

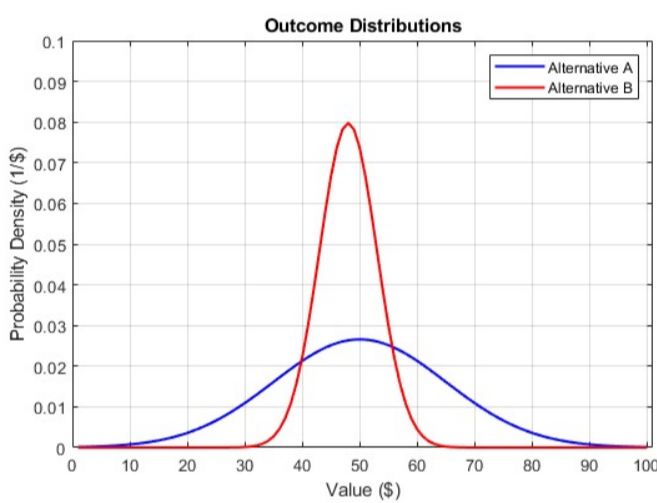
REEXAMINING THE LOGICAL FOUNDATION OF ENGINEERING DECISION MAKING UNDER UNCERTAINTY CHRISTOPHER WHITE AND BRYAN MESMER, PHD



RESEARCH TASK / OVERVIEW

- Decision-based design (DBD) often employs an **ordinal standard of validity for the value measures** used as objective functions [1].
- DBD also frequently employs expected utility methods [1], despite a **distribution mean requiring higher than ordinal validity** to produce consistent results.
- Lack of attention to unstated assumptions built into certain decision making methods can lead to **inconsistent decision making**.

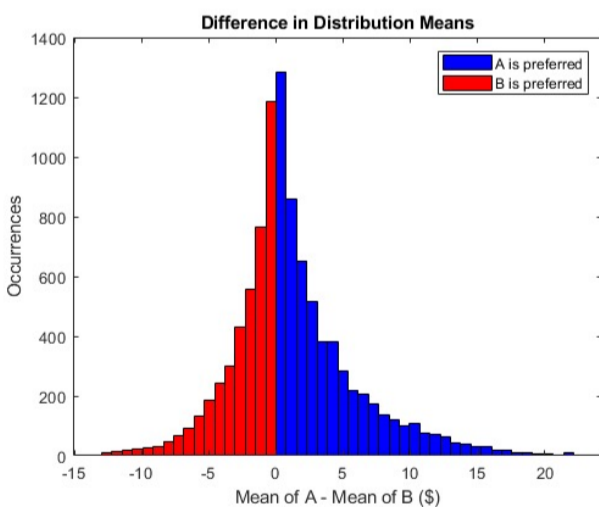
DATA & ANALYSIS



A choice between two uncertain alternatives is used as a test case.

Alternatives	Parameters	
	Mean	Standard Deviation
A	50	15
B	48	5

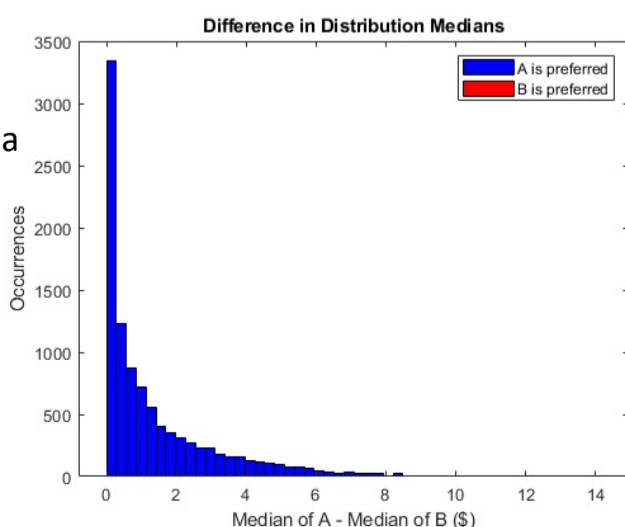
The value scale is then systematically altered through measurement scale manipulation. If the standard for validity is correctly rank-ordering the outcomes, then any of these alternate scales should be able to be used.



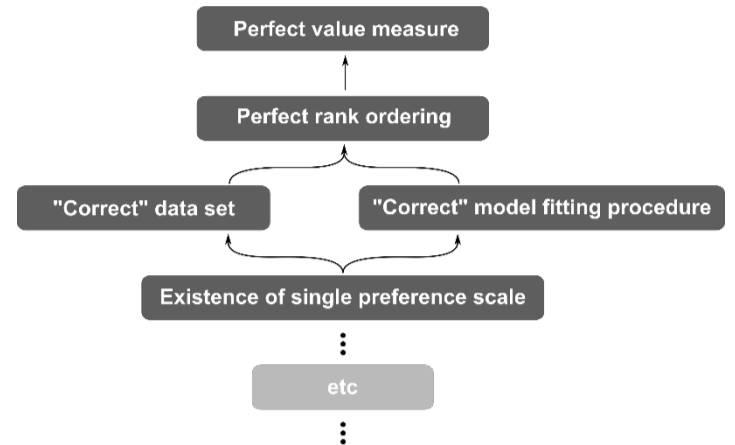
Distribution means produce inconsistent decision results.

The result of the decision relies on aspects of the model not being validated.

However, alternate decision criteria such as the **distribution median can produce consistent results under these conditions.**



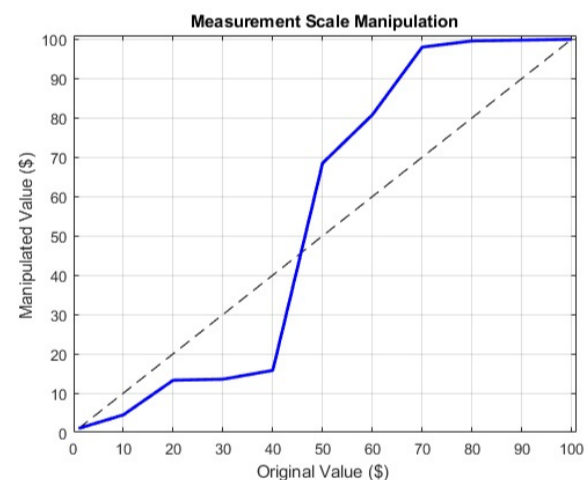
GOALS & OBJECTIVES



- Improve understanding** of what assumptions are necessary for given decision making techniques.
- Develop methods for **assessing the impact of these assumptions** on the decision making process.

METHODOLOGY

- Measurement Scale Manipulation** [2,3] is used to enforce assumptions of ordinal validity and explore alternate value scales which produce the same rank-ordering of outcomes.
- Subsections of the original value scale are **randomly expanded or contracted** to produce new value scales with the same rank-order of outcomes.



- The decision problem is then reassessed for each value scale, assessing the **impact of an assumption of perfect rank-ordering of outcomes**.

FUTURE RESEARCH

Understanding the impact of specific assumptions is extremely important for real-world applications of DBD. Practitioners with real problems do not get to choose which assumptions apply. Future directions for this work include:

- Exploring assumptions related to the creation of value models**, rather than merely assumptions about the final product.
- Further pursuing methods to **evaluate the selection of decision criteria** in DBD.

CONTACTS / REFERENCES

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- C. J. White, & B. Mesmer (2021), "Value Function Measurement Scale Manipulation for Evaluating Decision-Based Design Methodology," *CESUN 2021*.

Funding provided by NASA Systems Engineering Technical Discipline Team (SE TDT) Research and Technology (R&T)

cjw0053@uah.edu

bryan.mesmer@uah.edu