

WORKSHOP 1: Uncertainty, Risk and Decision Analysis for Geothermal Resources

Length: 2 days
Location: Reykjavik University
Dates: October 23-24, 2021
Convenors: *Dr. Egill Júlíusson*, Business Innovation Manager, Landsvirkjun - The National Power Company of Iceland and *Dr. Whitney Trainor-Guitton*, Affiliate Faculty, Colorado School of Mines. The latter is the main lecturer in the workshop.
Other lecturers: Two more international lecturers will be invited to present.

Scope of the workshop:

The aim of this workshop is to familiarize attendees with methods for quantifying uncertainty and risk for geothermal resources. Participants will learn how to use relevant software to generate stochastic earth models for simple data sets and transform the results to quantifiable uncertainty and risk metrics. The course will cover decision analysis principles to understand how to calculate the value of information, which can guide scientists and management on future data collection efforts. For the last part of the workshop, industry leaders in this field will be invited to present their work, to illustrate where the sector stands to date in terms of resource-based risk analysis. A number of decision makers from the industry will also be invited to participate in a round table discussion to help sharpen the focus of future development in this field.

The workshop is intended for students and professionals with backgrounds in geoscience, math and/or engineering, along with decision makers at various levels in the geothermal industry.

Outline of Workshop

October 23: Introducing and enabling stochastic earth model generation; Introducing and demonstrating how to build geological models: **categorical** (e.g. lithological); and Introducing conditional probability (Bayes law).

08:00 Registrat. Welcome, introductions, assessment of prior knowledge, objectives for workshop.
09:00 Big picture: Different schools of thought on uncertainty.
09:30 Definitions and generation of stochastic models of specific geologic features/objects.
10:00 *Coffee/tea break.*
10:15 Demonstration: Introduction to the modelling platform
11:00 Exercise: Generate participant-specific geologic features and/or training image.
12:00 Presentation: Geostatistical modelling.
12:30 *Lunch.*

13:30 Exercise: Conditional stochastic models
14:00 Gallery walk: Motivating conditional probabilities.
14:30 Presentation: Bayes Law principals (prior, likelihood, marginal).
15:00 Coffee/tea break.
15:15 Exercise: Bayes Law worksheets.
16:00 Exercise: Repeat any exercise with field-specific data.
16:45 Wrap-up: "Gots and Needs" for Day 2.
17:00 End of Day 1.

October 24: Introduce Decision Analysis (DA) and Value of Information (VOI);
Demonstrate calculation of DA and VOI via models produced in Day 1.

- 08:30 Gallery walk: Concept check from Day 1.
- 09:00 Presentation: Decision Analysis and Value of Information.
- 09:30 Exercise: Risk calculation for demonstration problem: Well siting.
- 10:00 *Coffee/tea break.*
- 10:30 Presentation of value of imperfect information: Information reliability.
- 11:15 Exercise: Decision Analysis and VOI for well siting problem.
- 12:30 *Lunch.*
- 13:30 Presentation: Invited speaker A.
- 14:30 Presentation: Invited speaker B.
- 15:30 *Coffee/tea break.*
- 16:00 Discussion: Future direction of uncertainty analysis for geothermal resources.
- 17:00 Closing ceremony and presentation of certificates.

Necessary material: Laptop computer with any operating system and privileges to install relevant software.

Given on-site – virtual participation will be announced later – if possible.