

TCBAYESIAN 2017

Report of the training course in Bayesian  
Network analysis including  
socio-cultural dimension

27 November - 1 December 2017

ICES Headquarters, Denmark

Laura Uusitalo, Päivi Haapasaari



**ICES**

International Council for  
the Exploration of the Sea

**CIEM**

Conseil International pour  
l'Exploration de la Mer

## **International Council for the Exploration of the Sea Conseil International pour l'Exploration de la Mer**

H. C. Andersens Boulevard 44–46  
DK-1553 Copenhagen V  
Denmark  
Telephone (+45) 33 38 67 00  
Telefax (+45) 33 93 42 15  
[www.ices.dk](http://www.ices.dk)  
[info@ices.dk](mailto:info@ices.dk)

Recommended format for purposes of citation:

ICES. 2018. Report of the training course in Bayesian Network analysis including socio-cultural dimension. TC BAYESIAN 2017 27 November - 1 December 2017. ICES Headquarters, Denmark. Laura Uusitalo, Päivi Haapasaari. 13 pp.

The material in this report may be reused using the recommended citation. ICES may only grant usage rights of information, data, images, graphs, etc. of which it has ownership. For other third-party material cited in this report, you must contact the original copyright holder for permission. For citation of datasets or use of data to be included in other databases, please refer to the latest ICES data policy on the ICES website. All extracts must be acknowledged. For other reproduction requests please contact the General Secretary.

This document is the product of an Expert Group under the auspices of the International Council for the Exploration of the Sea and does not necessarily represent the view of the Council.

## Contents

---

Executive summary .....	1
<b>1 Background .....</b>	<b>2</b>
1.1 Context .....	2
1.2 Objectives .....	2
1.3 Level .....	2
<b>2 Course programme, products, deliverance and instructors .....</b>	<b>3</b>
2.1 Programme .....	3
2.2 Course products .....	4
2.3 Deliverables .....	4
2.4 Instructors .....	4
<b>3 Recommendations .....</b>	<b>5</b>
<b>Annex 1: List of participants .....</b>	<b>6</b>
<b>Annex 2: Survey .....</b>	<b>7</b>



## **Executive summary**

---

A training course in Bayesian Network analysis including socio-cultural dimension took place at ICES Headquarters, in Copenhagen, Denmark, from 27 November to 1 December 2017. The number of participants was 13 from 8 countries.

The objective of the course was to introduce the basics of Bayesian Network modelling and to discuss how the method can be used to address questions related to social-ecological systems.

The course included hands-on exercises using free-of-charge Hugin demo software. The course also provided a chance for the participants to discuss their own research questions and get help and feedback for modelling them by using Bayesian Networks. The BlueBRIDGE virtual research environment (VRE) was used for sharing the lectures, relevant articles and other material among the participants.

## **1 Background**

---

### **1.1 Context**

Bayesian Networks (BNs) have gained increasing interest in the field of fisheries science and management. BNs are a flexible modelling method that can be used in various ways to address different types of research questions. Their strengths include their ability to integrate different types of data and knowledge as well as include, integrate, and represent uncertainty. The graphical nature of BNs makes them easy to communicate across scientific disciplines and to various groups of stakeholders. This makes them particularly useful for eco-socio-cultural modelling, where data sources are diffuse.

### **1.2 Objectives**

The objectives of the course were to introduce the basics of Bayesian Network modelling and to discuss how the method can be used to address questions related to social-ecological systems in interdisciplinary terms.

By the end of the course, the participants were expected to:

- Understand the epistemological and probabilistic basis of the Bayesian approach;
- Understand how the Bayesian statistics differ from the frequentist statistics;
- Be able to frame a social-ecological management problem using the Bayesian networks;
- Be able to build a Bayesian Network.

### **1.3 Level**

No previous knowledge of Bayesian modelling was required from the participants.

## 2 Course programme, products, deliverance and instructors

---

The course took place in Copenhagen, Denmark, from 27 November to 1 December 2017. The number of participants was 13 coming from 8 countries (Annex 1).

### 2.1 Programme

The schedule as set up prior to the course was as follows:

#### Day 1 – Monday

- Introduction
- Lecture: Why are we here? The need for integration of knowledge coming from various sources
- Introduction to Bayesian networks: what are they, and how are they useful in interdisciplinary research?
- Decision support models
- Basics of Bayesian statistics
- Hands-on: Checking that the software works

#### Day 2 – Tuesday

- Lecture and exercise: Problem framing
- Lecture: Basics of Bayesian networks
  - Joint, conditional, marginal probability distributions
  - (Conditional) probability tables
- Exercise: Building a small BN in Excel
- Exercise: Getting to know the Hugin software for Bayesian networks: Guided tour through the basic functionalities of the software. Build the same model in Hugin that was built in Excel.
- Lecture: The model structure, and why it is important?
  - Causal or not?
  - Expert judgment/data-derived/supervised learning
  - D-separation
- Lecture: How to define the social variables?
- Lecture: Case study examples of BNs (biological, interdisciplinary, up to highly complex models)
- Lecture and Exercise: Decision and utility variables and how to use them

#### Day 3 – Wednesday

- Start building a model including the socio-cultural dimension: jointly / in small groups / participants' own research problems
- Lecture: Where do the numbers come from?
- Lecture: Humans as evaluators of probabilities: intro to cognitive biases
- Lecture: Lessons learned from expert and stakeholder interviews
- Exercise: Interviewing experts/stakeholders
- Exercise: Start putting numbers into your model

#### Day 4 – Thursday

- Work on case studies continues
- Lecture: Value of information, Value of control
- Lecture: Learning models (structure, parameters) from data in Hugin

- Lecture: Hugin functionalities: node types (labelled/numbered/interval), built-in distributions, functions, Gaussian nodes, sub-modes
- Model evaluation/validation
- Case study: a complex BN with multiple simultaneous target functions
- Comparison of different flavours of Bayesian modelling: MCMC, data mining, Bayesian networks
- Discretization of data as a challenge
- How to deal with the time aspect?
- What if the model is way too complex?
- My model doesn't work, why? The most common problems
- BNs as a data mining tool

#### Day 5 – Friday

- Presentations of attendee's own case studies, discussion
- Feedback

The programme was adjusted according to the participants' wishes, and the final programme deviated slightly from the plan.

## 2.2 Course products

All course materials were shared in the BlueBRIDGE virtual research environment (VRE), including the lectures, relevant articles, example files of BNs, guidelines/examples for collecting (socio-cultural) data for a BN, etc. ([https://bluebridge.d4science.org/group/ices\\_bnetworkanalysis/ices\\_bnetworkanalysis](https://bluebridge.d4science.org/group/ices_bnetworkanalysis/ices_bnetworkanalysis)).

## 2.3 Deliverables

The course was to include both basic Bayesian statistics and the socio-cultural dimension. As the backgrounds of the participants and their expectations for the course were not known beforehand, the course agenda was structured flexibly to permit adapting it according to the participants' interests.

Each day included both lectures and exercises. Emphasis was put on cooperative model building and joint discussion. The issues that raised questions ranged from technical details of data handling and modelling to ways to collect socio-cultural data and to convert it to a probabilistic form. The participants were encouraged to work with their own case studies, but only a few of them did that. Most of the attendees wanted to participate in a joint model building exercise.

## 2.4 Instructors

- Laura Uusitalo, PhD, Finnish Environment Institute, Finland

Laura Uusitalo is a marine biologist and computer scientist working in the Finnish Environment Institute on Baltic Sea modelling, protection, and biodiversity and foodweb issues. She has used Bayesian networks in data analysis and expert judgement collation.

- Päivi Haapasaari, PhD, University of Helsinki, Finland

Päivi Haapasaari is a social scientist working in the Fisheries and Environmental Management Group (FEM) at the Department of Environmental Sciences, University of Helsinki. She has used Bayesian networks to address human-induced uncertainty in fisheries management in both social scientific and interdisciplinary modelling frameworks.

### **3 Recommendations**

---

The course was planned to adapt to the needs of the participants but that seemed to give an unorganized feeling for them. Fixing the agenda would give a better impression of a well-organized course, but still, as the participants had different backgrounds and expectations for the course, some flexibility is recommended.

The course combined basic Bayesian Networks with socio-cultural aspects. This implied balancing the approaches but also balancing between the interests of the participants. Most of the participants wanted to learn the basic Bayesian approach to modeling biological issues, whereas a few of them were more interested in learning the socio-cultural approach. It might have been more useful to arrange two separate courses, to be able to focus more on one or the other issue, not to cover both.

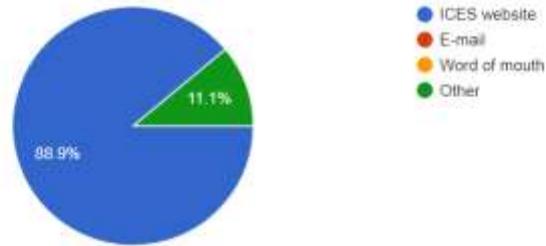
## Annex 1: List of participants

<b>Name</b>	<b>Institute</b>	<b>E-mail</b>
<b>Laura Uusitalo</b>	Finnish Environment Institute (SYKE) Finland	laura.uusitalo@ymparisto.fi
<b>Päivi Haapasaari</b>	Fisheries and Environmental Management Group Finland	paivi.haapasaari@helsinki.fi
<b>Carla Sbrocchi</b>	University of Technology Sydney School of International Studies, Faculty of Arts and Social Sciences Australia	carla.d.sbrocchi@student.uts.edu.au
<b>Adriana Villamor</b>	ICES Denmark	Adriana.villamor@ices.dk
<b>Xochitl Cormon</b>	Hamburg University Institute for Hydrobiology and Fishery Sciences Germany	xochitl.cormon@uni-hamburg.de
<b>Serena Donadi</b>	Sveriges lantbruksuniversitet Swedish University of Agricultural Sciences	serena.donadi@slu.se
<b>Katherine Maltby</b>	University of Exeter UK	km460@exeter.ac.uk
<b>Marie-Christine Rufener</b>	Technical University of Denmark Institute for Aquatic Resources Denmark	mruf@aqua.dtu.dk
<b>Melina Kourantidou</b>	University of Southern Denmark	mkour@sdu.dk
<b>Igor Eulaers</b>	Aarhus University Institute for Bioscience Denmark	ie@bios.au.dk
<b>Margit Eero</b>	Technical University of Denmark Institute for Aquatic Resources Denmark	mee@aqua.dtu.dk
<b>Leonie Färber</b>	University of Oslo Centre for Ecological and Environmental Synthesis Norway	l.a.farber@ibv.uio.no
<b>Anna-Marie Winter</b>	University of Oslo Centre for Ecological and Environmental Synthesis Norway	a.m.winter@ibv.uio.no
<b>Marran Hague</b>	Pacific Salmon Commission Canada	hague@psc.org
<b>Felipe Gusmao</b>	Federal University of Sao Paulo Brazil	felipeoceano@gmail.com

## Annex 2: Survey

### How did you hear about this course?

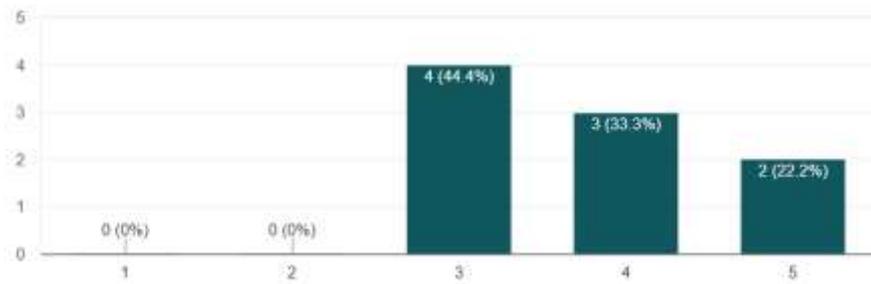
9 responses



### Course content

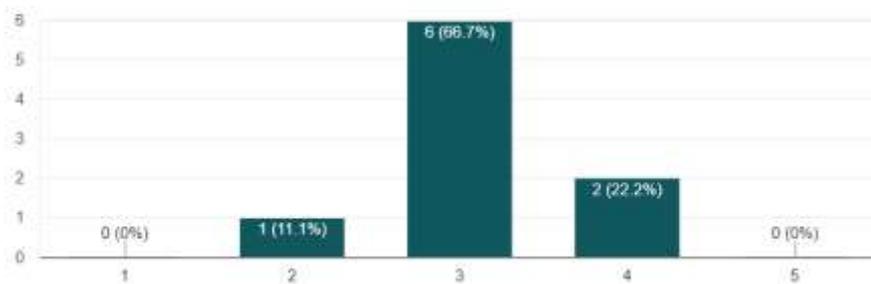
### Did the Training course meet your expectations?

9 responses



### Was the level of instruction appropriate?

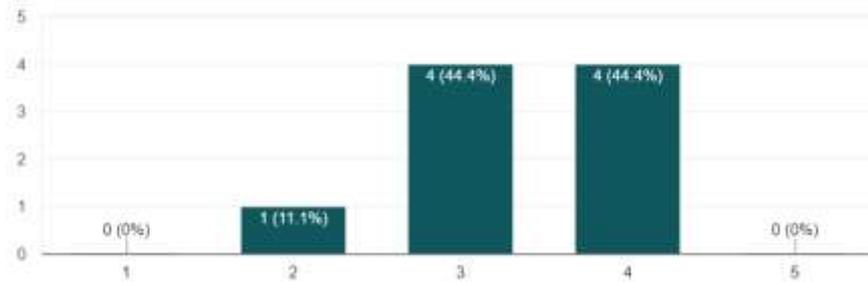
9 responses



### Was the length of the training course appropriate?



9 responses



### Comments

2 responses

I think one day shorter would have been fine as well.

Perhaps 1/2 day too long, but if content was rearranged slightly, the last day may be more productively spent on intensive cas study work. The last day felt a little unstructured and not quite enough time to productively work on example.

### What did you like best or find more useful about the training course?

8 responses

I liked the group case handy exercise, and the time for discussion throughout the week.

Practical examples, how to apply the method, also technically

hands-on exercises/working with own data, discussing with other participants

I got a nice feeling about the concept of BN and a lot of ideas what is possible since good case studies have been shown.

Flexibility and space for participation.

Hand-on exercises

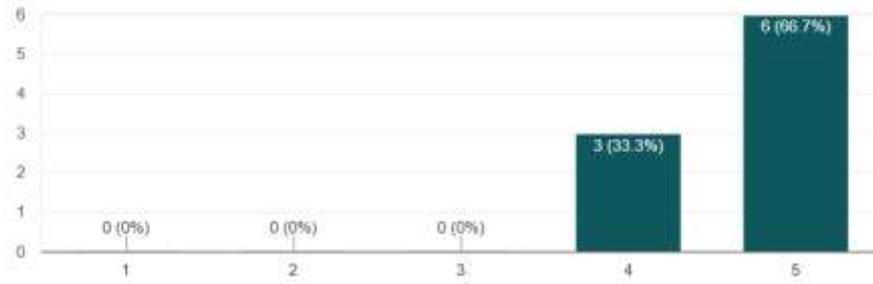
All the examples! It was very useful through all the practical cases. Laura's ability to pull relevant cases off the top of her head was amazing. Paiv's soci-cultural examples were on point and provided useful context and highlighted potential applications.

Construct a BNN with all a atendendents (thursday morning)

## Course Organization

Inscription to the training course and communication with organizers were efficient.

9 responses



### Comments

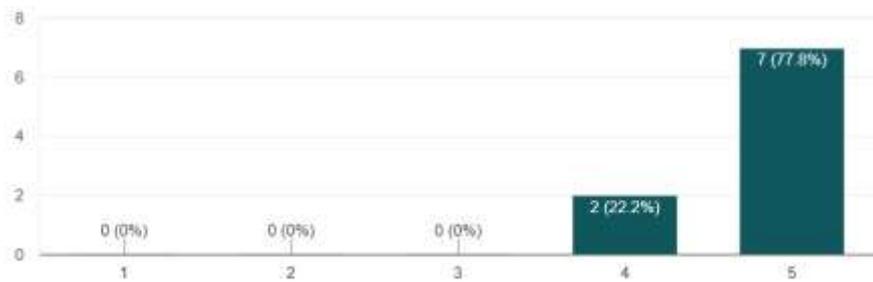
1 response

The registration process and use of the VRE was very easy.

## Teaching and Learning Support

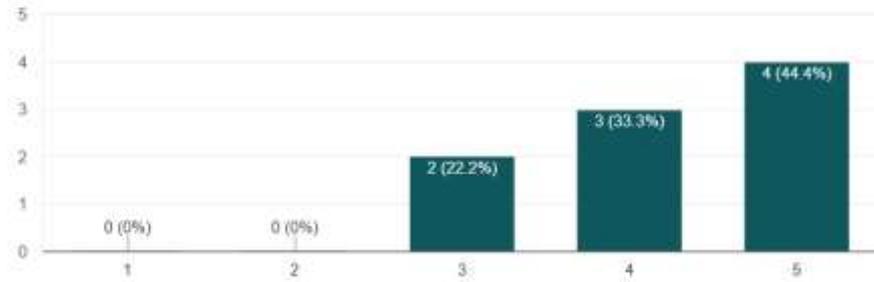
The instructors were helpful, informative, and approachable.

9 responses



The working documents were presented in a way that facilitated learning.

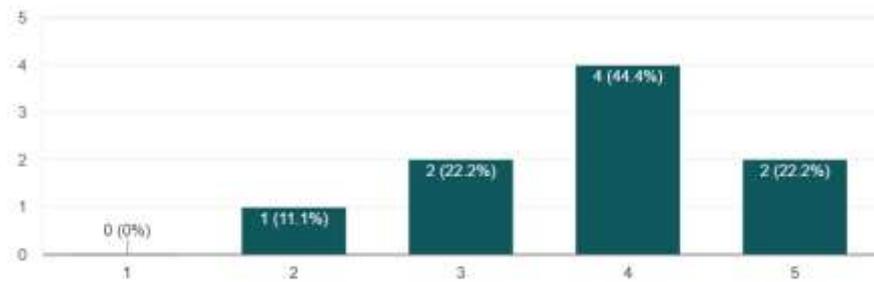
9 responses



## Overall Evaluation

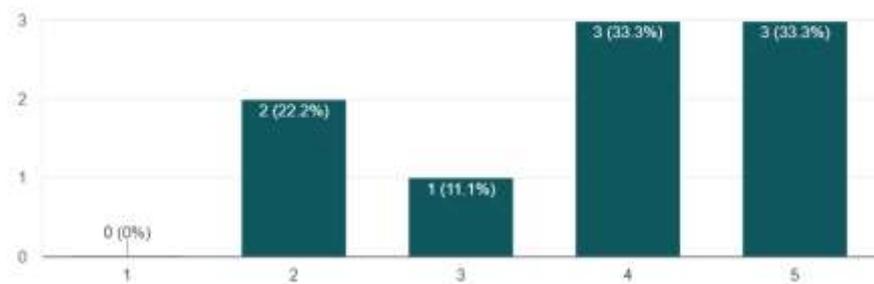
Overall, how would you rate this training course?

9 responses



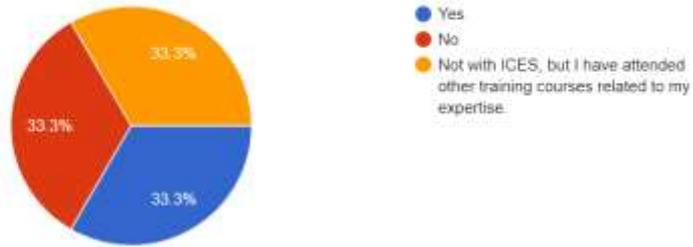
Overall, how would you rate the quality of the teaching?

9 responses



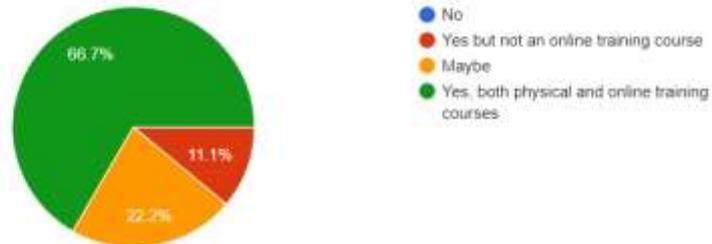
### Have you taken any other ICES training courses?

9 responses



### Would you be interested in another training course within ICES?

9 responses



### If yes, which topic would you be interested in?

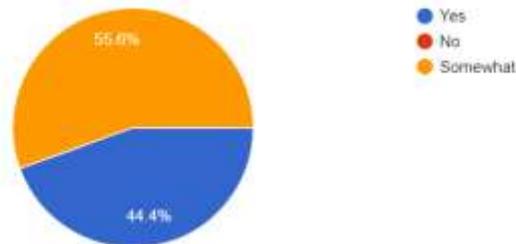
5 responses

- Handling uncertainty, communication between disciplines (researchers, fishermen, managers)
- Stock assessment in R
- Anything related to data management and analysis, especially dynamic modelling, matlab, advanced statistical techniques
- If a relevant topic was available, such as integrated assessment and reporting approaches. From anecdotal evidence, there appears to be a strong interest in use of Bayesian techniques for stock assessment and allocation type questions.
- Marine Spatial Planning

## Social Event

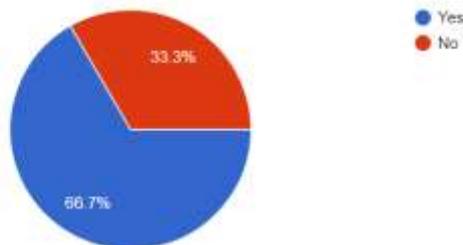
Do you feel that you have benefited from networking opportunities on the course?

9 responses



Did you participate in the course dinner on Thursday evening?

9 responses



## General comments on the Training Course

8 responses

Overall I enjoyed the course and felt it gave me a good understanding of Bayesian Networks. I felt it could have been structured a little better on some days but it was also good to have some flexibility to allow discussion or to answer what we wanted.

Generally I found the course very useful and good. Just for future further improvement, the order of the presentations/topics could perhaps be more structured, what one needs to know first before going to exercises etc. Also, come introduction of free software would have been useful as it is available for everyone and one is unlikely to purchase a commercial one while being a beginner to the method

The course was generally a very good experience, given that I did not have any background on BNs and their analysis. I got a good overview of the methodology, I could have benefitted from an example where we go from the raw data or even just the research question to how to get the data to obtain the probabilities and then fill in the network. My main challenge is how to obtain the probabilities from the raw data, which could have been addressed with more examples in the course. It would also have been nice to get the full Hugin version (not the demo version) provided to not be limited by the demo version.

Otherwise, a great course and super nice instructors. Also nice to get to know ICES more.

It was a nice group and great instructors, who could provide a good picture of the BNs. I enjoyed my time and learned something completely new, which is a good starting point for future work.

- Very interesting tool for many different biological, ecological but also management questions.  
good length and pace, good combination of expertises and the two teachers

I really enjoyed! And the atmosphere was really good! Thanks!

I commend ICES for offering this training course. It is certainly an emerging area of need and training in the BBN technique specifically to address socio-cultural aspects will be increasingly required. I think the instructors have a lot to offer in this area and I benefitted from their vast experience. I think the course may have suffered a little from lack of structure - and this may be a direct result of a disconnect between course participants' perceived expectations of the course content. Many participants were looking for instruction in Bayesian approaches broadly, and specifically to address biological questions and therefore I felt that the focus of the course tended to move in that direction as opposed to a more thorough discussion on the socio-cultural aspects and the purpose of a BBN as a decision support tool. Although I would have liked more discussion + practice with software related to the stated topic of the course, I am still happy with the information I have received. Perhaps in future a more clear statement of the intended audience and application of the BBN training course might help prospective participants understand the nature of the training course better.

In overall the training course was very interesting and certainly some ideas will be worth to use at some point in a research project. Nevertheless, I felt that the course could have been better structured it didn't seem that the instructors had concrete ideas to define the teaching topics along the course days. It was rather randomly chosen on the day what we could discuss about. Also, I think that both instructors could have integrally participated during the courses. It often happened that when one of the instructors wasn't teaching, it was working on something else and rarely gave some feedback, unless the other instructor asked for it I also think that when teaching/using a specific software, the instructors need to know as much as possible of what the different functions do. Unfortunately, many times the participants asked different questions about the software and most of the time the instructors weren't very sure about the answers.