

Software

An Open Source MCDM Macro for OpenOffice.org

by

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Implemented algorithms

This text is about a free Multiple Criteria Decision Making tool written as a Java macro for OpenOffice.org. For any decision problem entered, the classical multi attribute decision-making approaches Simple Additive Ranking (SAR) and Simple Additive Weighting (SAW) are offered, as well as the outranking approaches PROMETHEE I and PROMETHEE II.

The first two decision methods are very basic concepts, which may also be implemented using a template spreadsheet for standard office software. However, the tool described here can be used for any given decision problem without changing the calculation scheme and offers additional sensitivity analyses for each criterion.

The outranking approach PROMETHEE (as described by (Brans et al., 1986),(Brans, Mareschal, 2005)) is based on pairwise comparisons of alternatives with regard to each regarded criterion by several value functions, which makes quick analyses by hand (i.e. without using specialized software) more cumbersome. In order to value the deviation between the evaluations of two alternatives on a particular alternative, several value functions are proposed by (Brans et al., 1986).

PROMETHEE I results in a partial ranking, which declares alternatives with contradictory information about their comparative strengths and weaknesses as incomparable and leaves the decision on ranking them to the decision maker.

In order to determine how sensitive the results of each decision method are to changes in the weighting between the criteria, sensitivity analyses are used. This allows the user to assess how robust the results are to the subjective weighting of the criteria.

Open Source for implementing the tool

The reason for choosing an office suite as the underlying software is to provide an easy to use tool for standard software that people are familiar with. The input of the evaluation table as one spreadsheet is a very comprehensible user interface and the output as one spreadsheet for each method allows a facile subsequent treatment or presentation. Whereas Microsoft Office is the most diffused office suite, the alternative OpenOffice.org was chosen for several reasons: Firstly, this office suite is Open Source, meaning it can be downloaded without license fees. This is especially of advantage for academic use, as it allows all students to work with the same version of the office suite, and can thus contribute to the diffusion of tools designed for this office software. Thus this tool was developed within the EDUKALIBRE project which aimed at promoting the use of Open Source Software in academic teaching (see (Gonzalez-Barahona et al., 2005)). Secondly, OpenOffice.org allows programming macros in high-level languages, which allows utilizing and reusing complex class libraries.

The MADM-tool was realized as an Open Source Java macro for OpenOffice. Open Source Software is software available without charge and for which the underlying programming code is available to the users so that they may read it and make changes to it. The aim is to allow anyone with programming experience to revise and change the programming code to suit their individual needs and to share improved versions. There are many types of Open Source Software, mainly differing in the licensing term under which (altered) copies of the source code may be redistributed. This tool is subject to the GNU Lesser General Public License (LGPL). This means, that individual classes used in the program can be employed in any way (including commercially) but an improved version of the whole program is to remain under this license, i.e. Open Source. For more details about this license see <http://www.gnu.org/copyleft/lesser.html>. As we are hoping to trace the spread of the tool and to establish contact to other researchers, the complete source code will be sent on request by email, whereas the tool can directly be downloaded for the convenience of end users.

Implementation

The MADM tool was written as a Java macro for OpenOffice using Netbeans IDE 3.6. The use of common functions is eased by a collection of classes and libraries provided in the Application Program

Interface (API) of OpenOffice.org. As a Java macro can define its own data types and classes can inherit properties, it can be designed in a very structured modular way. Whereas the compiled tool comes as one single file, about 20 classes are employed for programming the data input and output, the calculations and graphics. This modular composition allows future enhancements and the reuse of single classes for other purposes. The source code contains numerous comments, as well as a packet and class description according to the Javadoc specification.

The tool can be downloaded from the following website:

http://www.iip.wiwi.unikarlsruhe.de/forschung/technik_html/forschungsgebiete/tool/index.htm

It requires the free office suite OpenOffice.org and Java to be installed beforehand, which both are available for several operating systems. Once installed, the tool can be easily started using its own button in the OpenOffice.org menu bar.

The basic data of any multi-criteria problem is contained in the evaluation table, which is required as the input for the MADM-tool. A template for this table is provided, which shows the structure of the data expected by the program. The number of alternatives and criteria is only limited by the hardware (and programming language) restrictions. The weights assigned to each criterion have to be inserted as numbers and are automatically normalized (their sum being one) when the tool is run.

For each criterion, the user has to specify if a minimum or maximum value is aspired, for use in PROMETHEE maximum and minimum values can be entered optionally. This outranking approach also requires the selection of a weighing function (the six functions proposed by (Brans, Mareschal, 2005) can be chosen) and the input of values for the parameters used by these value functions.

Once the data is inserted and the tool (macro) started, new spreadsheets are created for displaying the results of the implemented methods (Simple Additive Ranking, Simple Additive Weighting, PROMETHEE I and II). These spreadsheets include tables for intermediate steps, final results and sensitivity analyses for each criterion. The partial ranking resulting from PROMETHEE I and the total ranking resulting from PROMETHEE II are graphically displayed in a separate spreadsheet.

Screenshots:

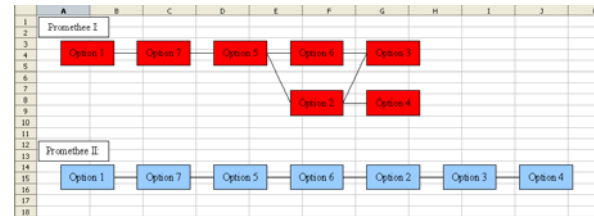


Figure 1: PROMETHEE Rankings

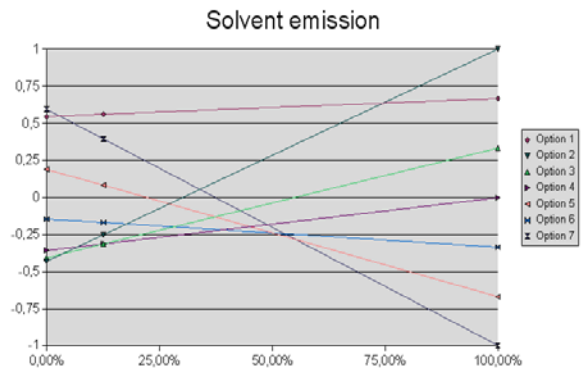


Figure 2: Sensitivity Analysis

References:

Brans, J-P, Mareschal, B (2005) PROMETHEE Methods. In: Figueira, J, Greco, S, Ehrgott, M (Eds.), Multiple Criteria Decision Analysis - State of the Art Surveys, Springer, New York, pp. 163-195.

Brans, J-P, Vincke, Ph, Mareschal, B (1986) How to select and how to rank projects: The PROMETHEE method, European Journal of Operational Research 24, pp. 228-238.

Gonzalez-Barahona, J, Tebb, C, Dimitrova, V, Chaparro, D, Romera, T (2005) Transferring Libre Software Development Practices to the Production of Educational Ressources: the Edukalibre Project, Proceedings of the 1st International Conference on Open Source Systems, July 11-15 2005, Genova.