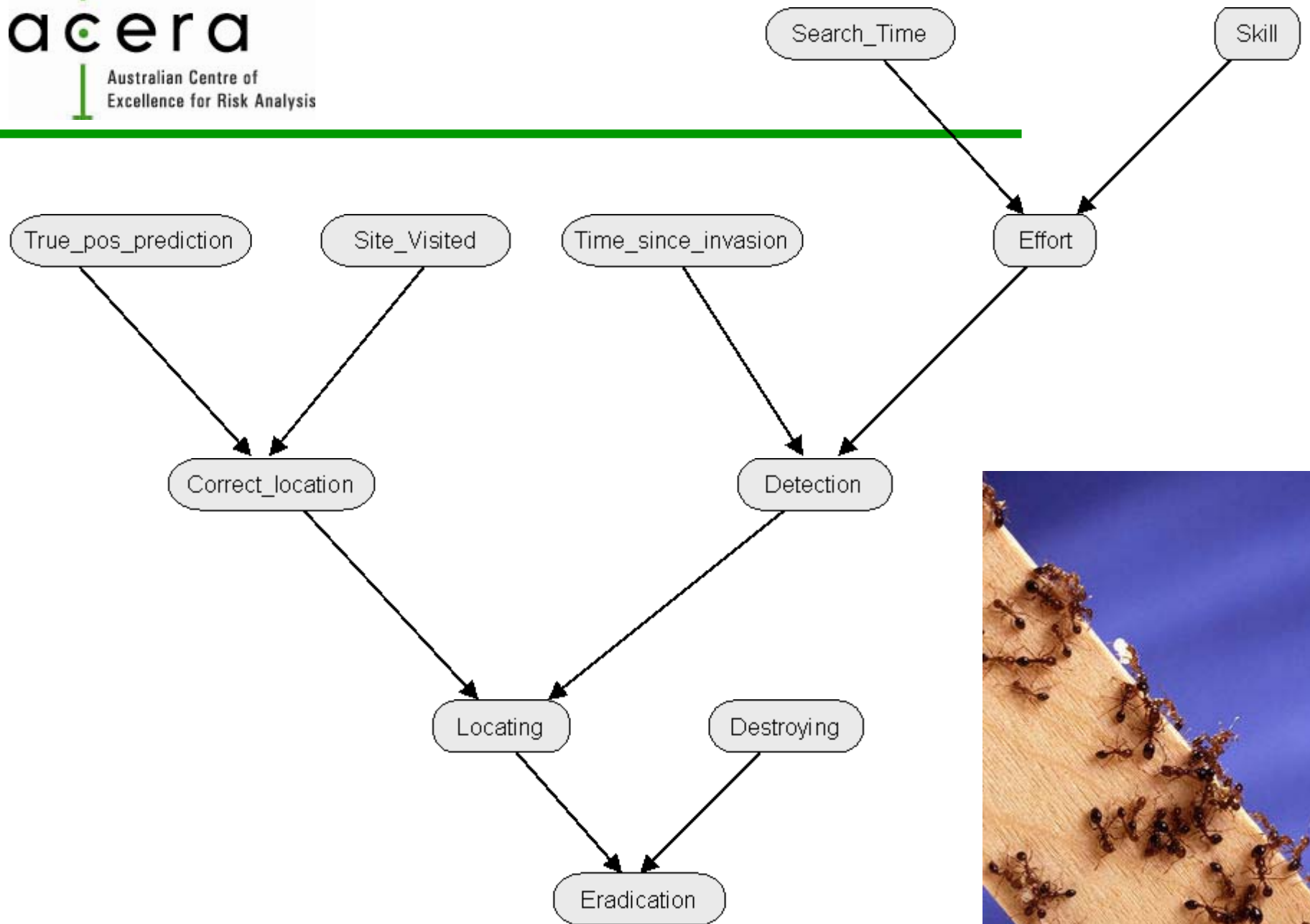


# Detectability and effort

The probability that a species (or disease) is present, given a survey effort ( $m$ ) and detectability ( $d$ ) is:

$$\Pr(\textit{presence} \mid m) = \frac{p^* (1-d)^m}{p^* (1-d)^m + (1-p)}$$





Search_Time	
Exhaustive	80.0
Fast	20.0

Skill	
Trained	50.0
Novice	50.0

True_pos_prediction	
True	90.0
False	10.0

Site_Visited	
True	90.0
False	10.0

Time_since_invasion	
Short	50.0
Long	50.0

Effort	
High	86.0
Low	14.0

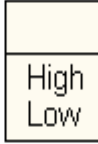
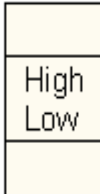
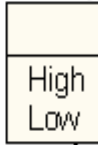
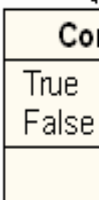
Correct_location	
True	81.4
False	18.5

Detection	
High	78.6
Low	21.3

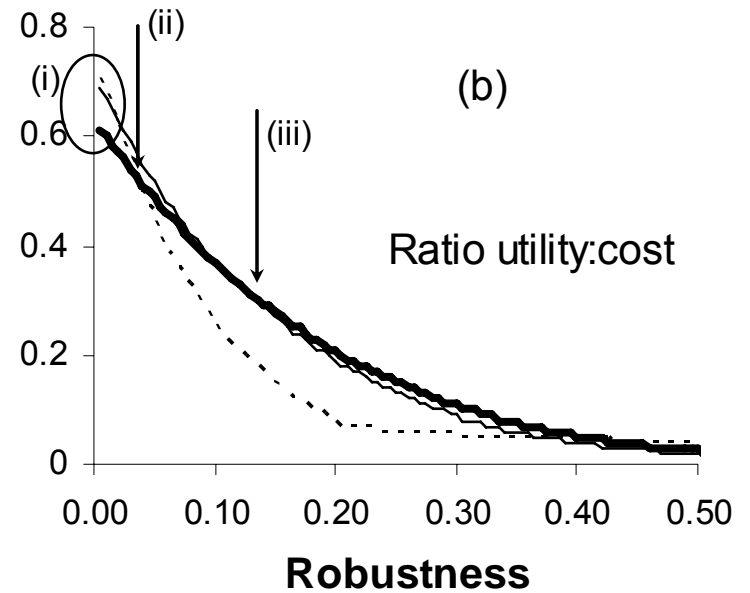
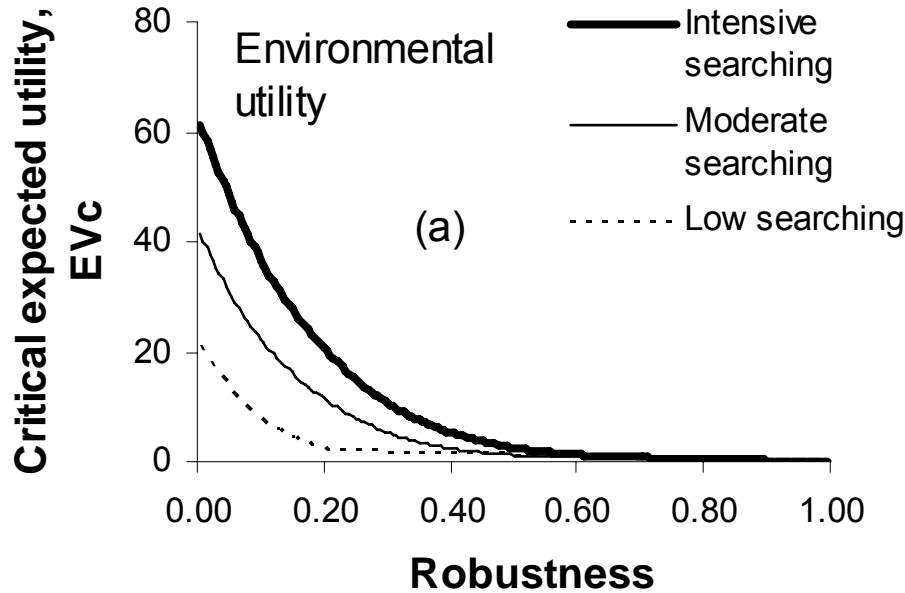
Locating	
High	78.4
Low	21.6

Destroying	
High	98.0
Low	2.00

Eradication	
High	80.1
Low	19.9



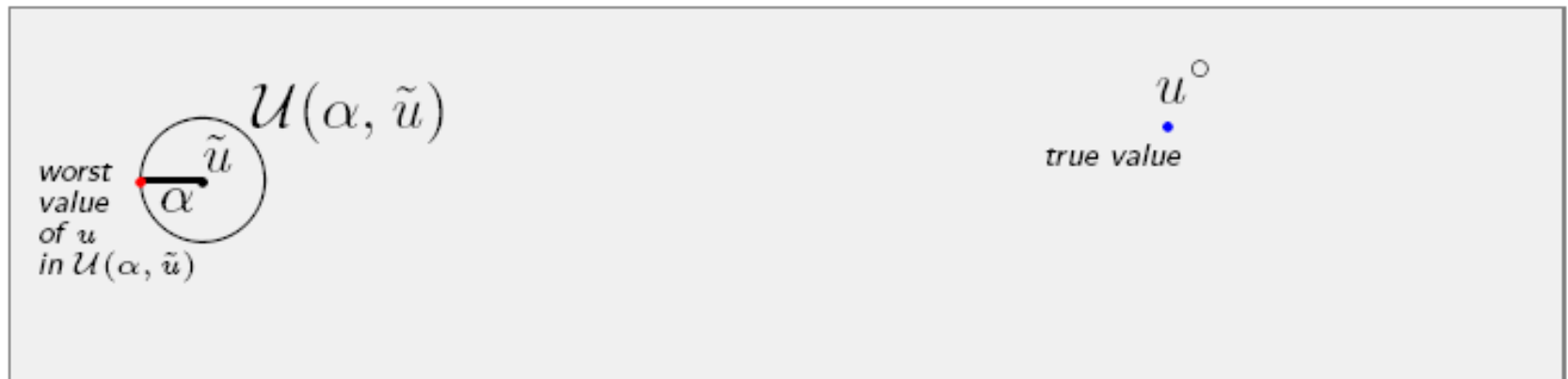
# Sensitivity and uncertainty analysis

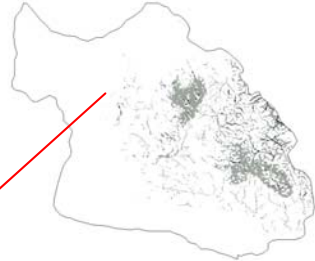


Classical decision theory distinguishes between three **levels** of uncertainty regarding the state of nature, namely

- Certainty
- Risk
- **Strict Uncertainty**  $\equiv$  Severe Uncertainty
  - Wald
  - Laplace

## Region of Severe Uncertainty, $\mathcal{U}$





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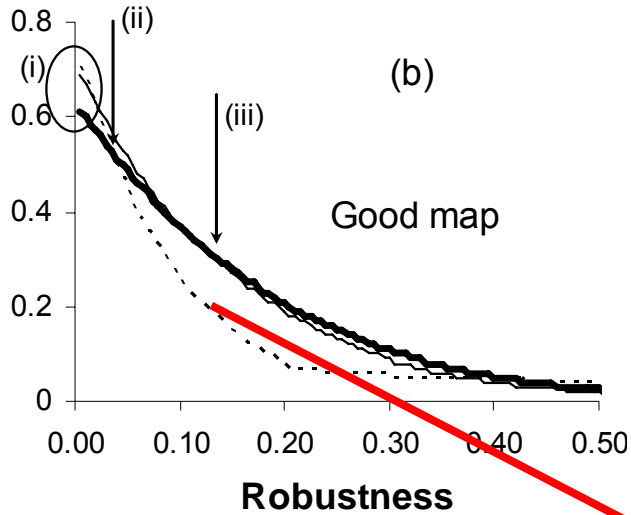
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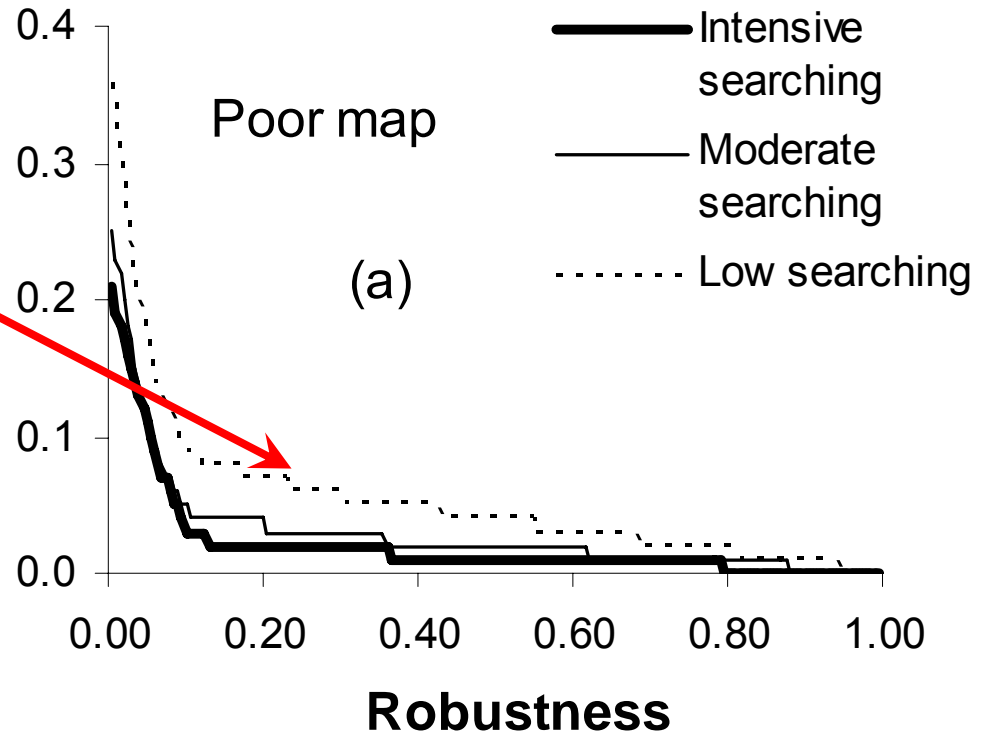
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# What if my map is 'really' terrible?

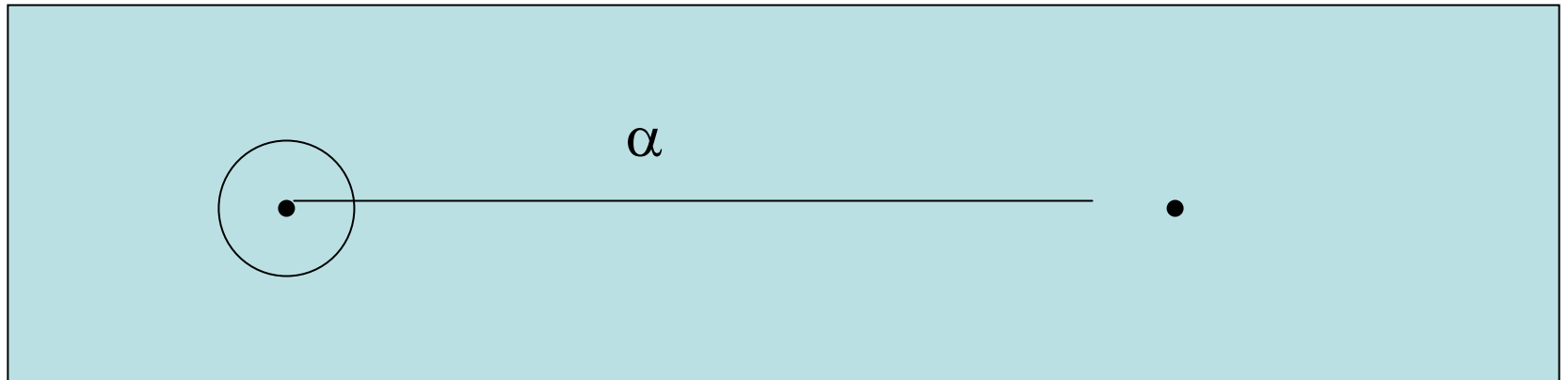


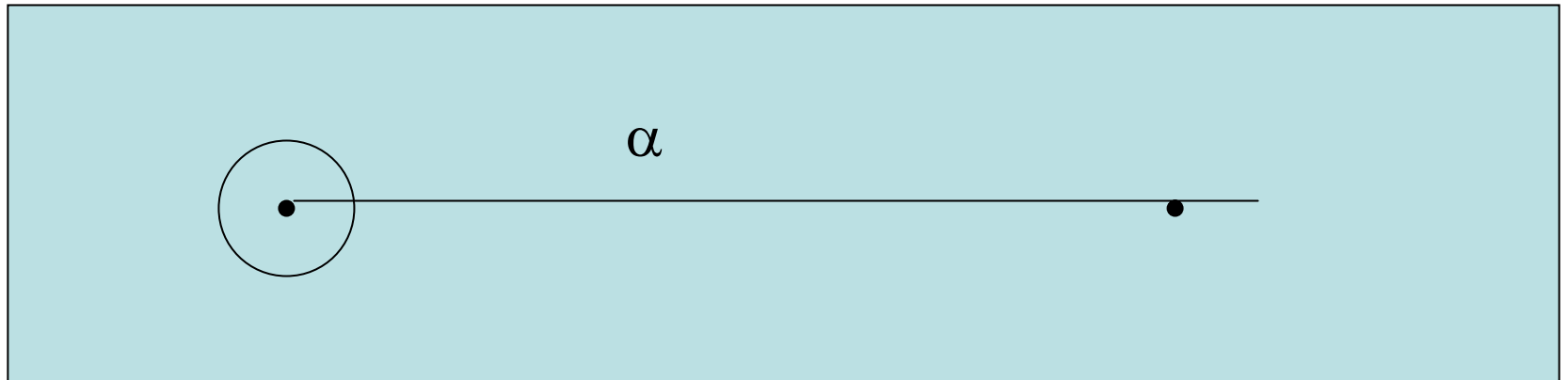
Critical expected utility,  
E/c

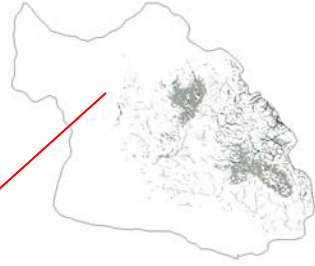


# A new layer in the uncertainty cake

- Certainty
- Risk
- ~~Strict Uncertainty~~ = Severe Uncertainty  
Opaque uncertainty: (I believe) the estimate is not  
poor and the data don't justify a probabilistic approach







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The transition to a scenario dominated by a 'low' intensity search strategy occurs when 'true' < 0.3

But is this 'just' good-old decision theory?

Yes (hooray)

- The assertion that satisficing is superior to optimizing is pure nonsense.
- What is important is what you optimize and what you satisfice

Is this new?



**Abraham Wald, 1902-1950**  
[cepa.newschool.edu](http://cepa.newschool.edu)

- Decision-making under severe uncertainty is difficult.
- This is a very active area of research/practice.
- The Robust Optimization literature is very relevant.
- The Operations Research literature is very relevant.
- The Decision Theory literature is very relevant.