PART 2 OF TUTORIAL ON EXTREMES TOOLKIT

(1) *Using Covariates in Extremes Toolkit*

Simulation from GEV distribution with trend

(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**
Trend (in location parameter): **0.01**

Sample size: **100**

Save as: `gevtrend.R`

Click on **Generate**

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

(ii) *Fit GEV with no trend to simulated data*

Analyze/Generalized Extreme Value (GEV) Distribution

Data Object: `gevtrend.R`

Optimization Method: **Nelder-Mead**

Response: `gev.sim`

Plot diagnostics: **check**

Click on **OK**

Note: Fitted output saved in `gev.fit1`

(iii) *Fit GEV with linear trend in location parameter to simulated data*

Analyze/Generalized Extreme Value (GEV) Distribution

Data Object: `gevtrend.R`

Optimization Method: **Nelder-Mead**

Response: `gev.sim`

Location parameter (mu): **obs**

Link: **identity**

Plot diagnostics: **check**

Click on **OK**

Note: Fitted output saved in `gev.fit2`

(iv) *Perform likelihood-ratio test for trend in location parameter*

Analyze/Likelihood-ratio test

Data Object: `gevtrend.R`

Significance level (alpha): **0.05**

Select base fit (M0): `gev.fit1`

Select comparison fit (M1): `gev.fit2`

Click on **OK**

(2) *Climate Change Applications*

(2.1) *Block maxima approach*

(2.1.1) *Port Jervis winter maximum temperature (fitting GEV distribution with Arctic Oscillation as covariate)*

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

(i) Read data file `PORTw.R` into `extRemes`

File/Read Data

Select file `PORTw.R`

File Type: **R source**

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

Click on **OK**

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

(ii) *Check data*

Plot/Scatter Plot

Select file `PORTw.R`

Select **points** option

x-axis variable: `AOindex`

y-axis variable: `TMX1`

Click on **OK**

(iii) *Fit GEV with no covariates to maximum temperature data*

Analyze/Generalized Extreme Value (GEV) Distribution

Data Object: `PORTw.R`

Optimization Method: **Nelder-Mead**

Response: `TMX1`

Plot diagnostics: **check**

Click on **OK**

<u>Note</u>: Fitted output saved in `gev.fit1`

(iv) *Fit GEV with location parameter depending on Arctic Oscillation*

Analyze/Generalized Extreme Value (GEV) Distribution

Data Object: `PORTw.R`

Optimization Method: **Nelder-Mead**

Response: `TMX1`

Location parameter (mu): `AOindex`

Link: **identity**

Plot diagnostics: **check**

Click on **OK**

<u>Note</u>: Fitted output saved in `gev.fit2`

(v) *Perform likelihood-ratio test for dependence of location parameter on AO*

Analyze/Likelihood-ratio test

Data Object: `PORTw.R`

Significance level (alpha): **0.05**

Select base fit (M0): `gev.fit1`

Select comparison fit (M1): `gev.fit2`

Click on **OK**

(vi) *Fit GEV with dependence of both location parameter and log(scale parameter) on AO*

Analyze/Generalized Extreme Value (GEV) Distribution

Data Object: `PORTw.R`

Optimization Method: **Nelder-Mead**

Response: `TMX1`

Location parameter (mu): `AOindex`

Link: **identity**

Scale parameter (sigma): `AOindex`

Link: **log**

Plot diagnostics: **check**

Click on **OK**

Note: Fitted output saved in `gev.fit3`

(vii) *Perform likelihood-ratio test for dependence of log(scale parameter) on AO*

Analyze/Likelihood-ratio test

Data Object: `PORTw.R`

Significance level (alpha): **0.05**

Select base fit (M0): `gev.fit2`

Select comparison fit (M1): `gev.fit3`

Click on **OK**

(2.1.2) *Phoenix summer minimum temperature (trend)*

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

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

File/Read Data

Select file `HEAT.R`

File Type: **R source**

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

Click on **OK**

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

(ii) *Check data*

Plot/Scatter Plot

Select file `HEAT.R`

Select **line** option

x-axis variable: `Year`

y-axis variable: `Tmin`

Click on **OK**

(iii) *Negate minimum temperature*

File/Transform Data/Negative

Data Object: `HEAT.R`

Variables to Transform: `Tmin`

Click on **OK**

Note: Creates new variable `Tmin.neg`

(iv) *Transform time variable*

File/Transform Data/Affine Transformation

Data Object: `HEAT.R`

Variables to Transform: `Year`

c (subtract): **47**

b (divide by): **1**

Click on **OK**

Note: Creates new variable `Year.c47b1`

(v) *Fit GEV with no trend to negated data*

Analyze/Generalized Extreme Value (GEV) Distribution

Data Object: `HEAT.R`

Optimization Method: **Nelder-Mead**

Response: `Tmin.neg`

Plot diagnostics: **check**

Click on **OK**

Note: Fitted output saved in `gev.fit1`

(vi) *Fit GEV with linear trend in location parameter to negated data*

Analyze/Generalized Extreme Value (GEV) Distribution

Data Object: `HEAT.R`

Optimization Method: **Nelder-Mead**

Response: `Tmin.neg`

Location parameter (mu): `Year.c47b1`

Link: **identity**

Plot diagnostics: **check**

Click on **OK**

Note: Fitted output saved in `gev.fit2`

(vii) *Perform likelihood-ratio test for trend in location parameter*

Analyze/Likelihood-ratio test

Data Object: `HEAT.R`

Significance level (alpha): **0.05**

Select base fit (M0): `gev.fit1`

Select comparison fit (M1): `gev.fit2`

Click on **OK**

(viii) *Fit GEV with linear trends in both location parameter and log(scale parameter) to negated data*

Analyze/Generalized Extreme Value (GEV) Distribution

Data Object: `HEAT.R`

Optimization Method: **Nelder-Mead**

Response: `Tmin.neg`

Location parameter (mu): `Year.c47b1`

Link: **identity**

Scale parameter (sigma): `Year.c47b1`

Link: **log**

Plot diagnostics: **check**

Click on **OK**

<u>Note</u>: Fitted output saved in `gev.fit3`

(ix) *Perform likelihood-ratio test for trend in log(scale parameter)*

Analyze/Likelihood-ratio test

Data Object: `HEAT.R`

Significance level (alpha): **0.05**

Select base fit (M0): `gev.fit2`

Select comparison fit (M1): `gev.fit3`

Click on **OK**

(2.3) *Point process model (Fort Collins daily precipitation with annual cycle in location parameter)*

(i) *Create cosine and sine variables*

File/Transform Data/Trigonometric Transformation

Data Object: `FtCoPrec.R`

Period: **365.25**

Variables to Transform: `obs`

Click on **OK**

Note: Creates new variables `obs.sin365` and `obs.cos365`

(ii) *Fit point process with annual cycle in location parameter*

Analyze/Point Process Model

Data Object: `FtCoPrec.R`

Response: `Prec`

Location parameter (mu): `obs.sin365` and `obs.cos365`

Link: **identity**

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.fit2`

(iii) *Perform likelihood-ratio test for annual cycles in location parameter*

Analyze/Likelihood-ratio test

Data Object: `FtCoPrec.R`

Significance level (alpha): **0.05**

Select base fit (M0): `pp.fit1`

Select comparison fit (M1): `pp.fit2`

Click on **OK**