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Voracious-AHP

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Introduction

Analytic Hierarchy Process (AHP), developed by Saaty (1977), is one of the most known multicriteria decision aid (MCDA) methods. Nevertheless, as it relies on decision makers (DM) pairwise comparisons, a problem may occur if some comparisons are not well done.

This problem, known as inconsistency, and appears when a threshold of consistency is violated. What's consistency? Well when two criteria, for instance k and l, are compared a value a_{kl} represents the judgment of the relative importance of the decision element k over l. It is assumed that the reciprocal property $a_{kl} = \frac{1}{a_{lk}}$, always holds and homogeneity also implies that $a_{kk} = 1$ for all k=1,2, ... ,n.

One way to deal with inconsistency is to redo all judgments, as many times as needed, in order to reach acceptable levels. A very time consuming task that may lead to a variety of errors. To help DMs to try to deal with the inconsistency problem the **Voracious-AHP** software - inspired by the work of Pereira and Costa (2015) - was developed to reduce the inconsistency to zero or near zero, without needing to redo all judgments. The reduction is achieved by adjusting the original judgments in a minimum way, keeping the DM's decisions within a tolerable range. Only discrete values are generated, so the solution respects the limits of the Saaty scale.

1- Installation Notes

The **Voracious-AHP.jar** is a runnable .jar file that does not need to be installed and it run in any OS. The unique requisite is the need to have the latest Java SE program installed. Check if your computer has the latest release, if not please download it (preferably Java SE 7 or superior) at:

www.oracle.com

or

www.oracle.com/technetwork/pt/java/javase/downloads/index.html?ssSourceSiteId=otnes

The **Voracious-AHP.exe** is a runnable .exe file that does not need to be installed and also do not need the installation of the latest Java SE program.

Download Voracious-AHP at: **http://sourceforge.net/p/voracious-ahp /**

2 - Deriving Weights and Consistency Ratio

Just download to any folder the **"Voracious-AHP.jar"** or "**Voracious-AHP.exe"** file and double click it. The following window should open:

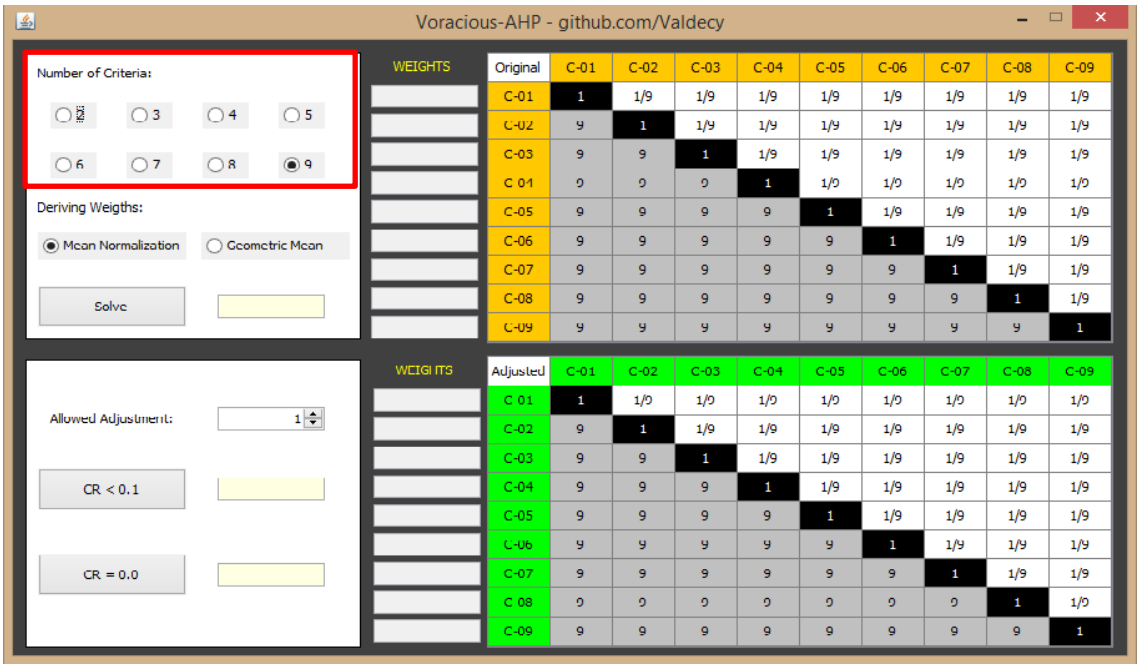

Figure 01 – Initial Window

The highlighted area in red choses the number of criteria (2, 3, 4, 5, 6, 7, 8 or 9 criteria) to build the AHP matrix.

For instance, if the user choses 5 with the following judgments (C1-C2 = 1/3; C1-C3 = 1/5; C1- C4 = 1; C1- C5 = 2; C2-C3 = 1; C2-C4 = 1/3; C2-C5 = 1/6; C3- C4 = 3; C3-C5 = 2 and C4-C5 = 7). Choosing the "*Mean Normalization*" or "*Geometric Mean*" to derive the weights, and then click in the button "*Solve*" and the following window should appear:

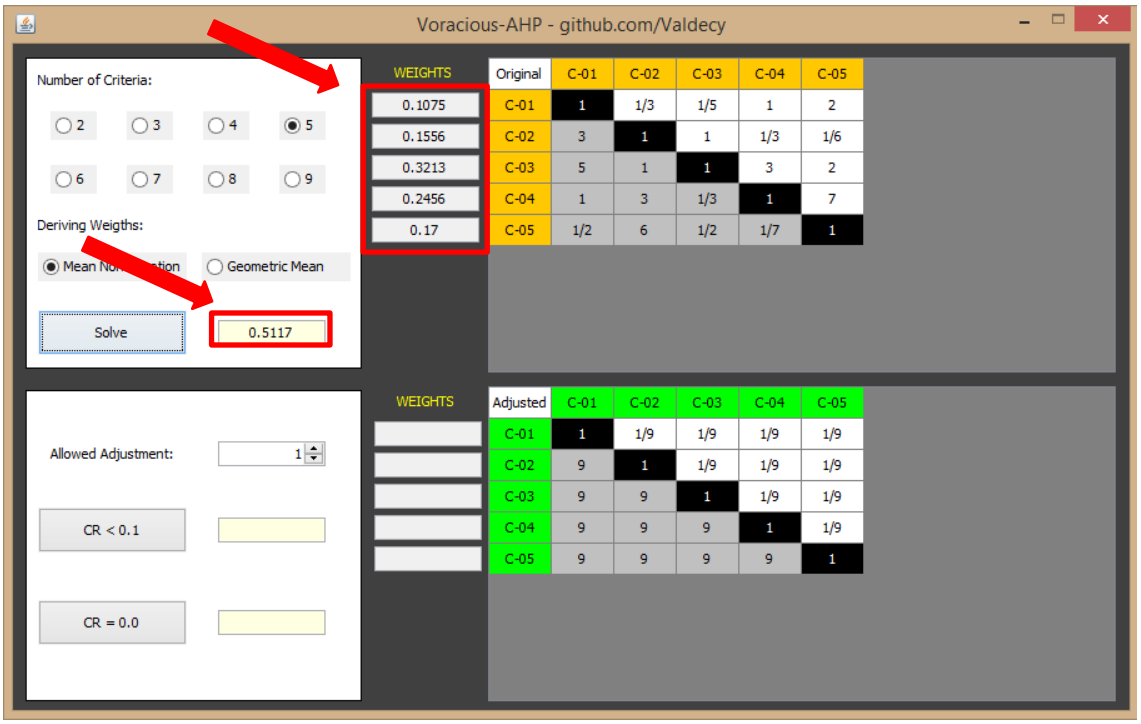

Figure 02 – Judgments

The calculated weights (eigenvector) were: criterion C1 - 0.1075; criterion C2 - 0.1556; criterion C3 - 0.3213; criterion C4 - 0.2456 and criterion C5 - 0.1700. However, these judgments are inconsistent which is demonstrated by the consistency ratio (field on the right of the "*Solve*" button), with a value of 0.51172212. Saaty (1977) affirms that the consistency ratio should be less or equal than 0.10 to validate all judgments.

3 – Removing or Reducing Inconsistency

To remove or reduce the inconsistency, the user should decide the range of "*Allowed Adjustment*" permitted for each judgment.

Table 01 helps to better understand the deviation points concept. Suppose that a pairwise comparison has the value of 1/3 (row 1 of Table 01), which is in the position 6 (row 2 of Table 02), and decision maker agrees to accept an "*Allowed Adjustment*" of 2 deviation points. Consequently, the decision maker accepts that his original comparison can vary from the lower bound value 1/5 (position 4, two deviation points to the left) to the upper bound value 1 (position 8, two deviation points to the right). Pereira and Costa (2015) recommends the utilization of a maximum of 3 deviation points, to avoid too much information loss.

Table 01 – Relative Positions

Scale	1/9	1/8	1/7	1/6	1/5	1/4	1/3	1/2	1	2	3	4	5	6	7	8	9
Position	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16

For this example, each judgment was allowed to be deviated by 2 points (Figure 3), and choosing "*CR < 0.1*" option means that the modifications will stop as soon as the consistency ratio is equal or less than 0.1. In this way more original judgments can be preserved.

Figure 03 – CR < 0.1

However, the minimum level of consistency ratio is only achieved if the user chooses "*CR = 0.0*" option. This means that the modifications will not stop until the minimum CR is not reached. Note that, this value not necessarily, is 0 (zero), however it's the best result for the permitted "*Allowed Adjustment*". To reach a consistency ratio equal 0 (zero), try to increase the value of the "*Allowed Adjustment*".

Figure 04 – CR = 0.0

References

PEREIRA V., COSTA, H. G. (2015). Nonlinear Programming Applied to the Reduction of Inconsistency in the AHP Method. Annals of Operations Research, 229, 635–655. DOI: 10.1007/s10479-014-1750-z.

SAATY, T.L. (1977), “A Scaling Method For Priorities In Hierarchical Structures”. Scandinavian Journal of Forest Research. 15: 234-281.