CHAPTER 19

EXERCISES: EXTREME VALUE ANALYSIS

In this homework set, you will use the Generalized Extreme Value Distribution to quantify the return period for extreme cold temperatures in the mid-Atlantic U.S. The data set and R code to read this data are summarized in the table below and can be downloaded from the class website. You also will need to install the `extRemes` library. Also, inside `tele_index.R`, you need to change `indices.fname` to the full directory path of the data file `tele_index.nh`.

Table 19.1 default

`GHNC_OBS_T_mid_atlantic_1950_2015.txt`	data file for mid-Atlantic temperature
`Rcode.exercise.Chapter19.R`	R code to read the mid-Atlantic temperature
`tele_index.R`	R code to read climate indices
`tele_index.nh`	NOAA climate indices

Exercise 19.1. Run `Rcode.exercise.Chapter19.R` and ensure it generates a time series/box plot identical to fig. 19.1. Next, fit the cold extremes to a GEV using the commands

```
t.cold        = -t.cold # reverse sign to use extreme value functions
cold.x        = fevd(t.cold)
```

Submit a print out of the output when you type `cold.x`. This print out should be consistent with table 19.1.

Make a plot using the command `plot(cold.x)` and submit it. This plot is discussed in Gilleland and Katz (2016). Consult this document and describe what this plot shows.

What are the return levels for 2-year, 20-year, and 200-year events (you will need a special command in Gilleland and Katz (2016) to answer this question)? □

Exercise 19.2. Is the fitted distribution a Gumbel, Fréchet, or Weibull? Explain your answer. □

Exercise 19.3. Fit the data to a GEV, but this time use NAO as a covariate for the location parameter. The NAO is `index` in the R code. Is this covariate significant? Is the fitted distribution a Gumbel, Fréchet, or Weibull? Explain your answer. Generate a plot similar to the first exercise above and describe the new information that it conveys. □

Exercise 19.4. Suppose the probability of exceedance in any randomly selected year is p. If the exceedances in different years are independent, then what is the average number of years one will wait before observing the next exceedance? Hint: the average number of years one will wait before observing the next exceedance is computed as

$$\text{return period} = \sum_{y=1}^{\infty} y * (\text{probability that next exceedance occurs in year } y) \,. \tag{19.1}$$

What is the probability that the exceedance occurs in year 1? year 2? etc?

□