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A 4 Day Course on  
**Info-Gap Theory and Its Applications**

17–20 August 2015  
Charles Sturt University  
Wagga Wagga, Australia

**Course Rationale** Scientists, engineers, policy planners and analysts use measurements and science-based models to design systems, evaluate reliability, and make plans and policies. However, models may be simpler than reality, causal factors may be unknown, measurements may err or be incomplete, and systems may change over time in unknown ways. Probability is useful for modeling and managing some of these uncertainties. However some uncertainties are *info-gaps*: disparities between what *is known* and what *needs to be known* in order to make good decisions. For instance, we sometimes do not know the correct probability distribution or all of the relevant physical mechanisms such as non-linearities or time dependencies. This course studies info-gap theory for modeling and managing uncertainties in planning, design and decision problems. The course emphasizes the added value of an info-gap analysis as well as its limitations, and the integration of info-gap theory with probabilistic analysis.

**Course Structure** This course has three components. *Lectures* use simple examples to illustrate the info-gap method for analyzing risk and prioritizing choices when faced with severe uncertainty. *Exercises* help the participants to master the operational aspects of info-gap theory. The first two days are devoted to lectures and exercises. The last two days are devoted to *mini-projects* that are formulated and implemented by the participants, in small groups, on topics of their choice such as simplified versions of projects they work on elsewhere. This facilitates the internalization of the concepts and methods learned, their integration with other methods familiar to the participants, and their application to problems of interest to the participants.

**The Instructor** Yakov Ben-Haim initiated and developed info-gap decision theory for modeling and managing severe uncertainty. Info-gap theory is applied in engineering, biological conservation, economics, project management, climate change management, national security, medicine, and other areas. He has been a visiting scholar in Australia, Austria, Canada, England, France, Germany, Italy, Japan, Korea, Netherlands, Norway, and the US. He has lectured at universities, medical and technological research institutions and central banks around the world. He has published more than 90 articles and 5 books. He is a professor of mechanical engineering and holds the Yitzhak Moda'i Chair in Technology and Economics at the Technion—Israel Institute of Technology.

**The Participants** Scientists, engineers and analysts involved in risk analysis, reliability assessment, policy selection, planning and design in environmental science, engineering, project management, economics, national security, health including food safety and epidemiology.

## Schedule

### Day 1 Monday 17 August 2015

#### MORNING

08:30–09:20 *Lecture 1. Risk analysis with severe uncertainty.*

09:30–10:20 *Lecture 2. Policy selection.*

10:20–10:40 Coffee break.

10:40–11:30 *Lecture 3. Surveillance and monitoring.*

LUNCH 11:30–13:00

#### AFTERNOON

13:00–13:50 *Exercise. Betting (but you're unsure of the probabilities).*

14:00–14:50 *Exercise. Choosing among policies with uncertain outcomes.*

14:50–15:10 Coffee break.

15:10–16:00 *Exercise. Project cost management.*

### Day 2 Tuesday 18 August 2015

#### MORNING

08:30–09:20 *Lecture 4. Optimizer's Curse: An Info-Gap Response.*

09:30–10:20 *Lecture 5. Info-Gap Statistics.*

10:20–10:40 Coffee break.

10:40–11:30 *Lecture 6. Forecasting.*

LUNCH 11:30–13:00

#### AFTERNOON

13:00–13:50 *Exercise. Transportation network.*

14:00–14:50 *Exercise: Robustness and opportuneness of failure probability.*

14:50–15:10 Coffee break.

15:10–16:00 *Exercise. In-house or out-source?*

### Day 3 Wednesday 19 August 2015

#### MORNING

08:30–11:30 *Brain-storm and initiate mini-projects.*

LUNCH 11:30–13:00

#### AFTERNOON

13:00–16:00 *Guided independent work on mini-projects.*

### Day 4 Thursday 20 August 2015

#### MORNING

08:30–10:00 *Guided independent work on mini-projects.*

10:00–11:30 *Preliminary reports on mini-projects.*

LUNCH 11:30–13:00

#### AFTERNOON

13:00–16:00 *Guided independent work on mini-projects.*

## **Selected Sources: Info-gap theory and applications**

### **Books:**

1. Yakov Ben-Haim, 2006, *Info-gap Decision Theory: Decisions Under Severe Uncertainty*, 2nd edition, Academic Press, London.
2. Yakov Ben-Haim, 2010, *Info-Gap Economics: An Operational Introduction*, Palgrave.

### **Foundations of info-gap theory:**

3. Yakov Ben-Haim, 2012, Doing Our Best: Optimization and the Management of Risk, *Risk Analysis*, 32(8): 1326–1332.
4. Yakov Ben-Haim, 2012, Why risk analysis is difficult, and some thoughts on how to proceed, *Risk Analysis*, 32(10): 1638–1646.
5. Barry Schwartz, Yakov Ben-Haim, and Cliff Dacso, 2011, What Makes a Good Decision? Robust Satisficing as a Normative Standard of Rational Behaviour, *The Journal for the Theory of Social Behaviour*, 41(2): 209–227.

### **Environmental protection:**

6. Jim W. Hall, Robert J. Lempert, Klaus Keller, Andrew Hackbarth, Christophe Mijere, and David J. McInerney, 2012, Robust Climate Policies Under Uncertainty: A Comparison of Robust Decision Making and Info-Gap Methods, *Risk Analysis*, 32(10): 1657–1672.
7. Dylan R. Harp and Velimir V. Vesselinov, 2013, Contaminant remediation decision analysis using information gap theory, *Stochastic Environmental Research and Risk Assessment*, 27(1): 159–168.
8. Yemshanov, Denys, Frank H. Koch, Yakov Ben-Haim and William D. Smith, 2010, Detection capacity, information gaps and the design of surveillance programs for invasive forest pests, *Journal of Environmental Management*, 91: 2535–2546.

### **Public policy:**

9. Yakov Ben-Haim, Craig Osteen and L. Joe Moffitt, 2013, Policy Dilemma of Innovation: An Info-Gap Approach, *Ecological Economics*, 85: 130–138.

### **Security:**

10. Yakov Ben-Haim, 2014, Strategy selection: An info-gap methodology, *Defense & Security Analysis*, 30(2): 106–119.
11. Lior Davidovitch and Yakov Ben-Haim, 2008, Is your profiling strategy robust? *Law, Probability and Risk*, 10: 59–76.

### **Medicine:**

12. Yakov Ben-Haim, Nicola M. Zetola and Clifford Dacso, 2012, Info-Gap Management of Public Health Policy for TB with HIV-Prevalence, *BMC Public Health*, 12: 1091.

DOI: 10.1186/1471-2458-12-1091, URL: <http://www.biomedcentral.com/1471-2458/12/1091>

### **Failure detection:**

13. M.Pasquali, C.J.Stull and C.R.Farrar, 2015, Info-gap robustness of an input signal optimization algorithm for damage detection, *Mechanical Systems and Signal Processing*, 50–51: 1–10.

### **Info-gap statistics:**

14. Yakov Ben-Haim, 2011, Interpreting null results from measurements with uncertain correlations: An info-gap approach, *Risk Analysis*, 31(1): 78–85.

### **Engineering design:**

15. Korteling, B., Dessai, S., Kapelan, Z., 2012, Using information-gap decision theory for water resources planning under severe uncertainty, *Water Resources Management*, 27(4): 1149–1172.
16. David Hambling, 5 Sept. 2012, Self-Defense for the Self-Driving Car, *Popular Mechanics*, Online version:  
<http://www.popularmechanics.com/military/a8093/self-defense-for-the-self-driving-car-12410682/>  
Selection from article: <http://tx.technion.ac.il/~yakov/IGT/hambling2012selection.html>

**More references, background material, links:** <http://info-gap.com>