

# Uncertainty and Risk

## Key Concepts & Terminology And As Used In Applications

### Uncertainty- definitions

In its broadest use, a state of mind characterized by various emotions such as:

- Caution, hesitation and delay
- Indecision and Anxiety
- Mistrust and skepticism
- Ambiguity
- Fear and trepidation
- “Wonder” and Other emotions

**Uncertainty** is the lack or absence of certainty, or a reduced state of knowledge. Results are only “probable” at best, particularly in the short term

**Uncertainty** can apply to the present the past and the future. It generally applies in somewhat different ways to a wide variety of differing fields including: physics and engineering, economics, finance and investment, insurance, psychology, sociology world events, philosophy, statistics and information science, general “news” and information.

**Uncertainty** Generally relates to statements about:

1. Future events or states given present evidence
2. Past events or states given current historical data
3. Present events or states given present available evidence.

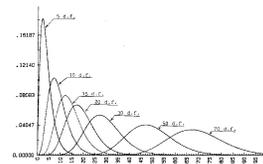
### Examples of uncertainty

- Heisenberg uncertainty principle (Physics)
- Measurement uncertainty (statistics, metrology).

Type A - statistical

Type B – All other aspects

- The “propagation of uncertainty” (in engineering models)
- In medical diagnosis
- In financial matters
- In a product’s performance – Quality.
- About natural events (e.g. weather related)
- Uncertainty about what we hear, read about or what is reported in the news.
- Uncertainty about past events – what is in fact true.
- Moral Uncertainty – subjective, emotive

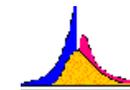


### Relation to probability and statistics

- Statistics generally tries to solve the problem of what happens and how often.
- “Data” refers to past experience.
- Statistical theory, together with data, fuels statistical inference and prediction.
- Common themes concerning uncertainty in statistics include: *standard deviation*, *standard error*, *margin of error*, *sampling error*, *scatter*, and *spread*. Each of these concepts measures uncertainty in some degree.

### Important Tools and concepts

- Confidence Interval
- Prediction interval
- Tolerance interval
- Point estimates
- Probability plots
- Key continuous distributions: Normal, lognormal, Weibull, exponential, extreme value, gamma.
- Key discrete distributions: binomial, Poisson, geometric, hypergeometric
- Bayesian Statistics
- Monte Carlo simulation
- Probability and conditional probability
- Expert testimony



## RISK

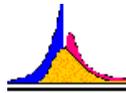
### *“The effect of Uncertainty on Objectives”*

#### *ISO Guide 73*

*An Objective is generally what is desired or planned.*

*NOTE 1: An effect is a deviation from the expected—positive and/or negative.*

*NOTE 2: Objectives can have different aspects (such as financial, health and safety, and environmental goals) and can apply at different levels (such as strategic, organization-wide, project, product and process).*



#### *Standards:*

ISO Guide 73 (2009) Risk management, Vocabulary, or ANSI Z690.1-2011 Vocabulary for Risk Management.

ISO 31000 (2009) Risk Management: Principles and Guidelines, or ANSI Z690.2-2011 Risk Management Principles

ISO 31010 (2009) Risk Management Assessment Techniques, or ANSI Z690.3-2011 Risk Assessment Techniques

### *General Considerations*

1. Three important components of Risk: 1) what can happen (events); 2) how often (probability, statistical); 3) with what consequence (loss/cost).
2. “context” means the specific application and this may vary greatly from one area to another.
3. *Likelihood* – Chance of something happening, ISO Guide 73. NOTE 1: In risk management terminology, the word “likelihood” is used to refer to the chance of something happening, whether defined, measured or determined objectively or subjectively, qualitatively or quantitatively, and described using general terms or mathematically [such as a probability or a frequency over a given time period].
4. *Risk Management*: “. . . the treatment of risk in organizations involves, systematic application of management policy, procedures and practices to the activities of communicating, consulting, establishing the context and identifying, analyzing, evaluating, treating, monitoring and reviewing risk”. (ANSI/ASSE Z690.1 2011)
5. *GENERAL PROCESS*: Policy; context; identification, analysis and evaluation, assessment, treatment, communication, monitoring and review, recording and documentation.

6. *FRAMEWORK*: mandate and commitment, policy, accountability, integration, resources, communication, implementation, improvement.

#### *Key assessment tools/methodology*

1. **Statistics** – The careful collection of data on past performance. The record of what has already happened.
2. **Expert testimony and scientific knowledge**
3. **Probability** – The mathematics of likelihood.
4. **Mathematical modeling** – The integration of data, science, statistics and probability theory to model a specific situation in theory.
5. **Simulation** – the imitation or artificial realization of a mathematical model over time.
6. **Forecasting** – prediction of what might happen, how often and with what consequence.
7. **Scenario modeling** – adjustments to models as related to changes in assumptions.