Uncertainty Modeling in Multiple Dimensions for Value Methodology

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"...a lack of knowledge about current and future information and circumstances."

what is risk?

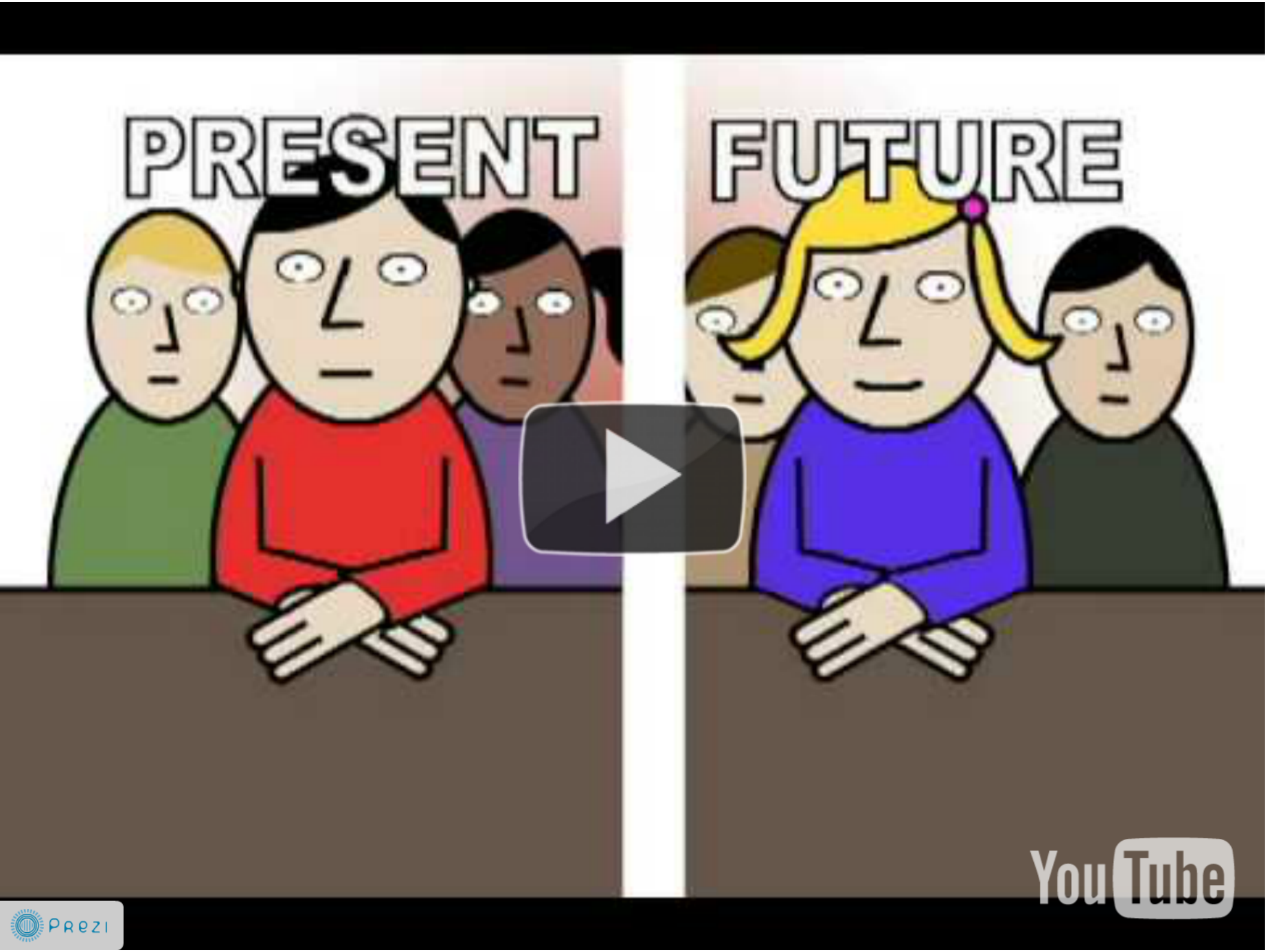
...a "risk" represents an uncertain event that could impact the project. Risks may have either positive or negative outcomes.

People are really bad at dealing with risk and uncertainty…

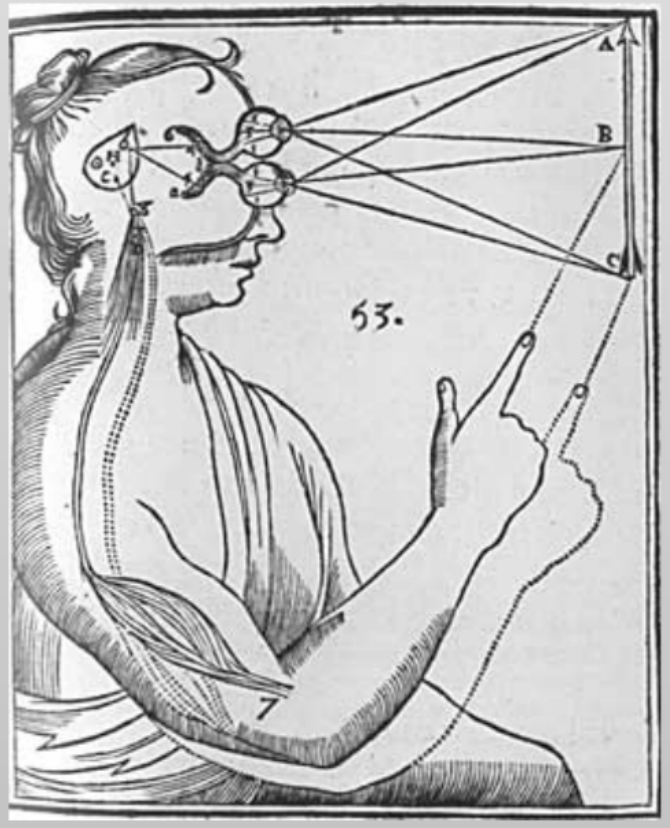
Why is this so?

Reason #1

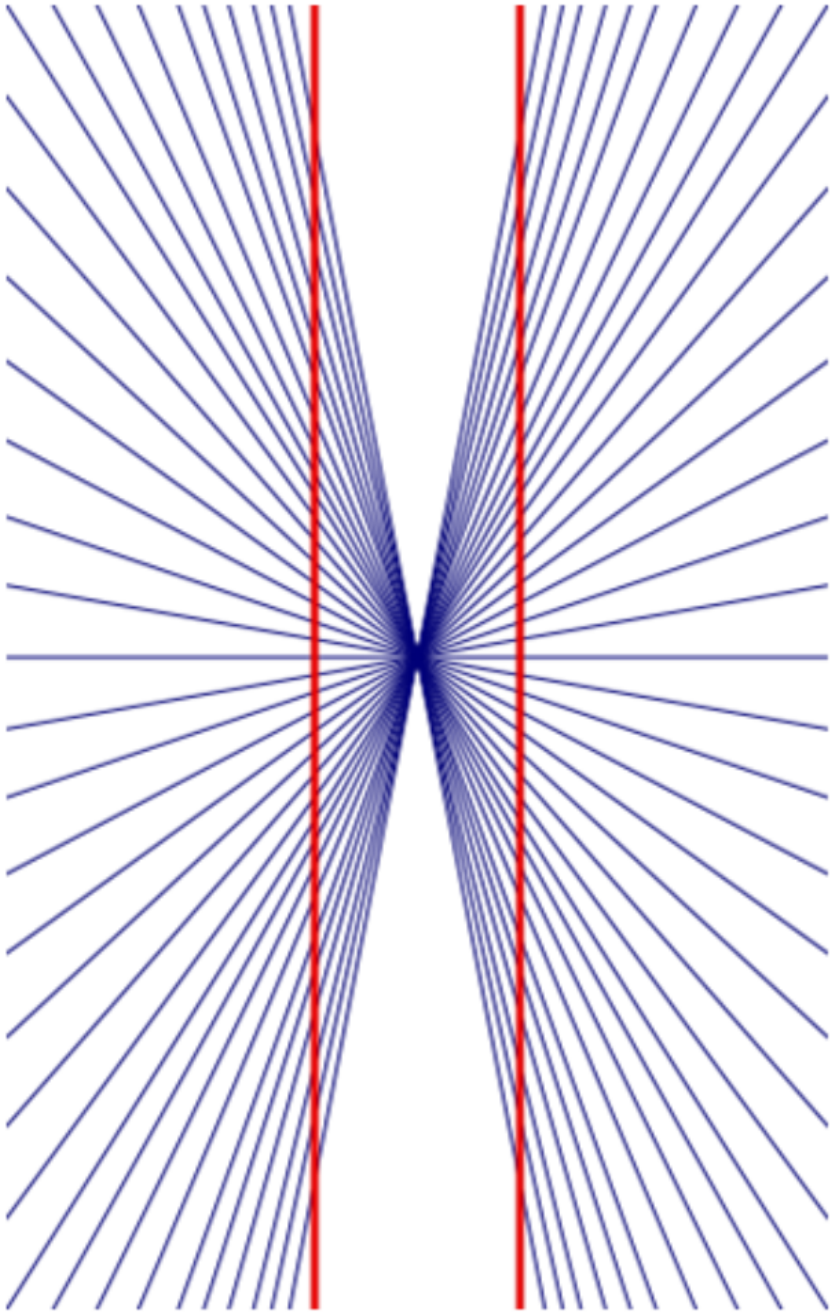
People percieve time in different ways


PRESENT
FUTURE
YouTube

Reason #2

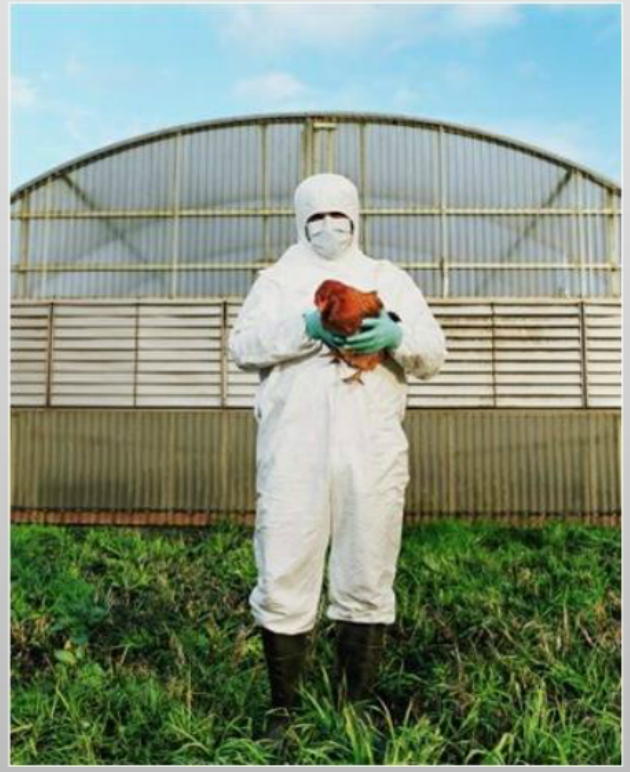


time lag between sight and cognitive perception



Reason #3

cognitive biases warp our reality...



Question:

Imagine that the U.S. is preparing for the outbreak of a strain of bird flu which is expected to kill 60,000 people. Two alternative programs to combat the disease have been proposed.

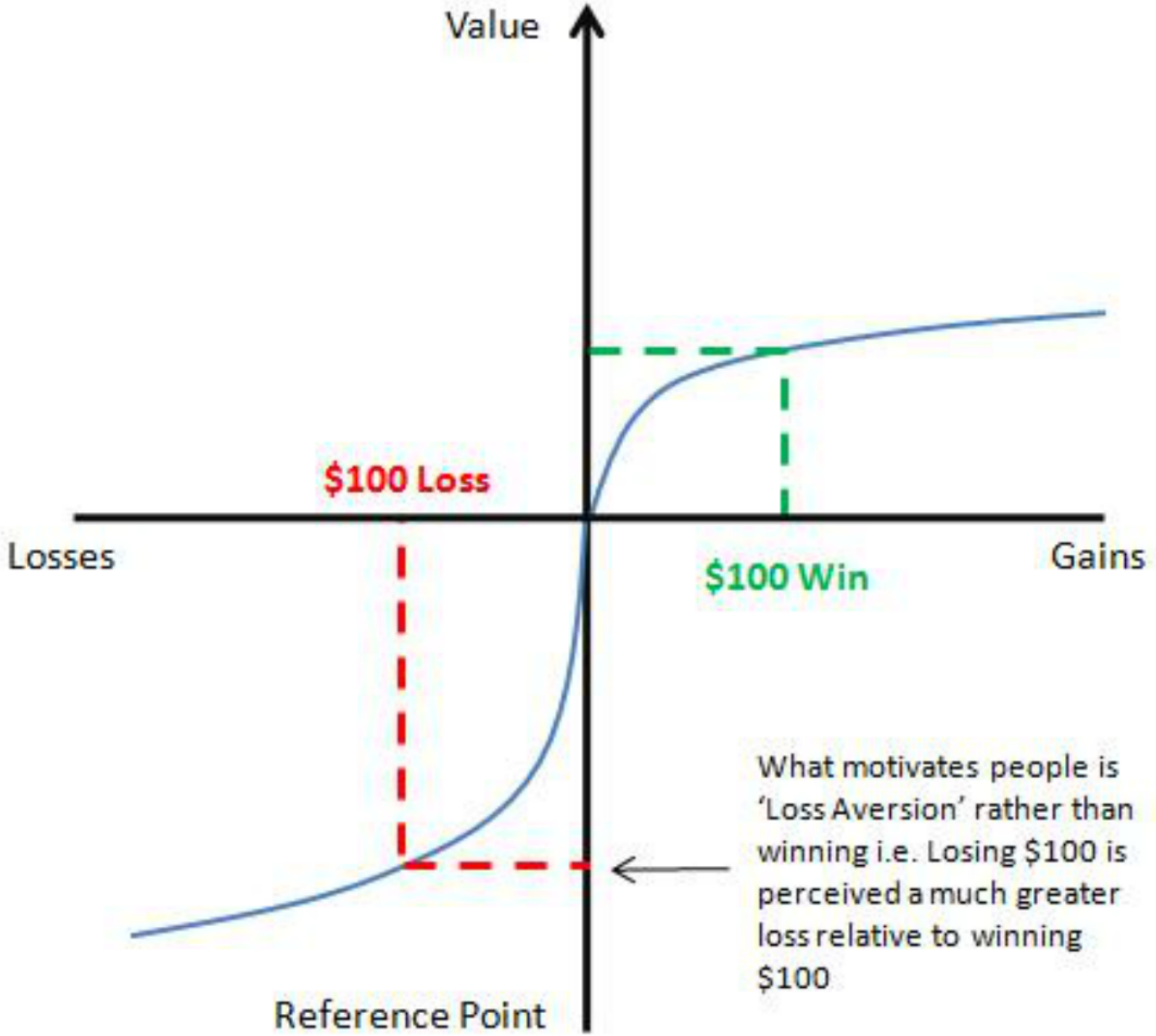
Which would you choose?

- If program A is adopted 20,000 people will be saved
- If program B is adopted there is a 33% probability that 60,000 people will be saved and a 66% probability that no people will be saved.

Which would you choose?

- If program C is adopted 40,000 people will die
- If program D is adopted there is a one third (33%) probability that nobody will die and a two-thirds (66%) probability that 60,000 people will die.

Kahneman and Tversky: Prospect Theory applied to gambling wins/losses

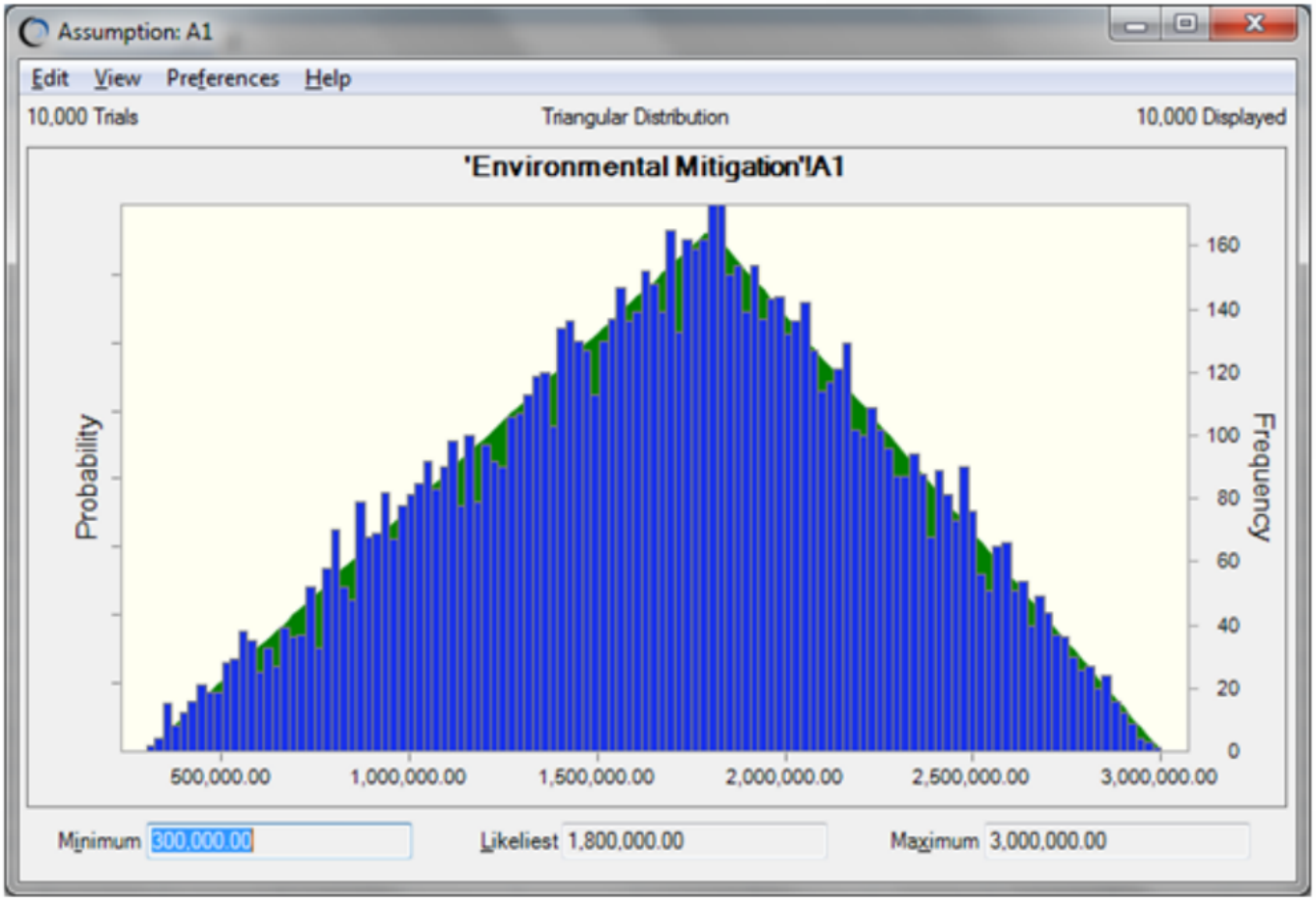


Equations for Value

$$V_f(P,C,t)_{total} = \frac{\sum_{n=1}^{N} P_n \cdot \alpha}{\sum_{n=1}^{N}[(C_n \cdot \alpha) + (t_n \cdot \alpha)]}$$

$$V_f(P,C,t)_{total} = \sum_{n=1}^{N}[W_P \cdot (P_n \cdot \alpha) + W_C \cdot \left(\frac{1}{C_n} \cdot \alpha\right) + W_t \cdot (t_n \cdot \alpha)]$$

Range Estimation



Toyota Prius

Ford Fiesta

Purchase Price	$21,650	Purchase Price	$13,320
Transmission	Automatic	Transmission	Manual
Mileage (City/Highway)	51 mpg / 48 mpg	Mileage (City/Highway)	28 mpg / 37 mpg
Fuel Costs	$3.25 (reg. gas)	Fuel Costs	$3.25 (reg. gas)
Cost for Oil Change	$35.00	Cost for Oil Change	$35.00
20,000 mile Service (yr. 2)	$513.00	20,000 mile Service (yr. 2)	$271.00
40,000 mile Service (yr. 3)	$763.00	40,000 mile Service (yr. 3)	$432.00
60,000 mile Service (yr. 4)	$1,441.00	60,000 mile Service (yr. 4)	$419.00
75,000 mile Service (yr. 5)	$722.00	75,000 mile Service (yr. 5)	$944.00
Monthly Insurance	$108.75	Monthly Insurance	$106.00
Salvage Value	$13,553.00	Salvage Value	$5,241.00

Period - 6 years

Interest Rate - 5%

Deterministic LCC Values

Prius = $26,572

Fiesta = $25,864

Fiesta = $708 less expensive

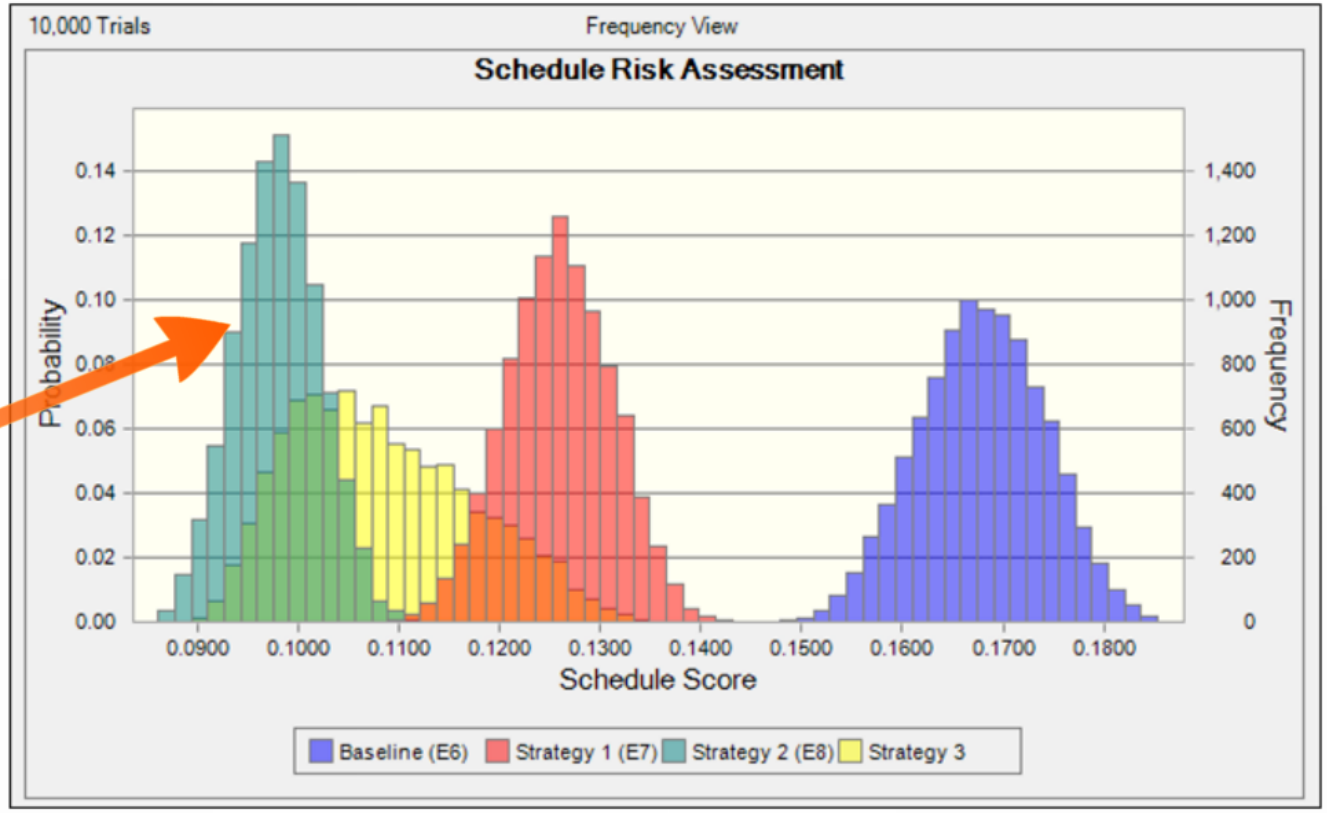
Deterministic Values

Priorities:	Cost	0.50	Schedule	0.50	
Alternatives	Costs	Rating	Schedule (Months)	Rating	Total Score
Baseline	30,300,000	0.1345	24	0.1714	0.3060
Strategy 1	29,128,000	0.1293	18	0.1286	0.2579
Strategy 2	26,495,000	0.1176	14	0.1000	0.2176
Strategy 3	26,693,000	0.1185	14	0.1000	0.2185
Total	112,616,000		70		1.0000

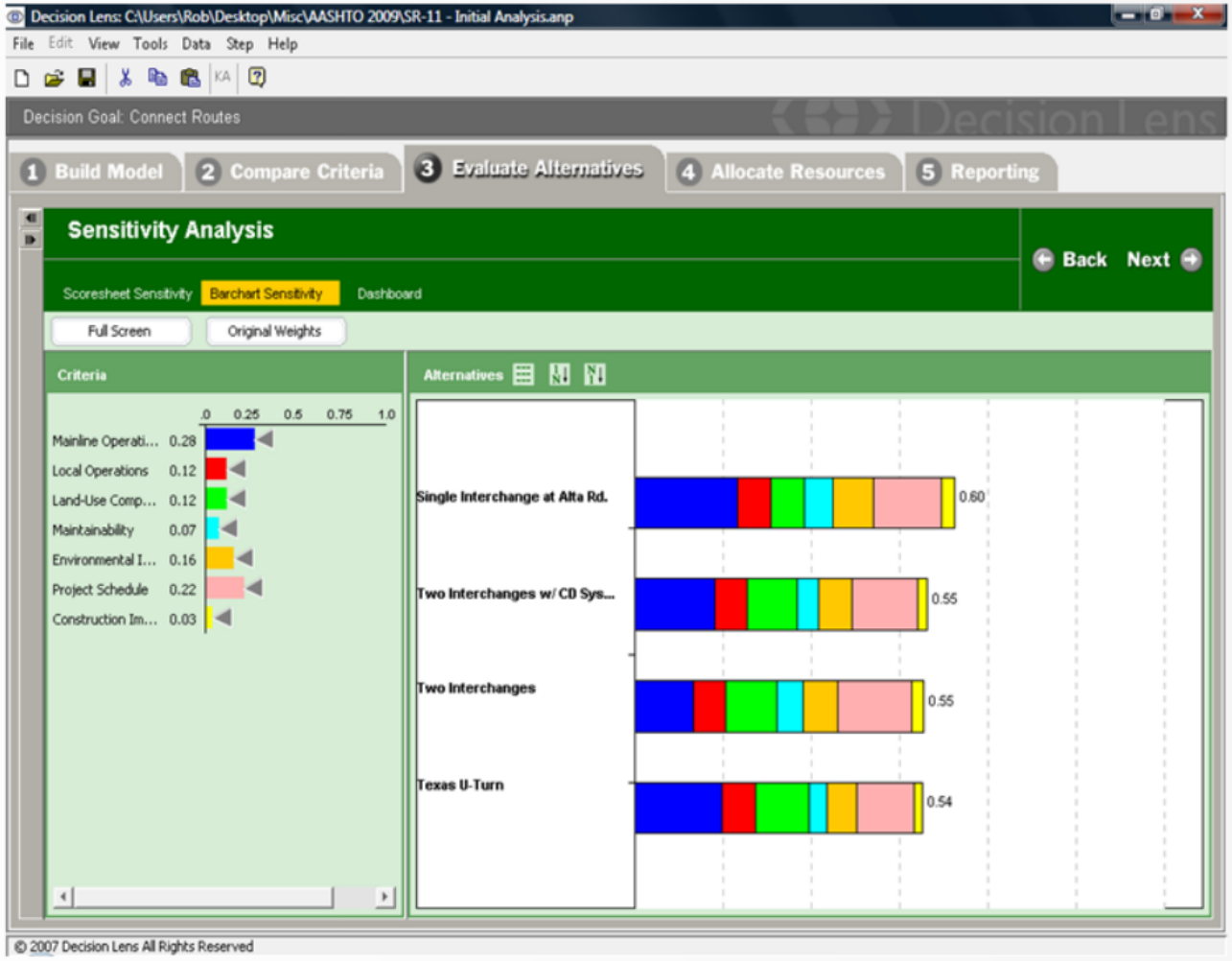
Strategy 2 and 3 appear to be nearly identical…

Schedule Values Considering Risk

Strategy 2 dominates Strategy 3



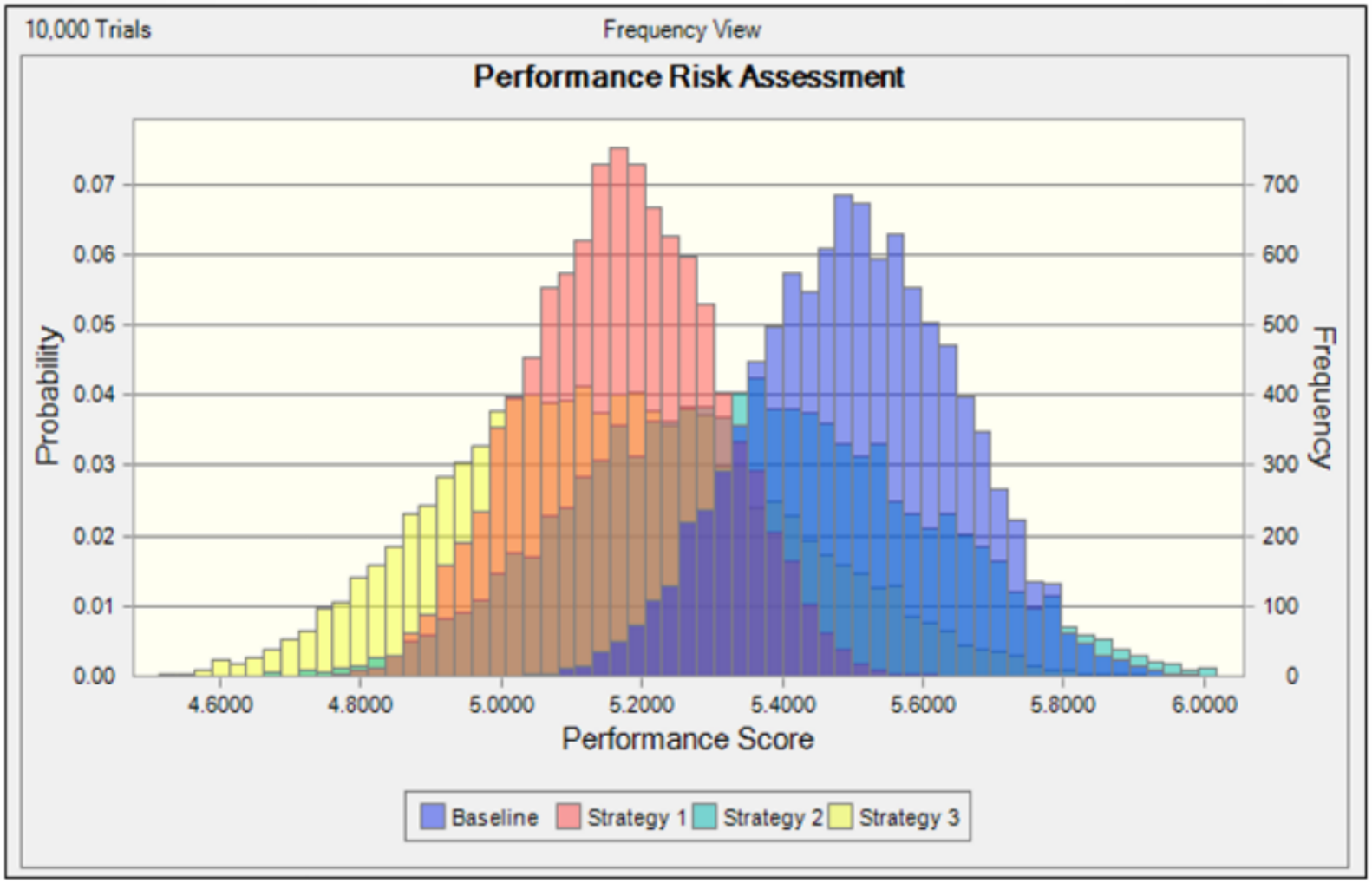
Sensitivity Analysis



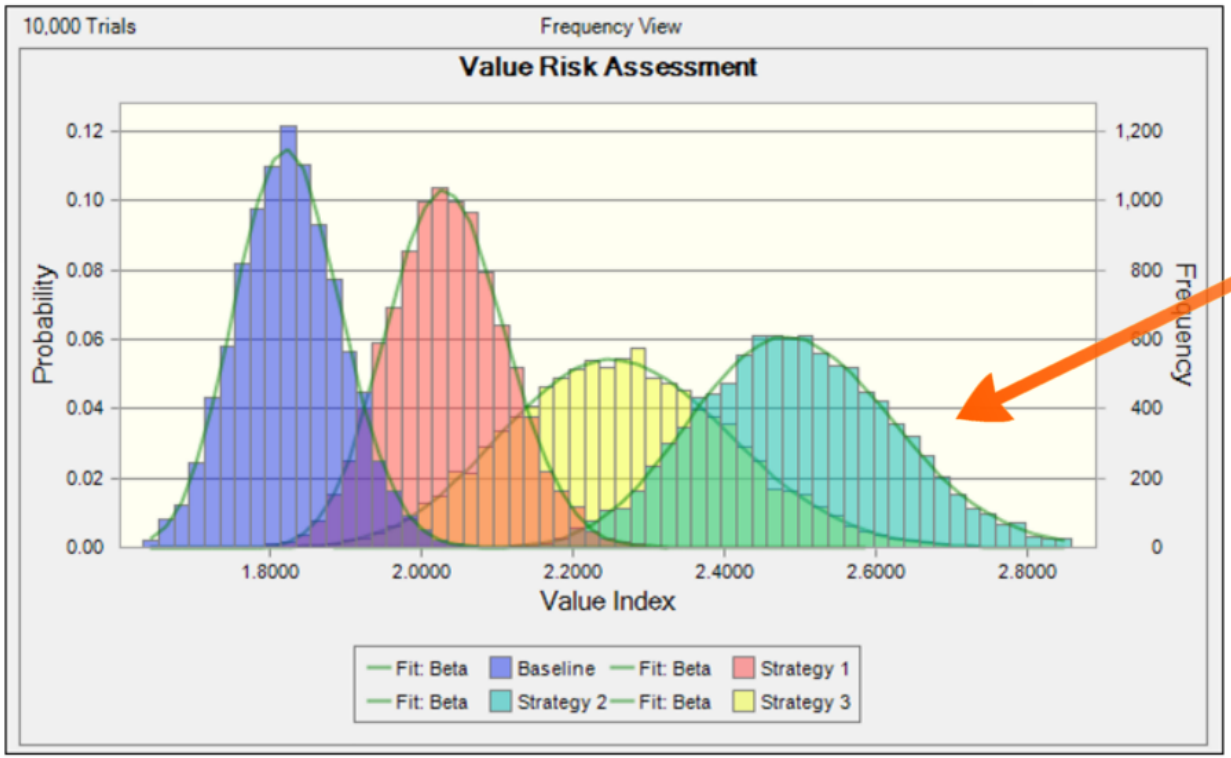
Deterministic Performance Values

	Baseline	VM Strategy 1	VM Strategy 2	VM Strategy 3
Nordahl Rd. - Traffic Ops.	0.841452	0.841452	0.841452	0.841452
Pedestrian Circulation	0.461122	0.461122	0.461122	0.461122
Bicycle Circulation	0.520668	0.520668	0.520668	0.520668
Nordahl Rd. - Geometry	0.833331	0.833331	0.833331	0.833331
Visual Impacts	0.603952	0.603952	0.603952	0.671058
Traffic Impacts to Nordahl Rd.	0.495538	0.555603	0.300326	0.300326
Traffic Impacts to SR-78	0.465260	0.474755	0.569706	0.465260
Temp. Environmental Impacts	0.122669	0.122669	0.122669	0.143460
Maintainability	0.802554	0.802554	0.802554	0.802554
TOTAL PERFORMANCE SCORES	5.15	5.22	5.06	5.04

Performance Values Considering Risk



Value Comparison Considering Risk



Strategy 2 dominates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