

Dr. Yakov Ben-Haim
Professor
Yitzhak Moda'i Chair in
Technology and Economics



Technion
Israel Institute of Technology
Faculty of Mechanical Engineering
Haifa 32000 Israel

<http://info-gap.com> <http://yakovbh.net.technion.ac.il>
Tel: +972-4-829-3262, +972-50-750-1402 Fax: +972-4-829-5711
yakov@technion.ac.il

Four-Day Short Course on Info-Gap Theory and its Applications

Department of Electrical and Computer Engineering
Rice University
Houston, Texas

This document outlines an intensive 4-day short course on info-gap theory and its applications that is intended to give the participants a basic competence in the info-gap analysis of decision making under severe uncertainty. This course has three components. *Lectures* present new material and *exercises* help the participants to master this material. The first two days are devoted to lectures in the mornings and exercises in the afternoons, 3 hours of each. The last two days are devoted to *mini-projects* that are formulated and implemented by the participants individually or in small groups. Each mini-project entails the info-gap analysis of a highly simplified version of the problem that you are really interested in working on. This facilitates the thorough internalization of the concepts and methods learned, their integration with other methods familiar to the participants, and their application to problems of interest. I will present the lectures, as well as accompany the group as they work on the exercises and develop their mini-projects.

With the skill and understanding that you have acquired in the short course, you are ready to being developing a full-scale info-gap robust-satisficing decision analysis of the real problem of interest. You may also wish to explore opportune-windfalling. I am in Houston until the end of April to help you along in this process, and available afterwards by e-mail.

On the next page you will find a schedule of the four days of lectures, exercises and mini-project activity. The final page contains citations of many source materials.

The website for this course can be found here: <http://info-gap.net.technion.ac.il/rice-short-course2017/>

Program of the 4-day info-gap short course.

1. Day 1. Monday 13 March 2017

(a) Morning: Lectures, DH1044.

09:00–09:50: Preliminary examples of info-gap robust-satisficing.¹

10:00–10:50: Continuation of preliminary examples.

11:00–11:50: Info-gap robust-satisficing and opportune-windfalling analysis of estimation problems.²

(b) Afternoon: Exercises, DH1049

15:45–16:35: Machine efficiency.³

16:45–17:35: Uncertain lotteries.⁴

17:45–18:35: Tichonov estimation with model uncertainty.⁵

2. Day 2. Wednesday, 15 March 2017

(a) Morning: Lectures, DH1049

09:00–09:50: Continuation of estimation problems.

10:00–10:50: Info-gapping the Poisson process.⁶ Search and evasion.⁷

11:00–11:50: Glimpse at some advanced ideas from among the following:

(1) Proxy theorems: robustness and probability of success.⁸

(2) Why are info-gap models of uncertainty (almost) always convex?⁹

(3) Min-max and robust-satisficing: how they differ and when they agree.¹⁰

(b) Afternoon: Exercises, DH2014

17:00–17:50: Robustness and opportuneness of failure probability.¹¹

18:00–18:50: Search and evasion.¹²

19:00–19:50: Supply network.¹³

3. Day 3. Tuesday, 21 March 2017, DH1044

09:00–09:30: Brainstorming on mini-projects. Form working groups.

09:30–12:00: Work on mini-projects in a common workspace. Assistance from Yakov.

13:00–16:00: Continue working on mini-projects.

4. Day 4. Thursday 23 March 2017

09:00–11:30, DH3076: Continue working on mini-projects.

11:30–12:00, DH3076: Brief (5–10 minute) presentations of preliminary results.

14:30–17:30, DH1044: Continue working on mini-projects. Write up results.

¹Lecture Notes on Robustness and Opportuneness, file ro02.pdf, sections 1 and 2, pp.3–17.

²Lecture Notes on Info-Gap Estimation and Forecasting, file estim02.pdf, sections 1, 3 and 4, pp.3–9, 23–28, 30–34.

³#26 in Problem Set on Robustness and Opportuneness, file ps2-02.pdf, p.24 (p.165).

⁴#27 in Problem Set on Robustness and Opportuneness, file ps2-02.pdf, p.25 (p.166).

⁵#43 in Problem Set on Robustness and Opportuneness, file ps2-02.pdf, p.40 (p.189–190).

⁶Lecture Notes on Hybrid Uncertainties, file: hybunc002.pdf, section 1, pp.3–11; parts of section 2, pp.12–30.

⁷Lecture Notes on Robustness and Opportuneness, file ro02.pdf, section 13, pp.57–59.

⁸Lecture Notes on Robust-Satisficing Behavior, file: rsb02.pdf, sections 6.1 and 6.2, pp.24–28.

⁹Lecture Notes on Info-Gap Uncertainty, file: igunc.pdf, section 7, pp.26–28.

¹⁰Lecture Notes on Decisions, Decisions, Decisions, file: rice2017lectures001.pdf, section 8, pp.91–102.

¹¹#46 in Problem Set on Robustness and Opportuneness, file ps2-02.pdf, p.43 (pp.194–195).

¹²#50 in Problem Set on Robustness and Opportuneness, file ps2-02.pdf, p.46 (pp.199–200).

¹³#73 in Problem Set on Robustness and Opportuneness, file ps2-02.pdf, pp.79–80 (pp.256–258).

Source material.

1. **Background reading material.** Intended to give an intuitive introduction to info-gap theory.
 - (a) 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.
 - (b) Yakov Ben-Haim, 2012, Doing our best: Optimization and the management of risk, *Risk Analysis*, 32(8): 1326–1332.

You will find links to both of these articles here:

<http://info-gap.technion.ac.il/foundations-and-philosophy/>

2. Textbooks on info-gap theory.

- (a) Yakov Ben-Haim, 2006, *Info-Gap Decision Theory: Decisions Under Severe Uncertainty*, 2nd edition, Academic Press.
Especially look at chapter 3.
- (b) Yakov Ben-Haim, 2010, *Info-Gap Economics: An Operational Introduction*, Palgrave-Macmillan.
Especially look at the chapter on estimation and forecasting. Don't be put off by the economics. This book — as indicated by the sub-title — presents detailed development of the info-gap robustness analysis.

3. **Lecture notes.** You will find many examples worked out in detail in the lecture notes prepared for the course that I had intended to teach at Rice. Here is the link:

<http://yakovbh.net.technion.ac.il/courses/14-lectures-on-info-gap-theory-and-its-applications/>

4. **info-gap.com** contains many citations on info-gap theory and its applications. Look especially at the webpage on engineering applications:

<http://info-gap.technion.ac.il/engineering-analysis-and-design/>

5. **Exercises.** The file “Problem Set on Robustness and Opportuneness” has many exercises that will give you a chance to develop your skill in info-gap analysis. You will find a link to this file here:

<http://yakovbh.net.technion.ac.il/courses/14-lectures-on-info-gap-theory-and-its-applications/>