

## **Workshop I – AD Model Builder Basics**

### **June 8-9, 2006**

This is intended for those who have never used the software or those needing a refresher in software basics. Workshop I will include (1) a review of what the software does and why it has become widely used; (2) details of how to create an ADMB template; (3) essentials of ADMB and C++ syntax; and (4) hands-on experience working with several examples.

#### **Workshop I Agenda**

##### **Session 1 - June 8 (8:30 AM to 12:00 PM)**

Introductions, logistics, course overview

What is ADMB and why use it

- Maximum likelihood estimation
- Nonlinear problems
- Non-normal distributions
- Need to iteratively adjust parameters
- ADMB is very fast (uses automatic differentiation)
- ADMB has several built in approaches for assessing uncertainty

General overview of how ADMB works

- Dat file
- Tpl file
- Conversion of tpl to cpp
- Conversion of cpp to exe

Simple ADMB example

- Parts of the dat file
- Parts of the tpl file
- Emacs and opening the files in e-macs
- Details (comments, indentation, semicolons, starting values)
- Compiling & running
- Looking at results
- Runtime switches

Working with and changing example

- Basics of e-macs editing
- Hands on
  - Students compile and run example
  - Students add a comment, create a new variable and add it to report file

Simple diagnostics and elaborations

- Error messages, exiting, trapping errors, safe mode, ...)

##### **Session 2 – June 8 (2:00 PM to 5:00 PM)**

Some essential theory

- What is “likelihood”
- Likelihood of independent observations
- Properties of maximum likelihood estimates
- ADMB expects negative log-likelihood

- Log-likelihood for normal
  - dropping constants
- Knowing about concentrated likelihood
- Example of a really different likelihood
  - (negative binomial example from Ecological Detective)
  - first exposure to loop and function
- Hands on with the negative binomial example

A more complex example (time-varying VB growth)

Overview of the model

Some new admb things

- Organizing code with functions
- Program control: loops, conditional statements, etc.
- Sdreport objects
- Random walk

Hands on session with time-varying growth model

### **Session 3 - June 8 (7:00 PM to 9:00 PM)**

A simpler example requiring loops

- Overview of surplus production model
- General suggestions on how to program a new problem

Hands on programming of surplus production model

(class codes their own model)

### **Session 4 - June 9 (8:30 AM to 12:00 PM)**

Recap of day 1 (clarifications, expansions, questions)

Asymptotic standard errors and admb

- Getting the wrong sd if you don't use the neg log likelihood

Overview of a basic catch-age model

Some new admb things

- Array and matrix functions
- Phases
- Bounds
- Parameterization issues with scaler and dev vector and by differences

Hands on with catch-age model part 1

(program the objective function)

### **Session 5 - June 9 (2:00 PM to 5:00 PM)**

Hands on with the catch-age model part 2

- Different selectivity function

Checking sensitivity to starting values

- Changing values specified in initial values section of tpl
- Reading values in from dat file
- Reading values in from input parameter file
- Precedence when using more than one method

Improving efficiency and other details

- Controlling when calculations are done

- things that are needed but do not change
  - things that are only needed to summarize results
  - calculations that are needed in some phases and not others
  - avoiding unneeded loops
  - controlling where data are read from and results are written to
- Struggling with convergence issues
- Types of admb messages when program stops
  - Checking convergence problems
  - Can you estimate all the parameters?
  - Examination of correlation matrix (if it exists)
  - Reparameterization of problem