Software instructions

Since both R and BUGS (or JAGS, which is an alternative Bayesian software) are free, you can install them on your own laptop/desktop, if you want.

The following gives you a quick guide on how you install the software that is required for the analyses that we will go through in the practicals:

- OpenBUGS
- JAGS (optional)
- R and specifically the packages R2OpenBUGS and BCEA. Other optional packages (e.g. reshape, dplyr, INLA and R2jags) may need to be installed
- The R front-end Rstudio (optional)



Notice that you don't have to install both OpenBUGS and JAGS — the former is sufficient for the purposes of this course.

Specific installation instructions (R, BUGS and JAGS)

MS Windows users

If you are a Windows user, your setting should be fairly easy.

- 1. Download the file OpenBUGS323setup.exe from the webpage https://www.mrc-bsu.cam.ac.uk/wp-content/uploads/2014/07/OpenBUGS323setup.zip, extract the exe file from the downloaded zip file and run it by double-clicking on it.
- 2. Download R from http://cran.r-project.org/bin/windows/ (click on the link "install

R for the first time"").

- 3. Once you have installed R, open it and type in the terminal the command install.packages("R2OpenBUGS"). This command will download the package R2OpenBUGS, which is needed to interface OpenBUGS with R. Follow the on-screen instructions (you will be asked to select a "mirror from which to obtain the file).
- 4. Make sure that the download has worked by typing in the terminal the command library(R2OpenBUGS). If you do not see any error message, then the package has been successfully installed.
- 5. Install the BCEA package that we will use throughout the practicals, by typing install.packages("BCEA").
- 6. Repeat the installation process for the other packages that are used in the practicals (e.g. reshape and dplyr). Since this is optional, you can leave this final step to when it is actually needed.

If you like, you can also install JAGS, following these steps.

- 1. Go to http://sourceforge.net/projects/mcmc-jags/files/JAGS/4.x/Windows/ and click on the latest available executable file (currently, JAGS-4.3.1.exe). Running this file will install JAGS on your machine.
- 2. If you do then in the R terminal the type command install.packages("R2jags"). This will allow you to use JAGS (instead of OpenBUGS) when doing the practicals — notice that to make a package available you will have to load it to the workspace by using the library(name_package) command.

Linux or Mac OS users

Installing R and BCEA

Linux or Mac OS users should follow slightly different approaches. The installation of R is pretty much the same as for MS WIndows users. From the webpage http://cran.r-project.org/ select your operating system (Linux or Mac OS) and then your version (eg debian, redhat, suse or ubuntu, for Linux). Follow the instructions to install the software. Once this is done, open R and install the package BCEA by typing at the terminal the command install.packages("BCEA"). You can use similar commands to install other packages.

Installing OpenBUGS and JAGS in Linux

While both OpenBUGS and JAGS run natively in Linux (see below for details on how to install them directly), the graphical interface is not available for OpenBUGS.

You can install the Linux version of OpenBUGS (available from here) by following the instructions given at https://www.mrc-bsu.cam.ac.uk/software/bugs/openbugs/buildingand-packaging-openbugs/openbugs-linux-installation/. This will work just as well, but you won't be able to access the graphical interface (which, again, is not really a problem, in our case...).

Warning

NB: Under Linux, you may need to also install additional packages to support the OpenBUGS installation. For instance, under Debian or Ubuntu, you may need to also run in your terminal

sudo apt-get install g++-multilib

to install the library g++multilib.

In addition, you can also install JAGS. Depending on your specific distribution of Linux, you may use a very simple command or need to install from source. If you are under Ubuntu or Debian, you can simply type in your terminal

sudo apt install jags

to install JAGS.

Alternatively, the source installation (which would work for all Linux distributions) is done following these steps.

- 1. Go to http://sourceforge.net/projects/mcmc-jags/files/JAGS/4.x/Source/ and download the latest tar.gz file (currently, JAGS-4.3.1.tar.gz)
- 2. Open a terminal window and extract the content of the archive file by typing the command tar xzvf JAGS-4.3.1.tar.gz
- 3. Move to the directory (which has just been created) using the command cd JAGS-4.3.1
- 4. Run the configuration by typing sudo ./configure --prefix=/us && sudo make && sudo make install
- 5. Clean up the unnecessary files and folder by typing cd .. && sudo rm -fr JAGS-4.3.1 && rm JAGS-4.3.1.tar.gz

Either way, if you decide to work with JAGS, then open R and also install the package R2JAGS (using the same command as for the installation of the package R2OpneBUGS). Notice that you don't have to install both OpenBUGS and JAGS — the former is sufficient for the purposes of this course.

Installing OpenBUGS and JAGS in Mac OS

While similar in spirit, installation under Mac OS is slightly more complex, because the process requires some extra software that is not automatically installed. Basically, you need to follow this procedure, as detailed at the website http://www.jkarreth.net/bayes-icpsr.html#bugsmac. Basically, you first install a Windows "a compatibility layer" (wine), which allows you to run Windows applications on other operating systems. This will also allow you to use the OpenBUGS graphical interface (although, again, we will not, in the practicals!).

- 1. Update your Mac OS to the newest version.
- 2. Install Xcode through the App Store.
- 3. Check if you have X11 installed (this is a a windowing system, common on Unix-like operating systems, which, believe it or not, MaxOs is!): hit Command-Space, type X11, and see if the program shows up. If not, install it from here.
- 4. Download a the stable pre-compiled version of wine. Instructions to install wine on Mac OS are available here.
- 5. Download OpenBUGS323setup.exe (windows executable) and place it in your default directory for wine programs (usually ~/.wine/drive_c).
- 6. Run the OpenBUGS installer:
 - Open XQuartz and a Terminal Window;
 - Move to the directory where you placed the OpenBUGS executable you downloaded in step 2;
 - Type: wine OpenBUGS323setup.exe;
 - Wait for a while and then follow the prompts to installremember the directory you created to install (default ~/[username]/.wine/drive c/Program Files/OpenBUGS323)
 - NB: There may be an error at the end, this is OK. Close down the Terminal Window
- 7. It is possible that you need to specify the installation directory to tell your system specifically where to look for BUGS. Typically this will mean adding

the option bugs.directory = "/Users/yourusername/.wine/drive_c/Program Files/OpenBUGS232" (or similar, depending on where you have installed the software!) to the call to the bugs function under R20penBUGS. Note that you need to replace "yourusername" with your Mac's user name.

Notice that, if you like, you can install R under wine (rather than natively in Mac OS). Download the MS Windows executable file from CRAN and repeat the instructions above, replacing the command wine OpenBUGS323setup.exe with the command wine R-XXXX.exe, where R-XXXX.exe is the name of the executable file.

Warning

There are some reports that OpenBUGS may fail to work on some Mac OS versions. Sometimes, when trying to use OpenBUGS from R, it will complain that it can't find the programme. The bugs function in the R20penBUGS package takes an additional input OpenBUGS.pgm, which should be set to the full path to the OpenBUGS executable file. You can try and issue the R command Sys.which("OpenBUGS") at a R terminal and see whether it returns a full path and then pass that string as value for OpenBUGS.pgm, eg if Sys.which("OpenBUGS") returns the string /usr/local/bin/OpenBUGS, then set

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bugs(..., OpenBUGS.pgm="/usr/local/bin/OpenBUGS")
```

In addition, you can also install JAGS, following these steps, as detailed at the webpage http://www.jkarreth.net/bayes-icpsr.html#jagsmac.

- 1. Install the most recent version of R from the CRAN website.
- 2. (Optional) Download and install RStudio (NB: select the version for the your release of MacOS!).
- 3. Install Clang (currently clang-8.0.0.pkg) and GNU Fortran (currently, gfortran-6.1.pkg.dmg) from the CRAN tools directory. Note that the most updated release for these may vary so check you select the correct one.
- 4. Now install JAGS version 4.3.1 (JAGS-4.3.1.pkg) from here. Detailed instructions quoted from the JAGS readme file:
 - Download the disk image from the JAGS website.
 - Double click on the disk image to mount (this may not be required).
 - Double click on the JAGS-4.3.1.pkg file within the mounted disk image.

- Follow the instructions in the installer. If you receive a warning that this software cannot be installed because it comes from an unidentified developer, you need to go to "System Preferences"" > "Security & Privacy", and authorize the installation there before proceeding.
- Authenticate as the administrative user. The first user you create when setting up Mac OS X has administrator privileges by default.
- 5. Start the Terminal and type jags to see if you receive the message: Welcome to JAGS 4.3.1.
- 6. Open R and install the packages R2jags, coda, R2WinBUGS, lattice, and rjags, by typing install.packages(c("R2jags", "coda", "R2WinBUGS", "lattice", "rjags")) in the R command line.

You may also try installing JAGS on your Mac using MacPorts, by typing in your terminal sudo port install jags



Tip

NB: This post may be helpful in finding instructions to install JAGS under MacOs. In general, the JAGS sourceforge page has several posts/requests for help that you may find very similar to your own.