PART 1 OF TUTORIAL ON EXTREMES TOOLKIT

(1) *Installation of* R *software*

`R-2.9.2-win32.exe`

Use default options

(2) *Installation of Extremes Toolkit*

`extRemes` (R package for extreme value analysis): `extRemes_1.60.zip`

`ismev` (R package used by `extRemes`): `ismev_1.34.zip`

`Lmoments` (R package used by `extRemes`): `Lmoments_1.1-3.zip`

Within R session (using `RGui`):

(i) Click on **Packages**

(ii) Select **Install package(s) from local zip files**

Note: Ordinarily, if connected to web, can download/install a package simply by selecting the **Install packages(s)** option instead.

Once packages have been installed, can load Extremes Toolkit by executing R command:

```
library(extRemes)
```

Or from `RGui`:

(i) Click on **Packages**

(ii) Select **Load package**

(iii) Select **extRemes** from list

Getting started:

To obtain help, execute R command: `help(extRemes)` or `?extRemes`

If `extRemes` GUI disappears, execute R command: `extremes.gui()`

Data sets that come with `extRemes`:

Located at `...\R-2.9.2\library\extRemes\data`

May be convenient to move them (or at least the data sets to be used in tutorial) to:
`My Documents`

Data sets to be used in tutorial:

Ft. Collins annual maximum precipitation: `ftcanmax.R`

Hurricane damage: `damage.R`

Phoenix daily minimum temperature: `Tphap.R`

Ft. Collins daily precipitation amount: `FtCoPrec.R`

Phoenix summer minimum temperature: `HEAT.R`

Port Jervis winter maximum temperature (and Arctic Oscillation index): `PORTw.R`

(3) *Climate Applications (Under Stationarity)*

(3.1) *Generalized Extreme Value (GEV) distribution/Block maxima*

(3.1.1) *Simulation from GEV distribution*

(i) *Simulate data*

File/Simulate Data/Generalized Extreme Value (GEV)

GEV parameters:
Location parameter (mu): **0**
Scale parameter (sigma): **1**
Shape parameter (xi): **0.2**

Sample size: **100**

Save as: `gevsim.R`

Click on **Generate**

Note: Creates `extRemes` data object `gevsim.R`

(ii) Fit GEV distribution to simulated data

Analyze/Generalized Extreme Value (GEV) Distribution

Data Object: `gevsim.R`

Optimization Method: **Nelder-Mead**

Response: `gev.sim`

Plot diagnostics: **check**

Click on **OK**

Note: Fitted output saved in `gev.fit1`

Repeat simulation exercise with Shape parameter (xi) changed to **−0.2**

R Commands (for above example)

```
x <- gen.gev(p = c(0, 1, 0.2), n = 100)
plot(1:100, x, type = "1")
summary(x)
result <- gev.fit(x)
result$mle
summary(result)
gev.diag(result)
```

(3.1.2) *Fort Collins annual maximum precipitation*

To obtain more information about this data set, use `R` command: `help(ftcanmax)`

(i) *Read Fort Collins data into* `extRemes`

File/Read Data

Select file `ftcanmax.R`

File Type: **R source**

Save as (in R): `ftcanmax.R`

Click on **OK**

Note: Creates `extRemes` data object `ftcanmax.R`

(ii) *Check data*

Plot/Scatter Plot

Select file `ftcanmax.R`

Select **line** option

x-axis variable: `Year`

y-axis variable: `Prec`

Click on **OK**

(iii) *Fit GEV distribution to Fort Collins data*

Analyze/Generalized Extreme Value (GEV) Distribution

Data Object: `ftcanmax.R`

Optimization Method: **Nelder-Mead**

Response: `Prec`

Plot diagnostics: **check**

Click on **OK**

Note: Fitted output saved in `gev.fit1`

(iv) *Estimate return level for Fort Collins data*

Analyze/Parameter confidence interval/GEV fit

Data Object: `ftcanmax.R`

Select a fit: `gev.fit1`

m-year return level: **100**

Return level: **check**

Shape parameter: **uncheck**

Lower limit: **300**

Upper limit: **900**

Plot profile likelihoods: **yes**

Click on **OK**

(3.2) *Generalized Pareto (GP)/Distribution tails*

(3.2.1) *Simulation from GP distribution*

(i) *Simulate data*

File/Simulate Data/Generalized Pareto (GP)

GP parameters:
Scale parameter (sigma): **1**
Shape parameter (xi): **0.2**

Threshold: **10**

Sample size: **100**

Save as: `gpdsim.R`

Click on **Generate**

Note: Creates `extRemes` data object `gpdsim.R`

(ii) *Fit GP distribution to simulated data*

Analyze/Generalized Pareto Distribution (GPD)

Data Object: `gpdsim.R`

Response: `gpd.sim`

Plot diagnostics: **check**

Optimization Method: **Nelder-Mead**

Threshold: **10**

Number of obs per year: **1**

Click on **OK**

Note: Fitted output saved in `gpd.fit1`

Also fit GP distribution to same simulated data with a threshold of **12**

(3.2.2) *Economic damage from hurricanes*

To obtain more information about this data set, use `R` command:

```
help(damage)
```

(i) *Read damage data into* `extRemes`

File/Read Data

Select file: `damage.R`

File Type: **R source**

Save as (in R): `damage.R`

Click on **OK**

Note: Creates `extRemes` data object `damage.R`

(iii) *Fit GP distribution to damage data*

Analyze/Generalized Pareto Distribution (GPD)

Data Object: `damage.R`

Response: `Dam`

Plot diagnostics: **check**

Method: **Nelder-Mead**

Threshold: **6**

Number of obs per year: **2**

Click on **OK**

Note: Fitted output saved in `gpd.fit1`

(3.2.3) *Phoenix daily minimum temperature*

(i) *Read Phoenix data into* `extRemes`

File/Read Data

Select file: `Tphap.R`

File Type: **R source**

Save as (in R): `Tphap.R`

Click on **OK**

Note: Creates `extRemes` data object `Tphap.R`

(ii) *Negate minimum temperature*

File/Transform Data/Negative

Data Object: `Tphap.R`

Variables to Transform: `MinT`

Click on **OK**

Note: Creates new variable `MinT.neg`

(iii) *Fit GP distribution to negated data*

Analyze/Generalized Pareto Distribution (GPD)

Data Object: `Tphap.R`

Response: `MinT.neg`

Plot diagnostics: **check**

Method: **Nelder-Mead**

Threshold: **−73**

Number of obs per year: **62**

Click on **OK**

Note: Fitted output saved in `gpd.fit1`

(iv) *Identify threshold for negated data*

Plot/Fit Threshold ranges (GPD)

Data Object: `Tphap.R`

Variable: `MinT.neg`

Threshold Ranges (GPD):

Minimum Threshold: **−78**
Maximum Threshold: **−68**
Number of Thresholds: **11**

Click on **OK**

(v) *Decluster negated minimum temperature*

File/Decluster

Data Object: `Tphap.R`

Variable to Decluster: `MinT.neg`

Decluster by: `Year`

Threshold(s): **−73**

Run Length: **1**

Click on **OK**

Note: Creates new variable `MinT.neg.u-73r1dcbyYear`

(vi) *Fit GP distribution to declustered data*

Analyze/Generalized Pareto Distribution (GPD)

Data Object: `Tphap.R`

Response: `MinT.neg.u-73r1dcbyYear`

Plot diagnostics: **check**

Method: **Nelder-Mead**

Threshold: **−73**

Number of obs per year: **62**

Click on **OK**

Note: Fitted output saved in `gpd.fit2`

(3.3) *Point process model*

Fort Collins daily precipitation

(i) *Read Fort Collins daily data into* `extRemes`

File/Read Data

Select file: `FtCoPrec.R`

File Type: **R source**

Save as (in R): `FtCoPrec.R`

Click on **OK**

Note: Creates `extRemes` data object `FtCoPrec.R`

(ii) *Fit point process to Fort Collins data*

Analyze/Point Process Model

Data Object: `FtCoPrec.R`

Response: `Prec`

Plot diagnostics: **uncheck**

Method: **Nelder-Mead**

Threshold: **0.395**

Number of obs per year: **365.25**

Click on **OK**

Note: Fitted output saved in `pp.fit1`