FLODRO 2.0: a user friendly personal computer package for flood and drought frequency analyses

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Abstract

User-friendly personal computer package FLODRO 2.0 was developed under the programming environment of Visual Basic (Visual Basic is a trademark of Microsoft, Inc.). FLODRO 2.0 has two independent programs: FLOOD and DROUGHT. On program FLOOD, flood frequency analysis is performed by using eight typical distribution functions: Normal, Two and Three Parameter Log-Normal, Two and Three Parameter Gamma, Log-Pearson Type III, Extreme Value Type I and General Extreme Value. On program DROUGHT, drought frequency analysis is performed by using four typical distribution functions: Three Parameter Log-Normal, , Extreme Value Types I and III and General Extreme Value. The characteristics, properties and construction of the programs FLOOD and DROUGHT of computer package FLODRO 2.0 are displayed in the paper towards its application in flood and drought frequency analyses. The selected methods of estimation of parameters are those of moments, maximum likelihood, sextiles and probability weighted moments.
1 Introduction

A subject of paramount interest in planning and design of water works is that related with the analysis of flood and drought frequencies. Due to the characteristic that design values have, they are linked to a return period or to an exceedance or non-exceedance probabilities, and the use of mathematical models known as probability distribution functions is a must. Among the most widely used probability distribution functions for hydrological analyses are the following, Kite[1], Matalas[2] and Salas and Smith[3]:

For flood frequency analysis: Normal, Two and Three parameters Log-Normal, Two and Three parameters Gamma, Log-Pearson Type III, Extreme Value Type I and General Extreme Value distributions

For drought frequency analysis: Three parameters Log-Normal, Extreme Value types I and III, and General Extreme Value distributions.

In the light of the personal computer applications in education and training in all the fields of science, a personal computer program was designed to take care of the processes of flood and drought frequency analyses, in particular in engineering hydrology but easily extended to other fields related with frequency analyses dealing with maxima and minima, providing a wide number of options in the models to be used as in the analyses that can be done with such a tool as well. The resulting code has been named FLODRO 2.0 as it will be referred herein. The paper contains the key features of FLODRO 2.0 and a few examples for flood and drought frequency analyses are included to show the main results that FLODRO 2.0 can supply to the user.

2 Framework of FLODRO 2.0

FLODRO is developed under Visual Basic, ( Visual Basic is a registered trademark of Microsoft Corporation ), a BASIC compiler compatible with IBM ( IBM is a registered trademark of International Business Machines ) personal computers. The interactive mode in which FLODRO 2.0 is written makes it to have a high user-friendly component. In any step, the user has the control on the processes that the program executes, from data input to printing of results of the analysis. The personal
computer package FLODRO 2.0 has the structure shown in figure 1.

![Diagram of FLODRO 2.0 structure]

All the probability distribution functions mentioned in the previous section are contained in FLODRO 2.0 and it is divided in two independent computer programs: FLOOD and DROUGHT.

In the FLOOD computer program, the flood frequency analysis is performed by the use of eight probability distribution functions, as it is shown in figure 1.
In the DROUGHT computer program, the drought frequency analysis is performed by the use of five probability distribution functions, as it is shown in figure 1.

Both programs can perform the required computations to obtain, as shown in figure 2:

a) Estimation of parameters, by the methods of moments in DROUGHT, and moments, maximum likelihood and probability weighted moments in FLOOD, where applicable.
b) Computation of probability distribution function (CDF) for sample values or for any other values provided by the user.
c) Computation of probability density function (PDF) for sample values or for any other values provided by the user.
d) Inverse of the CDF for a fixed number of values or for any other values provided by the user.
e) Confidence limits for design events, by the methods of moments in DROUGHT and moments and maximum likelihood in FLOOD.
f) Goodness of fit tests based in the standard error of fit, Kite[1], and based in a graphical comparison between the empirical and theoretical CDF and PDF’s.

Figure 2. Options of analysis in computer package FLODRO
Personal computer program FLODRO has been designed to use minimum of memory and computer peripherals. Each computer program FLOOD or DROUGHT have less than 1.4 MB so there is no need to have a hard disk to run any of such programs. The graphs provided by FLOOD or DROUGHT are printed in a common printer there is no need to use costly plotters to get in paper these graphs. These features makes FLODRO 2.0 very suitable in programs of hydrology education and training particularly in developing countries, and in continuing education as well.

3 Numerical Examples

Gauging stations Jaina and Villalba in Northwestern Mexico have been selected to analyze the annual floods and the one-day low flow, respectively using the General Extreme Value probability distribution function and the method of maximum likelihood. The parameters obtained through the use of FLODRO 2.0 are:

a) For floods, gauging station Jaina:
   - Location parameter = 651.25 ; Scale parameter = 328.93
   - Shape parameter = -0.5489
   - Mean = 1135.41 ; Standard Deviation = 1130.93
   - Skewness = 4.01

b) For droughts, gauging station Villalba:
   - Location parameter = 0.37 ; Scale parameter = 0.17
   - Shape parameter = 0.53
   - Mean = 0.34 ; Standard Deviation = 0.15
   - Skewness = 0.64

A sample of the graphic displays provided by FLODRO 2.0 is contained in figures 3 and 4, for the gauging stations considered.

Conclusions

A personal computer program has been presented for flood and drought frequency analyses education and training. The computer code has been applied successfully to train students coming from Latin American and African countries, showing the user-friendly component of such computer code, given that most of the students have not have any previous computer experience. Due to the minimum requirements of central memory and computer peripherals that the personal computer program
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has, as it has been shown in the paper, makes it a versatile tool to train students or technical personnel in the field or with a personal computer without a hard disk nor a plotter.

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References


Figure 3: Empirical and theoretical frequency curves for gauging station Jaina (Flood frequency analysis)

Figure 4: Empirical and theoretical distribution functions for gauging station Villalba (Drought frequency analysis)