ICES TCADSAM 2013 REPORT

Report of the Training Course: AD Model Builder and Stock Assessment (TCADSAM2013)

18–22 February 2013

ICES International Council for the Exploration of the Sea
CIEM Conseil International pour l'Exploration de la Mer

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Content

Participants at the course "AD Model Builder and Stock Assessment" conducted 18-22 February 2013 at ICES Headquarters in Copenhagen. The course was given by Anders Nielsen (admb T-shirt, to the left), and Arni Magnusson (admb T-shirt, to the right).

Report of the ICES training course:

"AD Model Builder and Stock Assessment"

by

Anders Nielsen and Arni Magnusson

Summary

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

AD Model Builder (ADMB) 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 Multifan-CL, Stock Synthesis, and Coleraine are implemented in AD Model Builder. Educating the ICES community to use this tool to build new models and customize existing ones 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 was in that respect extremely successful. On the last day, many participants were writing ADMB code specifically to analyse data from their own stock assessment work.

The approach taken was not a systematic lecturing of all aspects of the ADMB software, but a case-oriented 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 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 specific questions about reading in data we went through that presentation.

This reflects the teachers' belief 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 simple exercises 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 it is during this first exercise that one also has to pick up a new editor, set up a new compiler, figure out how to compile, run, where to find the results, and many more things not explicitly stated in the exercise.

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

Recommendations

"Based on TCADSAM2011 recommendations, the teachers aimed (and managed) to complete all presentations and exercises on the first 4 and a half day, leaving the last half day for Q&A, assisting participants to analyse their own data, and giving participants time to submit course evaluation feedback.

As a result, the atmosphere on the last half day was somewhat looser. Some participants analysed their own data, some asked questions, some organized their course notes, and some discussed the course content with other participants.

Seen from the teachers point of view, and compared to the course in 2011, this final half day was perhaps a bit anti-climatic, and the added time squeeze did leave important subjects uncovered (e.g. splines), so the recommendation for a third run would be to revert to something closer to the 2011 schedule, but seen from the participants point of view this was probably not a bad final half day either.

Some participants felt that too much time was spent on the state-space assessment model (SAM), while other participants wanted more coverage of SAM. Probably just the right amount, then, until a SAM training course is offered?"

The room setup was different from last time, with the teachers sitting at the HC Andersens Blvd side of the Atlantic room. Instead of two opposite projectors, one low-tech projector was sitting in front of the teachers. The underlying reason was that the teachers needed to project from their own laptops. On the whole, this worked better than last time, but the projected screen size was still rather small.

These technical issues are a continuing challenge for the courses. Small-to-medium projected screen size is adequate for showing slides, but a larger screen is required for demonstrating practical things related to AD Model Builder and going through solved exercises.

Like last time, the participants requested that all of the teaching material should be archived and made available as one large zip file. The file “Everything.zip” has now been uploaded to the course website.

Course description

Objective

This will be an advanced course in fisheries stock assessment modelling, 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 allow 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 (non-linear, highly parameterized, possibly time-varying parameters). Published benchmarks have shown that it provides faster and more reliable parameter estimation than other generic function minimizers. 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 that can be analysed 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 statistical assessment models, as quantities such as fishing mortalities and stock sizes are modelled as random effects.

Course Programme and Instructors

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).

Programme

Day		Topic
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

List of Participants forTraining Course on AD Model Builder and Stock Assessment, Atlantic Room 18-22 February 2013

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Annex 2: Detailed course programme

Title: AD Model Builder and Stock Assessment
PROGRAM:

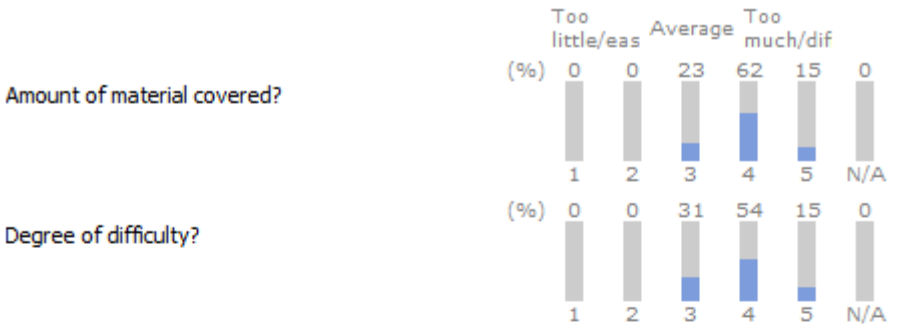
Time	Event	
Monday, 18 February		
9.00 – 10.00	Welcome (AN = Anders Nielsen and AM = Arni Magnusson): Introduction of participants and lecturers; expectations	
10.00 – 10.30	**Tea/Coffee**	
10.30 – 11:30	Introduction to AD Model Builder	
11:30 - 13:00	Building a simple model	
13:00 - 14:00	**Lunch**	
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*	
Tuesday, 19 February		
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	
Wednesday, 20 February		
9.00 – 9.45	Sum up yesterday and introduce today's subject	
9.45 – 10.15	**Tea/Coffee**	
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	
Thursday, 21 February		
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)	
Friday, 22 February		
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	

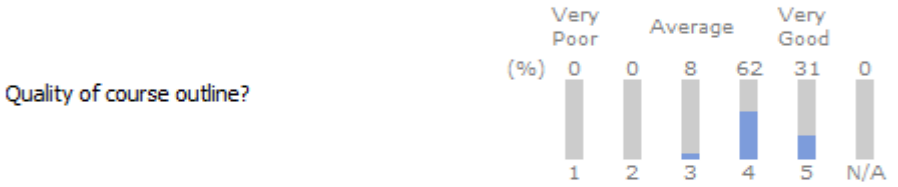
Annex 3: Results of course evaluation questionnaire

2. Course Content



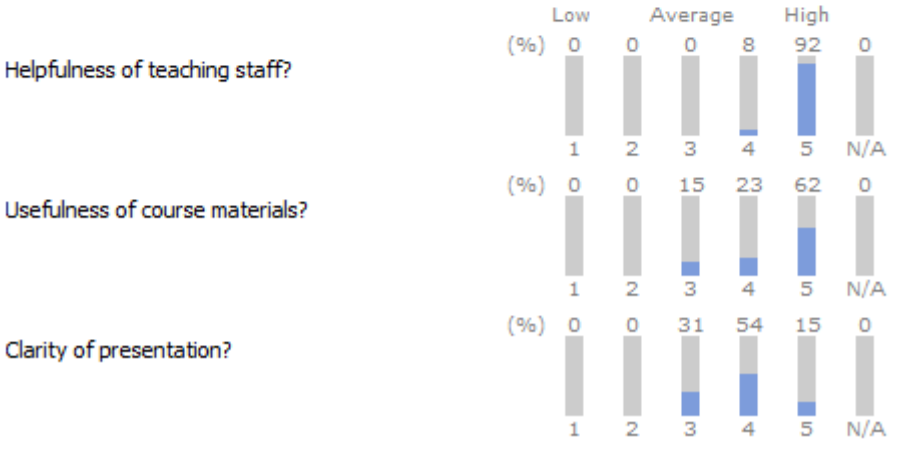
Total: 13

3. Course Organization



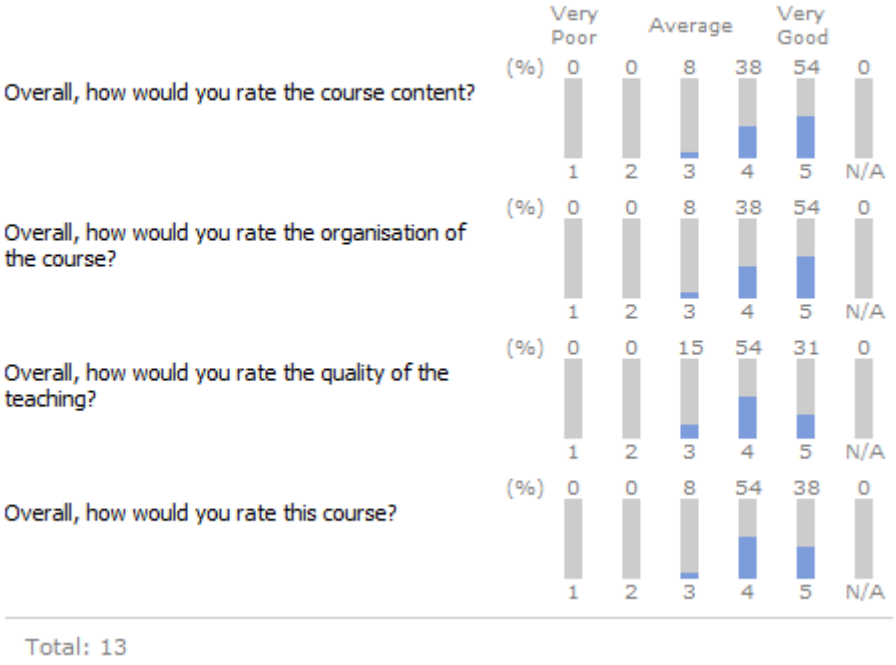
Total: 13

4. Teaching and Learning Support



Total: 13

5. Overall Evaluation



Good features of this course / suggestions for improvement:

- The course and the teachers were very good but there are some things that could be improved. The theory sometimes was explained too fast, and difficult to follow. Maybe it would help to do more exercises together with the theory but without giving much time to that. The course did not give much importance to the results in the exercises and I think it would help to understand more the exercise.

- Very good coverage of the capabilities of ADMB software during the 5 days. Examples were well related to the type of problems i encounter in my job. However the level of difficulty did not follow a linear progression throughout the course.

- A great course with good depth of the models and the core concepts. Lots of examples (a good thing). Nice mix of easier and more difficult exercises.

- The course presenters did an excellent job presenting relatively complex topics to a wide range of users. Furthermore, the course material (presentations, examples, and useful functions) are invaluable and will vastly expand many course participants' analytical tools. This was an outstanding course. If there were more time, I would like it for the course to incorporate more theoretical discussions of various aspects of stock assessment models, such as assumptions, because these guide modelling decisions. But in the time allotted for the course, it is more important to focus on learning the programming.

- Nice slow introduction and gradual build-up of experience is a good feature, but with too limited time to go through exercies. A catalog that accumulates all essential tips and examples would be useful for fast reference during exercises, too much time is spent on looking for previous examples and tips, also the reference book to useful fisheries models and stat methods would be nice to have available.

- Really covered a lot of ground at a fast pace so sometimes I did get a bit lost, especially when instructors were moving fast between different slides and programs. I think a lot more comment added into the demonstration programs would also help, especially in a week or two when the material is not so fresh in the mind
- The course tried to cover too much material. It would be better to be clear what the objectives are and stick to them. Is the course really about AD model builder or is it about SAM? I would have liked more hands on use of/and teaching of AD model builder itself.
- When trying to elaborate how the catch-at-age model worked it was not that helpful to go through the model in R. It would have been better to do a line-by-line explanation in ADMB. Otherwise a great course.