BLUE WIND user’s manual

BLUE WIND is a suite of Matlab (version 2014b) programs that calculates the extreme wind speeds corresponding to specified Mean Return Intervals (MRI) for thunderstorms and non-thunderstorm events from the NIST database <http://www.itl.nist.gov/div898/winds/datasets.htm>, or from a user-defined time series of annual wind speed peaks, using Lieblein (1974)’s BLUE (Best Linear Unbiased Estimate) method. The suite consists of:

* Function blue8, which estimates the extreme wind speeds and calls bluecoeff.
* Function bluecoeff, which provides the coefficients of BLUE for 4 ≤ n epochs ≤ 100.
* Function AnnualWindSpeed, which extracts the annual wind speed peaks from the NIST database.

**function [speed, mu, sigma] = blue8(V, M)**

Given a time series of annual wind speed max V of length n years, 4 ≤ n ≤ 100 (n is an integer), blue8 estimates extreme wind speeds for mean return intervals M, which do not have to be integers.

INPUT:

V = vector of time series of interest (annual wind speed max of length n years, 4 ≤ n ≤ 100).

M = vector of MRI.

OUTPUT:

speed = vector of estimated extreme wind speeds with MRI M.

mu, sigma = location and scale parameters of the Gumbel distribution fitted to the data.

**function [ai,bi] = bluecoeff (n)**

Function bluecoeff provides the coefficients of BLUE for 4 ≤ n epochs ≤ 100 (n is an integer).

INPUT:

n = number of years of annual wind speed max, 4 ≤ n ≤ 100.

OUTPUT:

ai, bi = coefficients for BLUE, calculated according to formulas by Lieblein (who provided coefficients for 4 ≤ n ≤ 16).

**function [V\_NT,V\_TH] = AnnualWindSpeed(filename,shtname)**

This script selects the time-series of annual peaks of non-thunderstorm and thunderstorm wind from the NIST database <http://www.itl.nist.gov/div898/winds/datasets.htm>.

INPUT:

filename, shtname = location of data

OUTPUT:

V\_NT,V\_TH = vectors of annual peaks of non-thunderstorm and thunderstorm wind.

**Here is how to run the program:**

1. Select a time series of wind speed and write a script to read it;
2. Place data, rea-script (pp. 3, 4), function blue8 (p. 6) and function bluecoeff in one directory. In addition, place function AnnualWindSpeed (p.5) in the same directory if the NIST database is used.
3. Run the programs.

**Results**

Extreme wind speeds corresponding to the specified Mean Return Intervals. The program also outputs the location (mu) and scale (sigma) parameters of the Gumbel distribution.

**References**

Lieblein, J. (1974) “Efficient Methods of Extreme Value Methodology,” NBSIR 74-602, National Bureau of Standards, Washington, DC 20234

**Examples** follow. % indicates a Matlab non executable comment, in green. Results are in blue.

2.9.2017

Example 1 uses NIST database.

This is an example of a script that reads a data file extracted from the NIST database. The script also specifies the vector M of MRI and calls functions AnnualWindSpeed and blue 8.

wind\_speed.m

% reads data from NIST database, defines Mean Return Intervals (MRI) M and % calls other functions to find:

% V\_TH, V\_NT = annual wind speed max for thunderstorms and non-thunderstorms;

% and to calculate, by Lieblein's BLUE method:

% speed = vector of extreme wind speeds with MRI M years.

% M(i)does not have to be an integer.

% mu, sigma = location and scale parameters of Gumbel distribution.

% addpath('C:\windPRESSURE');

filename = 'Bakersfield\_723840'; % Name of Excel file

shtname = 'Sheet1'; % Name of sheet including data

[V\_NT,V\_TH] = AnnualWindSpeed(filename,shtname)

M = [10 20 25 50 100 300 700 1700 3000]

[speed, mu, sigma] = blue8(V\_NT,M)

[speed, mu, sigma] = blue8(V\_TH,M)

Results

V\_NT V\_TH

46.0205 53.1791

42.8082 43.3287

44.8636 44.7141

57.2821 47.8720

55.6454 49.6582

53.9642 30.4583

43.7917 30.1855

43.5350 33.2095

44.1281 39.5721

58.8611 34.5018

49.5423 31.7498

53.1292 30.6337

51.6149 30.0697

47.3822

45.3811

47.8909

51.0505

45.1080

40.6757

54.1570

48.5957

49.8266

M = 10 20 25 50 100 300 700 1700 3000

Speed\_NT = 56.0726 59.1623 60.1425 63.1617 66.1587 70.8887 74.5296 78.3400 80.7786

speed\_TH = 48.2694 52.6604 54.0532 58.3440 62.6031 69.3250 74.4993 79.9144 83.3799

mu\_NT= 46.4133 sigma\_NT = 4.2923

mu\_TH = 34.5422 sigma\_TH = 6.1000

Example 2: user defines annual wind speed max data

The script reads the data, specifies the vector of MRI and calls function blue8.

wind\_speed2.m

% reads annual wind speed max data V, defines Mean Return Intervals (MRI) M % [M(i)does not have to be an integer]

% and calls other functions to calculate, by Lieblein's BLUE method:

% speed = vector of extreme wind speeds with MRI M years.

% mu, sigma = location and scale parameters of Gumbel distribution.

% addpath('C:\windPRESSURE');

% filename = 'WASP.csv'; % Name of Excel file of wind annual speeds

% xlrange = 'A1:A8';

% V = xlsread(filename,xlrange);

M = [10 20 25 50 100 300 700 1700 3000]

[speed, mu, sigma] = blue8(V,M)

The following dataset is taken from Example 1 of Lieblein (1974), who obtained the same values of location and scale (p. 12).

Results

V= [5.41 3.70 3.97 4.39 4.66 3.62 3.82 3.62]

M = 10 20 25 50 100 300 700 1700 3000

Speed = 4.8111 5.1114 5.2066 5.5000 5.7913 6.2509 6.6048 6.9751 7.2121

mu = 3.8724 sigma = 0.4171

function [V\_NT,V\_TH] = AnnualWindSpeed(filename,shtname)

%%% AnnualWindSpeed

%%% This script reads NIST wind speed data files and selects

%%% the time-series of annual peaks of thunderstorm and non-

%%% thunderstorm wind.

if isempty(filename) || isempty(shtname)

 % Specify filename of wind speed dataset

 filename = 'Bakersfield\_723840'; % Name of Excel file

 shtname = 'Sheet1'; % Name of sheet including data

end

%% 1. Reads the dataset

% Reads Excel dataset

eval(sprintf('[num,~,~] = xlsread(''%s.xlsx'',''%s'');',filename,shtname));

% Remove unnecessary rows

num(1:3,:) = [];

% Comments on the required dataset from the matrix [num]

% all rows = number of data

% column 2 = wind speed (standardized, mph)

% column 10 = annual max (non-thunderstorm)

% column 11 = annual max (thunderstorm)

%% 2. Makes a matrix for the time-series of annual peaks

% Finds a row number when column 10 is unity (for non-thunder)

r\_index\_NT = find(num(:,10) == 1);

V\_NT = num(r\_index\_NT,2);

% Finds a row number when column 11 is unity (for thunder)

r\_index\_TH = find(num(:,11) == 1);

V\_TH = num(r\_index\_TH,2);

end

function [speed, mu, sigma] = blue8(V, M)

% Given a time series of annual wind speed max V of length n years,

% blue8 estimates extreme wind speeds for mean return intervals M,

% which do not have to be integers (but n does).

% Written by Dat Duthinh 2\_6\_2017.

% References: 1)Julius Lieblein "Efficient Methods of Extreme-Value

% Methodology" NBSIR 74-602 OCT 1974 for n = 4:16

% 2)Nicholas John Cook "The designer's guide to wind loading of

% building structures" part 1, British Research Establishment 1985

% Table C3 pp. 321-323 for n = 17:24.

% version 8: MRI

% V = vector of time series of interest (annual wind speed max)

% M = vector of MRI

% n = number of years of annual wind speed max data, 4 <= n <= 100

% speed = vector of estimated extreme wind speed with MRI M.

% mu, sigma = location and scale parameters of Gumbel distribution.

n = length(V); % number of years of annual wind speed max

k = length(M); % number of MRI to estimate

[ai,bi]= bluecoeff(n); % read coefficients of BLUE

speed = zeros(1,k);

% Organize values in ascending order

x\_max = sort(V);

u = 0; % location parameter

b = 0; % scale parameter

%

% % Calculates parameter of location and scale

for j = 1:n

 u = u + ai(j)\*x\_max(j);

 b = b + bi(j)\*x\_max(j);

end

mu = u;

sigma = b;

% speed = u-b\*log(-log(1-1/M));

for i = 1:k

 speed(i) = u-b\*log(-log(1-1/M(i)));

end