

User's Guide BFI

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1 Introduction

This program performs a separation of the base flow from the total streamflow and calculates the Base Flow Index (BFI). It is written as a Visual Basic Application within Excel and contains the sample data used in Worked Example 5.3 of the Textbook. The algorithm is based on the calculation procedures introduced by the Institute of Hydrology (1980) and further details can be found in the Textbook (Section 5.3.3).

2 Running the program

The program is started by opening the file 'BFI.xls'¹, which contains two spreadsheets:

- **'Calculation'**: This is the main sheet of the application. All steps of a calculation are performed on this sheet:
 - Importing input data/Loading of sample data
 - Starting and running the calculations
 - Displaying the results

These steps are further described in the following sections.

- **'Sample_Data'**: This sheet contains three years of daily streamflow data (1995–1997) from River Ray at Grendon Underwood (UK), as also used in Worked Example 5.3. The sample data can be loaded by pressing a button on the 'Calculation' sheet. The Sample Data sheet itself does not need to be accessed.

¹ Macros must be enabled; this can be done in Excel under Tools/Options/Security/Macro Security

3 Input Data

Input data are time series of daily streamflow data. The time series must be continuous and should not contain missing data. Even though the program might run if missing data are included, e.g. coded as ‘-1’ values, the results would be wrong.

The input data are inserted into the first two columns of the spreadsheet ‘Calculation’ using ‘copy and paste’ of data in other Excel files (e.g. files of the Global or Regional Data Set on the CD). The Dates are entered in column A, starting with cell A2, and streamflow values in column B, starting with cell B2 (Figure 1). There are no restrictions for the units of the streamflow – the calculated base flow values will have the same units as the input data and the BFIs are relative measures without unit.

	A	B	C
1	Date	Discharge	Baseflow
2	01/01/1995	0.109	
3	02/01/1995	0.063	
4	03/01/1995	0.043	
5	04/01/1995	0.039	
6	05/01/1995	0.229	

Figure 1 Data input.

The sample data can be loaded directly by pressing the  button.

4 Calculation

When column A and B contain the necessary input data, the calculation can be started by pressing the  button. The calculated base flow values are displayed in column C and a window shows up for the selection of season (Figure 2).



Figure 2 Selection of season.

In this window, the start and end day of the hydrological year or season for which the BFI will be calculated, can be specified. The full calendar year is given as default dates. The season may contain a year shift if the hydrological year does not equal the calendar year.

After pressing the ‘Run’ button in the ‘Seasonal BFI’ window, the base-flow-index calculations are performed and the results are displayed as described in the next section.

5 Output

5.1 Graph

A graph of the base flow separation, showing the total streamflow (input data) and the calculated base flow values, is displayed in the middle part of the ‘Calculation’ sheet. The displayed interval corresponds to the season selected for the calculation. To view the graphs of different years, use the arrow buttons below the graph or chose the year from the year-selection field (Figure 3).

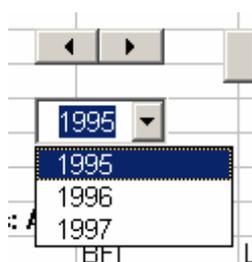


Figure 3 Year selection.

The year-selection field also shows the year of the displayed graph. If the hydrological year or season chosen contains a year shift, the displayed year number is the year of the *end day* of the year or season. If a more detailed view of part of the hydrograph and the separation line is wanted, the user can choose to estimate the BFI for a shorter period (similar to seasonal calculation).

5.2 Results: Annual values

BFI for individual years are displayed below the graph. These are based on full year or seasonal calculations. If a hydrological year or season contains a year shift, the displayed year number is the year where the *end day* of the year or season belongs (analogue to the years of the graph).

Under ‘Lost days’ the number of days which are missing in the first and last season of the data series, are displayed. Days are lost as the base flow separation cannot start on the first day of the record nor end on the last day. Further, when the chosen season starts earlier or ends later than the time series, these days before or after the series increase the number of lost days. However, when the season start is chosen later than the start of the time series or the season end earlier than the end of the time series, the number of lost days may be reduced to zero.

5.3 Results: Whole series

- **BFI:** This field gives the BFI for the whole streamflow series, calculated as:

$$BFI = \frac{\sum_i b_i}{\sum_i d_i}$$

with: b_i base flow values (entire series) that are part of the selected season
 d_i total streamflow values (entire series) that are part of the selected season

- **Mean of annual BFIs:** This field displays the mean of the annual BFIs, which are displayed under ‘Results: Annual values’:

$$\text{Mean of annual BFIs} = \frac{\sum^a BFI_a}{n}$$

with: BFI_a annual or seasonal BFI where a denotes the year/season
 n total number of years/seasons

5.4 Season Information

These fields display the season selected during the calculation procedure and whether the season contains a year shift or not.

5.5 Series Information

‘Series information’ displays the first and last day of the input series as well as the first and last day of the calculated base flow series. Due to the calculation procedure of the base flow separation, the base flow series is always shorter than the input series as discussed earlier (‘Lost days’).

6 Reset

The  button should be used to prepare the ‘Calculation’ sheet for a new calculation with new input data. Data should not be deleted ‘by hand’ as this might result in program errors. In this case of errors, the program should be closed and a new copy opened. The program file might also be stored with a different name saving the data and results from a particular calculation.