Manual of AGROP software application

Introduction

As part of the research on the concept of the generalized Choquet integral and its applicability, it became necessary to create a software implementation of this calculation, i.e. its automation, due to the difficulty of manual calculation. We have created a software application and called it AGROP (abbreviation of aggregation operators). It is a part of the paper entitled "*Choquet integrals based on conditional aggregation operators in decision making and image processing, software implementation*" and it can be downloaded from

`https://github.com/Stanislav-B/CAO_Choquet_in_DM_and_IM.git`

We present the working with this software on the example from the mentioned paper. Its solution using the AGROP application consists of seven steps listed below in this manual, complete with print screens of application windows.

Example

Let us consider the basic set $[n] = \{1, 2, 3\}$, the input vector $\mathbf{x} = (2, 3, 4)$, $\mathscr{E} = 2^{[3]}$, and the monotone measure μ with values given in Table 1.

E	$\varnothing$	$\{1\}$	$\{2\}$	$\{3\}$	$\{1,2\}$	$\{1,3\}$	$\{2,3\}$	$\{1,2,3\}$
$\mu(E)$	0	0	0	0.5	0.2	0.6	0.7	1

Table 1: Values of monotone measure μ

Further, let us consider the conditional aggregation operators $\mathsf{A}^{\mathrm{sum}}$, $\mathsf{A}^{\mathrm{max}}$, $\mathsf{A}^{\text{2-mean}}$, $\mathsf{A}^{\mathrm{Ch}\#}$, $\mathsf{A}^{\mathrm{Su}\#}$, $\mathsf{A}^{\mathrm{Sh}\#}$. The task is to calculate the generalized Choquet integrals with respect to the mentioned aggregation operators using the AGROP application.

Solution

Step 1

When the application starts, the following dialog window is opened. The user can choose from two options – load saved input or enter new input. Let us choose the second option.

Figure 1: Introductory dialog window

Step 2

Now we have to enter a number of alternatives and criteria – the terminology is taken from decision processes. In our case (Example), the number of alternatives is 1, since we work with a 1 input vector. The number of criteria is 3, since the basic set consists of three elements (the basic set is [3]). In general, we can enter up to 9 input vectors (a separate calculation will be performed for each vector) and we can consider up to a four-element basic set (it has up to 2^4 subsets). The number of parameters is limited for the user because of practical reasons.

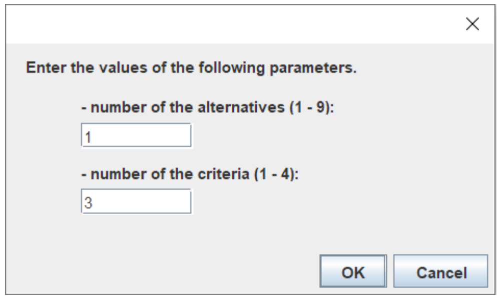

Figure 2: Dialog window for loading the number of input vectors and elements of the basic set

Step 3

In the next dialog window, you need to enter vector labels and name the elements of the basic set. The application offers default labels that can be changed. In our case, we have denoted the vector as $\mathbf{x}$ and the elements of the basic set are 1, 2, and 3.

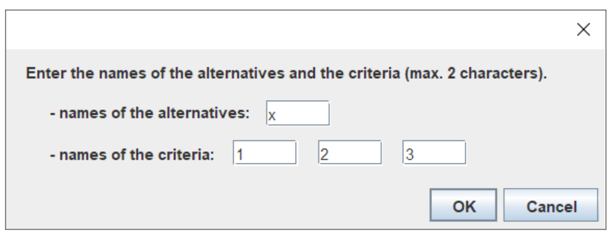

Figure 3: Dialog window for loading the denotation of input vectors and elements of the basic set

Step 4

Further, it is necessary to select sets from the power set of the basic set that form the collection. In our case, we chose “Select all” to select the power set of the basic set as the collection. Note that the empty set and the basic set must always be included in the collection. This is done automatically.

Figure 4: Dialog window for selecting sets

Step 5

After pressing the "OK" button in the previous step, the main application window will open. There are empty fields in which you need to enter

- the values of the vector components,
- the monotone measures of the complements of sets belonging to the collection.

It is not necessary to enter the values of the monotone measure manually, we can choose one of the default monotone measures by pressing the button "Default monotone measure". We can also change the selection of sets belonging to the collection using the button "Change collection". The sets in the collection are automatically listed under the mentioned buttons. On the right side next to the text pane, there is a list of aggregation operators the application can work with (compare with Example). Among all, there is the Choquet, the Sugeno, and the Shilkret integral as aggregation operators, therefore, for each of them we must choose a monotone measure that can differ from the monotone measure μ. Using the button "Change monotone measure" a dialog window opens. In this dialog, you can set the values of the monotone measure or select one of the default measures. In our case, according to Example, we chose all aggregation operators. For the p-mean we set $p = 2$ and for the Choquet, the Sugeno, and the Shilkret integral as aggregation operators we set the counting measure. Below the list of aggregation operators, there is the button "Save". It allows us to save the current inputs in the application.

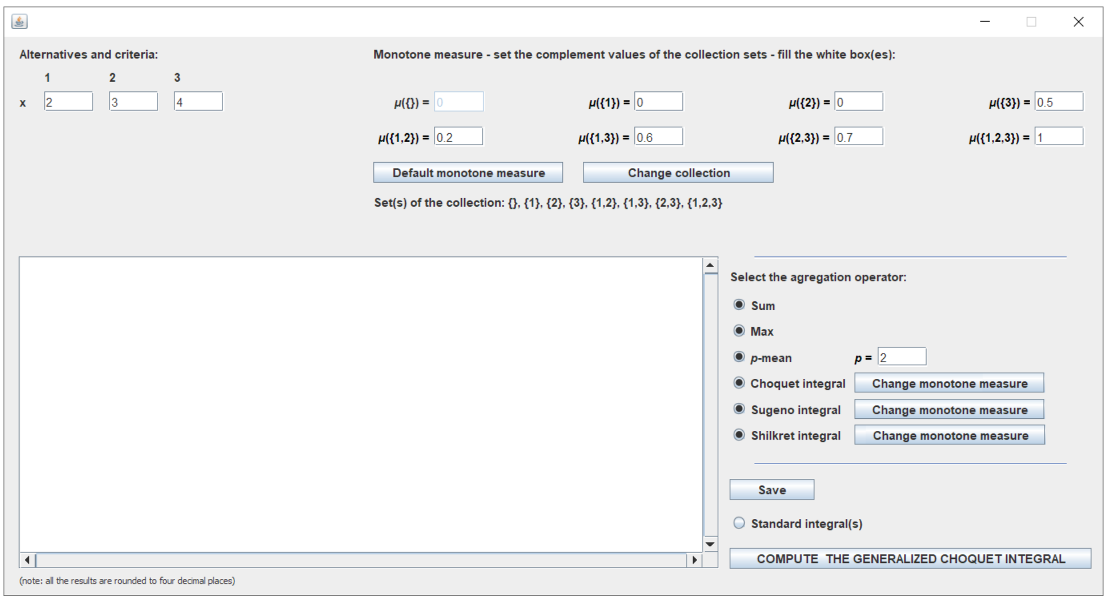

Figure 5: The main application window

Step 6

When we press the button "COMPUTE THE GENERALIZED CHOQUET INTEGRAL" a generalized Choquet integral is calculated for each vector and each aggregation operator with a detailed report. The report contains inputs and their values, further for each vector there is the value of the aggregation operator for each set from the collection, and also the generalized survival function with respect to each family of conditional aggregation operators. If we choose more than 1 input vector, the software at the end of the calculation will list alternatives in decreasing order according to values of the generalized Choquet integral. This is useful for decision making processes as we have shown in the mentioned paper. Pressing this button again will keep the original report and print a new report below it. It can be copied and saved in a text editor.

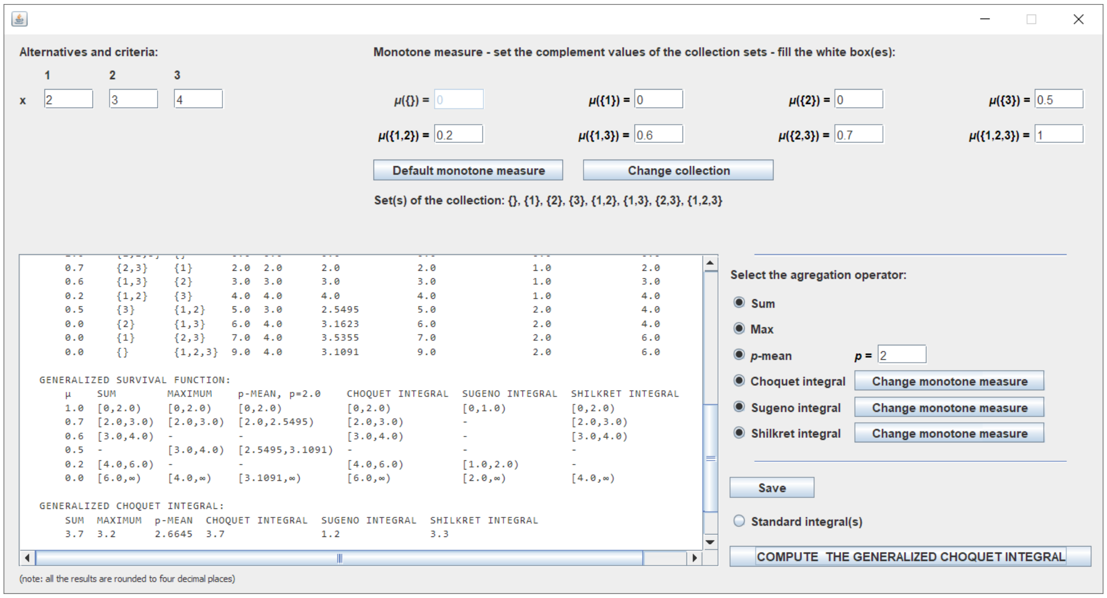

Figure 6: The main window of application – computation of the generalized Choquet integral

Step 7

The main window also contains the radio button "Standard integral(s)". Clicking this button will switch the application to the calculation mode of the standard fuzzy integrals – the Choquet, the Sugeno, and the Shilkret integrals. For the calculation, we have to set the monotone measure by the button "Change monotone measure" for each of the above-mentioned integrals. After pressing the button "COMPUTE THE STANDARD INTEGRAL(S)", we get the report of the calculation. Unclicking this radio button returns the application to its original mode.

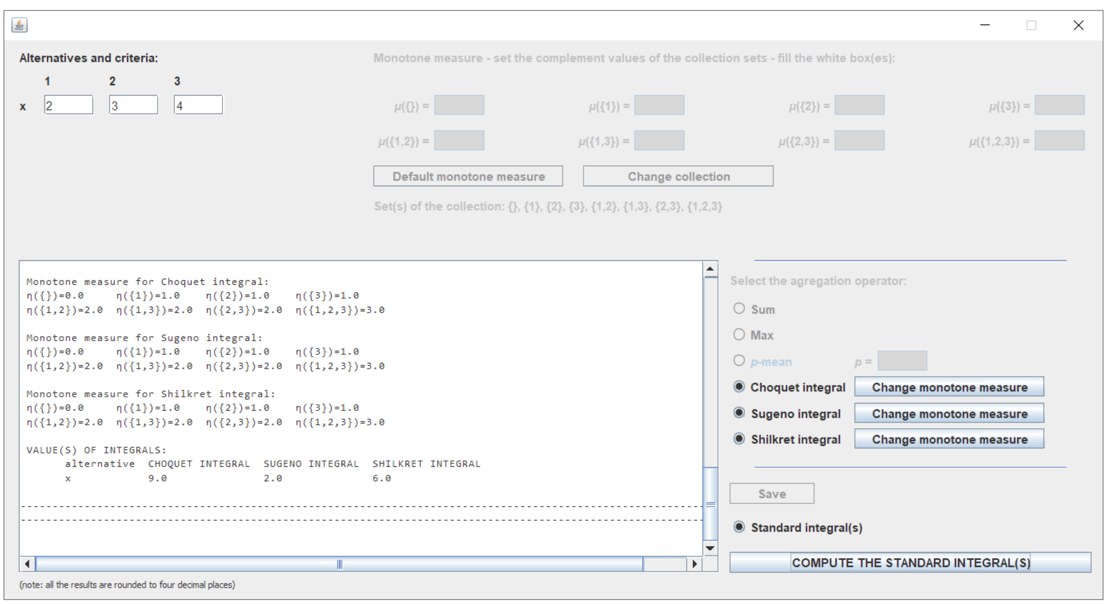

Figure 7: The main window of application – computation of standard integrals