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

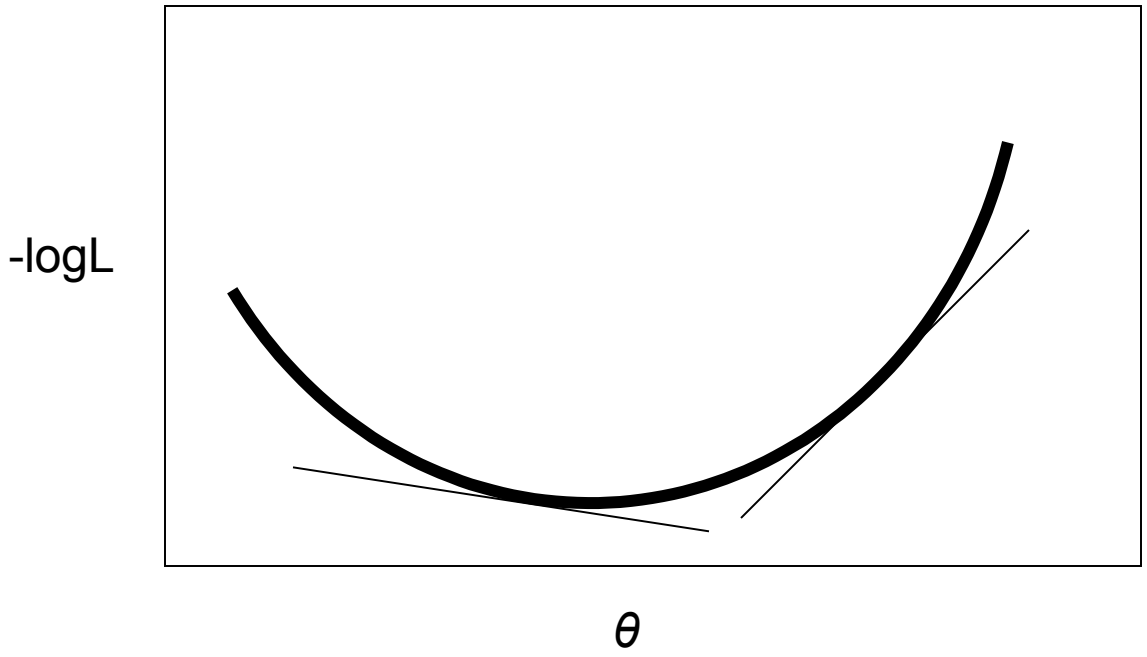
- Even simple models (<10 parameters) can have complex likelihood space
- Multiple minima, ridges and canyons
- Excel solver is easy to use, but cannot handle complex models or evaluate uncertainty
- R optim() evaluates uncertainty, but cannot handle complex models

Performance

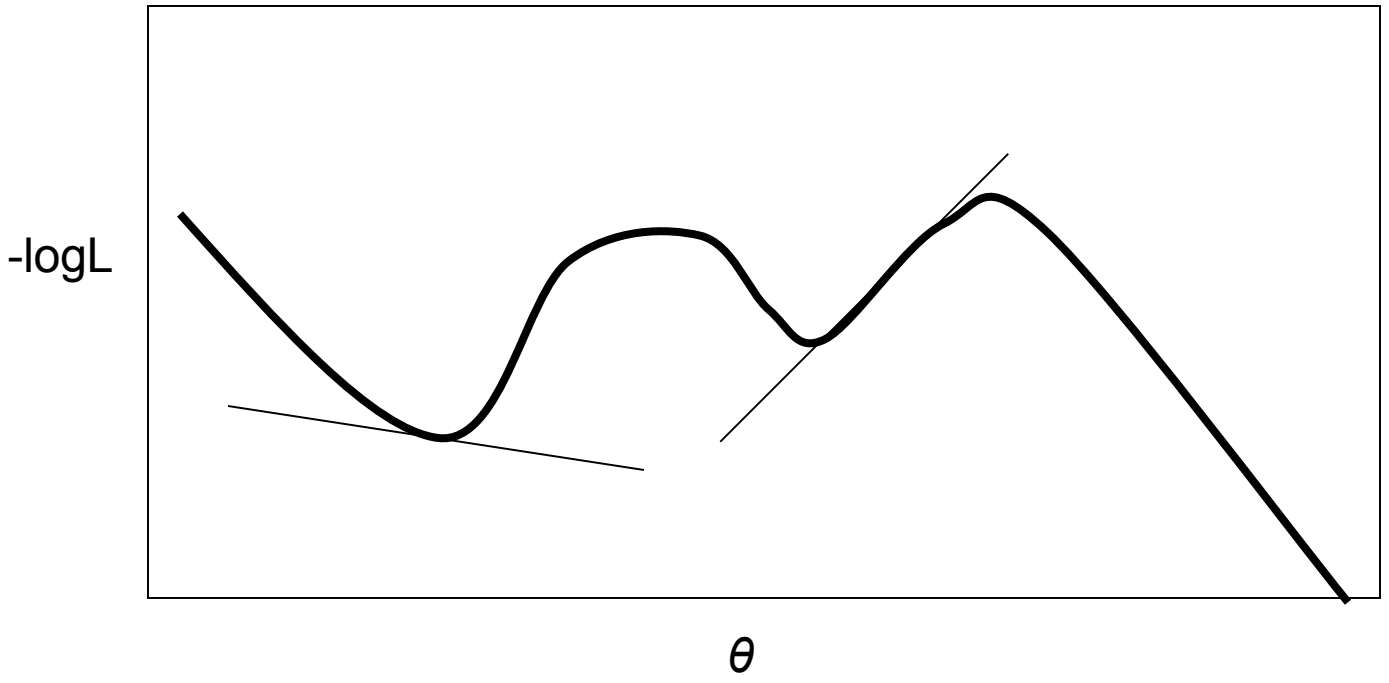
Modeling Package	msec/function call	number of function calls	time to converge
AD Model Builder	131	291	38 seconds
Gauss	167	23,365	1.08 hours
Matlab	639	18,360	3.25 hours
S-plus	n/a	n/a	n/a

Schnute et al. (1998)
fisheries stock assessment model

Derivatives

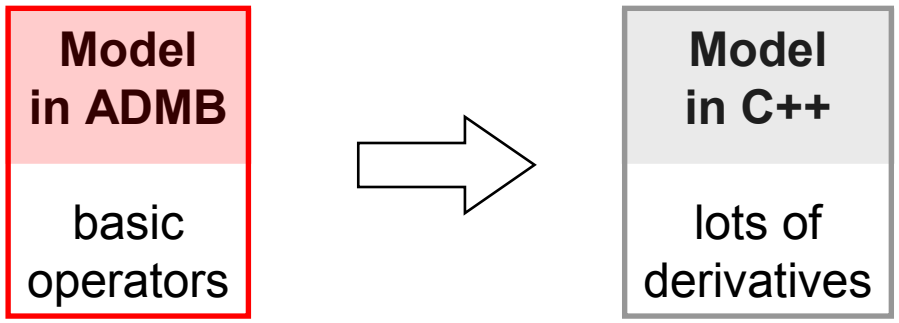


Derivatives



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)

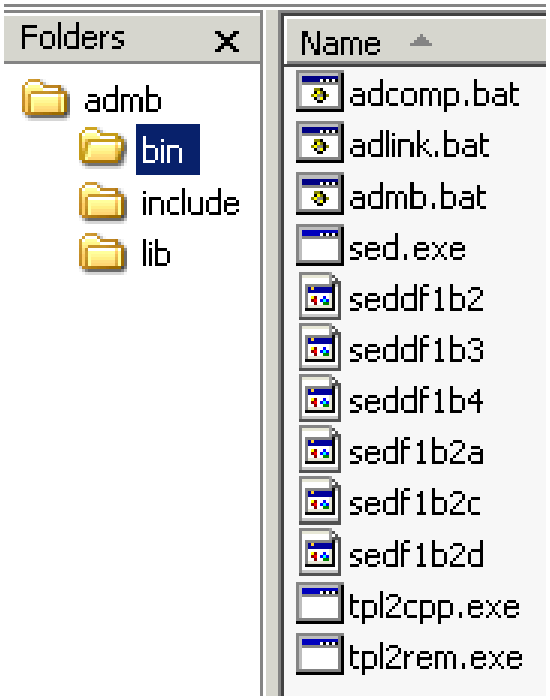
2008 ADMB 9.0 (freeware)

2009 ADMB 9.1 (free software)

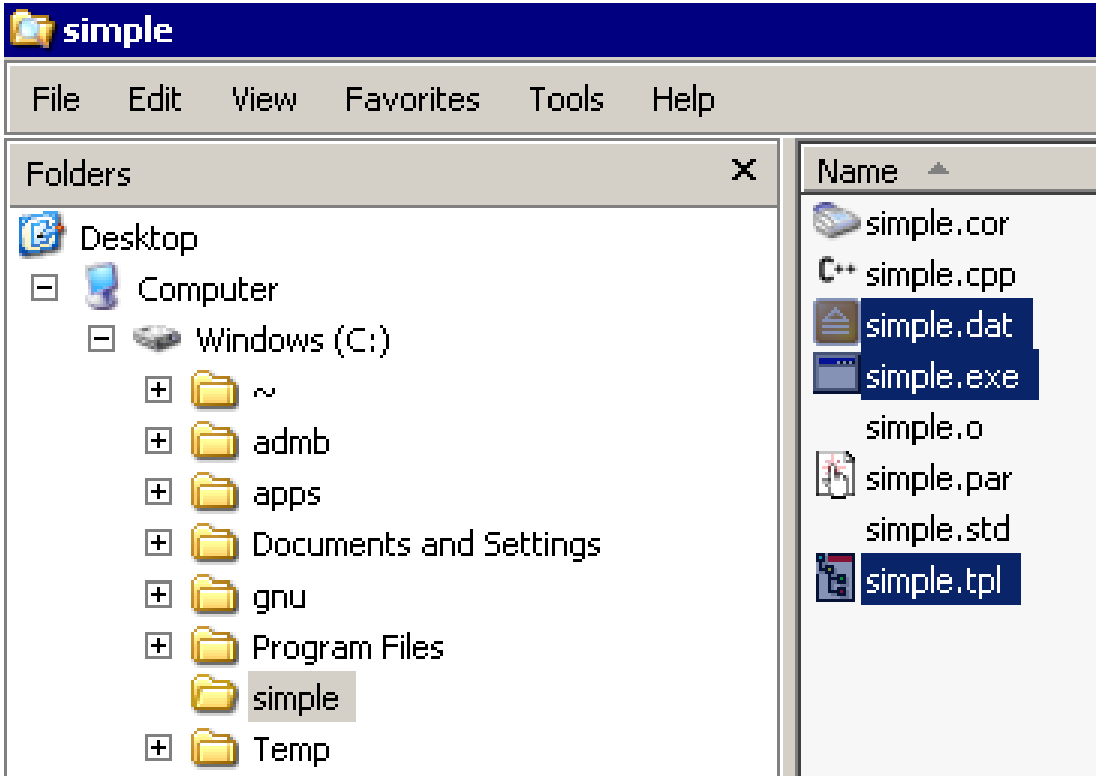
2010 ADMB Meeting (short-term and long-term goals)

admb-project.org

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);
```

1a Edit code

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
```

1b Edit data

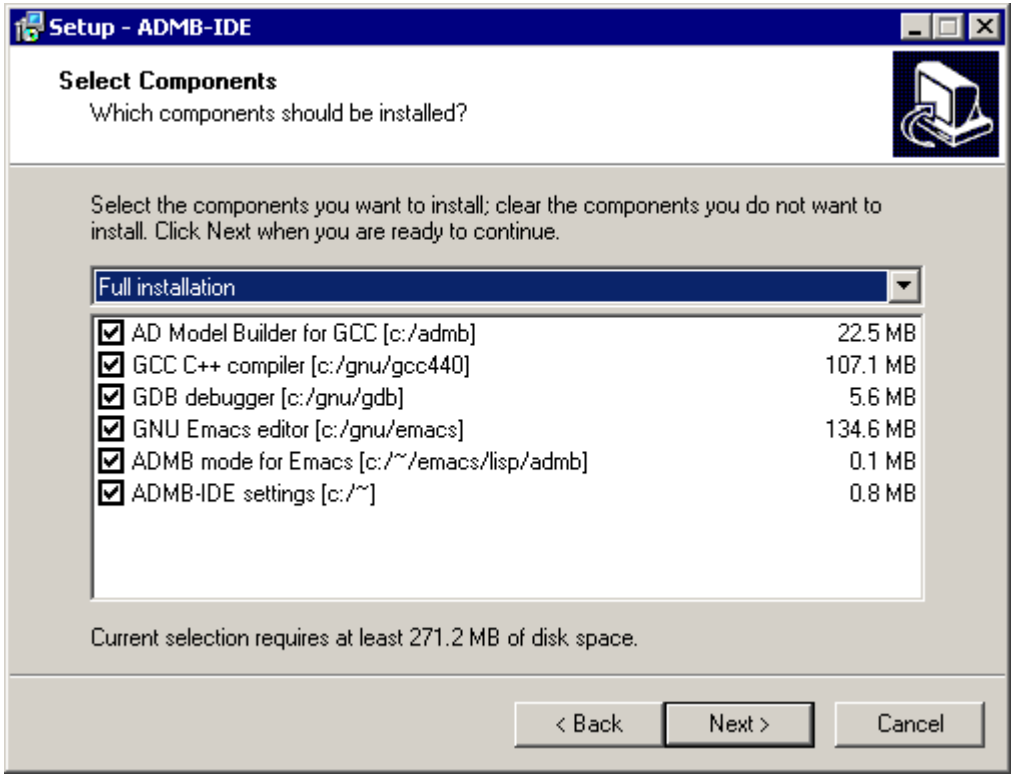
Dos

```
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 -ladt -lado -ldf1b2stub -ladmod -ladt -lado -o simple

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

Initial statistics: 2 variables; iteration 0; function evaluation 0
Function value  2.0500000e+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 criter  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>_
```

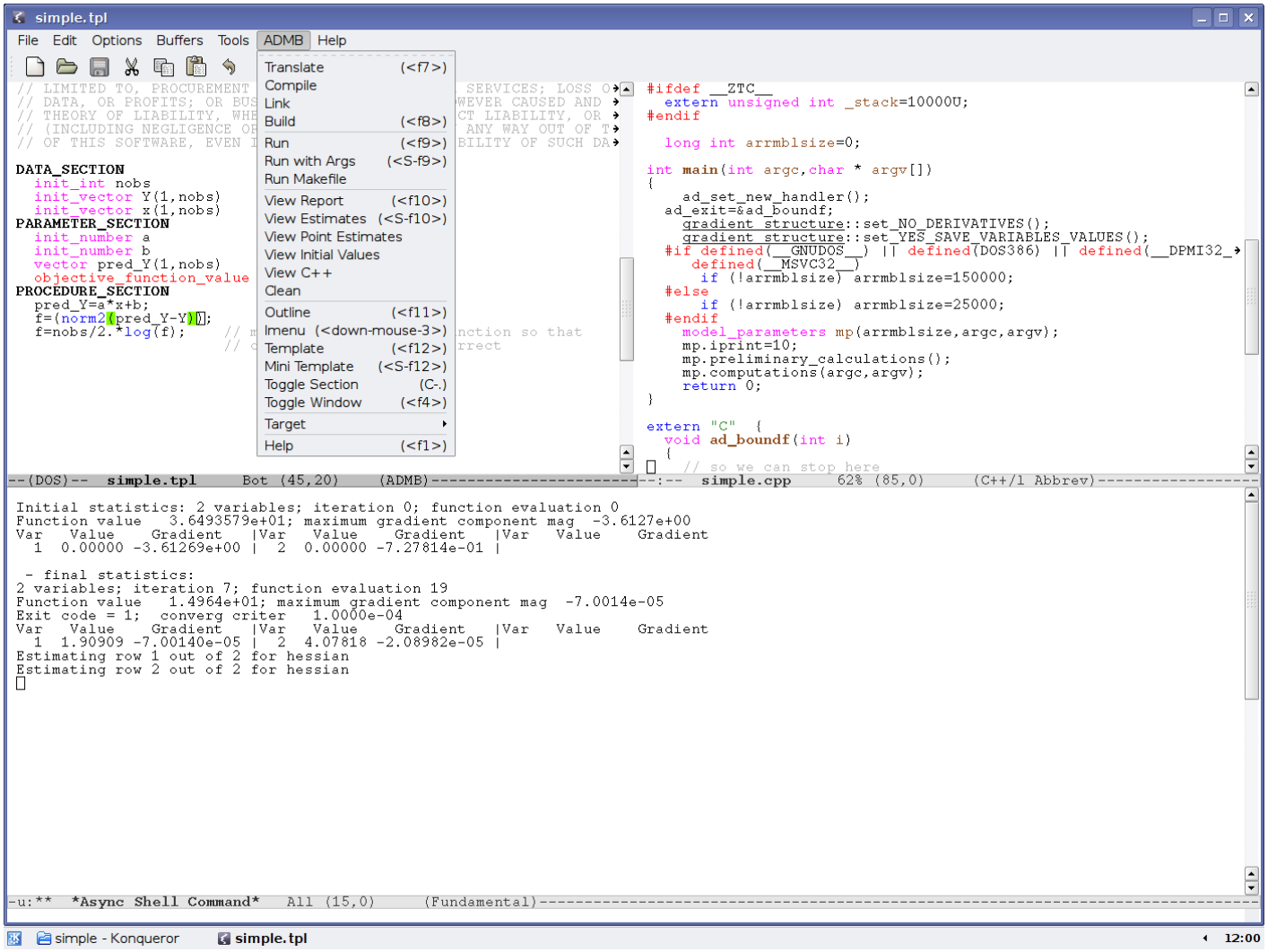
2 Compile

3 Run model

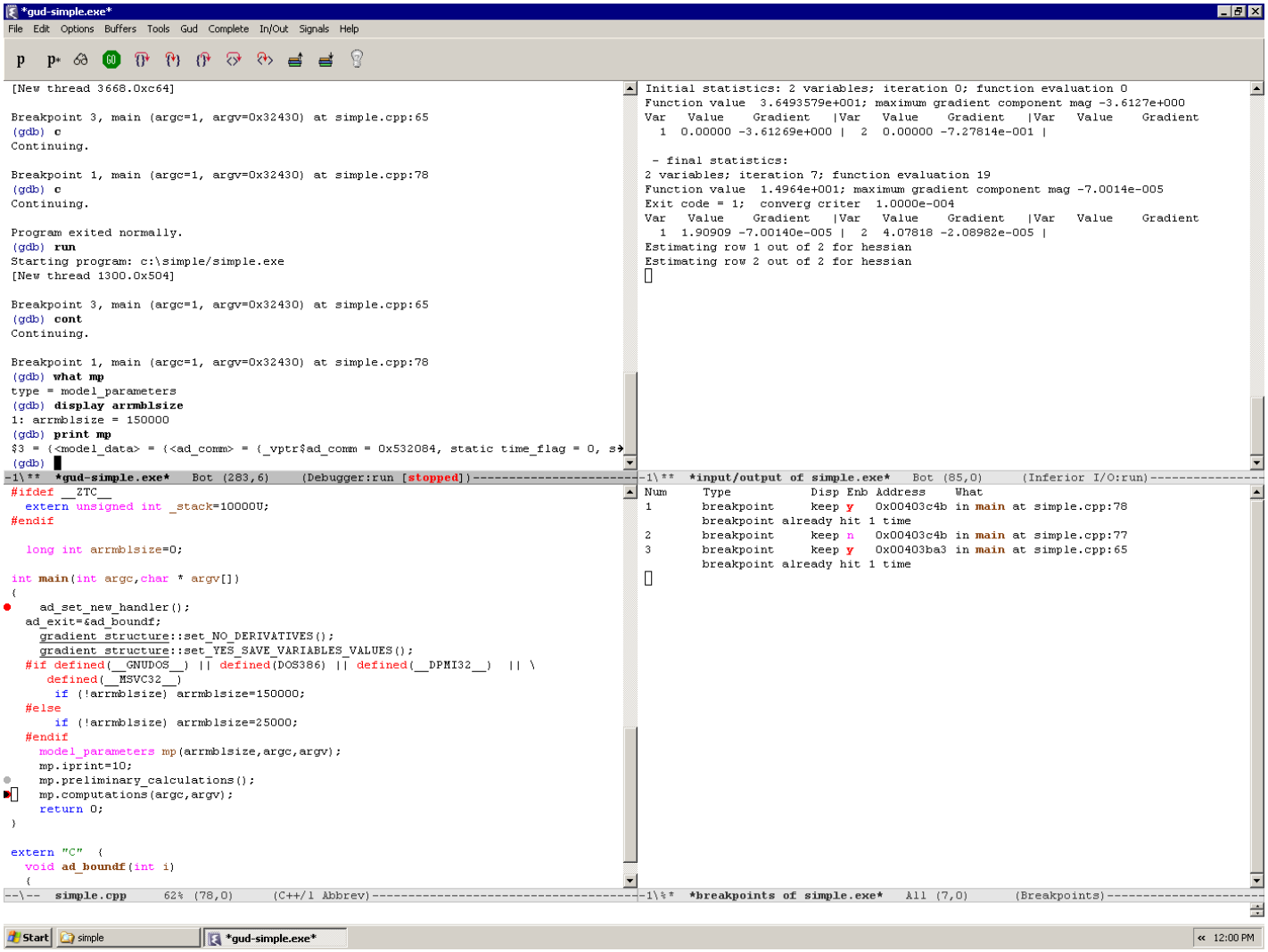
ADMB-IDE


Setup - ADMB-IDE
Select Components
Which components should be installed?
Select the components you want to install; clear the components you do not want to install. Click Next when you are ready to continue.
Full installation
AD Model Builder for GCC [c:/admb] 22.5 MB
GCC C++ compiler [c:/gnu/gcc440] 107.1 MB
GDB debugger [c:/gnu/gdb] 5.6 MB
GNU Emacs editor [c:/gnu/emacs] 134.6 MB
ADMB mode for Emacs [c:/~/emacs/lisp/admb] 0.1 MB
ADMB-IDE settings [c:/~] 0.8 MB
Current selection requires at least 271.2 MB of disk space.
< Back
Next >
Cancel

ADMB-IDE


simple.tpl
File Edit Options Buffers Tools ADMB Help
Translate (<f7>)
Compile
Link
Build (<f8>)
Run (<f9>)
Run with Args (<S-f9>)
Run Makefile
View Report (<f10>)
View Estimates (<S-f10>)
View Point Estimates
View Initial Values
View C++
Clean
Outline (<f11>)
Imenu (<down-mouse-3>)
Template (<f12>)
Mini Template (<S-f12>)
Toggle Section (C-.)
Toggle Window (<f4>)
Target
Help (<f1>)
DATA_SECTION
init_int nobs
init_vector Y(1,nobs)
init_vector x(1,nobs)
PARAMETER_SECTION
init_number a
init_number b
vector pred_Y(1,nobs)
objective_function_value
PROCEDURE_SECTION
pred_Y=a*x+b;
f=(norm2(pred_Y-Y));
f=nobs/2.*log(f);
--(DOS)-- simple.tpl Bot (45,20) (ADMB)
--:-- simple.cpp 62% (85,0) (C++/l 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)
simple - Konqueror
simple.tpl
12:00

ADMB-IDE


gud-simple.exe
File Edit Options Buffers Tools Gud Complete In/Out Signals Help
[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 arrmblsize
1: arrmblsize = 150000
(gdb) print mp
$3 = {<model_data> = {<ad_comm> = {_vptr$ad_comm = 0x532084, static time_flag = 0, s
(gdb)
-1** *gud-simple.exe* Bot (283,6) (Debugger:run [stopped])
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 criter 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
-1** *input/output of simple.exe* Bot (85,0) (Inferior I/O:run)
#ifdef __ZTC__
extern unsigned int _stack=10000U;
#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(__MSVC32__)
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)
{
--\-- simple.cpp 62% (78,0) (C++/l Abbrev)
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
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)
Start
simple
gud-simple.exe
12:00 PM

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