

Value of Information in the Earth Sciences

Integrating Spatial Modeling and Decision Analysis

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Description of computer code

On the book website (URL: srb.stanford.edu/VOI), one can download datasets and computer code for running a number of book examples. This code allows readers to try out various concepts discussed in the book, and it helps readers getting started on the problem sets and the hands-on projects. The code consists of **Matlab** functions (.m files) and **Netica** project examples (.neta files).

The code and datasets are in one zip file. Once this is downloaded and un-zipped, the files will be organized in folders. These folders are structured according to the examples that recur through the book. **Table 1 below summarizes these example folders.** The folder names are identical to the example name tags: `Treasure_island`, `Gotta_get_myself_connected`, etc. For each example, Table 1 describes the practical decision situations, the information gathering scheme, and modeling and methodology keywords. It also points out the relevant book sections where each example is discussed. Some examples are quite small and require only very few files, while others are more involved with many lines of code and require datasets and sometimes higher-level software. The example code files are tailored to the hands-on projects in Chapter 7 or to the cases used in the main part of the book (Chapter 1-6).

A separate **Datasets** folder holds the relevant datasets for all examples, which are loaded by running the files in the examples. Some of the more stand-alone problems from Section 7.1 are collected in the **Problems_Chapter7_1_1** folder.

Each folder has a **Contents.m** file that describes the computer code files for that example folder. (Including the Datasets folder.)

Name	Decision	Information	Modeling, tools, keywords	Sections
Treasure_island – The pirate example MATLAB	Dig for treasure or not	Metal detector experiment	Binary variables, Bayes rule	2.3, 3.2, 3.4, 7.1
Gotta_get_myself_connected – Bayesian network example MATLAB (BNT#)	Develop petroleum reservoir prospects or not	Exploration wells	Bayesian network model, Junction tree algorithm	2.3, 5.7, 6.2, 7.2
Never_break_the_chain – Markov chain example MATLAB	Develop prospects or not	Exploration wells	Markov chain model, Forward-Backward algorithm	2.3-4, 5.4, 7.1
For_whom_the_bell_tolls – Gaussian projects example MATLAB	Invest in projects or not	Reports of profits for projects	Bivariate Gaussian model, Correlation	2.3, 3.2-4, 7.1

I love rock and ore – Mining oxide grade example MATLAB*	Start mining or not	X-ray of cores in boreholes	Gaussian spatial regression model, Kriging	2.4, 4.4, 6.4, 7.4
Risky business – Petroleum prospect risking example MATLAB	Develop petroleum reservoir prospects or not	Exploration wells	Empirical forward modeling, Nearest neighbors, Kernel density	2.5, 6.2, 7.2
Time after time – Time lapse seismic example NETICA MATLAB (BNT#)	Perform 4D seismic monitoring or not	(No VOI analysis)	Graphical model	3.3, 7.1.
MacKenna's gold – Oil and gold example NETICA	(Lottery, not a decision situation)	(No VOI analysis)	Graphical model	3.3, 7.1
Norwegian wood – Forestry example MATLAB	Harvest forest units or not	Surveys of the forest	Gaussian random field, Kriging	4.4, 5.3-4, 5.9, 7.1
We will rock you – Rock hazard example MATLAB*	Add support in mining tunnels or not	Rock joint data in boreholes	Spatial generalized linear model, Poisson distribution	4.5, 6.4, 7.4
Black gold in a white plight – Reservoir characterization example MATLAB	Drill at reservoir units or not	Seismic data	Markov random field, MCMC sampling, Forward-backward algorithm	4.6, 6.3, 7.3
Go with the flow – Petroleum simulation example MATLAB (MRST#) (Realizations: zip file in /Datasets)	Develop petroleum reservoir, or not	Interpreted seismic data	Multiple point geostatistics, Flow simulator	4.7, 5.5, 7.1
The tree amigos – Conservation biology example MATLAB	Establish conservation sites or not	Surveying of spatial domain	Markov random field, Forward-backward algorithm	5.4, 5.7, 5.9, 7.1
Frozen – Hydropower example MATLAB	Optimal water level behind dam	Snow depth data	Transformed Gaussian random field, ABC sampling.	5.6, 7.1
Basin street blues# – Basin modeling example MATLAB (BNT#)	Develop reservoir prospects or not	Exploration wells	Basin modeling, Bayesian networks, Junction tree algorithm	6.2, 7.2
Reservoir dogs – Seismic and electromagnetic data example MATLAB	Drill at petroleum reservoir units or not	Seismic and/or electromagnetic data	Hierarchical Gaussian spatial model, Rock physics modeling	6.3, 7.3
Salt water wells in my eyes – Groundwater management example NETICA MATLAB (BNT#)	Perform recharge for groundwater management	Electromagnetic data	Multiple geological scenario models, Graphical models.	6.5, 7.5

Table 1. Summary of the main examples running through the book. Code has folders indexed by the nametags. For the examples marked with * the datasets are not identical to the ones used in the book, because of confidentiality reasons. Examples marked with # include code that requires additional software packages that must be downloaded: Bayesian Network Toolbox, BNT, (<https://code.google.com/p/bnt/>) or Matlab Reservoir Simulation Toolbox, MRST, (<http://www.sintef.no/projectweb/mrst/>).