

# ICES TCADSAM REPORT 2011

## Report of the Training Course: Ad Model Builder and Stock Assessment (TCADSAM 2011)

21-25 February 2011

ICES Headquarters, Copenhagen



**ICES**

International Council for  
the Exploration of the Sea

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**Participants at the course “AD Model Builder and Stock Assessment” conducted 21–25 February 2011 at ICES Headquarters in Copenhagen. The course was given by Anders Nielsen (admb T-shirt, middle), and Arni Magnusson (admb T-shirt, left).**



# Report of the ICES training course: “AD Model Builder and Stock Assessment”

by

Anders Nielsen and Arni Magnusson

## Summary

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This was the first course on AD Model Builder and Fish Stock Assessment to be held in ICES.

AD Model Builder is a general purpose statistical tool, which is ideal for handling large non-linear models. The main application of AD Model Builder is for managing natural resources. General stock assessment models used worldwide such as multi-fan-cl, stock synthesis, and colerain are all implemented in AD Model Builder. Educating the ICES community to use this tool to build own model and customize existing models is an important step for ICES towards critically evaluating its current toolbox of assessment models, which should always be an ongoing process.

The course was strongly focused on giving the participants working knowledge of the program, and in that respect extremely successful. One teacher was extremely happy to find a full page AD Model Builder program left at the table in the coffee room on the third day of the course. That was one small indication that the participants was getting into writing their own code.

The approach taken was not a systematic lecturing of all aspects of the AD Model Builder software, but a case orientated one. Knowing what problems typically occur in stock assessment models the teachers had prepared a lot of cases in advance. Then they presented the material needed to solve such a case and allowed the participants to work on it. The more systematic lectures were kept ready, and then launched exactly when the need for them occurred to the participants.

For example a lecture on all the details and options regarding reading in data was not given before the first few exercises. The participants were simply allowed to do a few simple examples first, then when they starting asking questions about general patterns w.r.t. Reading in data wy went though that presentation.

This reflects the teachers believe that you listen more carefully when you know you are going to need it. Much like no one listens for the safety demonstration on a normal plane ride, but if the pilot mid-air announces that he will be “safety landing” in ten minutes, the stewards will have the undivided attention of all passengers.

Another choice taken was to start out really slowly, making sure that everyone got the first really simple examples done correctly and understood all details, and gradually go faster and faster throughout the course. Again the teachers knew that the participants were highly skilled, and capable of learning huge amounts in those five days (which they really proved during the course), but the teachers also knew how important it is to get the first few steps right when you are trying to pick up a new programming environment.

For example the first exercise was simply to estimate the mean of ten normally distributed numbers. That sounds way too trivial for this group, but please remember that it is during this first exercise that you also have to pick up a new editor, set up a

new compiler, figure out how to compile, figure out how to run, figure out where to find the results, and many more things not explicitly stated in the exercise.

The program reflects the subjects covered, so a lot of stuff was definitely covered, and the participants were following all along, so the slow-then-fast strategy was successful. By the end of the course the participants were able to write a simple statistical assessment from scratch, and able to modify existing models to better fit their needs.

The course evaluation on the ICES web-page was generally very positive (Annex 3), and the teachers got a lot of private email thanking them for a course that challenged the participants, but also gave the participants a lot of useful tools and skills.

## **Recommendations**

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From the course evaluation and from the teachers' personal impression a few recommendations are listed below.

Last day should only be programmed up till noon. Some participants had to leave at noon, and were really sorry to not to get the last part. Others postponed their flights to stay for the last half day.

More time could be spent on the state-space assessment model (SAM). The course reviled a great interest in applying that particular model to participants own data sets (stocks).

Possibly more reading material sent out before the course.

The main pedagogical decisions should be retained.

## **Course description**

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### **Objective**

This will be an advanced course in fisheries stock assessment modeling, but rather than running the audience through a number of predefined models and have them memorize check lists for how to use them, this course will enable participants to:

- 1 ) Build assessment models in AD Model Builder (ADMB)
- 2 ) Modify existing ADMB models

AD Model Builder is a package designed to meet the requirements posed by typical stock assessment models (nonlinear, highly parameterized, possibly time-varying parameters). Published benchmarks have shown that it provides faster and more reliable parameter estimation than other generic function minimisers'. This is achieved with automatic differentiation (AD) and the programming interface is a thin layer on top of C++, with convenient features to read and write data files, perform vector and matrix calculations, with optional features like random effects and MCMC analysis. Model input and output is in plain text files, which can be analyzed and plotted in R or other statistical packages. AD Model Builder is free software (<http://admb-project.org>), originally written by Dave Fournier, the 2009 recipient of the American Fisheries Society's William E. Ricker Award.

After going through biomass-dynamic models, statistical age-structured models and MCMC analysis, the focus will be on random effects and finally a State-space Assessment Model (SAM), which is used for several assessments in ICES. This is a full stochastic model that allows selectivity to vary gradually with time, and can handle years with missing data. It has fewer model parameters than full parametric statisti-

cal assessment models, as quantities such as fishing mortalities and stock sizes are modelled as random effects.

### Course Programme and Instructors

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The five-day course is organized as a series of morning sessions that are focused on theoretical concepts and afternoon sessions on more applied concepts associated with assignments and work sessions.

The programme was designed with an about even split between lectures/discussions and tutorials. In summary form the programme was (details in Annex 2).

<b>Programme</b>		
<b>Day</b>		<b>Topic</b>
Monday	AM	Introduction to AD Model Builder Building a simple model
	PM	Estimating the mean Linear regression
Tuesday	AM	Biomass-dynamic models
	PM	Statistical catch-at-age models
Wednesday	AM	Bayesian models and priors
	PM	MCMC analysis and diagnostics
Thursday	AM	Random effects Linear mixed effects
	PM	Univariate state-space model State-space assessment model
Friday	AM	State-space assessment model
	PM	Student problems Summary

#### Instructors:

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## Annex 1: List of participants

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### List of Participants for Training Course on AD Model Builder and Stock Assessment Atlantic Room 21–25 February 2010

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## Annex 2: Detailed course programme

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### Title: AD Model Builder and Stock Assessment Programme:

Time	Event
<b>Monday, 21 February</b>	
9.00 – 10.00	Welcome (AN = Anders Nielsen and AM = Arni Magnusson): Introduction of participants and lecturers; expectations
10.00 – 10.30	Tea/Coffee
10.30 – 11:30	Introduction to AD Model Builder
11:30 - 13:00	Building a simple model
13:00 - 14:00	Lunch
14.00 – 15.30	Exercise: Estimating the mean
15.30 – 16.00	Tea/Coffee
16.00 – 18.00	Exercise: Linear regression
18.00 – 20.00	Icebreaker
<b>Tuesday, 22 February</b>	
9.00 – 9.45	Sum up yesterday and introduce today's subject
9.45 – 10.15	Tea/Coffee
10.15 – 11.00	Biomass-dynamic models
11.00 – 13.00	Exercise: Biomass-dynamic model
13.00 – 14.00	Lunch
14.00 – 15.30	Statistical catch-at-age models
15.30 – 16.00	Tea/Coffee
16.00 – 18.00	Exercise: Statistical catch-at-age model
<b>Wednesday, 23 February</b>	
9.00 – 9.45	Sum up yesterday and introduce today's subject
9.45 – 10.15	Tea/Coffee

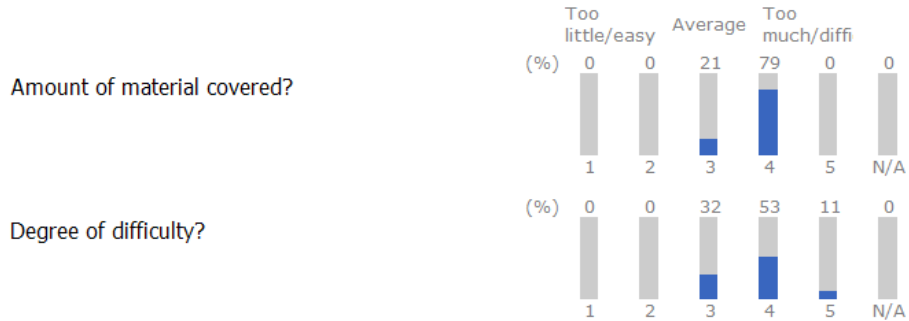
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10.15 - 13.00	Bayesian models
13.00 - 14.00	Lunch
14.00 - 15.00	Exercise: Priors
15.00 - 15.30	Tea/Coffee
15.30 - 18.00	Exercise: MCMC analysis and diagnostics
<b>Thursday, 24 February</b>	
9.00 - 9.45	Sum up yesterday and introduce today's subject
9.45 - 10.15	Tea/Coffee
10.15 - 11.30	Random effects
11.30 - 13.00	Exercise: Linear mixed effects
13.00 - 14.00	Lunch & Group photo
14.00 - 15.30	Exercise: Univariate state-space model
15.30 - 16.00	Tea/Coffee
16.00 - 18.00	State-space Assessment Model
18.15 - 22.00	Course dinner (optional, expenses to be covered by participants)
<b>Friday, 25 February</b>	
9.00 - 9.45	Sum up yesterday and introduce today's subject
9.45 - 10.15	Tea/Coffee
10.15 - 13.00	Exercise: State-space Assessment Model
13.00 - 14.00	Lunch
14.00 - 15.00	Discussion and course evaluation
15.00 - 15.30	Tea/Coffee
15.30 - 16.00	Closing

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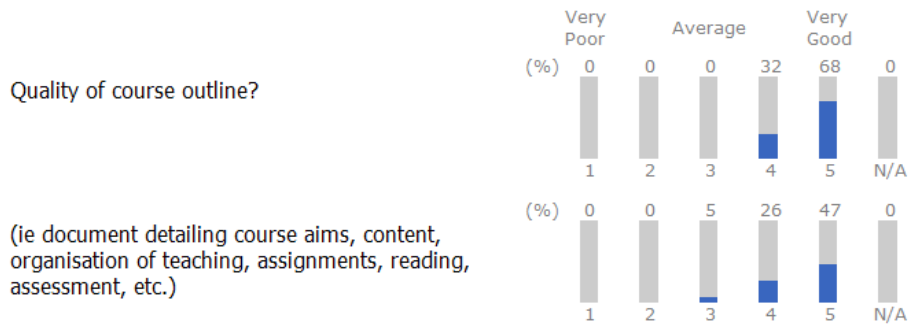
### Annex 3: Results of course evaluation questionnaire

#### Course Content

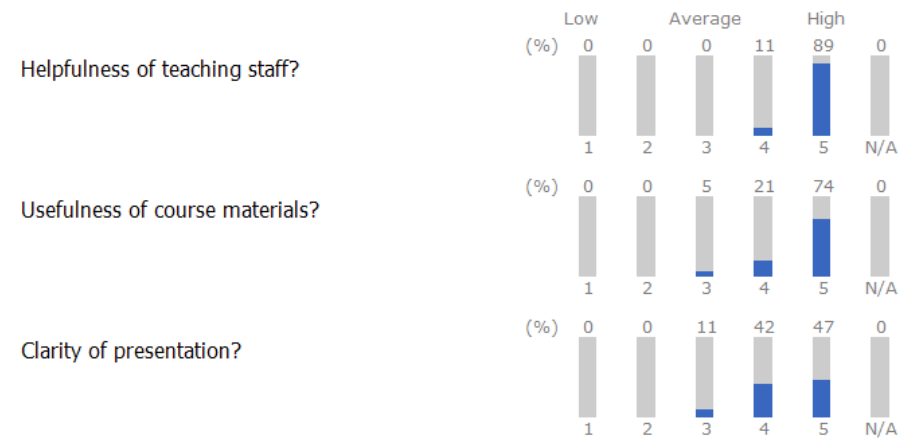


Total: 19

#### Course Organization

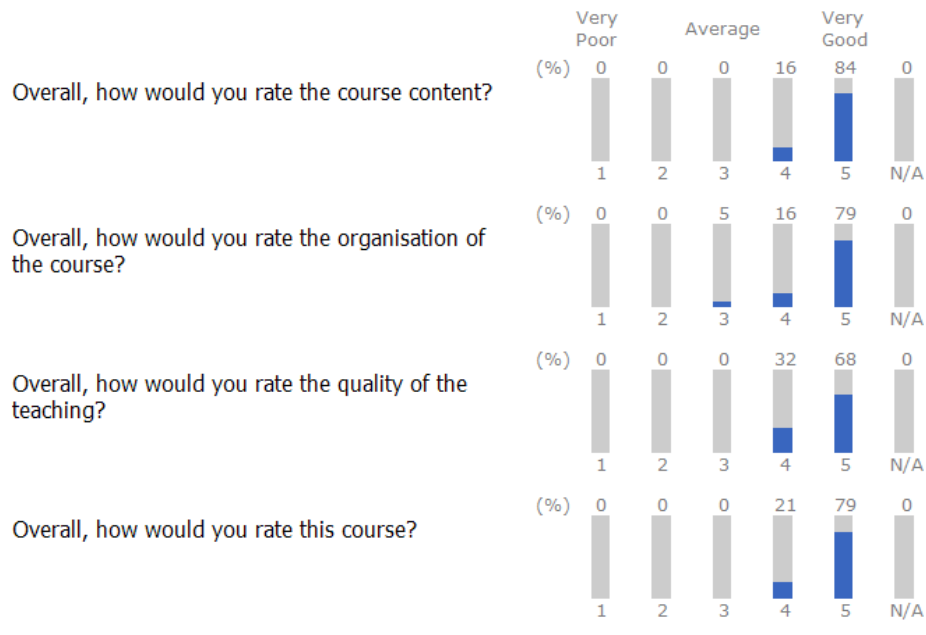


#### Teaching and Learning Support



Total: 19

**Overall Evaluation**



Total: 19

**Good features of this course/suggestions for improvement:**

- Excellent course, which was very informative. The presenters are to be congratulated on their patience and clarity in teaching a very difficult/involved piece of software. Only suggestion is for more Bayesian material ;o)
- Enlightening but definitely not for beginners. A lot of material and ideas to bring back home and implement. The course is impressively complete but fast, very fast, too fast. More time for exercises would be welcome.
- Liked the use of 2 instructors covering material.
- Small screens in the meeting room, not all presentation available at share-point. Especially tricky to follow some of Arni's demo's.
- Very few complaints. Well organized, examples were very useful, plenty of time to work on examples with help from instructors whenever needed. I had very little background (either with admb or with stock assessment methods), but I was perfectly able to follow and work through the examples (sometimes to my surprise!).
- This is perhaps the best course I've ever attended under the auspices of ICES. The tutors appeared to have been well prepared and the course material was excellent. A good balance between theoretical presentation and hands-on experience. I can hardly suggest an area for improvement. Thanks!
- Earlier move towards the state space model & SAM and omit the seeds example and exercise

- Given the range of experience, I thought the course content and presentation was excellent
- The teaching staff did a very good job in communicating very difficult subject matter to a group with a broad range of prior experience/abilities. Some more background readings, preparatory notes on the sharepoint BEFORE the course may be useful to help improve the knowledge background of participants in advance of the course. (Other ICES courses I have done were unrelated to this one, therefore didn't prepare me for this course).
- The material provided in the course was of very high quality but another very valuable feature of the course, not explicit in the questionnaire, was the guidance and advice provided by the experts who are knowledgeable in state of the art stock assessment techniques.
- The course material is very good. To facilitate students it would be very handy to have the .tpl files before they are presented during the lessons. This would allow people to comment in the file. Having examples files commented would help understand more easily each coding step.
- Lunch break should be increased from 1 to 1.5 hours.