User Installation Instructions Manual for `BayesF2D`

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The `BayesF2D` software is a package for R written in R and C. It has utilities which allow users to associate Functional 2D objects (i.e GLCM matrices) with scalar responses, and predict the later. Various functions in R are called by the user to input data information. The main R function, `BayesF2DMCMC`, estimates our parameters using MCMC techniques. This function calls a C function based on the user's input, and is compiled and shared with the rest of the `BayesF2D` C code in order to estimate the parameters of the model.

1 Instructions for Installing and Using `BayesF2D` on a Windows Computer

Because the `BayesF2D` package compiles C code in response to user input, more setup is required for the `BayesF2D` package than for many others. The general requirements are as follows:

1. R must be installed.
2. Rtools must be installed so that C code can be compiled on Windows. See Section 1.2.
3. Additional GSL libraries must be installed so that the C code can use GSL for matrix multiplication routines and random number generations. See Section 1.3.
4. The environment variable for the system Path must contain Rtools. See Section 1.2.
5. An environment variable for GSL called LIB_GSL must be created. See Section 1.4.

Each of these steps is detailed below.

1.1 Instructions for Installation of R

- Make sure that R is installed and Check the directory in which R is installed.
- If not go to https://www.r-project.org/ and click on download R and select any mirror.

1.2 Instructions for Installation of R-tools

1. If you already have R-tools on your machine, make sure the version of R-tools matches with your R version. This package was tested with the R-tools version 3.5. Newer versions than 3.0 may work fine with `BayesF2D`.
2. Install R-tools through `https://cran.r-project.org/bin/windows/Rtools/`. Install the latest version of Rtools.
3. After saving the file "Rtools34.exe", double-click on the icon for the file to run it.
4. You will be asked what language to install it in - choose English.
5. The Rtools Setup Wizard will appear in a window. Click "Next" at the bottom of the R Setup wizard window.
6. The next page says "Information" at the top. Click "Next" again.
7. The next page says "Select Destination Location" at the top. By default, it will suggest to install R-tools in "C:\Rtools" on your computer. You may also install R-tools in *any other directory where there are* **no spaces** *in the words describing the directory*. Click "Next" at the bottom of the R tools Setup wizard window.
8. The next page says "Select components" at the top. Make sure that the Cygwin Dlls box **is checked**. Click "Next" again.
9. The next page says "Select additional tasks" at the top. Check the box to edit the system PATH. Click "Next" again.
10. Add the directory path containing R Rtools. For instance, add the path `C:\Rtools\bin;` to your list of *system path* variable if not available .
11. (optional) You may want to add also the path containing R.exe (e.g., in C:\R\R-3.5.1\bin;) if you intend to install the `BayesF2D` with the command R CMD INSTALL from the command Windows.
12. The next page says "Ready to install" at the top. Click "install".
13. Rtools should now be installed. This will take about a minute. Click "Finish".

1.3 Instructions for Installation of GSL

1. If you already have GSL libraries installed on your machine, you may skip this step and go to Section 1.4. But we advise to follow these steps.

2. To install GSL libraries, go to http://www.stats.ox.ac.uk/pub/Rtools/libs.html.

3. Download "local323.zip" (or the latest version) by clicking it. The 323 refers to R 3.2.3 but this installation works for 3.5.1.

4. Extract it into a new folder and copy and paste the extracted new folder into the directory a"C:\" for instance (C:\local323).

1.4 Setting up the GSL Environment Variable

1. Open - Control Panel\System and Security\System

2. Click on Advanced system settings and then click on "Environment Variables"

3. Add a new *system* variable by clicking on New. Note that this should be a *System* environment variable, not a *User* environment variable.

4. Name the new variable as LIB_GSL and set the variable value to the directory containing the local323 files downloaded in Section 1.3 or the directory where your GSL libraries are installed. Example C:/local323 but please note that the direction of these slashes is important. This slash / will work but *not* this one \.

1.5 Wrapping up the Installation Procedure for Windows

1. Open RGui, Rstudio or whatever editor you use to run R. Please type the following code to check whether the gsl commands can be found correctly:
`shell("echo %LIB_GSL%")`
If this returns something like "C:/local323", then everything worked fine.

2. If that command returns something like "%LIB_GSL%", then something might be wrong with the GSL installation (Return to Section 1.3) or GSL path (Return to Section 1.4).

3. If the command worked fine, follow the steps in section 3 to finish the installation process in R.

2 Instructions for Installing and Using BayesF2D On Mac

2.1 Instructions for Installing Prerequisites on Mac

1. Install `Xcode` with the command line tools from your Apple store. For this and all the subsequent steps, please read the installation instructions on the individual websites carefully to pick the correct software versions for your operating system.

2. Install Homebrew. See this website for more details: https://brew.sh

3. Open the terminal window. In the terminal window install the gsl library by typing: "brew install gsl".

4. Follow the steps in section 2.2 to verify that these steps worked properly.

2.2 Checking the Installation for Mac

1. Open RGui, Rstudio or whatever editor you use to run R. Please type the following code to check whether the gsl commands can be found correctly:
`system("gsl-config -cflags", intern=TRUE)`
When the command can not be found, and you know where it is stored (e.g., "/opt/local/bin"), we could then set the PATH variable by typing:
`Sys.setenv(PATH=paste0(Sys.getenv("PATH"),":","/opt/local/bin"))`
and then check again.

2. If the above failed, then something went wrong with one or several of the steps in Section 2.1. Please go back and try repeating or checking that section.

3. Follow the steps in section 3 to finish the installation process in R.

3 Getting BayesF2D from GitHub

1. Open RGui, Rstudio, or whatever editor you use to run R.

2. Install the package `devtools` from CRAN by typing install.packages('`devtools`') and then library(devtools).

3. Install `BayesF2D` from GitHub as usual by typing install_github('`chekouo/BayesF2D`') and then library('`BayesF2D`').

4. To test if `BayesF2D` is installed correctly, run this example:

```
> library(BayesF2D)
> data(nonsymCor)
> Cor = nonsymCor
> s.cov0 = 5*matrix(c(1,-0.1,-0.1,1), nrow=2)
> S0 = list(s.cov0, s.cov0, s.cov0, s.cov0)
> s.cov1 = 10*matrix(c(1,-0.1,-0.1,1), nrow=2)
> S1 = list(s.cov1, s.cov1, s.cov1, s.cov1)
> glcm = BayesF2D::simulateGLCM_binary(n0=30,n1=20,GLCM.type = "nonsym",
+                                      m0 = list(c(1,7),c(3,5),c(5,3),c(7,1)),
+                                      S0 = S0,
+                                      m1 = list(c(2,6),c(2,2),c(5,2),c(7,1)),
+                                      S1 = S1,
+                                      Gam = Cor,
+                                      noise = 3)
> meth1="NoCorBeta"
> y=glcm$y ## binary response
> N=length(y)
> R=4# number of imaging sequences
> TT=8 # number of image intensities
> X=array(0,dim=c(R,N,TT,TT))
> for (i in 1:N){
+ X[,i,,]=glcm$GLCM[[i]];
+ }
> Res<-BayesF2DMCMC(covbCov=(meth1=="CorBeta"),y=y,typeoutcome="binary",
+                   TwoDX=X,nbriter=5000,nbrburnin=1000,chainNber=1,
+                   hypsigm_rr=c(0.5,0.5),h=1)
```

5. If you're on Windows and everything worked fine until you tried to run the model, something probably went wrong with installing Rtools (Section 1.2) or installing GSL (Section 1.3). Please refer to those sections for troubleshooting.