Optimizing Risk Decisions with Imperfect Data

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## Abstract

In any integrity management program, there are always competing alternatives for any decision, such as to dig or not to dig an anomaly, replace or not replace. If perfect information were always available similar to a math problem where everything is given except the answer, risk engineers would be an unnecessary expense. Barring perfect information, the alternative option could be an exhaustive corpus of data with frequencies of every outcome and condition combination. However, in all but the most trivial cases, neither of these exist, and the engineer is dealt partial, imperfect information where the true state of nature is uncertain. To deal with this uncertainty in everyday life people develop heuristics, mental shortcuts that allow us to process this information with minimal effort and time. But when the probabilities are imprecise, the decisions based on these shortcuts can be fraught with biases and fallacies. However, all decisions carry some amount of risk which is dependent on the (uncertain) true state of nature, and the potential loss associated with each action.

This paper will demonstrate an innovative application of decision theory that incorporates existing knowledge with observations to quantify the tradeoffs of competing alternatives in an integrity management program to arrive at a decision that minimizes the risk based on the state of knowledge at that given time.

# Introduction

Two people of equal experience shown the same data can come to different conclusions. Why is that?

Any decision involves the following things:

* The true but uncertain state of nature
* The potential loss (or gain) for each combination of selected state and outcome
* Some sort of observation with some level of uncertainty