The PROMETHEE family

Just as in ELECTRE III, this methods consist in building a valued outranking relation, but this time trying to resolve concepts and parameters that have some physical (or economic) interpretation by the DM.

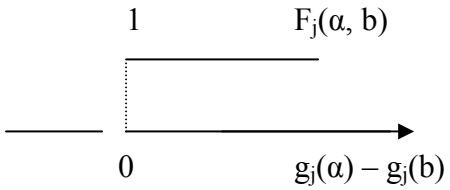
Having assigned to each criterion a weight p_j increasing with the importance of the criterion, the outranking degree $\pi(\alpha, b)$ of each ordered pair of actions (α, b) is computed as follows:

$\pi(\alpha, b) = 1/P \Sigma p_j F_j(\alpha, b)$, where $P = \Sigma p_j$

and where $Fj(\alpha, b)$ is a number between 0 and 1 which increases if $g_j(\alpha) - g_j(b)$ is large and equals zero if $g_j(\alpha) \leq g_j(b)$. In order to estimate the $F_j(\alpha, b)$'s, the DM is offered a choice, for each action, between the six forms of curves presented here. According to the way his preference increases with the difference $g_j(\alpha) - g_j(b)$, the DM sets, for each criterion< the form F_j and the associated parameters. The parameters to be estimated have a simple interpretation since they are indifference and preference thresholds; they usually take on of the following six different forms:

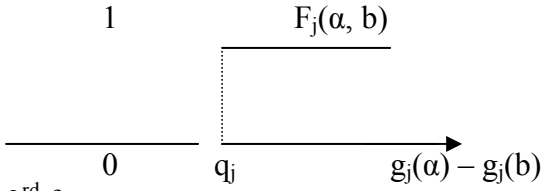
1st form

Immediate strict preference; no parameter to be determined.



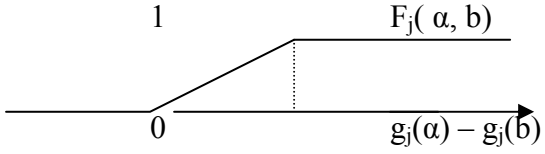
2nd form

There exists and indifference threshold which must be fixed



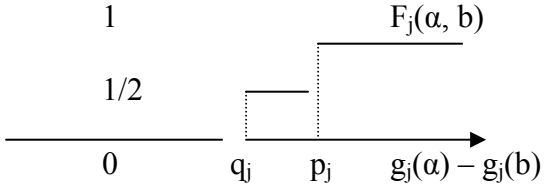
3rd form

Preference increases up to a preference threshold to be determined.



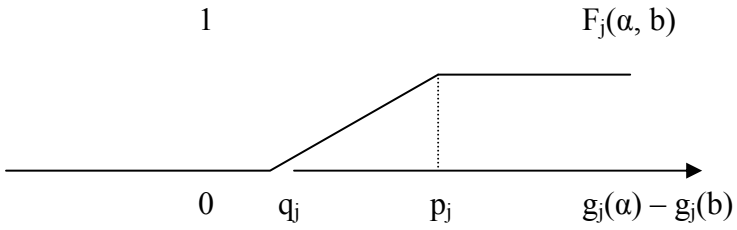
4th form

There exists an indifference and a preference threshold which must be fixed; between the two, preference is average.



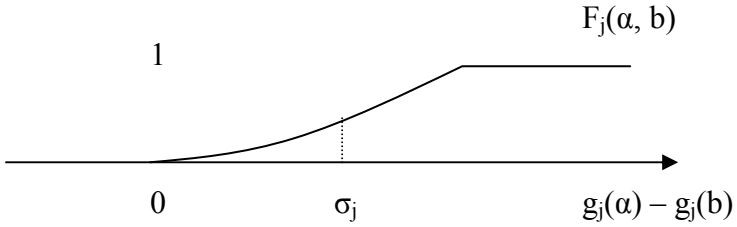
5th form

There exists an indifference and a preference threshold which must be fixed; between the two, preference increases.



6th form

Preference increases following a normal distribution, the standard deviation of which must be fixed.



From a mathematical point of view, forms 1, 2 and 3 are obviously particular cases of form 5; it is nevertheless easier to present them separately to the DM since each one corresponds to a very specific attitude, but in general, these six forms are sufficient to cover a large number of possible attitudes $F_j(\alpha, b)$ is thus a ”type of preference intensity”.

This outranking degree of the PROMETHEE method is quite similar to the concordance index in the ELECTRE III method; they are even identical if all functions F_j are of form 5, except for the fact that the indifference and preference

thresholds are considered constant in the PROMETHEE method (which is a simplification but also a restriction. On the other hand no discordance concept is introduced in PROMETHEE.

Just as in the previous methodologies, two complete preorders are built: one consists in ranking the actions following the decreasing order of numbers $\varphi^+(\alpha)$ such that:

$\varphi^+(\alpha) = \Sigma\, \pi(\alpha, b)$ (the outgoing flow),

and the other following the increasing order of numbers $\varphi^-(\alpha)$ such that:

$\varphi\text{-}(\alpha) = \Sigma\, \pi(b, \alpha)$ (the ingoing flow)

The intersection yields the partial preorder of the PROMETHEE I method. The PROMETHEE II method consists in ranking the actions following the decreasing order of numbers such that:

$\varphi(\alpha) = \varphi^+(\alpha) - \varphi^-(\alpha)$ (the net flow)

and yields a unique complete preorder.

The main advantage of the PROMETHEE method is to integrate the most recent ideas of preference modeling in a very simple way. However, as in the ELECTRE model, what is missing is the theoretical basis which would allow a better appreciation of the assumptions on which lies.