Decisions Under Uncertainty

Module 3: Information Value for Continuous Variables

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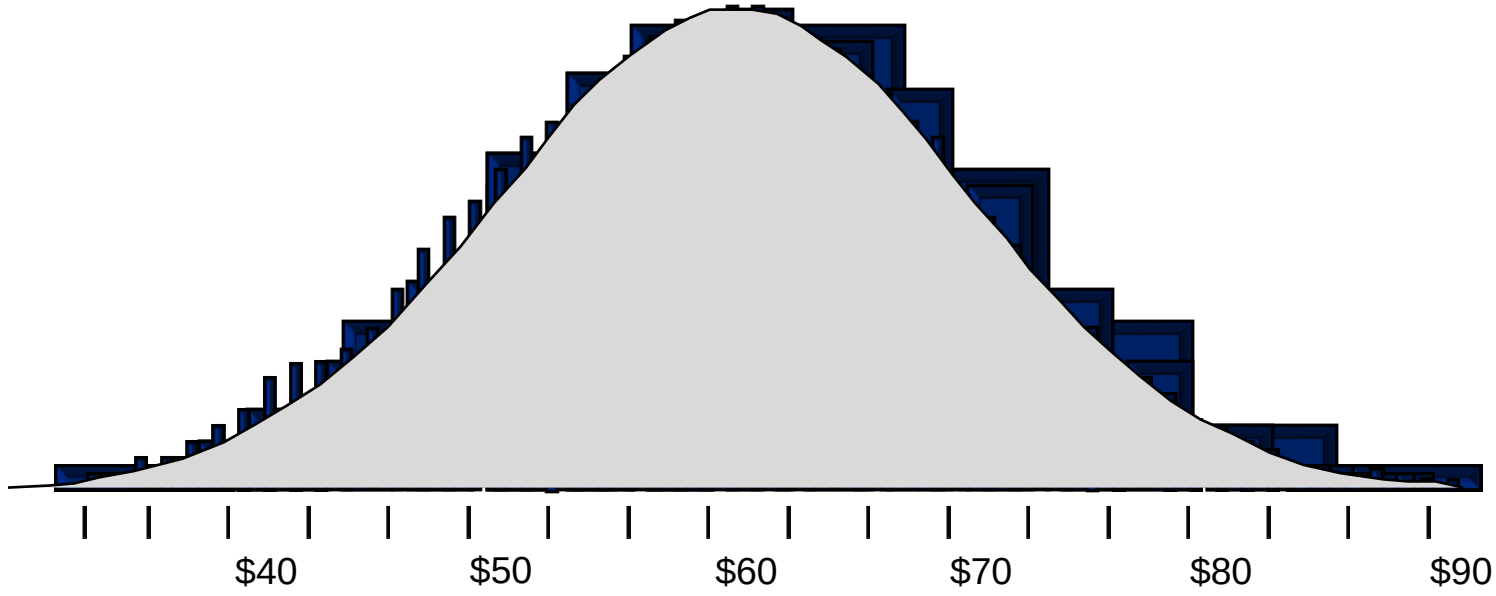
Model The Current State of Uncertainty

Constructing a Distribution

Uncertainty about “either/or” events are expressed as “discrete” probabilities (e.g., 35%).

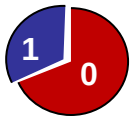
Uncertainty about continuous values can still be thought of as sets of discrete probabilities.



Model The Current State of Uncertainty

Basic Distributions

Each of these examples can be found on: **www.howtomeasureanything.com**

Distributions*	Upper & Lower Bound	Best Estimate
Binary distribution 	NA	Represents the % chance of the event occurring
Normal distribution 	Represents the "90% confidence interval"	Always half-way between upper and lower bound
Lognormal distribution 	Represents the "90% confidence interval"; the absolute lower bound of a lognormal is always 0	Always a function of the upper and lower bound
Uniform distribution 	Represents the absolute (100% certain) upper and lower bounds	NA
Triangular distribution 	Represents the absolute (100% certain) upper and lower bounds	Represents the mode; the most likely value
Beta distribution 	Generates a value between 0 and 1 based on “hits” and “misses”	The mode of a beta is (hits-1)/(hits+misses-2)

*A “●” means a “hard” stop, an “➔” arrow means unbounded

Compute the Value of Additional Information

The Value of Information

The Formula For The Value of Information:

$$EVI = \sum_{i=1}^{k} p(r_i) \max\left[\sum_{j=1}^{z} V_{1,j}\, p(\Theta_j|r_i), \sum_{j=1}^{z} V_{2,j}\, p(\Theta_j|r_i), \ldots \sum_{j=1}^{z} V_{l,j}\, p(\Theta_j|r_i),\right] - EV^*$$

OR, in its simplest form:

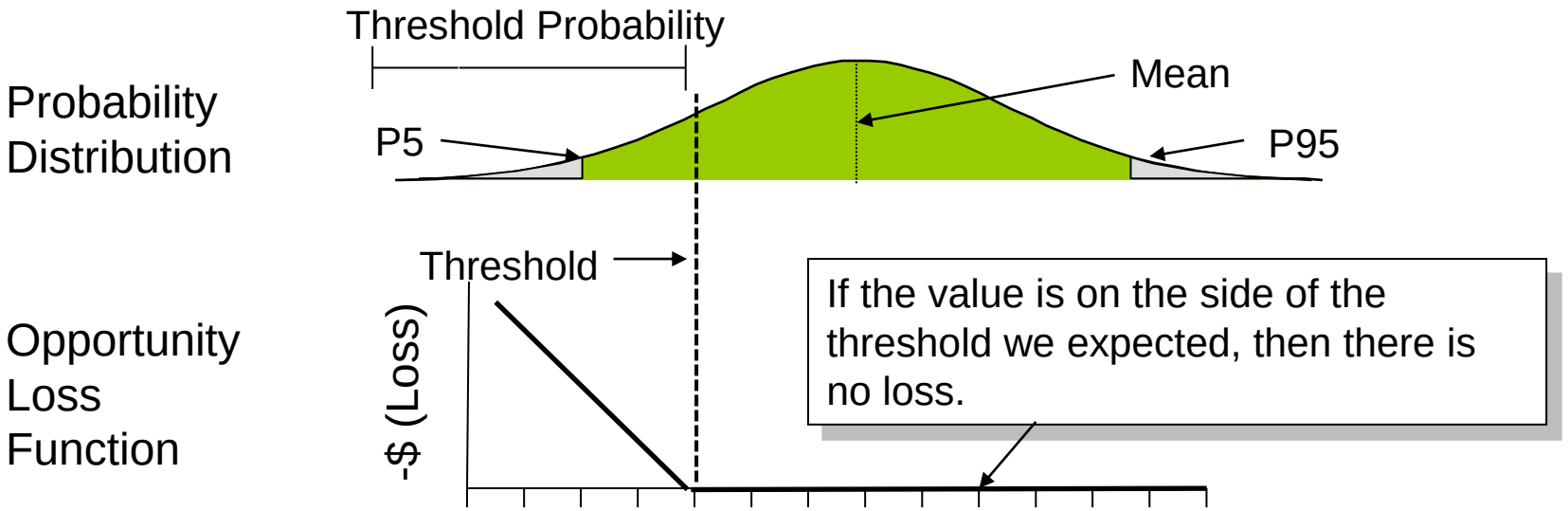
"The cost of being wrong times the chance of being wrong"

The formula for the value of information has been around for almost 60 years. It is widely used in many parts of industry and government as part of the "decision analysis" methods — but still mostly unheard of in the parts of business where it might do the most good.

Compute the Value of Additional Information

Information Value w/Ranges

- Estimate a range and distribution of hours/week spent on task
- There is a point below which investment would lose money
- The less time spent below that point, the greater the loss

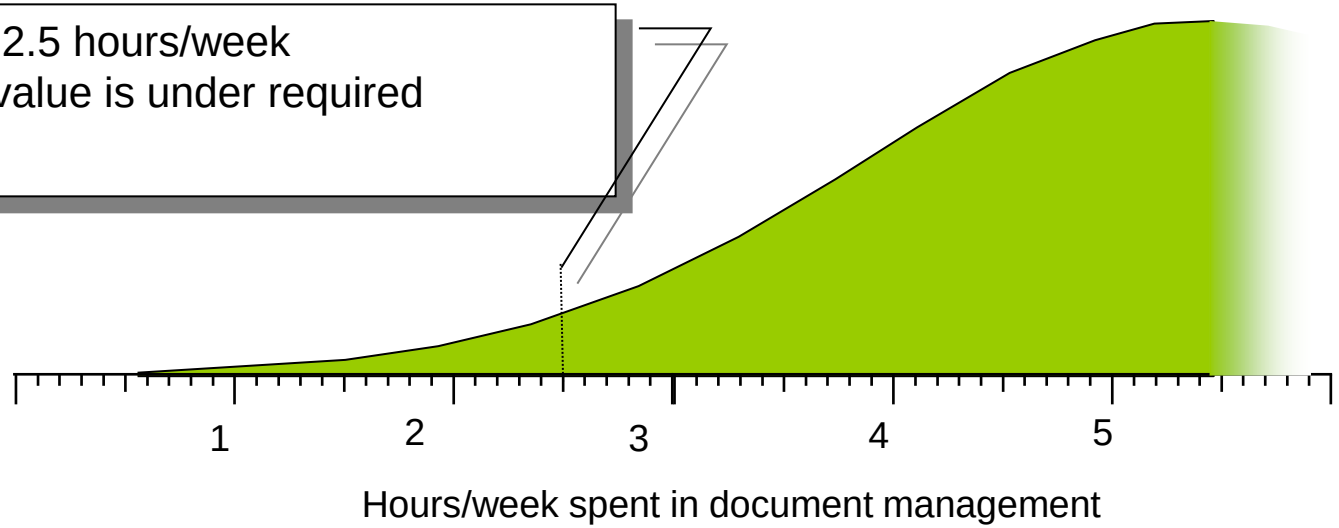


Compute the Value of Additional Information

Normal Distribution Information Value

- The “expected value” of the variable is the mean of the range of possible values.
- A threshold is a point where the value just begins to make some difference in a decision — a breakeven.
- The expected value is on one side of the threshold.
- If the true value is on the opposite side of the threshold from the mean then the best decision would have been different then one based on the mean.
- The “Threshold Probability” is the chance that this variable could have a value that would change the decision.

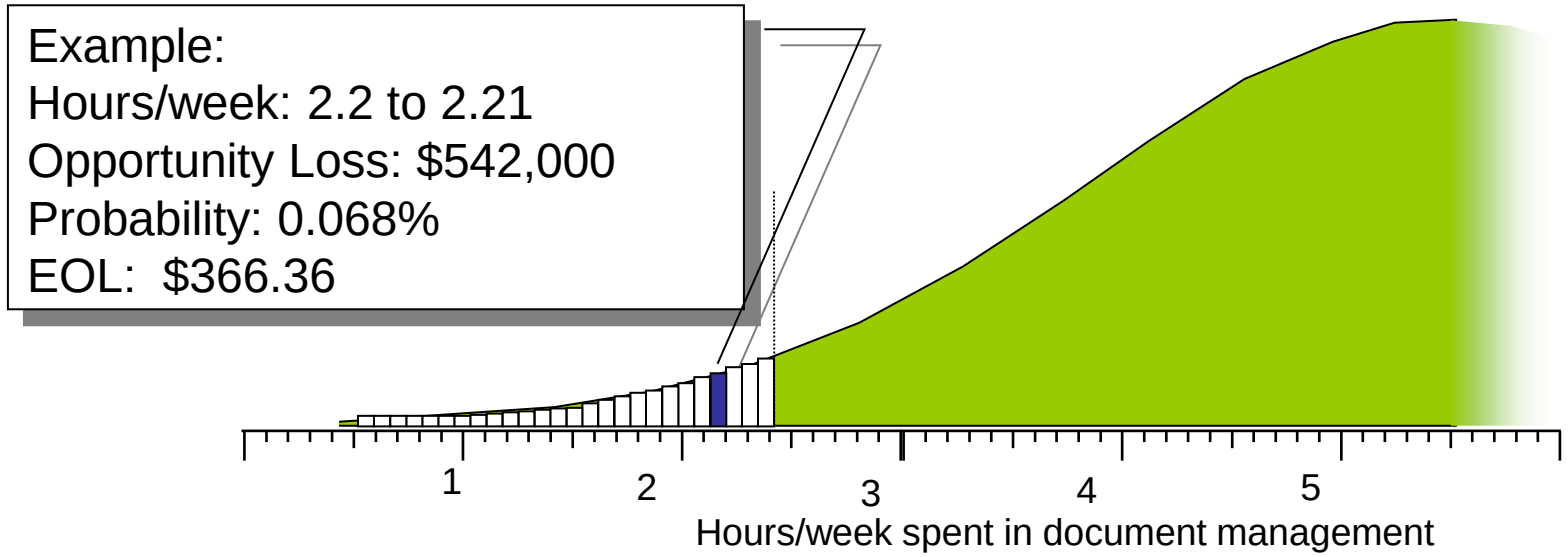
Example Threshold: 2.5 hours/week
Probability that true value is under required threshold: 8.5%



Compute the Value of Additional Information

Normal Distribution Value of Information Analysis (VIA)

- The curve on the other side of the threshold is divided up into hundreds of “slices.”
- Each slice has an assigned quantity (such as a potential productivity improvement) and a probability of occurrence.
- For each assigned quantity, there is an Opportunity Loss.
- Each slice’s Opportunity Loss is multiplied by probability to compute its Expected Opportunity Loss.



Compute the Value of Additional Information

Normal Distribution VIA (Continued)

- Total EOL for all slices equals the EOL for the variable.
- Since EOL=0 with perfect information, then the Expected Value of Perfect Information (EVPI) = sum(EOLs).
- Even though perfect information is not usually practical, this method gives us an upper bound for the information value, which can be useful by itself.
- Many of the EVPIs in a business case will be zero.
- We do this with a macro in Excel but it can also be estimated.