AD Model Builder IDE

Emacs `admb-mode` without the Emacs
Version 11.2 (2015-01-12)

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This is the manual for AD Model Builder IDE (ADMB-IDE) version 11.2.
The latest edition of the manual is available at:
http://admb-project.org/tools/admb-ide

To cite ADMB-IDE, use the newsletter article (see [References], page 20) as a fixed reference.

AD Model Builder IDE is an aggregate of the following software components:

- AD Model Builder 11.2 is released under the BSD License.
  Source code: http://ftp.admb-project.org/
- GCC 4.8.1 and 4.9.2 is released under the GPL.
  Source code: ftp://ftp.gnu.org/gnu/gcc/
- GDB 7.6.1.1 and 7.8.1 is released under the GPL.
  Source code: ftp://ftp.gnu.org/gnu/gdb/
- GNU Emacs 24.4.1 is released under the GPL.
  Source code: ftp://ftp.gnu.org/gnu/emacs/
- AUCTEX 11.88 is released under the GPL.
  Source code: ftp://ftp.gnu.org/gnu/auctex/
- Emacs Speaks Statistics (ESS) 14.09 is released under the GPL.
  Source code: http://ess.r-project.org/downloads/ess/
- ADMB Mode 9.0 for Emacs is released under the Simplified BSD License.
  Source code: http://admb-project.org/tools/editors/emacs
- ADMB-IDE `.emacs` 11.2 is released under the Simplified BSD License.
  Source code: http://admb-project.org/tools/admb-ide

Table of Contents

1 Preamble

The purpose of ADMB-IDE is to make the convenient features of Emacs `admb-mode` available to non-Emacs users. In other words, to disable the standard Emacs behavior.

Experienced Emacs users may prefer to ignore the ADMB-IDE '`.emacs`' file, and simply install and load '`admb.el`' like other Emacs packages. It is a standard "major mode" that follows all Emacs mode conventions.

2 Introduction

2.1 Emacs `admb-mode`

The process of creating statistical models with AD Model Builder (ADMB) involves writing, compiling, and testing. An integrated development environment (IDE) allows the user to perform these tasks more efficiently than with a basic editor and a shell.

GNU Emacs is a complex and powerful editor that comes with particularly good support for R, LaTeX, backup/revision control, and other useful tools for statistical computing. Its `admb-mode` provides syntax highlighting, compilation, file manipulation, outline code navigation, templates, and smaller tools for creating ADMB models. Emacs users can fetch `admb-mode` from http://admb-project.org/tools/editors/emacs/admb.el and start using it right away, after reading the commentary at the top of the file.

The problem with Emacs is that it requires considerable time to learn and configure, although for heavy-duty statistical computing this can be a rewarding investment. As the programmer Larry Wall once said: "If ease of use was the highest goal, we'd all be driving golf carts." The `http://admb-project.org/tools/editors/emacs` page contains some pointers for setting up and learning Emacs. There are, however, good reasons why many users may not feel like adopting Emacs as their main editor, but would still appreciate a simple IDE for ADMB.

The rest of this tutorial demonstrates how Emacs with `admb-mode` can be configured as a user-friendly ADMB-IDE, without learning the details of Emacs. This is achieved with an unusual '`.emacs`' configuration file that emulates common keybindings of basic editors, while disabling some of the most used Emacs keybindings. This '`.emacs`' file is therefore not intended for experienced Emacs users, although they may find it an interesting read.

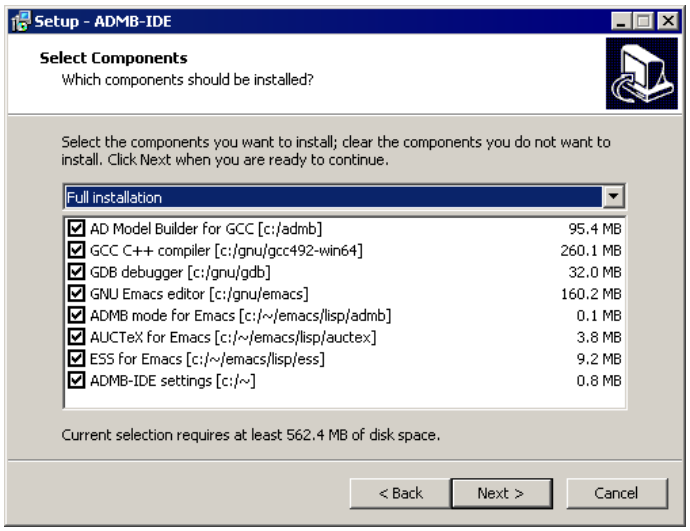
2.2 ADMB-IDE for Windows

> *Somebody set up us the bomb.*

There are two ways to install ADMB-IDE for Windows: use an installer or set up the individual components by hand.

Installer

The '`admb-ide-112-win64.exe`' installer sets up the main components (ADMB, GCC, GDB, Emacs, AUCTeX, ESS, `admb-mode`) with a customized Emacs user interface, file associations, and environment variables to glue everything together. The only catch is that the user must accept the default directory structure, and the full installation option is strongly recommended:



The directory structure is designed to accommodate coexisting versions of ADMB and GCC:

Directory	Component	Overwrite
`c:/admb/admb112-gcc492-win64`	ADMB	Yes
`c:/gnu/gcc492-win64`	GCC	Yes
`c:/gnu/gdb`	GDB	Yes
`c:/gnu/emacs`	Emacs	Yes
`c:/~/emacs/lisp/admb`	ADMB Mode	Yes
`c:/~/emacs/lisp/auctex`	AUCTEX	Yes
`c:/~/emacs/lisp/ess`	ESS	Yes
`c:/~`	`.emacs`	No

It is possible to install ADMB-IDE on top of existing ADMB installations, which could reside in subdirectories of `c:/admb` or anywhere else. Compilers may also coexist, in subdirectories of `c:/gnu` or anywhere else (see [Conflicting compilers and libraries], page 19). Short and shallow paths without spaces are helpful when configuring and writing customized scripts.

This is a practical setup for other free software as well. Take for example the R statistical software. By separating the main program (`c:/gnu/r`) from the user settings (`c:/~/.Rprofile`, `c:/~/Rconsole`) and user libraries (`c:/~/r/library`), the main program can be removed and upgraded without affecting the user setup.

As indicated in the table above, the installer will not overwrite an existing `c:/~/.emacs` file. This is because a personal '`.emacs`' configuration file is the only component that is irreplaceable; all other components are available and free on the internet.

One thing to keep in mind is that the installer modifies the user `PATH` and file associations. In rare cases, users may need to reconfigure these according to taste and needs after installing ADMB-IDE. Advanced users may choose to deselect these options during the installation for this reason.

Manual setup

Users can also set up and configure the individual components by hand, starting from the '`admb-ide-112-win64.zip`' kit. The following guidelines may be useful for that:

`http://admb-project.org/documentation`

`http://admb-project.org/tools/editors/emacs/install`

`http://admb-project.org/tools/editors/emacs/config`

`http://mingw.org/wiki/HOWTO_Install_the_MinGW_GCC_Compiler_Suite`

See also the chapters on [ADMB-IDE for Linux/Mac OS], page 4 and [Troubleshooting], page 18 in this manual.

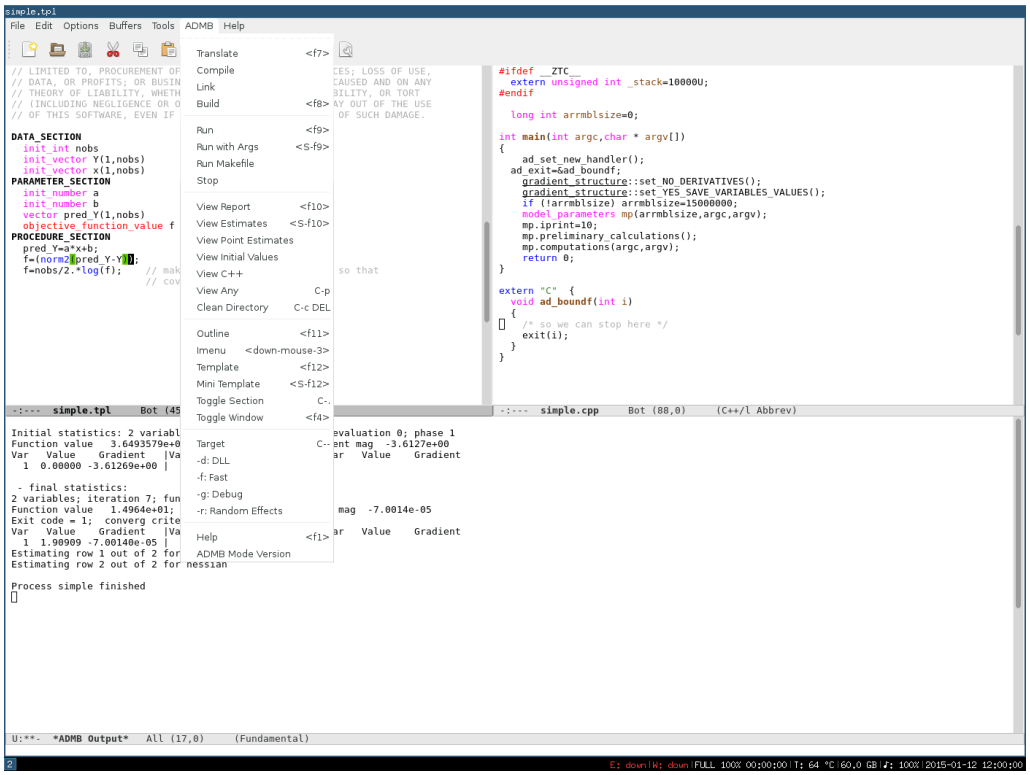
2.3 ADMB-IDE for Linux/Mac OS

Behold, the blueprints of a golf cart.

Setting up ADMB-IDE for Linux or Mac OS is equivalent to the "manual setup" described above, so the same guidelines apply. The key steps are:

1. Install ADMB, GNU Emacs, GCC (including the C++ component), and GDB.
2. Download the ADMB-IDE `.emacs` configuration file and place it in `~/.emacs` to apply the simplified Emacs user interface.
3. Download `admb-mode`, and place it in `~/emacs/lisp/admb/admb.el` to provide ADMB syntax highlighting and IDE features.

The tutorial in the next chapter uses Windows, but ADMB-IDE is very similar in Linux:



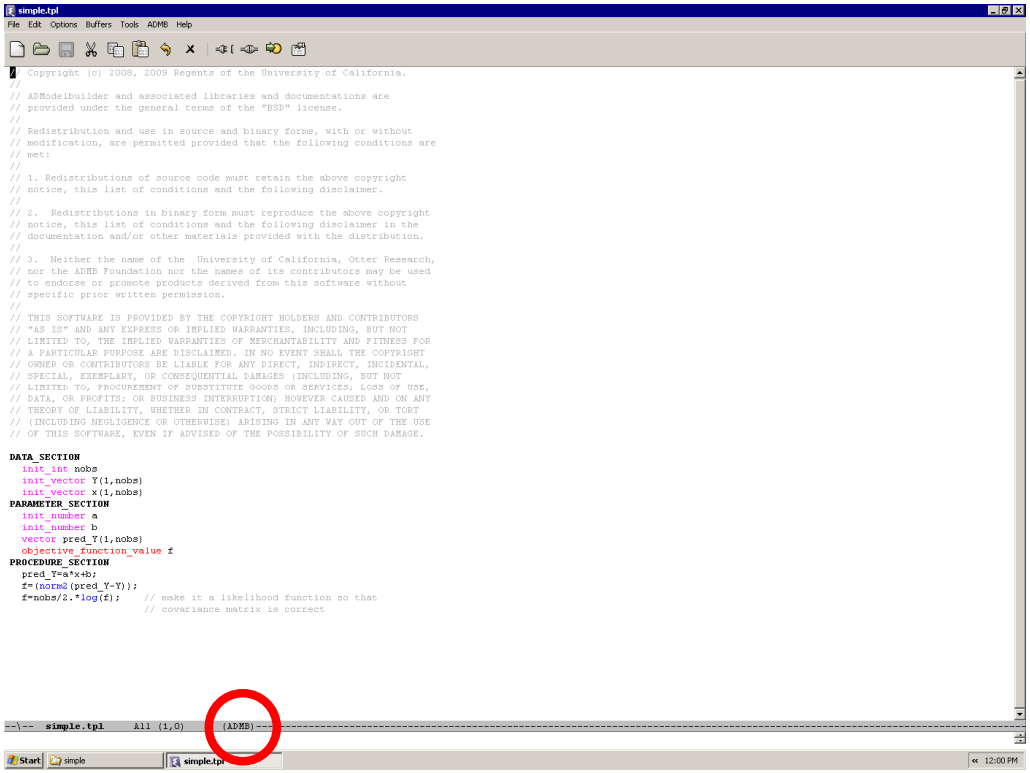
3 Tutorial

3.1 Create a working copy of `simple`

First open Windows Explorer and create a folder called `c:/simple`. Then navigate to `c:/admb/admb112-gcc492-win64/examples/admb/simple` and copy the model and data files, creating:

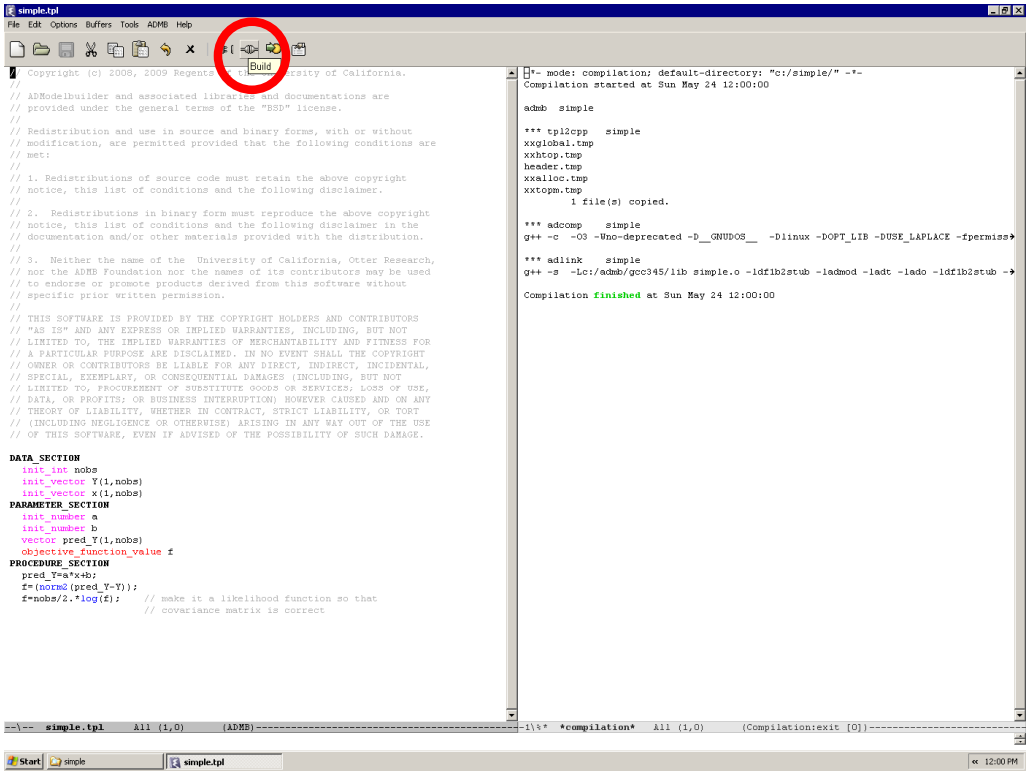
`c:/simple/simple.dat`
`c:/simple/simple.tpl`

Now double-click '`simple.tpl`' in the `c:/simple` folder. The file should open in Emacs in `admb-mode` (see red circle) and the code should be in color:

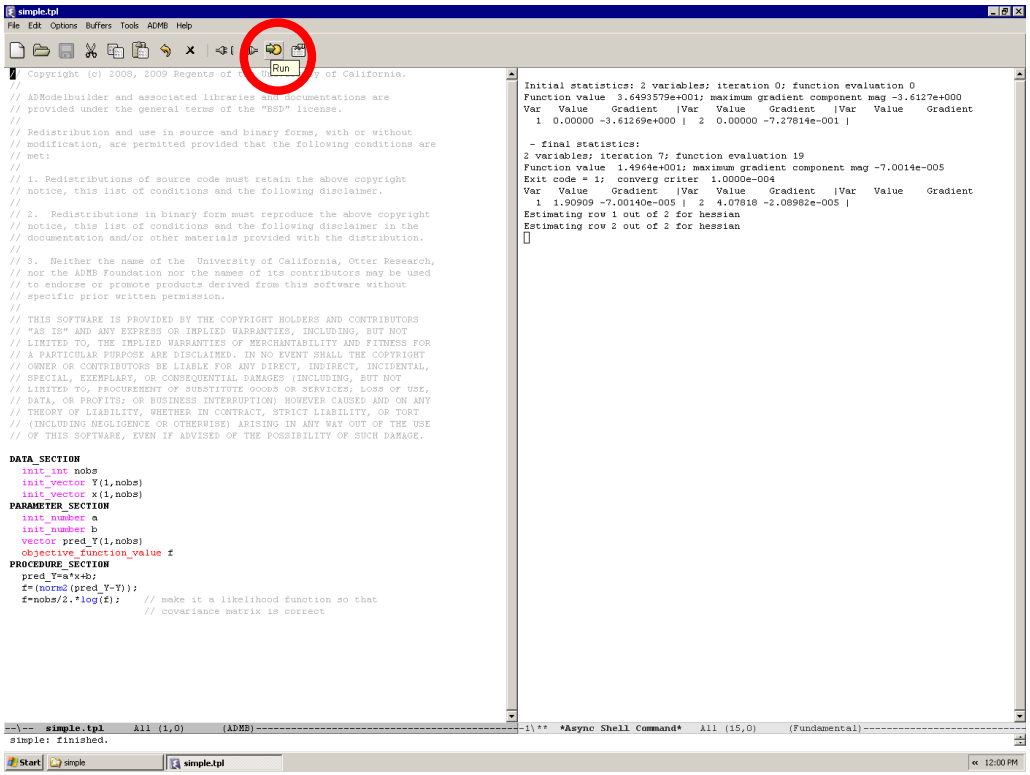


3.2 Build, run, and view the results

Build the model by clicking the icon, or press `f8`:



Run the model by clicking the icon, or press `f9`:

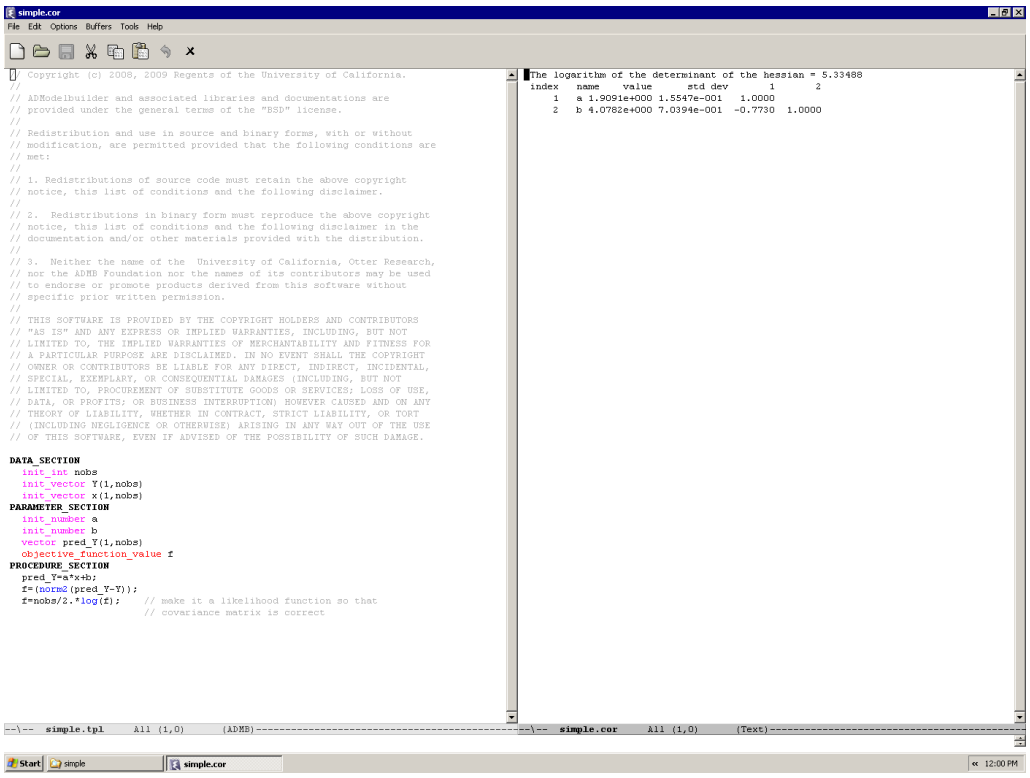


Many ADMB models output their results to a '`.rep`' report file, and ADMB-IDE provides the icon and `f10` key to open the report file. The `simple` model outputs no report file, but the parameter estimates, standard errors, and correlations are found in the '`.cor`' file.

This is an opportunity to introduce basic buffer and window management. In Emacs, a buffer is like a page, often representing a file, but sometimes other things, like the compilation and command output buffers in the previous two screenshots. The Emacs screen is divided into one or more windows, where each window shows one buffer, while other buffers reside in the background. Explore the ***Buffers*** menu, as well as [Shortcut keys], page 15.

Try out different ways to open the '`.cor`' file:

1. Press `escape` to maximize the active window. Then click the icon or press `C-o` (`Ctrl` and `o`) and select `c:/simple/simple.cor`.
2. Press `escape` to maximize the active window, `C-x 3` to split into two windows, and select the window on the right with a mouse click or `f6`. Click the icon or press `C-o` and select `c:/simple/simple.cor`.
3. Click the ***ADMB*** → ***View Estimates*** menu entry or press `S-f10`.
4. Click the ***ADMB*** → ***View Any*** menu entry or press `C-p`, then type '`cor`' and `return`.



After viewing, maximize a window by pressing `escape`, or close a window by clicking the icon or pressing `C-w` or `C-f4`.

Note how the ADMB menu and toolbar icons are only available when the active window is in `admb-mode`. Press `f2` at any point to switch a window to `admb-mode`.

3.3 Debug

Types of bugs

Bugs in ADMB models can be categorized by the point of discovery:

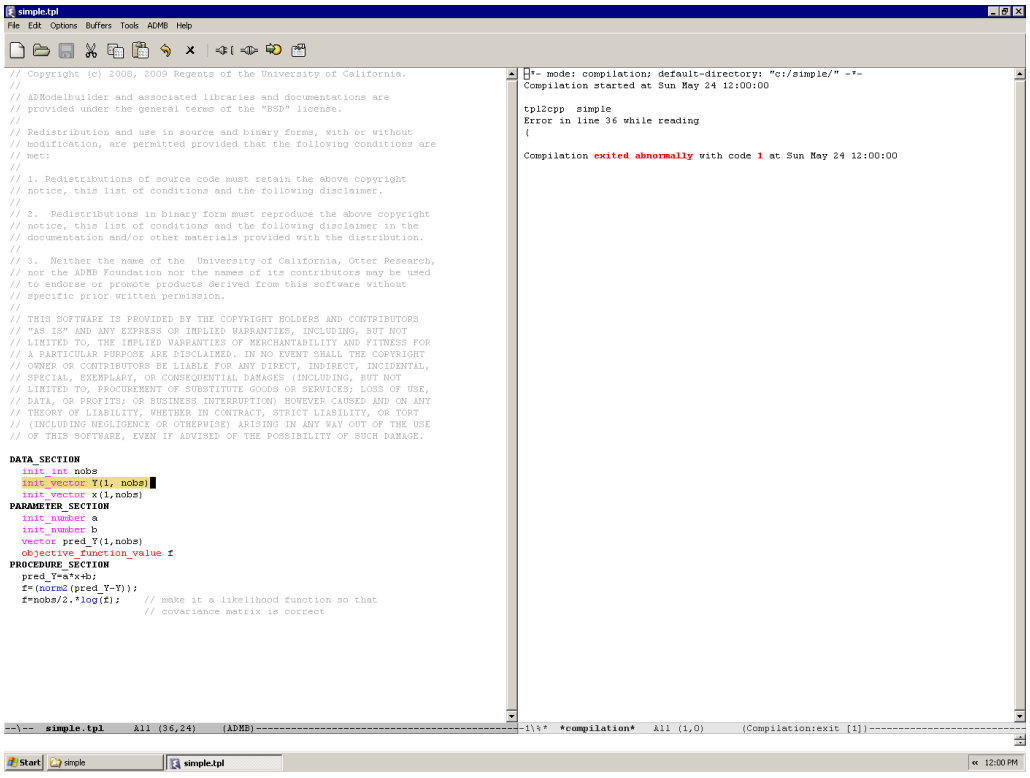
1. `tpl2cpp` reports a bug (cannot translate)
2. `g++` reports a bug (cannot compile or link)
3. The model builds fine, but crashes or writes no output when run (no results)
4. The model runs fine, but not like it is supposed to (strange results)

Locating bugs

- Warnings or error messages indicate line number, or function/variable name
- Insert lines of code that print informative messages during runtime
- Comment out parts of the code
- Use a debugger

Example 1: `tpl2cpp` reports a bug

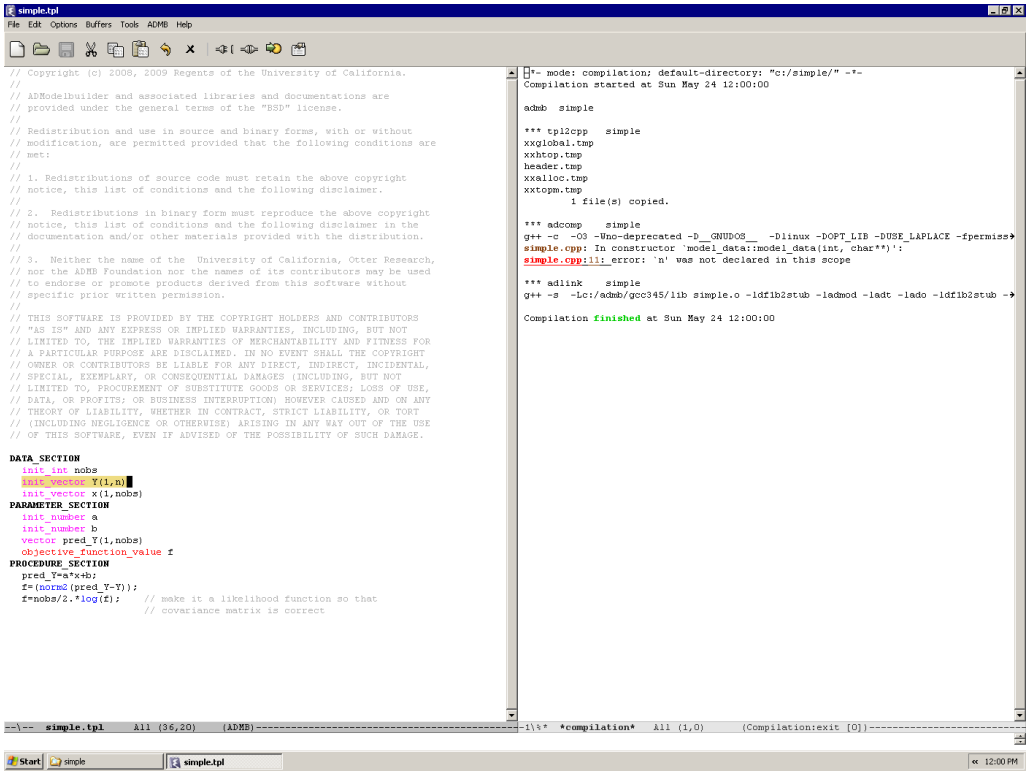
Create a bug by inserting an extra space inside a vector declaration: `init_vector Y(1,nobs)` → `init_vector Y(1, nobs)`. Then click the icon or press `f7` to translate TPL to C++:



The `tpl2cpp` translator reports an error in line 36 of '`simple.tpl`'. Click *`Edit` → `Go To` → `Goto Line`* or press `C-g` to move the cursor to that line, and then remove the unwanted space.

Example 2: g++ reports a bug

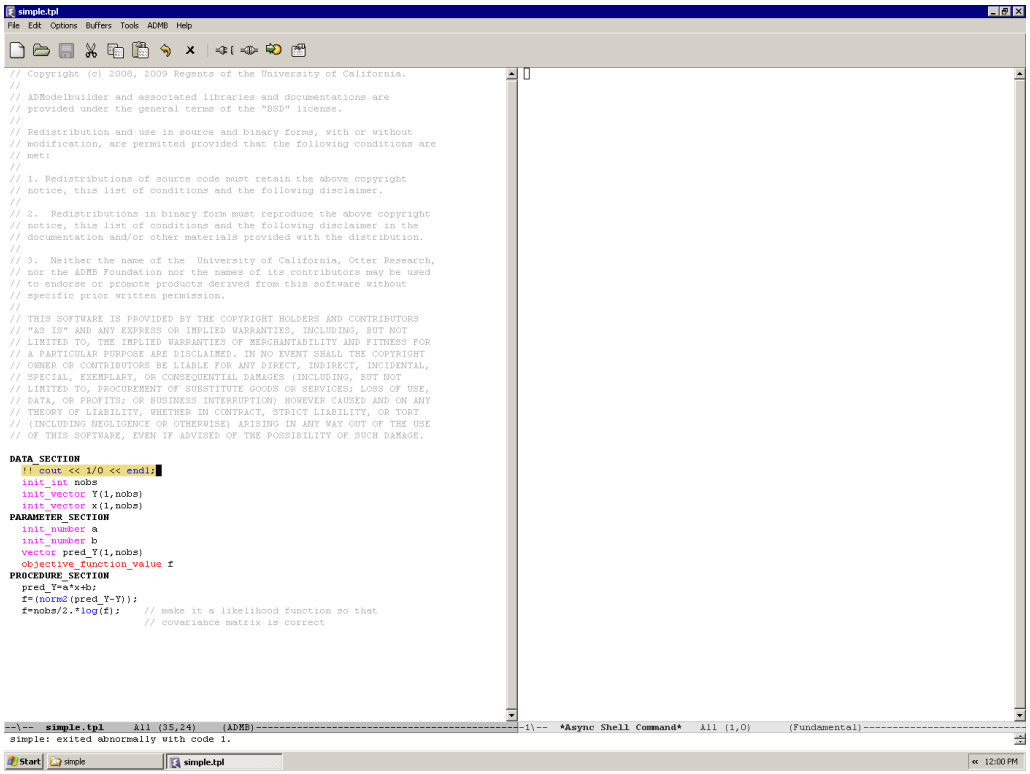
Create a bug by referring to a nonexistent variable: `init_vector Y(1,nobs)` → `init_vector Y(1,n)`. Then click the icon or press `f8` to build the model:



The `g++` compiler reports an error in line 11 of '`simple.cpp`'. Click the highlighted filename to open the C++ source file with the cursor in that line. After realizing what the problem is (with the help of the error message *`'n' was not declared in this scope`*), go back to the ADMB code in '`simple.tpl`' and change the '`n`' to '`nobs`'.

Example 3: No results

Create a bug by dividing by zero at the top of the `DATA_SECTION`: `!! cout << 1/0 << endl;`. Then click the icon or press `f8` to build the model. Ignoring the warning, click or press `f9` to run the model:



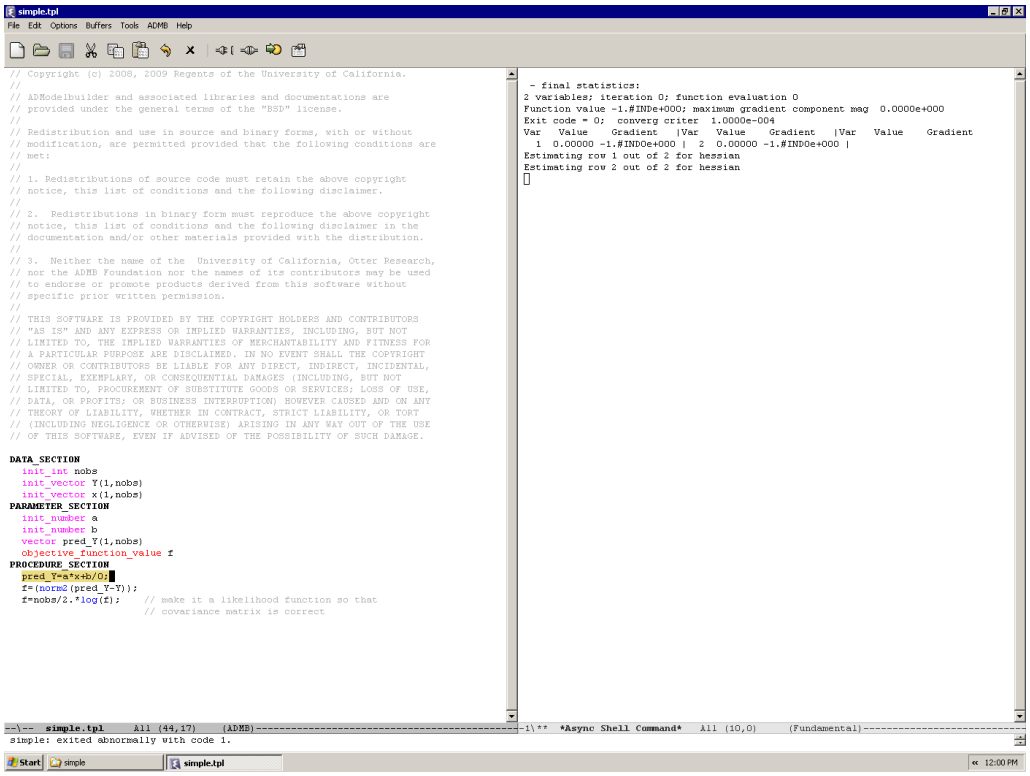
The shell command `simple` exits abnormally with code 1, a generic code for failure. The easiest way to search for this bug is to insert informative messages in the code, like

```
DATA_SECTION
  !! cout << "DATA_SECTION begins" << endl;
  ...
  !! cout << "DATA_SECTION ends" << endl;
```

and/or simplify the model, possibly by commenting out parts of the code. After narrowing the search step by step, the problematic line(s) can be changed or removed. To comment or uncomment large parts of code, use the `M-;` keystroke (see [Shortcut keys], page 15).

Example 4: Strange results

Create a bug by dividing by zero in a `PROCEDURE_SECTION` assignment: `pred_Y=a*x+b;` → `pred_Y=a*x+b/0;`. Then click the icon or press `f8` to build the model (this time there is no compiler warning). Click or press `f9` to run the model:



The ADMB on-screen report indicates successful convergence (exit code 0) with an objective function value of '`-1.#INDe+000`', while Emacs reports failure (exit code 1). The easiest way to search for this bug is to insert informative messages in the code, like

```
PROCEDURE_SECTION
  cout << "The value of a   is: " << a   << endl;
  cout << "The value of a*x is: " << a*x << endl;
  cout << "The value of b   is: " << b   << endl;
  cout << "The value of b/0 is: " << b/0 << endl;
  cout << "The value of f   is: " << f   << endl;
```

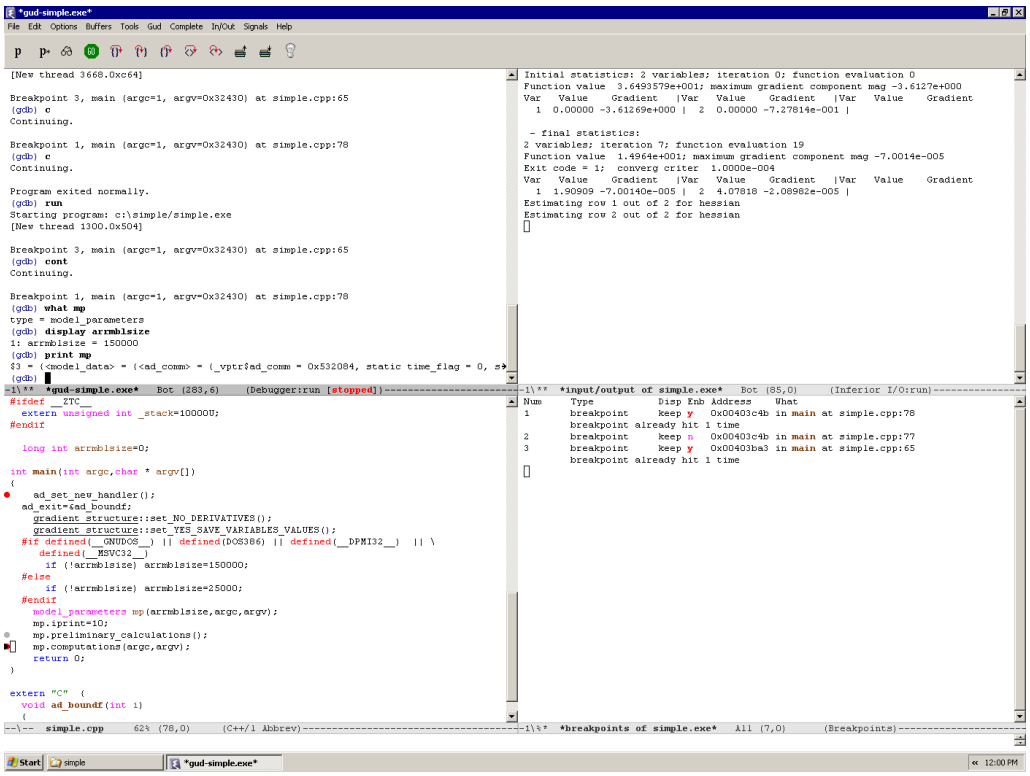
and/or simplify the model, possibly by commenting out parts of the code. A more advanced option is to use a debugger.

GDB: When the going gets tough

GNU Emacs and GCC can interact closely with the GDB debugger—these programs were all created by the same programmer, Richard Stallman. A program must fulfill two conditions before debugging:

- The model executable (e.g., '`simple.exe`') must build successfully, so a debugger is only helpful for bugs of type 3 and 4 (see [Types of bugs], page 8).
- The model executable must include debugging symbols. To embed debugging symbols with ADMB-IDE, either select "Debug" compilation from the ***ADMB*** → ***Target*** menu, or press `C-- g` (`Ctrl` and `-`, then `g`), followed by `return`.

Using GDB to debug an ADMB model is beyond the scope of this tutorial, but when simpler debugging methods fail, it is time to click ***Tools*** → ***Debugger (GDB)***:



4 Interface

4.1 Menu

Menu label	Purpose	Emacs command
Translate	Translate TPL to C++	`admb-tpl2cpp`
Compile	Compile C++ to object code	`admb-compile`
Link	Link object code to exe	`admb-link`
Build	Build executable from TPL	`admb-make`
Run	Run executable	`admb-run`
Run with Args	Run executable with args	`admb-run-args`
Run Makefile	Run Makefile in current dir	`admb-run-makefile`
View Report	Open .rep file	`admb-rep`
View Estimates	Open .cor file	`admb-cor`
View Point Estimates	Open .par file	`admb-par`
View Initial Values	Open .pin file	`admb-pin`
View C++	Open C++ file	`admb-cpp`
View Any	Open model file	`admb-open`
Clean Directory	Remove temporary files	`admb-clean`
Outline	Navigate with outline	`admb-outline`
Imenu	Navigate with imenu	`imenu`
Template	Insert template	`admb-template`
Mini Template	Insert minimal template	`admb-template-mini`
Toggle Section	Toggle section indicator	`admb-toggle-section`
Toggle Window	Toggle secondary window	`admb-toggle-window`
Target	Choose what to build	`admb-set-flags`
Help	Show help page	`admb-help`
ADMB Mode Version	Show ADMB Mode version	`admb-mode-version`

4.2 Toolbar

Icon	Purpose	Emacs command
	New buffer	`new-buffer`
	Open file	`find-file`
	Save file	`save-buffer`
	Cut	`kill-region`
	Copy	`copy-region-as-kill`
	Paste	`cua-paste`
	Undo	`undo`
	Close	`kill-this-buffer`
	Translate TPL to C++	`admb-tpl2cpp`
	Build executable from TPL	`admb-make`
	Run executable	`admb-run`
	Open .rep file	`admb-rep`

4.3 Shortcut keys

In combinations, '`S-`' means `Shift`, '`C-`' means `Ctrl`, and '`M-`' means the `Alt` key.

Keystroke	Purpose	Emacs command
`f1`	Help	`admb-help`
`S-f1`	Show ADMB-IDE version	`admb-ide-version`
`f2`	ADMB mode	`admb-mode`
`f3`	Data mode	`conf-unix-mode`
`f4`	Toggle secondary window	`admb-toggle-window`
`C-f4`	Close	`kill-buffer-maybe-window`
`M-f4`	Quit	`save-buffers-kill-emacs`
`f5`	Reload	`revert-buffer`
`f6`	Other window	`other-window`
`C-f6` / `M-f6`	Next buffer	`next-buffer`
`f7`	Translate TPL to C++	`admb-tpl2cpp`
`f8`	Build executable from TPL	`admb-make`
`f9`	Run executable	`admb-run`
`f10`	Open .rep file	`admb-rep`
`S-f10`	Open .cor file	`admb-cor`
`f11`	Navigate with outline	`admb-outline`
`f12`	Insert template	`admb-template`
`S-f12`	Insert minimal template	`admb-template-mini`
`C--`	Toggle compilation flags	`admb-toggle-flag`
`C-,`	Toggle trailing whitespace	`toggle-trailing-whitespace`
`C-.`	Toggle section indicator	`admb-toggle-section`
`C-a`	Select all	`mark-whole-buffer`
`C-b`	Next buffer	`next-buffer`
`C-c`	Copy	`cua--prefix-override-handler`
`C-f`	Find, find next	`isearch-forward`
`C-g`	Goto line	`goto-line`
`C-h`	Emacs help system	`help`
`C-l`	Recenter	`recenter`
`C-n`	New	`new-buffer`
`C-o`	Open	`find-file`
`C-p`	Open in other window	`admb-open`
`C-q`	Quit	`save-buffers-kill-emacs`
`C-r`	Replace	`query-replace`
`C-s`	Save	`save-buffer`
`C-S`	Save as	`write-file`
`C-v`	Paste	`cua-paste`
`C-w`	Close	`kill-buffer-maybe-window`
`C-x`	Cut	`cua--prefix-override-handler`
`C-x 2`	Split window above/below	`split-window-vertically`
`C-x 3`	Split window left/right	`split-window-horizontally`
`C-z`	Undo	`undo`
`C-return`	Rectangle functions	`cua-set-rectangle-mark`
`C-space`	Expand recognized words	`dabbrev-expand`

`C-M-space`	Open recent files	`recentf-open-files`
`M-,`	Delete trailing whitespace	`delete-trailing-spc-tab-m`
`M-;`	Comment/uncomment region	`comment-dwim`
`escape`	Cancel dialog, maximize window	`keyboard-escape-quit`

Mouse button	**Purpose**	**Emacs command**
`C-left`	Switch buffers	`mouse-buffer-menu`
`right`	Navigate with imenu	`imenu`

ADMB-IDE does not emulate perfectly the way many editors open menus with the `Alt` key. To open the ***`Edit`*** menu, for example, it is not enough to press `Alt` and `e` simultaneously. ADMB-IDE provides four ways to open the ***`Edit`*** menu:

1. Mouse click on the menu bar
2. Tap `Alt` first and then `e` (Windows)
3. Hold `Alt` and tap `e` twice (Windows)
4. Hold `Alt` and tap `f`, then release `Alt` and tap `Right` arrow (Linux)

The idea behind ADMB-IDE, however, is that users can memorize intuitive keystrokes to undo, cut, copy, paste, find, replace, and goto line, without opening the ***`Edit`*** menu. Also don't forget that ADMB-IDE is open source, so users are free to modify any part of the program, including the keybindings defined in the '`.emacs`' file.

Longtime users of the Vi editor can turn on Emacs `evil-mode` or `viper-mode`, which are full-featured Vi emulators for Emacs.

5 Configuration

Personal `.emacs` file

ADMB-IDE is intended for people who don't know Emacs, are not interested in learning it, and will only use it to work with ADMB. The design goal is that ADMB-IDE should work out of the box and get the job done with minimum fuss.

It is, however, in the nature of modellers to experiment and improve. Users who modify the original '`.emacs`' file are no longer using ADMB-IDE, but Emacs with `admb-mode` and a personal '`.emacs`' file. One reason to modify the '`.emacs`' file or write a new one from scratch is to install additional Emacs packages. Another reason is to redefine the keybindings, probably closer to the Emacs defaults. Other reasons include setting fonts and colors, setting user variables, or defining new user functions. Users with a personal '`.emacs`' file can update ADMB, Emacs, GCC, GDB, and `admb-mode` independently, or salvage pieces from a recent ADMB-IDE zip bundle.

Note that it is not advisable to configure Emacs by clicking *Options* → *Save Options* or *Options* → *Customize Emacs*. Editing the '`.emacs`' file directly is a more reliable and transparent approach. See http://admb-project.org/tools/editors/emacs for guidelines.

Example

The `f10` key in ADMB-IDE runs `admb-rep` to a open a report file:

```
(local-set-key [f10]   'admb-rep           ) ; menu-bar-open
```

The semicolon starts a comment, reminding that the default behavior of Emacs is to run `menu-bar-open` when `f10` is pressed. In ADMB-IDE, it is easy to activate the menu bar with the mouse or the `Alt` key, so `f10` can be used for something else. The liberal spacing is to align surrounding lines of code, but neither the comment nor multiple spaces are necessary.

Some users may find it practical to open the report file in an external browser, rather than inside ADMB-IDE. The report file is often best viewed in a large window, and the ADMB-IDE windows are somewhat busy showing other things. It is easy to rebind the `f10` key,

```
(local-set-key [f10]   'admb-rep-browser   ) ; menu-bar-open
```

but as mentioned in the documentation of `admb-rep-browser`, the '`.rep`' file ending in Windows may need to be associated with the desired browser program, Firefox or the like.

Providing ADMB-IDE while retaining a personal `.emacs` file

It can be practical to make a canned version of ADMB-IDE available, while using a different '`.emacs`' file for most Emacs sessions. For example, an experienced Emacs user may want to test how ADMB-IDE works, or demonstrate it to colleagues, without constantly shuffling '`.emacs`' files. In Windows, one can place the ADMB-IDE '`.emacs`' file in `c:/admb/ide` and then start ADMB-IDE with the shell command:

```
c:/gnu/emacs/bin/runemacs.exe -Q -l c:/admb/ide/.emacs -f admb-mode
```

The '`-Q`' option tells Emacs to ignore the default startup file(s), the '`-l`' tells it to load a Lisp file, and the '`-f`' tells it to call a function. This command can be used in a start menu or desktop shortcut, with the `c:/~/icons/admb64.ico` decorative icon, and similar tricks can be used in Linux and Mac OS.

6 Troubleshooting

6.1 General usage

The ADMB menu and toolbar icons disappear

These only appear when the current buffer is in `admb-mode`. Either switch to a '`.tpl`' buffer that is already in `admb-mode`, or press `f2` to switch to `admb-mode` in the current buffer. Other modes may have special menus and toolbar icons that are useful for that mode, see for example the [GDB screenshot], page 12.

Undo is confusing and redo is missing

The undo feature in ADMB-IDE does both undo and redo. When undo is performed repeatedly, it goes further back in the undo history. Any command other than undo will interrupt this sequence, and from that point the previous undo commands become ordinary changes that can be undone, equivalent to redo. Try, for example, copying some text and then paste it three times. Now undo three times, interrupt with a harmless key like the `Up` arrow, and then undo again to redo. To undo all changes since last save, it's easiest to reload using the `f5` key.

The `Tab` key does not indent code properly

ADMB-IDE does not know the appropriate indentation of every line, so generally users indent their code manually using `Space` and `Backspace`. The `Tab` key is programmed to insert a number of spaces, as suggested by the previous line, which is sometimes useful.

Lines end with strange `^M` characters

This is how Emacs shows Dos line endings, although in most cases Dos line endings are handled more gracefully. It could be that the file contains mixed line endings (both Dos and Unix), and the simplest solution is to delete all `^M` characters. It could also be that the Emacs variable `file-name-buffer-file-type-alist` matches the '`.tpl`' file ending, and the simplest solution is to set that variable to `nil`.

Clicking *ADMB* → *Run Makefile* returns an error

Makefiles are a sophisticated build automation tool, not required for general ADMB usage. This command invokes the `make` program that looks for a file called '`Makefile`'. If the `make` program or the makefile is not found, an error is returned. This feature is provided for advanced users who have prepared a makefile in the working directory.

6.2 Configuration

Double-clicking a '`.tpl`' file in Windows Explorer does not open it in Emacs

The '`.tpl`' file ending needs to be associated with Emacs. This can be done with registry entries or in Windows Explorer folder options.

Emacs cannot load `admb-mode`

The directory containing the '`admb.el`' file needs to be in the Emacs variable `load-path`, and the `admb-mode` command needs to be autoloaded in the '`.emacs`' configuration file.

Compilation commands are not recognized

The `PATH` environment variable needs to point to the directories containing the compilation programs (`tpl2cpp`, `tpl2rem`), scripts (`admb`, `adcomp`, `adlink`), and the `g++` program. Likewise, the `ADMB_HOME` environment variable needs to point to the main ADMB directory. Windows environment variables can be set using Dos scripts like `c:/~/bat/admb-set.bat`, or by right-clicking the My Computer icon, then *Properties* → *Advanced* → *Environment Variables* → *User variables* → *New*.

Limited user (i.e., non-administrator) accounts in Windows can also prevent the ADMB-IDE installer from setting the environment variables `ADMB_HOME` and `PATH`. In those cases, the right-click-properties method described above can be used to set the variables after the installation. Many Linux distributions include only the C component of GCC, so users need to install the optional C++ component before using ADMB.

Conflicting compilers and libraries

When developing models using ADMB, it is important to have only one C++ compiler and one ADMB version in the PATH. Otherwise, errors will occur as objects and libraries of different versions are linked together.

For example, the Rtools collection includes a C++ compiler that should be removed from the PATH, unless ADMB was originally built using that compiler. One can either modify the PATH environment variable, or temporarily rename directories (e.g., '`Rtools`' to '`Rtools_`') so they are not in the PATH while building models with ADMB.

7 References

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