ADMB

Automatic Differentiation Model Builder

ADMB Foundation newsletter

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ADMB now free

AD Model Builder, or ADMB, the most widely used software package for the development of state-of-the-art fisheries stock assessment methods, can now be downloaded without charge from admb-project.org.

ADMB-based computer models are used globally to monitor populations of many endangered and commercially valuable species, to develop place-based resource management policies, and to reconstruct movements of animals tracked with electronic tags. ADMB- based stock assessments are critical to the management of commercially important fisheries stocks worth billions of dollars as well as ecologically sensitive species, in the United States and internationally. Every NOAA Fisheries Science Center uses the ADMB software.

In 2007, scientists from the University of Hawai'i at Mānoa Pelagic Fisheries Research Program and the Inter-American Tropical Tuna Commission, in consultation with scientists from NOAA Fisheries, created the non-profit ADMB Foundation with the goal of increasing the number of ADMB users by making the software free and open source.

During its first year of operation, the UH Pelagic Fisheries Research Program provided a home and logistical support for the Foundation. In partnership with NOAA Fisheries and the National Center for Ecological Analysis and Synthesis (NCEAS), the Foundation drafted a proposal to the Gordon and Betty Moore Foundation, to acquire the copyright to the ADMB software suite, in order to make it broadly and freely available to the research community. A generous grant from the Moore Foundation to NCEAS enabled an agreement with Otter Research Ltd. to open the ADMB source.

ADMB has proven to be an essential tool for a wide range of statistical analysis, especially in fisheries stock assessments. With its recent emergence as free software, it is likely that ADMB will find application to a growing number of challenges in ecological modeling.

Creation of the public download web site is only the first step in making all aspects of ADMB publicly available. Over the next year, a team of software developers will improve documentation of the computer code with the goal of making ADMB an open source enterprise. Releases of binaries (executable code) for the Windows and Linux operating systems are currently freely available, with a port to OS X to follow. Ultimately, the full source code will be available, enabling researchers to contribute their own enhancements and add-ons, using the code repository and support forums established on the ADMB project web site.

ADMB creator Dave Fournier (front) with fellow stock assessment gurus

The Gordon and Betty Moore Foundation, established in 2000, seeks to advance environmental conservation and cutting-edge scientific research around the world and improve the quality of life in the San Francisco Bay Area. For more information, visit www.moore.org.

Fournier nominated for American Fisheries Society's William E. Ricker Resource Conservation Award

The ADMB Foundation supported the nomination Dr. David Fournier for the American Fisheries Society's William E. Ricker Resource Conservation Award. Dr Fournier's nomination was the runner-up in 2008, and he will be re-nominated next year using the same material.

Thanks to everyone who provided support letters. This nomination helps to give Dr. Fournier recognition both for his general contribution to fisheries stock assessment and for creation of ADMB. For those of you who did not provide support letters, we encourage you to send a letter next year.

http://www.fisheries.org/afs/docs/award_nominations.pdf

Inside this issue:

"Thanks to ADMB, it is no longer necessary to omit or transform data because they do not meet the arbitrary assumptions of some 'canned' software package. Instead, it is possible to include a diversity of data in statistical models. This power has revolutionized modeling of natural resources." Dr. John Sibert, Manager, Pelagic Fisheries Research Program, University of Hawaii.

ADMB Foundation creates new awards

The Foundation has established two awards to recognize outstanding student achievement in the application of statistical modeling in fisheries. One for the Tuna Conference and one for the American Fisheries Society Annual Meeting. The awards will help pay expenses for attending these meetings.

The outstanding achievement will be judged on the basis of:

1. *Integration of diverse data*
2. *Creative solution of computational problems*
3. *Analytical innovations*
4. *Contribution to the goals of the ADMB Foundation*

by a special committee nominated by ADMB Foundation members.

More information is available at the Foundation's website. For more information on the Tuna Conference visit http://tunaconference.org/. For more information on the AFS Conference visit www.fisheries.org

Eunjung Kim, a graduate student at the Department of Oceanography, University of Hawaii, Manoa, won the 2009 Tuna Conference award. Eunjung uses advection diffusion models implemented in AD Model Builder to investigate the influence of fish aggregating devices on skipjack tuna movements.

Eunjung Kim, the winner of the ADMB Tuna Conference Award

Visit the Tuna Conference at www.tunaconference.org

"Without ADMB, the Inter-American Tropical Tuna Commission would be unable to conduct the sophisticated [tuna stock] assessments that it currently does." Dr. Mark Maunder, a Senior Scientist at the Inter-American Tropical Tuna Commission.

Compiler benchmarks

ADMB is available for several different compilers. Each compiler has its advantages and disadvantages compared to the other compilers. One aspect that is important to ADMB users is the runtime of a compiled model. The runtime can differ depending on the compiler used, the operating system, or the underlying architecture of the computer. Arni Magnusson of the Marine Research Institute in Iceland has run a number of benchmarks on different compilers and systems. The benchmarks are created using a Lenovo T61 laptop with Intel Core 2 Duo T7500 processor and 4GB RAM, running Windows XP and Kubuntu 8.04 for 32 and 64 bits. The benchmarks are based on the 'truncreg' and 'catage' examples included with ADMB. In the 'truncreg' benchmark, linux64 runs around 100% faster than win32. Among the Windows compilers, Borland performs best, then Microsoft Visual C++, and finally the GNU Compiler Collection. In the 'catage' benchmark, linux64 runs around 58% faster than win32, and linux32 runs around 36% faster than win32. Among the Windows compilers, GCC performs best, then Microsoft, and finally Borland. It looks like GCC is better at MCMCing 'catage', but Borland and Microsoft are better at handling the large 'truncreg' dataset.

Hopefully a MAC version of ADMB will be available soon. But, don't hold your breath for the reverse Polish calculator version.

ADMB Presentation at Seventh European Automatic Differentiation Workshop

On November 25 2008, the Seventh European Workshop on Automatic Differentiation heard a presentation by Hans Skaug entitled Automated Likelihood Based Inference for Stochastic Volatility Models using AD Model Builder. Skaug and coauthors Jun Yu and Dave Fournier apply the Laplace approximation to fit stochastic volatility (SV) models. The models are implemented in AD Model Builder which uses third order automatic differentiation. The use of AD Model Builder substantially reduces computation time relative to Markov chain Monte Carlo (MCMC) algorithms.

The ADMB Foundation supports interaction with other groups that conduct research on automatic differentiation. The success of the ADMB open-source project relies on the ability to attract a diverse range of people who will contribute to the project. In addition to the users (e.g. quantitative ecologists, fisheries scientists, economists, engineers), who will direct future needs, the project needs, mathematicians, statisticians, and computer scientists to implement efficient algorithms to continually improve the features of ADMB.

Donations

The ADMB Foundation is a non-profit organization that relies on donations from individuals and organizations. The Foundation needs these donations to cover operating expenses. The donations are also used to promote the use of ADMB through activities such as workshops, presentations, and awards.

The Inter-American Tropical Tuna Commission provided a startup grant that enabled the formation of the foundation. The foundation has also received donations from the Second International Symposium on Tagging and Tracking Marine Fish with Electronic Devices (and AZTI Technalia), the Marine Resource Assessment and Management Group (MARAM), Department of Mathematics and Applied Mathematics, University of Cape Town, and the international Pacific Halibut Commission.

The Foundation always welcomes donations from individuals and organizations to help supports its efforts to promote the use of ADMB. For those wishing to donate, please contact one of the Foundation members for more information.

The Inter-American Tropical Tuna Commission provided a startup grant that enabled the formation of the ADMB Foundation.

Most of the newsletter articles are available online with additional details. See:

admb-foundation.org

and

admb-project.org

Interfacing ADMB with R

Most researches that would find ADMB beneficial to their work already use the free statistical package R. Hence, to facilitate the use of ADMB, it is important to link ADMB with R. Currently there are several approaches that have been used to link ADMB with R. The simplest is to run an ADMB executable from within R and pass data using files. This is the system that is used for the ADMB based GLMM function for R.

Steve Martel, from UBC, has created some simple R code to read ADMB report files. The function is capable of reading single variables, vectors, and 2-D arrays (including ragged arrays) and produces a list object. Mike Prager and his NMFS team has created ADMB2R, a collection of AD Model Builder routines for saving complex data structures into a file that can be read into R with a single command. ADMB2R provides the means to transfer data structures significantly more complex than simple tables. ADMB also has the capacity to create DLLS with R, but this has been infrequently used. A more complete interface with R is needed so that complete control of ADMB can be conducted within R.

Go to the Tutorials and Examples section of the Community page for more information.

"It is no exaggeration to say that the scientific assessment of many fisheries would grind to a halt without ADMB. There are hundreds of other applications for this tool that will undoubtedly benefit greatly by making it a public piece of software." Professor Ray Hilborn, School of Aquatic and Fisheries Sciences, University of Washington.

ADMB Workshops

The ADMB Foundation is running two ADMB workshops in the near future. The first is at NCEAS in Santa Barbara 9-10 of March and the second is at the 2009 ESA Annual Meeting in Albuquerque, New Mexico at the start of August. These workshops are intended to expose ecologists to ADMB and increase the number and diversity of ADMB users. Workshop topics include : 1) overview of ADMB. 2) refresher on model development and likelihood based inference. 3) Installing the software. 3) first example. 4) Options for reading your data in. 5) Definition of model parameters. 6) Programming the likelihood function. 7) Specification and formatting of output. 8) Debugging, memory management, and other issues. 9) Estimation uncertainties (delta, profile, and MCMC). 10) Random effects.

Coding tip: reporting the gradient

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report<<objective_function_value::pobjfun->gmax
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Send comments and contributions to
newsletter@admb-foundation.org

Signup for the newsletter at
ADMB Foundation website or send an e-mail to newsletter@admb-foundation.org

Were on the web! admb-foundation.org

The objectives of the ADMB Foundation are to (a) advance the ADMB project for improving data analysis and non-linear statistical modeling; (b) act as an official voice for the ADMB project, providing means of communication with the press, commercial and noncommercial organizations interested in the ADMB software; (c) coordinate development and promote use of ADMB.

The ADMB Foundation is a non-profit organization working in the public interest for charitable, educational and scientific purposes under section 501(c)(3) of the United States Internal Revenue Code.

"ADMB has empowered an entire generation of fishery stock assessment scientists." Dr. Richard Methot, Senior Scientist for Assessments, NOAA Fisheries.

Recent ADMB based publications

Deriso, R.B., Maunder, M.N., and Pearson, W.H. 2008. Incorporating covariates into fisheries stock assessment models with application to Pacific herring of Prince William Sound, Alaska. Ecological Applications 18(5): 1270-1286.

Ichinokawa, M, Coan, A.L., and Takeuchi, Y. 2008. Transoceanic migration rates of young North Pacific albacore, Thunnus alalunga, from conventional tagging data. Canadian Journal of Fisheries and Aquatic Sciences, 65(8): 1681-1691.

Lessard, R.B, Hilborn, R., and Chasco, B. E. 2008. Escapement goal analysis and stock reconstruction of sockeye salmon populations (Oncorhynchus nerka) using life-history models. Canadian Journal of Fisheries and Aquatic Sciences, 65(10): 2269-2278.

Linton, B.C. and Bence, J.R. 2008. Evaluating methods for estimating process and observation error variances in statistical catch-at-age analysis. Fisheries Research, 94(1): 26-35.

Maunder, M.N., Skaug, H.J., Fournier, D.A., and Hoyle, S.D. 2008. Comparison of estimators for mark-recapture models: random effects, hierarchical Bayes, and AD Model Builder. In: Modeling Demographic Processes in Marked Populations. Eds. Thomson, D.L., Cooch, E.G., and Conroy, M.J. Environmental and Ecological Statistics 3: 917-948.

Trenkel, V.M. 2008. A two-stage biomass random effects model for stock assessment without catches: What can be estimated using only biomass survey indices? Canadian Journal of Fisheries and Aquatic Sciences, 65(6): 1024-1035.

Ye, Y., Dennis, D., and Skewes, T. 2008. Estimating the sustainable lobster (Panulirus ornatus) catch in Torres Strait, Australia, using an age-structured stock assessment model. Continental Shelf Research, 28(16): 2160-2167.