



AD Model Builder

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AD Model Builder

Powerful program to fit models

Fast, reliable, flexible

Free software

Somewhat hard to learn

Number cruncher

Use alongside Excel, R, etc.

Fitting nonlinear models

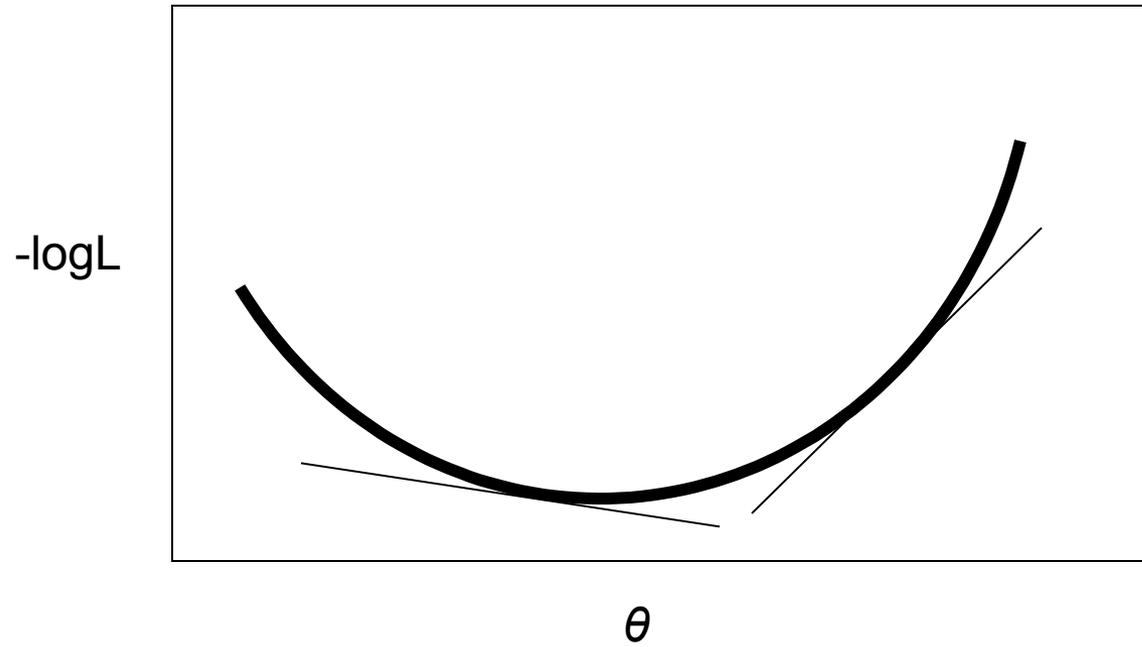
- Even simple models (<10 parameters) can have complex likelihood space
- Multiple minima, ridges and canyons
- Excel solver is easy to use, but cannot handle complex models or evaluate uncertainty
- R `optim()` evaluates uncertainty, but cannot handle complex models

Performance

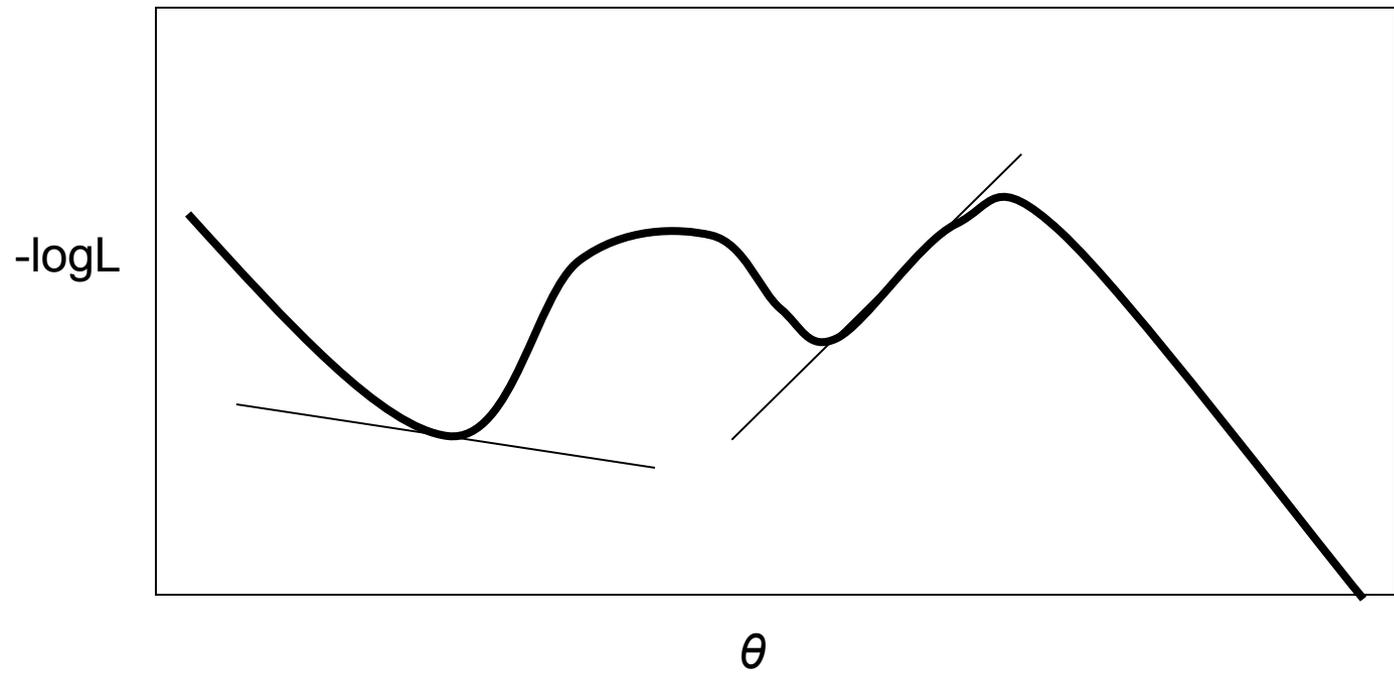
Modeling Package	msec/function call	number of function calls	time to converge
AD Model Builder	131	291	38 seconds
Gauss	167	23,365	1.08 hours
Matlab	639	18,360	3.25 hours
S-plus	n/a	n/a	n/a

Schnute et al. (1998)
fisheries stock assessment model

Derivatives

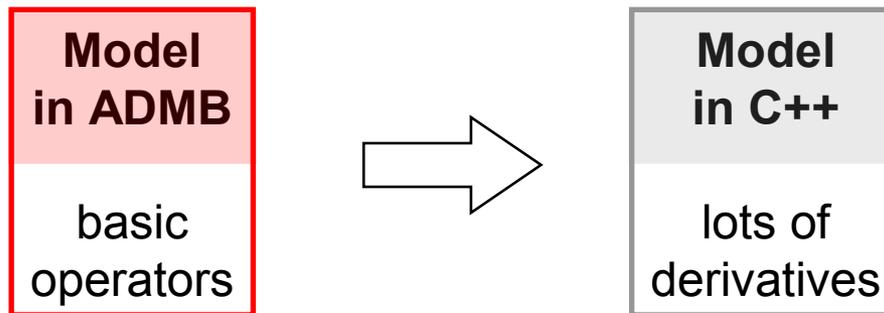


Derivatives



Automatic differentiation

- The "AD" in AD Model Builder
- Models and loops can be rolled out to basic operators like + - * / ^ sqrt log exp
- All those operators are overloaded to perform differentiation (chain rule, etc.)



History

- 1990 MULTIFAN (Fournier et al.)
- 1991 AD book (Griewank and Corliss, eds.)

- 1993 ADMB 1.0
- 2007 ADMB 8.0.2

- 2007 ADMB Foundation (Sibert, Ancheta, and Maunder)
- 2008 ADMB 9.0 (freeware)
- 2009 ADMB 9.1 (free software)
- 2010 ADMB Meeting (short-term and long-term goals)

admb-project.org

The screenshot shows a Mozilla Firefox browser window displaying the homepage of the AD Model Builder (ADMB) project. The browser's address bar shows the URL <http://admb-project.org/>. The website features a green and white color scheme. At the top, there is a search bar labeled "Search ADMB" and a navigation menu with links for Home, Downloads, Examples, Documentation, Courses, Community, and Contacts and Support. A "Log in" link is also present. The main content area includes a "Welcome" message by John Sibert, dated March 30, 2010, describing the software as a powerful package for developing nonlinear models. A list of links provides access to libraries, documentation, community contributions, and courses. A "News" sidebar on the right lists recent updates, including training courses and software availability for various operating systems. The footer contains information about the project's funding, graphic design credits, and the website's power source.

Welcome — ADMB Project - Mozilla Firefox

File Edit View History Bookmarks Tools Help

http://admb-project.org/

Search ADMB Search



FAST, ACCURATE, STABLE OPTIMIZATION

Home Downloads Examples Documentation Courses Community Contacts and Support Log in

You are here: Home

Welcome

by [John Sibert](#) — last modified Mar 30, 2010 10:45 PM

AD Model Builder, or ADMB, the most powerful software package for the development of state-of-the-art nonlinear models, can now be freely downloaded for Windows, Linux, MacOS, and Sun/SPARC

This is the place to come to

- [download libraries](#) for your compiler and OS
- view and download [documentation](#)
- view the contributions to the ADMB project by the [ADMB user Community](#)
- find out about [courses](#) and [get support](#)

For background on the ADMB project [click here](#). Send this — Print this —

News

- AD Model Builder Training Course
Mar 18, 2010
- The new ADMB project website
Dec 31, 2009
- ADMB libraries for Intel MacOS Snow Leopard is available
Dec 02, 2009
- ADMB2R is available
Nov 09, 2009
- Deadline extended for ADMB programmer position.
Nov 03, 2009

[More news...](#)

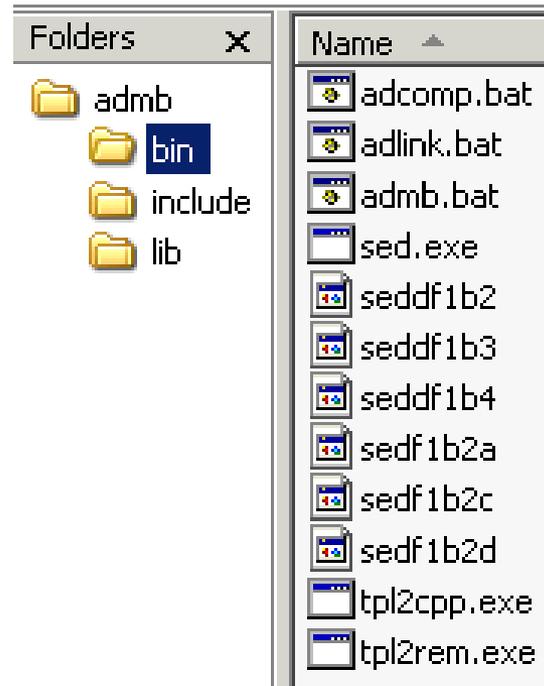
The ADMB Project is supported by the National Center for Ecological Analysis and Synthesis, the Pelagic Fisheries Research Program, the ADMB Foundation, and a grant from NOAA Fisheries to the Joint Institute of Marine and Atmospheric Research.

 Graphic design by Fusion Creative. This web site is powered by Plone.

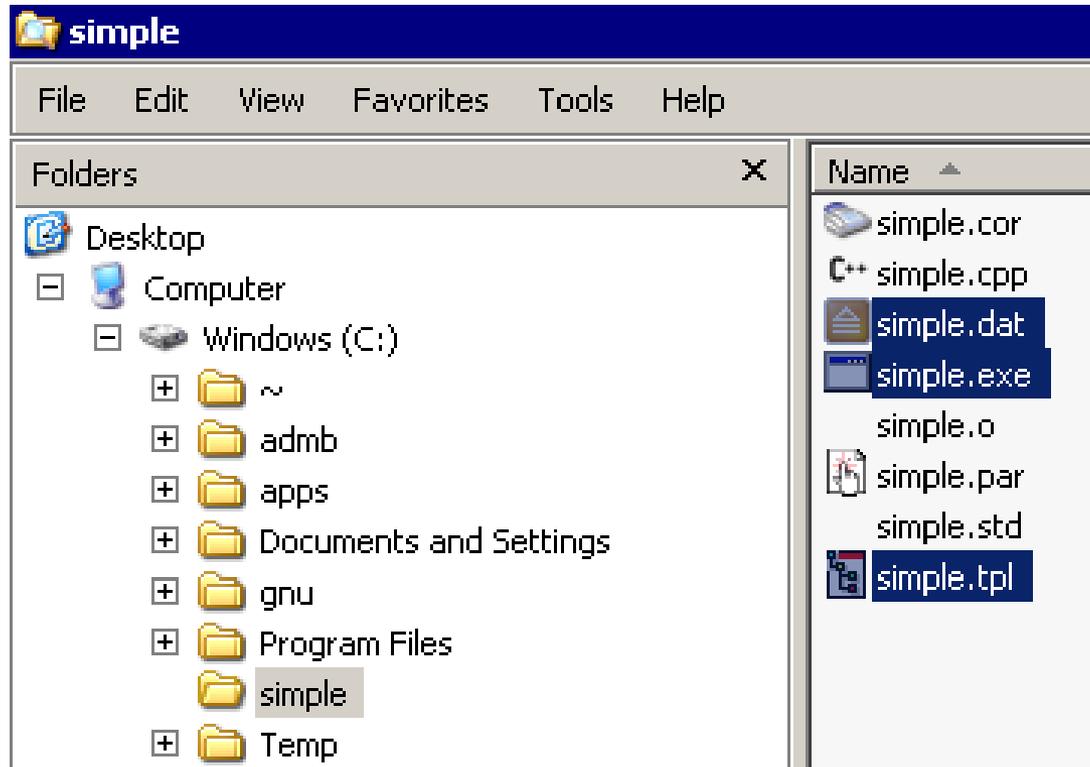
ADMB Foundation © 2007–2009 • [Log in](#)

Done

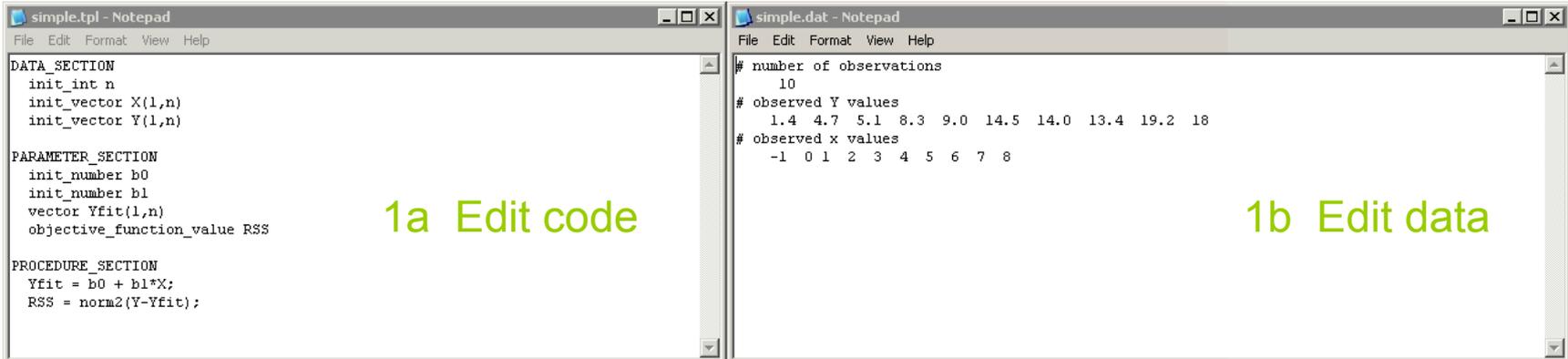
ADMB directory



Model directory



Working environment



```
simple.tpl - Notepad
File Edit Format View Help
DATA_SECTION
init_int n
init_vector X(1,n)
init_vector Y(1,n)

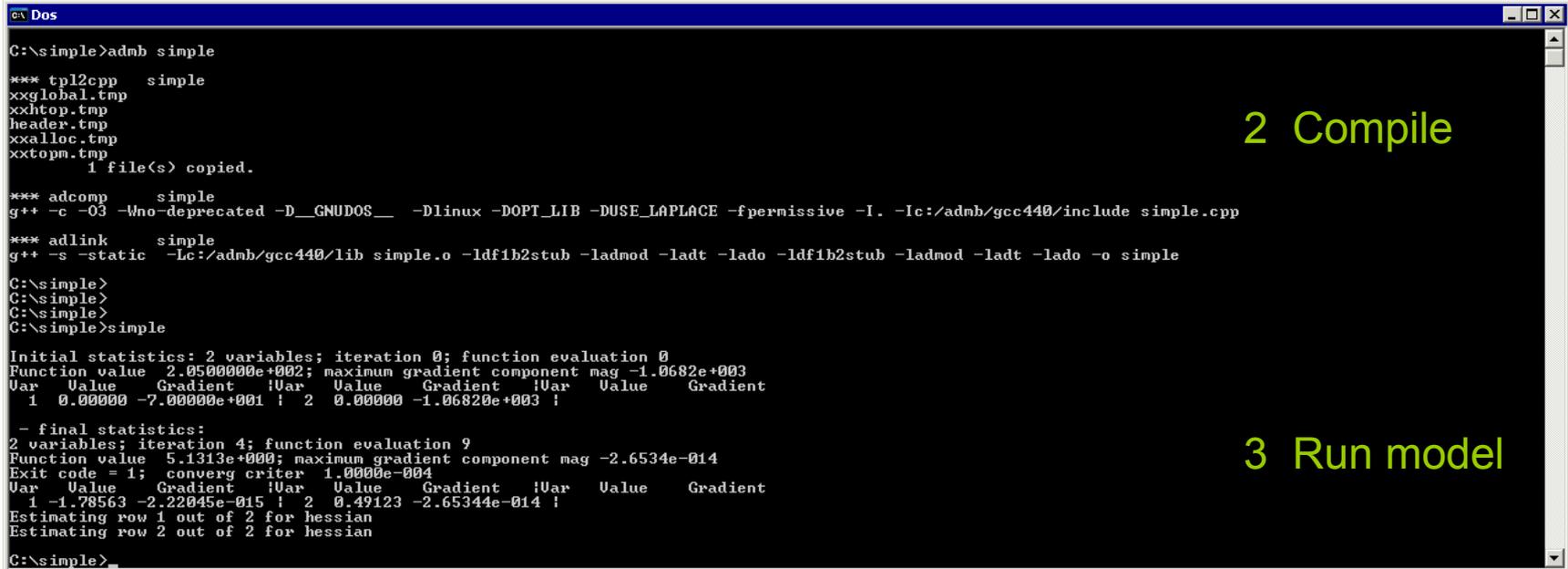
PARAMETER_SECTION
init_number b0
init_number b1
vector Yfit(1,n)
objective_function_value RSS

PROCEDURE_SECTION
Yfit = b0 + b1*X;
RSS = norm2(Y-Yfit);

simple.dat - Notepad
File Edit Format View Help
# number of observations
10
# observed Y values
1.4 4.7 5.1 8.3 9.0 14.5 14.0 13.4 19.2 18
# observed x values
-1 0 1 2 3 4 5 6 7 8
```

1a Edit code

1b Edit data



```
Dos
C:\simple>admb simple

*** tpl2cpp simple
xxglobal.tmp
xxhtop.tmp
header.tmp
xxalloc.tmp
xxtopm.tmp
1 file(s) copied.

*** adcomp simple
g++ -c -O3 -Wno-deprecated -D_GNUDOS__ -Dlinux -DOPT_LIB -DUSE_LAPLACE -fpermissive -I. -Ic:/admb/gcc440/include simple.cpp

*** adlink simple
g++ -s -static -Lc:/admb/gcc440/lib simple.o -ldf1b2stub -ladmod -lادت -lادو -ldf1b2stub -ladmod -lادت -lادو -o simple

C:\simple>
C:\simple>
C:\simple>
C:\simple>simple

Initial statistics: 2 variables; iteration 0; function evaluation 0
Function value 2.050000e+002; maximum gradient component mag -1.0682e+003
Var Value Gradient !Var Value Gradient !Var Value Gradient
1 0.00000 -7.00000e+001 ! 2 0.00000 -1.06820e+003 !

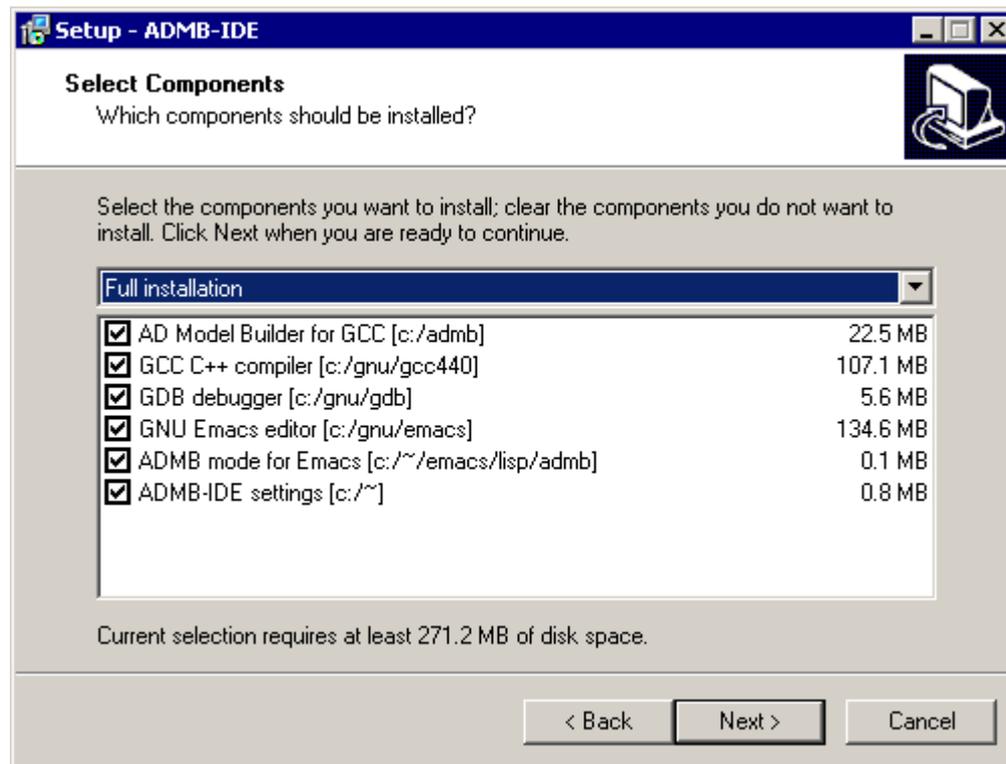
- final statistics:
2 variables; iteration 4; function evaluation 9
Function value 5.1313e+000; maximum gradient component mag -2.6534e-014
Exit code = 1; converg critr 1.0000e-004
Var Value Gradient !Var Value Gradient !Var Value Gradient
1 -1.78563 -2.22045e-015 ! 2 0.49123 -2.65344e-014 !
Estimating row 1 out of 2 for hessian
Estimating row 2 out of 2 for hessian

C:\simple>
```

2 Compile

3 Run model

ADMB-IDE



ADMB-IDE

The screenshot displays the ADMB-IDE interface with the following components:

- Menu:** File, Edit, Options, Buffers, Tools, ADMB, Help.
- Code Editor (simple.tpl):**

```
// LIMITED TO, PROCUREMENT  
// DATA, OR PROFITS; OR BUSI  
// THEORY OF LIABILITY, WHATE  
// (INCLUDING NEGLIGENCE OR  
// OF THIS SOFTWARE, EVEN I  
  
DATA_SECTION  
init_intc nobis  
init_vector Y(1,nobis)  
init_vector z(1,nobis)  
PARAMETER_SECTION  
init_number a  
init_number b  
vector pred_Y(1,nobis)  
objective_function_value  
PROCEDURE_SECTION  
pred_Y=a*x+b;  
f=(norm2(pred_Y-Y));  
f=nobis/2.*log(f);
```
- Code Editor (simple.cpp):**

```
SERVICES; LOSS OF PROFITS;  
NEVER CAUSED AND IN NO  
CT LIABILITY, OR IN ANY  
ANY WAY OUT OF THE REA  
BILITY OF SUCH DATA  
  
#ifndef __ZTC__  
extern unsigned int _stack=100000;  
#endif  
  
long int arrmblsize=0;  
  
int main(int argc, char * argv[])  
{  
    ad_set_new_handler();  
    ad_exit=&ad_boundf;  
    gradient_structure::set_NO_DERIVATIVES();  
    gradient_structure::set_YES_SAVE_VARIABLES_VALUES();  
    #if defined(__GNUDOS__) || defined(DOS386) || defined(__DPMI32_) || defined(__DPMI64_)  
        if (!arrmblsize) arrmblsize=150000;  
    #else  
        if (!arrmblsize) arrmblsize=25000;  
    #endif  
    model_parameters mp(arrmblsize,argc,argv);  
    mp.iprint=10;  
    mp.preliminary_calculations();  
    mp.computations(argc,argv);  
    return 0;  
}  
  
extern "C" {  
    void ad_boundf(int i)  
    {  
        // so we can stop here  
    }  
}
```
- Terminal Window:**

```
--(DOS)-- simple.tpl Bot (45,20) (ADMB)----- simple.cpp 62% (85,0) (C++/1 Abbrev)-----  
  
Initial statistics: 2 variables; iteration 0; function evaluation 0  
Function value 3.6493579e+01; maximum gradient component mag -3.6127e+00  
Var Value Gradient |Var Value Gradient |Var Value Gradient  
1 0.00000 -3.61269e+00 | 2 0.00000 -7.27814e-01 |  
  
- final statistics:  
2 variables; iteration 7; function evaluation 19  
Function value 1.4964e+01; maximum gradient component mag -7.0014e-05  
Exit code = 1; converg criter 1.0000e-04  
Var Value Gradient |Var Value Gradient |Var Value Gradient  
1 1.90909 -7.00140e-05 | 2 4.07818 -2.08982e-05 |  
Estimating row 1 out of 2 for hessian  
Estimating row 2 out of 2 for hessian  
█  
  
-u:** *Async Shell Command* All (15,0) (Fundamental)-----
```

ADMB-IDE

The screenshot displays the ADMB-IDE interface with a debugger window (GDB) and a console window. The debugger window shows the execution of a program with several breakpoints and a 'stopped' state. The console window displays the output of the program, including initial and final statistics for a function evaluation.

Debugger Window (GDB):

```
[New thread 3668.0xc64]
Breakpoint 3, main (argc=1, argv=0x32430) at simple.cpp:65
(gdb) c
Continuing.

Breakpoint 1, main (argc=1, argv=0x32430) at simple.cpp:78
(gdb) c
Continuing.

Program exited normally.
(gdb) run
Starting program: c:\simple\simple.exe
[New thread 1300.0x504]

Breakpoint 3, main (argc=1, argv=0x32430) at simple.cpp:65
(gdb) cont
Continuing.

Breakpoint 1, main (argc=1, argv=0x32430) at simple.cpp:78
(gdb) what mp
type = model_parameters
(gdb) display arrmb1size
1: arrmb1size = 150000
(gdb) print mp
$3 = (<model_data> = (<ad_comm> = {_vptr$ad_comm = 0x532084, static time_flag = 0, s...
(gdb)
```

Console Window:

```
Initial statistics: 2 variables; iteration 0; function evaluation 0
Function value 3.6493579e+001; maximum gradient component mag -3.6127e+000
Var Value Gradient |Var Value Gradient |Var Value Gradient
1 0.00000 -3.61269e+000 | 2 0.00000 -7.27814e-001 |

- final statistics:
2 variables; iteration 7; function evaluation 19
Function value 1.4964e+001; maximum gradient component mag -7.0014e-005
Exit code = 1; converg critr 1.0000e-004
Var Value Gradient |Var Value Gradient |Var Value Gradient
1 1.90909 -7.00140e-005 | 2 4.07818 -2.08982e-005 |
Estimating row 1 out of 2 for hessian
Estimating row 2 out of 2 for hessian
[]
```

Debugger Output (Bottom):

```
1\** *gud-simple.exe* Bot (283,6) (Debugger:run [stopped])
#ifdef __ZTC
extern unsigned int _stack=10000U;
#endif

long int arrmb1size=0;

int main(int argc,char * argv[])
{
    ad_set_new_handler();
    ad_exit=$ad_boundf;
    gradient_structure::set_NO_DERIVATIVES();
    gradient_structure::set_YES_SAVE_VARIABLES_VALUES();
    #if defined(_GNUDOS) || defined(DOS386) || defined(_DPHI32_) || \
    defined(_MSVC32_)
        if (!arrmb1size) arrmb1size=150000;
    #else
        if (!arrmb1size) arrmb1size=25000;
    #endif
    model_parameters mp (arrmb1size,argc,argv);
    mp.iPrint=10;
    mp.preliminary_calculations();
    mp.computations(argc,argv);
    return 0;
}

extern "C" {
void ad_boundf(int i)
{
}
}

simple.cpp 62% (78,0) (C++/1 Abbrev)
1\** *input/output of simple.exe* Bot (85,0) (Inferior I/O:run)
Num Type Disp Enb Address What
1 breakpoint keep y 0x00403c4b in main at simple.cpp:78
breakpoint already hit 1 time
2 breakpoint keep n 0x00403c4b in main at simple.cpp:77
breakpoint already hit 1 time
3 breakpoint keep y 0x00403ba3 in main at simple.cpp:65
breakpoint already hit 1 time

1\** *breakpoints of simple.exe* All (7,0) (Breakpoints)
```

R packages

- CRAN: PBSadmb, (scapeMCMC)
- R-Forge: r2admb
- Otter Research: glmmADMB
- ADMB Project: admb2r
- ADMB Newsletter: import functions

Demo

- **ADMB-IDE**
 - download, manuals, simple, pella
- **Control file**
 - initial, limits, phases, priors
- **Advanced statistics**
 - hessian, mcmc, random effects