December 2020

Training Course in Bayesian Network Analysis Including the Socio-Cultural Dimension

ICES TRAINING COURSE REPORT

ICES INTERNATIONAL COUNCIL FOR THE EXPLORATION OF THE SEA
CIEM CONSEIL INTERNATIONAL POUR L'EXPLORATION DE LA MER

Contents

1 Summary

A training course in Bayesian Network analysis including the socio-cultural dimension was organized as online teaching on 7-11 December 2020. The number of participants was 11 from 5 countries.

The objective of the course was to introduce the basics of Bayesian Network modelling and to learn how the approach can be used in inter- and transdisciplinary analysis of socio-ecological systems.

The course included video-recorded lectures, reading articles, participating in group discus-si-ons, exercises, and modelling. Two days of the five-day course were dedicated to building and presenting the participants' own Bayesian network models.

Microsoft Teams was used as the online course platform, and the video material was available in YouTube via link access.

2 Background

2.1 Context

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

2.2 Objectives

The objectives of the course were to introduce the basics of Bayesian Network modelling and to learn how the method can be used in inter- and transdisciplinary analysis of socio-ecological systems.

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

- Explain what BNs are and how they work;
- Explain what inter- and transdisciplinary research mean and what is their value;
- Estimate and evaluate the need for interdisciplinary and transdisciplinary/participatory approaches in socio-ecological research questions;
- Create a BN model that reflects a socio-ecological research question;
- Evaluate theoretical, scientific, and cognitive factors that need to be considered when designing an inter/transdisciplinary BN model;
- Use a readily available software package to build a BN;
- Find and evaluate information sources to populate the model.

2.3 Level

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

3 Course programme, products, deliverance and instructors

The course was organized as online teaching on 7-11 December 2020. 11 participants from 5 countries attended the course (Annex 1). The course was realized by applying a flipped learning method. Thus, the students were asked to watch video-recorded lectures and do exercises by themselves, while still staying within the time schedule of the course programme. There were scheduled sub-group and whole group discussions to reflect on the learnt material. The video lectures and other material were prepared by the teachers beforehand, and links to them were provided in the course programme. In the main classroom of Teams, potential problems and questions were jointly discussed. The Teams platform was open all day during the course, which enabled the participants to ask, get help and chat whenever needed.

3.1 Programme

The schedule of the course was as follows:

Day 1 – Monday

- Introductions (teachers, participants, ICES staff, and ICES SCICOM chair Jörn Schmidt) and overview of the course
- Introduction to BNs
    - Video lectures: 1) Probability calculus, classical / frequentist and Bayesian statistics, 2) Introduction to Bayesian networks and decision support models
    - Reading: 1) Advantages and challenges of Bayesian networks in environmental modelling (Uusitalo 2007), 2) Good practice in Bayesian network modelling (Chen and Pollino 2012)
- Reflection in subgroups
- Introduction to inter/transdisciplinary research and participatory modelling
    - Video lecture: Multi- Inter- and Transdisciplinary Approaches to address complex problems
    - Reading: 1) Open your mind to interdisciplinary research (O'Neill 2011), 2) The 5 significant advantages of interdisciplinary research (Glod B. 2016), 3) Growing into interdisciplinarity: How to converge biology, economics and social science in fisheries research (Haapasaari et al. 2012), 4) Interdisciplinary problem framing for sustainability: Challenges, a framework, case studies (Clark et al. 2017)
    - Videos lectures: How can Bayesian networks be useful in interdisciplinary research?, 2) Interdisciplinary evaluation of the long term management of Baltic salmon stocks by using BBNs
- Reflection in subgroups
- Recap jointly

Day 2 – Tuesday

- Preview jointly
- BN theory and introduction to the exercises
    - Video lectures: 1) Model structure theory, 2) Conceptual model to frame the problem, 3) Joint, marginal and conditional distributions, 4) Hugin demo
- Hands-on work on BNs with the Hugin software

    - Reading and exercises: Introduction to Hugin software with exercises (sheet)
- Discuss in subgroups
- Hands-on work continued
- Further on BNs
    - Reading: Bayesian networks (Darwiche 2010)
    - Hugin help pages
- Recap jointly

Day 3 – Wednesday

- Preview jointly
- Model structure and parameters
    - Video lectures: 1) On defining the variables and model structure, 2) Where do the numbers come from, 3) How to define the social variables in a BBN, 4) BBNs in participatory modelling: Questions and Considerations
- Real-life examples
    - Reading: 1) Making the most of mental models: advancing the methodology for mental model elicitation and documentation with expert stakeholders (LaMere et al. 2020), 2) Integration of biological, economic, and sociological knowledge by Bayesian belief networks: the interdisciplinary evaluation of potential management plans for Baltic salmon (Levontin et al. 2011), 3) Participatory development of a Bayesian network model for catchment-based water resource management (Chan et al. 2010)
- Humans as evaluators
    - Video lecture: Humans as evaluators of probabilities – introduction to cognitive biases
- Model parameterization
    - Reading: 1) Building probabilistic networks: where do the numbers come from? Guest editors' introduction (Drudzel and van der Gaag 2000), 2) An overview of methods to evaluate uncertainty of deterministic models in decision support (Uusitalo et al. 2015), 3) A guide to eliciting and using expert knowledge in Bayesian ecological models (Kuhnert et al. 2010)
- Reflection jointly
- Recap

Day 4 – Thursday

- Preview jointly
- Building own (interdisciplinary) models (Including: the description of research problem, problem framing, creation of model structure and defining variables, quantifying the model)
    - Teachers available on-line to help and discuss
- Preparation of presentation of the modelling for Friday

Day 5 – Friday

- Presentations of the attendee's own models, discussion
- Wrap-up
- Feedback for the course

3.2 Course products

Course slides and exercises sheets were shared in the ICES SharePoint, and the videos that were available in YouTube through the provided links. The models the participants created were not recorded.

3.3 Deliverables

Microsoft Teams was used as the online platform for the course, including a main classroom, three breakout rooms, and a meeting chat. Both the teachers and the course participants were online all day during the course days, which facilitated discussions and asking for help any time. From the teachers' perspective, the online course worked well. In the feedback discussion, also the participants seemed to be happy with the course, although some improvements were suggested (see Recommendations).

The course included building a BN model individually by each participant, focusing on his/her own research question. This seemed to be a motivating exercise, which in many cases will be completed as part of the participants' PhD studies or research project. Many problems related to model building were solved and dis-cussed through joint online discussions, which benefited all. 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.

3.4 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 food web issues. She has used Bayesian networks in data analysis and expert judgement collation.

- Paivi Haapasaari, PhD, University of Helsinki, Finland

  Päivi Haapasaari is a social scientist. She has used Bayesian networks to address human-induced uncertainty and social issues in fisheries management in both social scientific and interdisciplinary modelling frameworks, and used BN-based methods also in transdisciplinary research.

4 Recommendations

The participants would have preferred less reading during the course, and instead, more working on the BNs and the Hugin software, in practice. Thus, the articles recommended to read could be sent to the participants well before the course. This would save course time for practical exercises, modelling, and joint group sessions. In addition, this would help participants with no prior experience of the method to orientate to the topic.

The participants hoped for going through the exercises together, to demonstrate and explain the correct way to do them, and to show the right answers.

More time could be dedicated for discussing and practising model building in small groups, before the participants concentrate on their own models. This way those students that have less prior experience of the method could also learn and get ideas from those that have used the method earlier.

Some of the participants expressed interest for a more advanced course on the same topic.

Annex 1: List of participants

Name	Country	Organization
Michael Kriegl	Germany	Thuenen Institute of Baltic Sea Fisheries
Henrike Rambo	Germany	Thünen Institute Federal Research Institute for Rural Areas
Fanny Barz	Germany	Thuenen Institute of Baltic Sea Fisheries
Antje Gimpel	Germany	Thünen Institute of Baltic Sea Fisheries
Sebastian Villasante	Spain	Universidad de Santiago de Compostela
Edgaras Ivanauskas	Lithuania	Klaipėdos universitetas
Jessica Fuller	Norway	University of Bergen - Department of Biological Sciences
Francisco Izquierdo	Spain	Instituto Español de Oceanografía (IEO)
Stefanie Broszeit	UK	Plymouth Marine Laboratory
Morgane Declerck	Scotland	University of Aberdeen

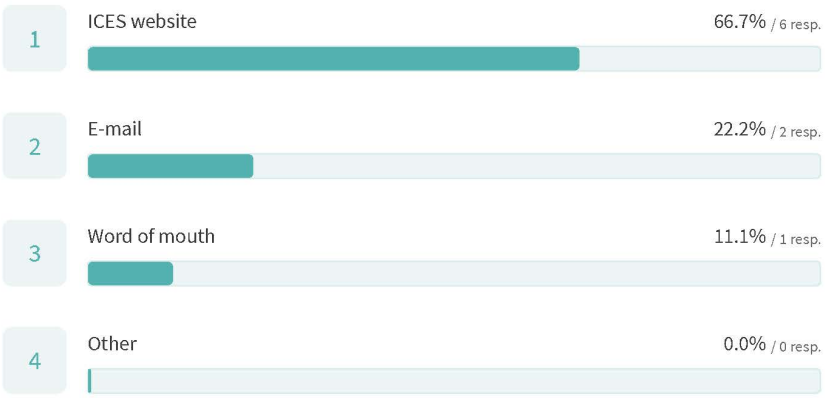
Annex 2: Survey results

TCBAYENET2020

9 responses

How did you hear about this course?

9 out of 9 answered



Did the training course meet your expectations?

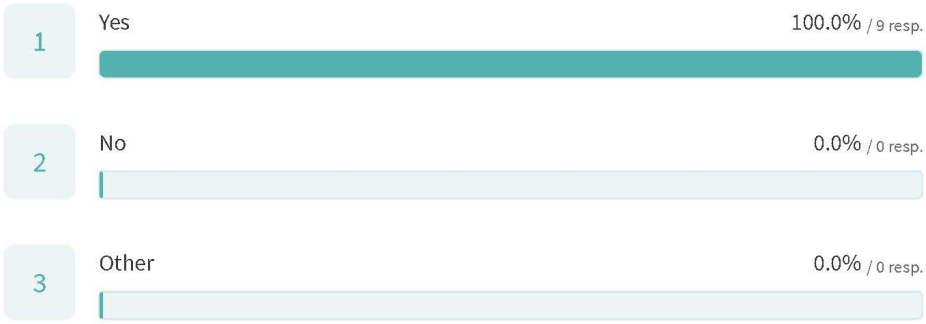
9 out of 9 answered

Was the level of instruction appropriate?

9 out of 9 answered

Was the level of difficulty appropriate?

9 out of 9 answered

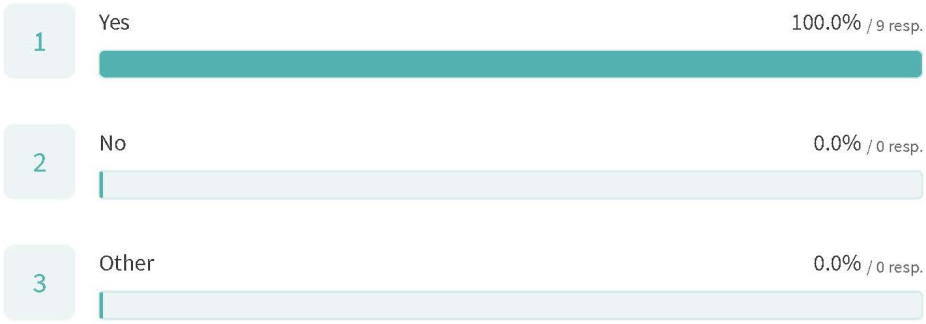


Inscription to the training course and communication with organizers were efficient

9 out of 9 answered

The instructors were helpful, informative, and approachable.

9 out of 9 answered



The length of the training course was

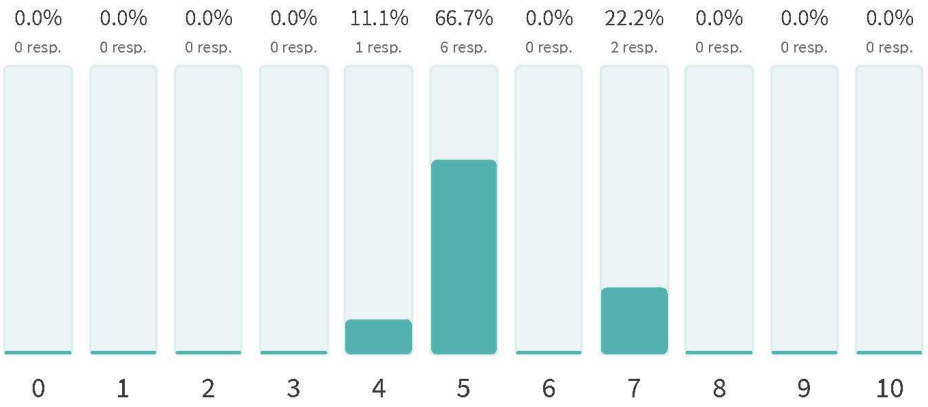
9 out of 9 answered

4.6 Average rating

The length of the lectures were

9 out of 9 answered

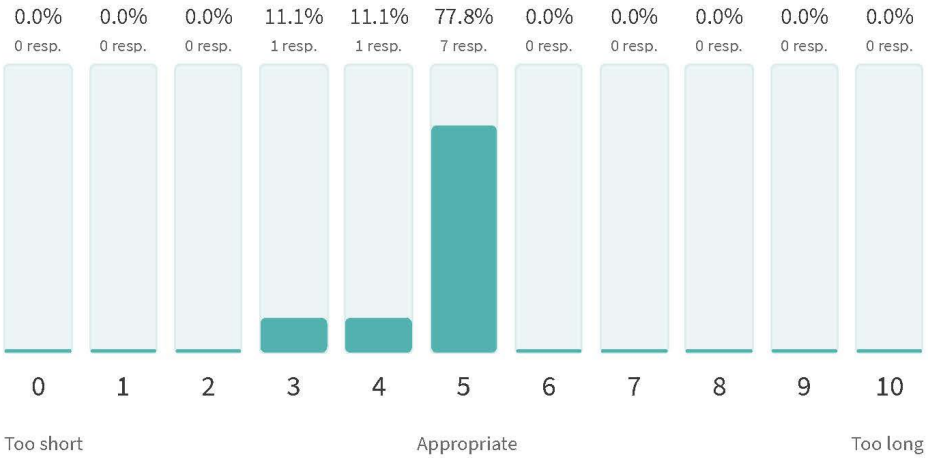
5.3 Average rating



The length of the Q&A sessions were

9 out of 9 answered

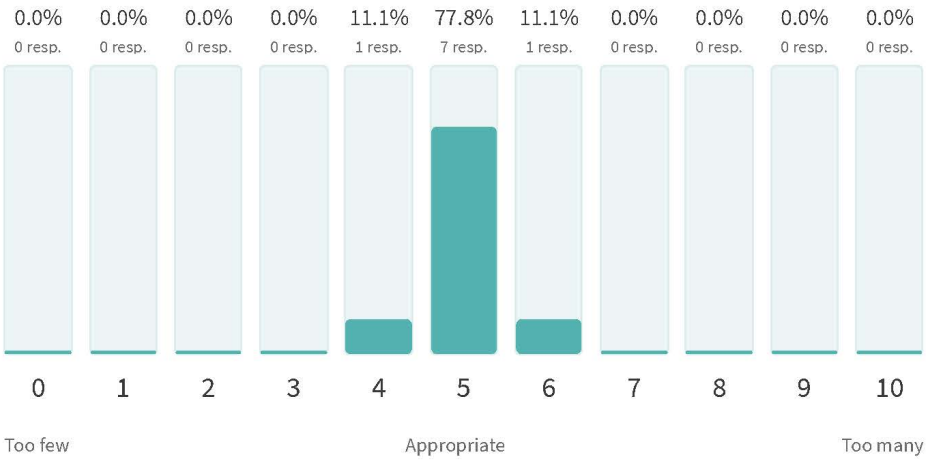
4.7 Average rating



The amount of breaks during the course were

9 out of 9 answered

5.0 Average rating



Did you receive sufficient support regarding platform testing and set-up?

9 out of 9 answered

Have you previously used Microsoft Teams for meetings or online courses?

9 out of 9 answered

Would you have been able to join this course if it had not been online (without COVID travel restrictions affecting)?

9 out of 9 answered

Have you attended any other ICES training courses?

9 out of 9 answered

Would you be interested in another training course within ICES?

9 out of 9 answered