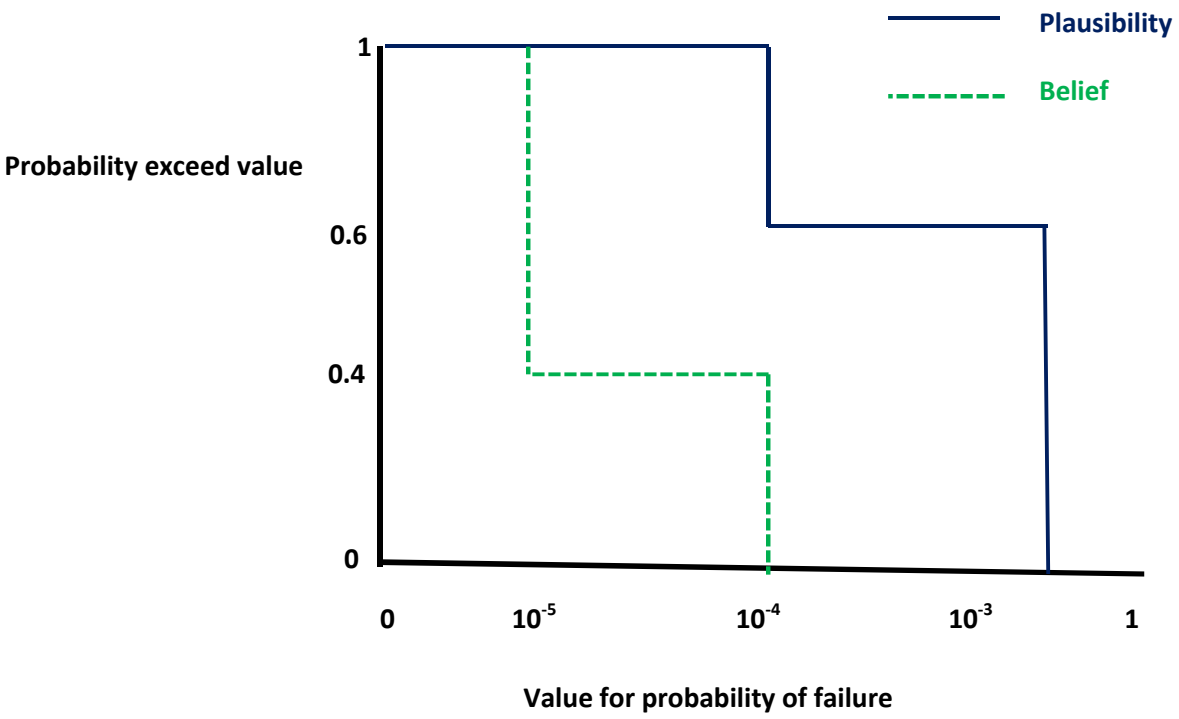
SAND2015-3194PE

Homework Problems for
NST 560:
Surety and Reliability Analysis Techniques that Estimate Uncertainty
Part 3: Belief and Plausibility

NST560 Problem 3-1.

Consider the following (subjective) probability of exceedance for the value for the (objective)probability of failure of a component.



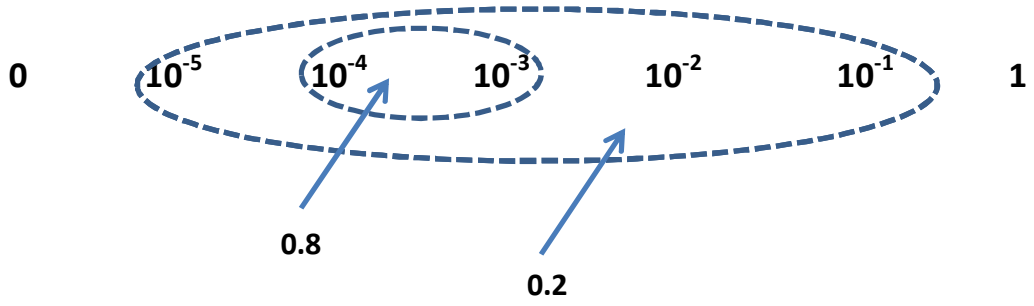
At the value 10^{-4} the plausibility changes from 1.0 to 0.6, and the belief changes from 0.4 to 0. So to be technically precise, the belief/plausibility of ***exceeding*** 10^{-4} is 0.4/0.6. However, we should report the belief/plausibility of exceeding 10^{-4} as 0.4/1. Why?

NST560 Problem 3-2.

(a) Can a singleton (subset with one element) have zero evidence assigned to it and have belief greater than zero?
(b) Can a subset that is not a singleton have zero evidence assigned to it and have belief greater than zero?
(c) Can a singleton (subset with one element) have zero evidence assigned to it and have plausibility greater than zero?
(d) Can a subset that is not a singleton have zero evidence assigned to it and have plausibility greater than zero?

NST560 Problem 3-3.

The following evidence is assigned to the probability that a switch spuriously closes during an abnormal environment.

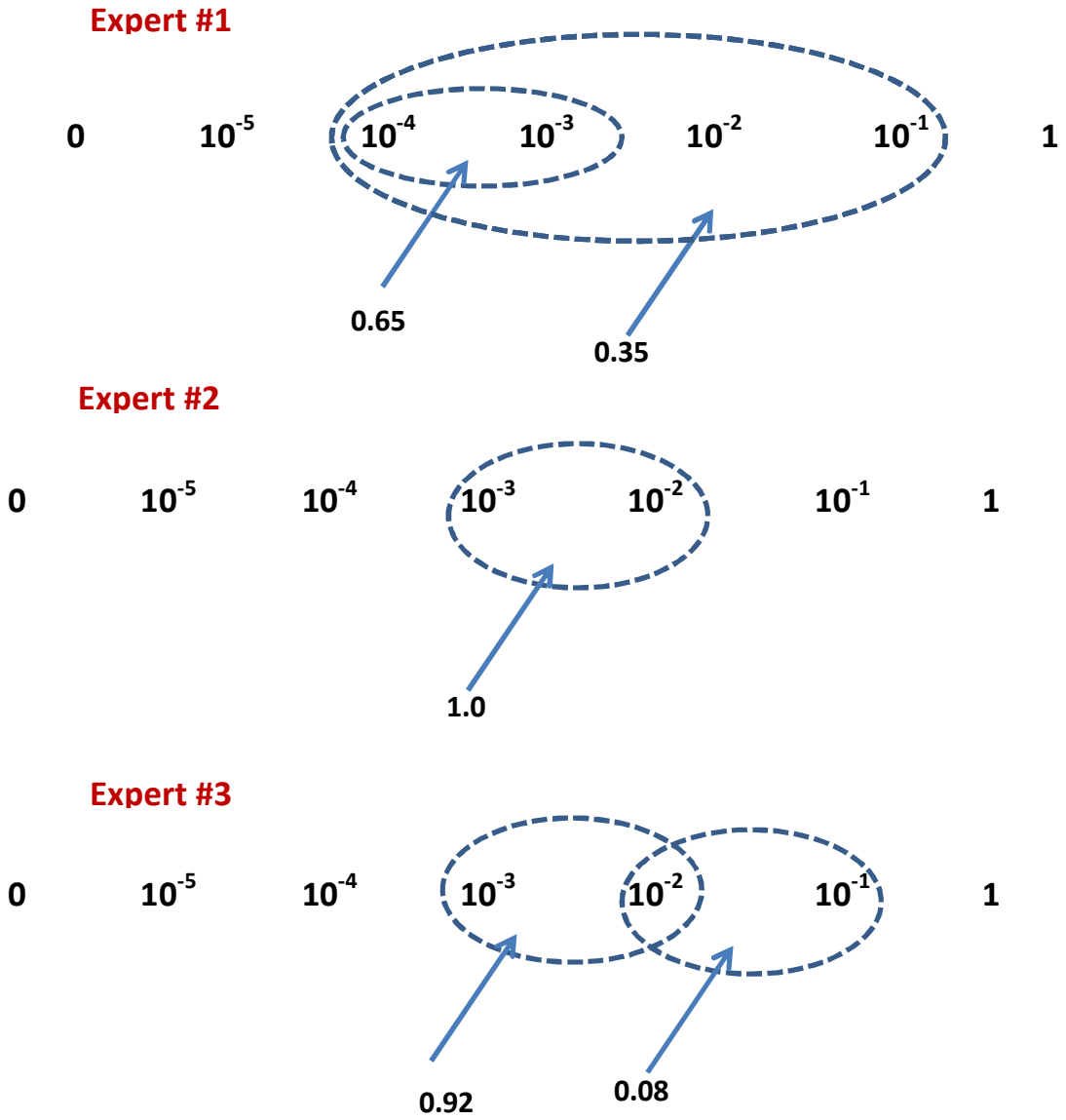


A cut set for overall failure consists of three identical switches failing. Assume each switch has the same probability of failure (100% correlated).

a. What is the evidence for failure of all three switches?
b. What is the belief/plausibility that failure of all three switches exceeds 10^{-5}?
c. What type of failure that we discussed in NST560 part 1 could greatly increase the probability that all three switches fail?

NST560 Problem 3-4.

Three experts assign the following evidence for the probability of failure of a component to operate on demand.



The evidence from experts 1 and 2 are weighted equally, and the evidence from expert 3 is weighted with half the weight of expert 1.

a. What is the evidence for all experts combined into one pooled assignment of evidence?
b. Using the pooled evidence, plot the belief/plausibility of exceedance.
c. What is the probability that the value for the probability of failure exceeds 10^{-3}?

NST560 Problem 3-5.

You have the following information about a coin. Two tosses were both tails.

a. Based on this information, subjectively assign evidence for the probability the coin is heads.
b. Using this evidence, plot the probability of exceedance for the probability the coin is heads.
c. Using this evidence, plot the probability of exceedance for the probability the coin is tails.

NST560 Problem 3-6.

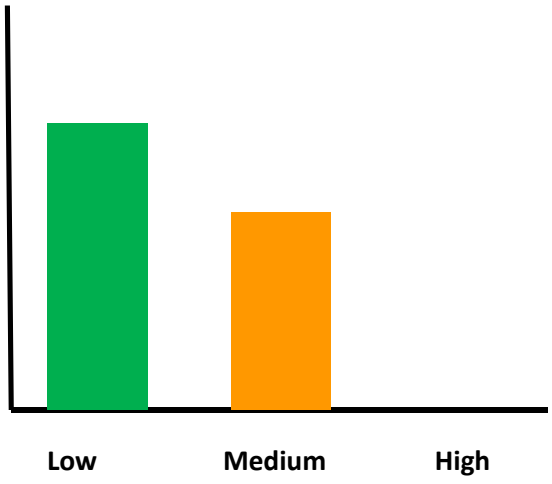
Suppose a number of terrorist scenarios have been evaluated for risk, considering the risk to be Low, Medium, or High.

The scenarios are ranked from most to least concern as discussed in the lecture. Specifically, outcomes from worst to least severe risk are successively considered, and within each outcome scenarios with non-zero plausibility are ranked by highest plausibility, sub ranked by highest belief.

Consider the following six scenarios.

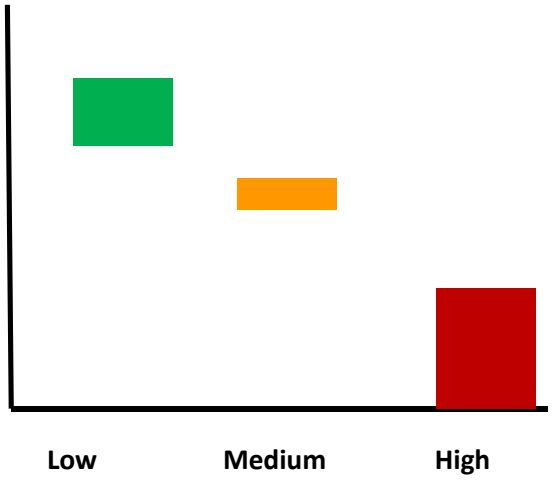
Scenario A

Probability for Severity of Risk as a belief to plausibility interval



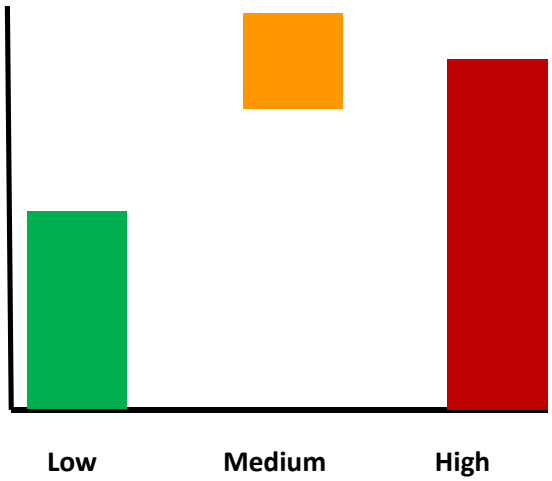
Scenario B

Probability for Severity of Risk as a belief to plausibility interval



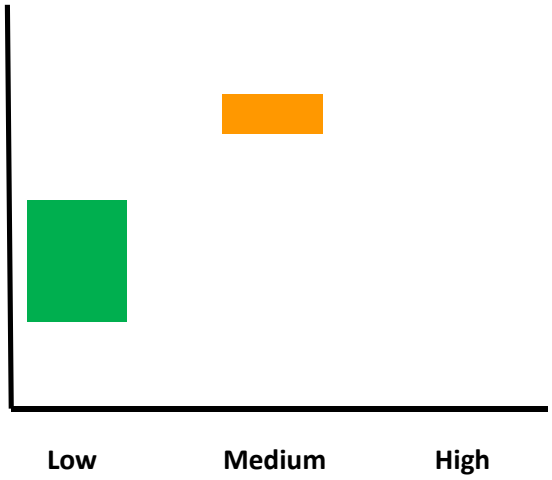
Scenario C

Probability for Severity of Risk as a belief to plausibility interval



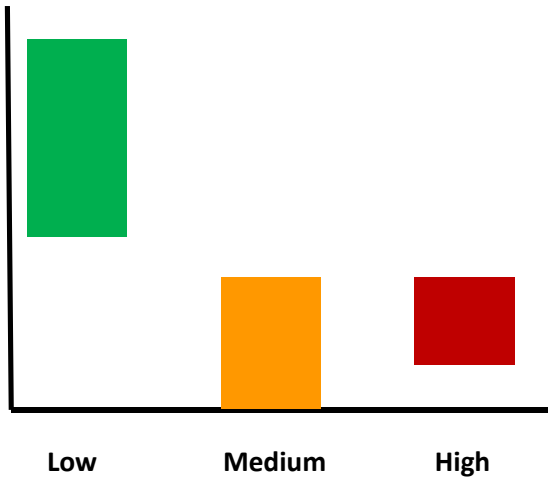
Scenario D

Probability for Severity of Risk as a belief to plausibility interval



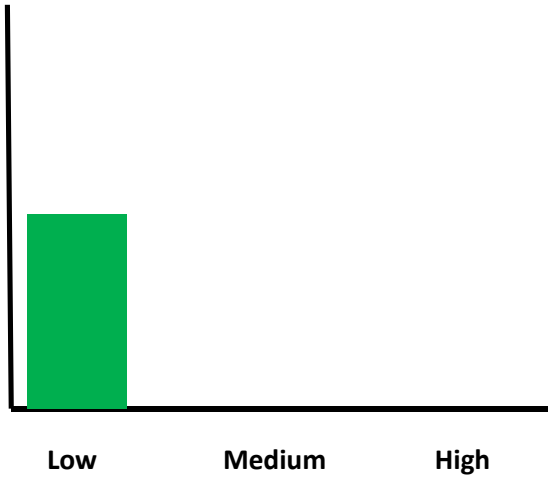
Scenario E

Probability for Severity of Risk as a belief to plausibility interval



Scenario F

Probability for Severity of Risk as a belief to plausibility interval



The plausibility for “High” is the same for scenarios B and E. Provide the ranking of these six scenarios from highest to lowest concern.