

Analysing Congreve & Lamsdell matrices

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Contents

1	Bayesian analysis	1
1.1	bayesgen.pl — Generate MrBayes files	1
2	Parsimony analysis	2
2.1	mptgen.pl — Generate parsimony trees in TNT	2
3	Analysing output data	3
	References	3

The files required to reproduce these analyses are included in the R package directory on installation, and can be downloaded from Github.

If you have RStudio, you can open the R Markdown file used to generate this document (`vignettes/Conduct-analyses.Rmd`) to run the R scripts that will copy all necessary files and begin analyses on your behalf. You will need to specify some paths for automatic downloading:

```
# Directory in which to install MrBayes
BAYES_DIR <- "C:/Research/MrBayes"

# Directory in which to conduct parsimony analysis
HOME <- "C:/Research/iw" # Must not end in a trailing '/'

# GitHub remote
INST_ROOT <- "https://raw.githubusercontent.com/ms609/CongreveLamsdell2016/master/inst/"
```

1 Bayesian analysis

1.1 bayesgen.pl — Generate MrBayes files

A Perl script to execute analysis using Markov models in MrBayes.

The script reads the datasets of Congreve and Lamsdell [1], appends a MrBayes block to the Nexus files, and executes a MrBayes run, saving the consensus trees and preparing them for analysis in R.

Before running the script:

- Install MrBayes

```
MRBAYES_RELEASE <- "https://github.com/NBISweden/MrBayes/releases/download/v3.2.6/MrBayes-3.2.6_WIN32_x86.exe"
zipFile <- paste0(BAYES_DIR, '/MrBayes.zip')
download.file(MRBAYES_RELEASE, destfile=zipFile, method='auto', mode='wb')
unzip(zipFile, c('MrBayes/mrbayes_x64.exe', 'MrBayes/mrbayes_x86.exe'),
      exdir=BAYES_DIR, junkpaths=TRUE)
file.remove(zipFile)
```

- Download Appendix S5 from Congreve and Lamsdell [2] (doi:10.5061/dryad.7dq0j/5 (https://dx.doi.org/10.5061/dryad.7dq0j/5)) and unzip its 100 nexus files to a local directory (default: C:/Research/MrBayes/iw)

```
tempFile <- tempfile(fileext='.zip')
download.file("https://datadryad.org/bitstream/handle/10255/dryad.108351/S5%20-%20Character%20Weights%20Matrix%20Appendix%20S5.zip", tempFile)
unzip(tempFile, exdir=paste0(BAYES_DIR, '/iw'), junkpaths=TRUE,
      files = paste0('Weights tests/', formatC(1:100, width=3, flag=0), '.txt.nex'))
file.remove(tempFile)
```

- Copy mrbayesblock.nex to the iw directory, and bayesgen.pl and t2nex.pl to the root MrBayes directory.
Modify the latter files to specify path to MrBayes (default: C:/Research/MrBayes/) and path to extracted matrices (default: C:/Research/MrBayes/iw)

```
download.file(paste0(INST_ROOT, "analysis-bayesian/mrbayesblock.nex"),
             paste0(BAYES_DIR, '/iw/mrbayesblock.nex'))

bayesGenPath <- paste0(BAYES_DIR, '/bayesgen.pl')
download.file(paste0(INST_ROOT, "analysis-bayesian/bayesgen.pl"), bayesGenPath)
bayesGen <- readLines(bayesGenPath)
bayesGen[5] <- paste0('$dir = "', BAYES_DIR, '/iw";')
bayesGen[6] <- paste0('$bayes_dir = "', BAYES_DIR, '";')
writeLines(bayesGen, bayesGenPath)

t2nexPath <- paste0(BAYES_DIR, '/t2nex.pl')
download.file(paste0(INST_ROOT, "analysis-bayesian/t2nex.pl"), t2nexPath)
t2nex <- readLines(t2nexPath)
t2nex[2] <- paste0('$dir = "', BAYES_DIR, '/iw";')
writeLines(t2nex, t2nexPath)
```

- Perform the analyses by executing bayesgen.pl. (Once Perl is installed, you can just double-click the file.)
- Once the analyses are complete, copy all files ending .run#.nex to C:/Research/iw/MrBayes.

2 Parsimony analysis

2.1 mptgen.pl — Generate parsimony trees in TNT

A Perl script to generate most parsimonious trees by parsimony search in TNT.

The script generates TNT scripts to perform parsimony analysis on each of the Congreve and Lamsdell datasets, under equal and implied weights, with and without suboptimal trees. It then executes these scripts and converts the output into a format suitable for analysis in R.

Before running the script, you'll need an installation of Perl. Strawberry Perl works on MS Windows.

Then:

- Create a local directory (default: C:/Research/iw) with subdirectories entitled Matrices, and Trees. Then, within the new Trees directory, create the further subdirectories eq, k1, k2, k3, k5 and kX.

```
supply(paste0(HOME, '/', c('', 'Matrices', 'Trees')), dir.create)
supply(paste0(HOME, '/Trees/', c('eq', 'k1', 'k2', 'k3', 'k5', 'kX')), dir.create)
```

- Install TNT.

```
zipFile <- paste0(HOME, '/TNT.ZIP')
# This is the Windows path; use the appropriate path for your operating system
download.file("http://www.lillo.org.ar/phylogeny/tnt/ZIPCHTNT.ZIP",
              destfile=zipFile, method='auto', mode='wb')
unzip(zipFile, 'tnt.exe', exdir=HOME)
file.remove(zipFile)
```

- Copy mptgen.pl and (optionally) tnt2nex.pl into this root directory, updating each file so its variable \$dir corresponds to the appropriate path.
tnt2nex.pl translates TNT output into NEXUS format and may be useful if you wish to perform further analysis of TNT output. This will be performed automatically if you uncomment the final line of mptgen.pl.

```
tnt2nexPath <- paste0(HOME, '/tnt2nex.pl')
mptgenPath <- paste0(HOME, '/mptgen.pl')

download.file(paste0(INST_ROOT, "analysis-parsimony/tnt2nex.pl"), tnt2nexPath)
tnt2nex <- readLines(tnt2nexPath)
tnt2nex[3] <- paste0('$dir = "', HOME, '/Trees";')
writeLines(tnt2nex, tnt2nexPath)

download.file(paste0(INST_ROOT, "analysis-parsimony/mptgen.pl"), mptgenPath)
mptgen <- readLines(mptgenPath)
mptgen[3] <- paste0('$dir = "', HOME, '";')
writeLines(mptgen, mptgenPath)
```

- Copy the file tnt_template.run into the root directory.

```
download.file(paste0(INST_ROOT, "analysis-parsimony/tnt_template.run"),
              paste0(HOME, '/tnt_template.run'))
```

- Download Appendix S1 from Congreve and Lamsdell [2] (doi:10.5061/dryad.7dq0j/1) and unzip its 100 text files to Matrices.

```
tempFile <- tempfile(fileext='.zip')
download.file("https://datadryad.org/bitstream/handle/10255/dryad.101095/S1%20-%20TNT%20files.zip", tempFile)
unzip(tempFile, exdir=paste0(HOME, '/Matrices'))
```

- Perform the analyses by executing mptgen.pl. (Once Perl is installed, you can just double-click the file.)

3 Analysing output data

Once these analyses have generated the necessary data,

References

1. Congreve CR, Lamsdell JC. 2016 Implied weighting and its utility in palaeontological datasets: a study using modelled phylogenetic matrices. *Palaeontology* **59**, 447–465. (doi:10.1111/pala.12236)
2. Congreve CR, Lamsdell JC. 2016 Data from: Implied weighting and its utility in palaeontological datasets: a study using modelled phylogenetic matrices. *Dryad Digital Repository*, doi:10.5061/dryad.7dq0j. (doi:10.5061/dryad.7dq0j)