# Course Catalog

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# a. Locations


Our trainings take place at various locations in the German-speaking countries.

**Public trainings:**

You can enroll for public trainings at our training centers across Germany like in Berlin, Dresden, Hamburg, München / Munich, Düsseldorf, Frankfurt, and Stuttgart. Not all public trainings will be organized in all cities but you can still book a particular training for your team in one of our training and conference centers.

In Austria you can attend seminars and trainings in Wien / Vienna while we offer training dates in Switzerland in Zürich / Zurich.

**On-site trainings:**

We have mobile and flexible trainers / lecturers who like to visit you and your team for an on-site training or a training in a conference center or hotel near you.

## USA

| | |
|---|---|
| Chicago | Tel:<br>Fax: |
| Miami | Tel:+1.305.395.7962<br>Fax:+1.305.395.7964 |
| New York | Tel:+1.212.380.1181<br>Fax:+1.305.395.7964 |

# 1. Bayesian Statistics

## A. R

## (i) Bayesian Statistics using R

### Overview

| | |
|---|---|
| **Course ID** | 1000031 |
| **Language** | en |
| **Duration** | 3 D ys |
| **Delivery mode** | Classroom |
| **Course Type** | |
| **Target Group** | Data Analysts |
| **Prerequisites** | Basics in R and Statistics |
| **Method** | Presentation with examples and hands-on labs. |
| **Course level** | Beginning |

### Course Dates

| Chicago | Miami | New York |
|---|---|---|
| 2,050.00 USD | 1,950.00 USD | 2,050.00 USD |
| 07-09 Sep<br>02-04 Nov<br>28-30 Dec | 24-26 Aug<br>19-21 Oct<br>14-16 Dec | 31 Aug - 02 Sep<br>26-28 Oct<br>21-23 Dec |

Prices plus local taxes.

### Course Description

Bayesian statistics is a subset of the field of statistics in which the evidence about the true state of the world is expressed in terms of degrees of belief or, more specifically, Bayesian probabilities. The general set of statistical techniques can be divided into a number of activities, many of which have special Bayesian versions. This training shows how to use Bayesian and probabilistic thinking to analyze data, to make predictions, and to fit models. In a first part, you will see the differences between the frequentist and probabilistic approach and see how you can use R for Bayesian statistics. In a second part, you will see how you can apply Bayesian inference as a method of statistical inference in which Bayes' rule is used to update the probability for a hypothesis as evidence is acquired. A third part focuses on the formulation of statistical models where the unique feature of Bayesian statistics consists in requiring the specification of prior distributions for any unknown parameters. The training closes with a part on machine learning / Data Mining for classification. The examples and hands-on labs are carried out using both R and OpenBUGS. OpenBUGS is a software for the Bayesian analysis of complex statistical models using Markov Chain Monte Carlo (MCMC) methods.

### Course Outline

#### A. Bayesian Statistics

(0.5 Days) Introduction: Quantifying Uncertainty Using Probabilities, Models and Prior Probabilities, Likelihoods and Posterior Probabilities, Bayesian Sequential Analysis - Review of Probability: Events and Sample Spaces, Unions - Intersections, Complements - Marginal and Conditional Probabilities - Bayes' Rule - Addition and Multiplication Rules

## B. One-Parameter Models

(0.5 Days) Bayesian Models - Prior Probability and Prior Distributions - The Posterior Distribution - Conjugate Priors - Inference for a Population Proportion: Frequentist Approach, Bayesian Inference, Bayesian Point Estimates - R for Bayesian Analysis - Inference Using Nonconjugate Priors on Mean and Variance - Noninformative Priors

## C. Multiparameter Models

(0.25 Days) Informative Priors for Mean and Variance - Conjugate Joint Prior Density for Mean and Variance

## D. Model Fit using Markov Chain Monte Carlo (MCMC)

(0.5 Days) Sampling-Based Methods - Markov Chain Monte Carlo (MCMC) Methods - Bayesian Models - Hierarchical Models: Fitting Bayesian Hierarchical Models, Estimation Based on Hierarchical Models - Software OpenBUGS

## E. Regression and Hierarchical Regression Models

(0.5 Days) Review of Linear Regression - Introduction to Bayesian Simple Linear Regression - Generalized Linear Models - Hierarchical Normal Linear Models - Model Comparison, Model Checking, and Hypothesis Testing - Bayes Factors for Model Comparison and Hypothesis Testing - Bayes Factors and Bayesian Hypothesis Testing

## F. Data Mining and Classification in Bayesian Statistics

(0.75 Days) Statistics for Machine Learning - Learning as Inference - Principal Components Analysis - Naive Bayes - Nearest Neighbour Classification - Gaussian Processes

# (ii) Statistical analysis using Bayesian Networks

## Overview

| | |
|---|---|
| **Course ID** | 1000019 |
| **Language** | en |
| **Duration** | 2 D ys |
| **Delivery mode** | Classroom |
| **Course Type** | |
| **Target Group** | Data Analysts |
| **Prerequisites** | Basics in Statistics |
| **Method** | Presentation with examples and hands-on labs. |
| **Course level** | Beginning |

## Course Dates

| Chicago | Miami | New York |
|---|---|---|
| 1,750.00 USD | 1,700.00 USD | 1,750.00 USD |
| 03-04 Sep<br>29-30 Oct<br>24-25 Dec | 20-21 Aug<br>15-16 Oct<br>10-11 Dec | 27-28 Aug<br>22-23 Oct<br>17-18 Dec |

Prices plus local taxes.

## Course Description

A Bayesian network, Bayes network, belief network, Bayes(ian) model or probabilistic directed acyclic graphical model is a probabilistic graphical model that represents a set of random variables and their conditional dependencies via a directed acyclic graph. There are three main inference tasks for Bayesian networks: Structure learning, inferring unobserved variables, and parameter learning. This training presents the diverse techniques of statistical data analysis using Bayesian networks and shows in hands-on labs using R how to implement the techniques and algorithms. You will become familiar with R packages like bnlearn, deal, pcalg, and catnet for structure learning, and you will get to know packages like gRbase and gRain for inferential analysis. Time series data will be analyzed using packages like vars, lars, simone, and GeneNet.

## Course Outline

### A. Introduction

(0.25 Days) Introduction to Graph Theory: Graphs, Nodes, and Arcs - Bayesian Networks

### B. Bayesian Networks and Static Data

(0.75 Days) Bayesian Networks: Essential Definitions and Properties: Graph Structure and Probability Factorization, Fundamental Connections, Equivalent Structures, Markov Blankets - Static Bayesian Networks Modeling: Constraint-Based Structure Learning Algorithms, Score-Based Structure Learning Algorithms, Hybrid Structure Learning Algorithms, Parameter Learning

## C. Bayesian Networks and Time Series Data

(0.5 Days) Time Series and Vector Auto-Regressive Processes (VAR) - Dynamic Bayesian Networks: Essential Definitions and Properties, Dynamic Bayesian Network Representation of a VAR Process - Algorithms: Least Absolute Shrinkage and Selection Operator (LASSO), James–Stein Shrinkage, First-Order Conditional Dependencies Approximation

## D. Bayesian Network Inference Algorithms

(0.25 Days) Reasoning Under Uncertainty: Probabilistic Reasoning and Evidence, Algorithms for Belief Updating: Exact and Approximate Inference, Causal Inference - Inference in Static Bayesian Networks: Exact Inference, Approximate Inference - Inference in Dynamic Bayesian Networks

## b. Disclaimer

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