Stalemate Resolution Mechanism

This is a short document describing the main principle behind the Stalemate Resolution Mechanism.

How does it solve the problem?

Firstly, resolving stalemates requires operating within the -100 to 100 preference scale, where:

- Solutions above 0 are considered desirable.
- Solutions below 0 are considered unacceptable or acceptable only under extreme circumstances and after thorough discussion.
- Solutions at 0 are considered acceptable with discussion.

The thinking process behind this feature is based on a comparison. Preference curves, by their definition, represent the attitude of decision-makers to a certain problem. Then the DSS can be compared to a very smart advisor who can aggregate everybody's preferences and the project context to provide the design variant that maximizes group preference. As an advisor who is faced with a conflict situation, the first step would not be to try and address the project's desirability, because there are still key project participants who are not going to accept it under current conditions. Similarly, you would not try to "soften the blow" for those whose preference is in the unacceptable region, because it would remain unacceptable. What you would try to do first is see if the decision-makers are willing to consider more options than they are already considering.

How does it work?

For a given preference curve "c" a point P with coordinates (x;0) will be introduced between the point with negative preference and the closest point with 0 preference, as shown in Figure 1.

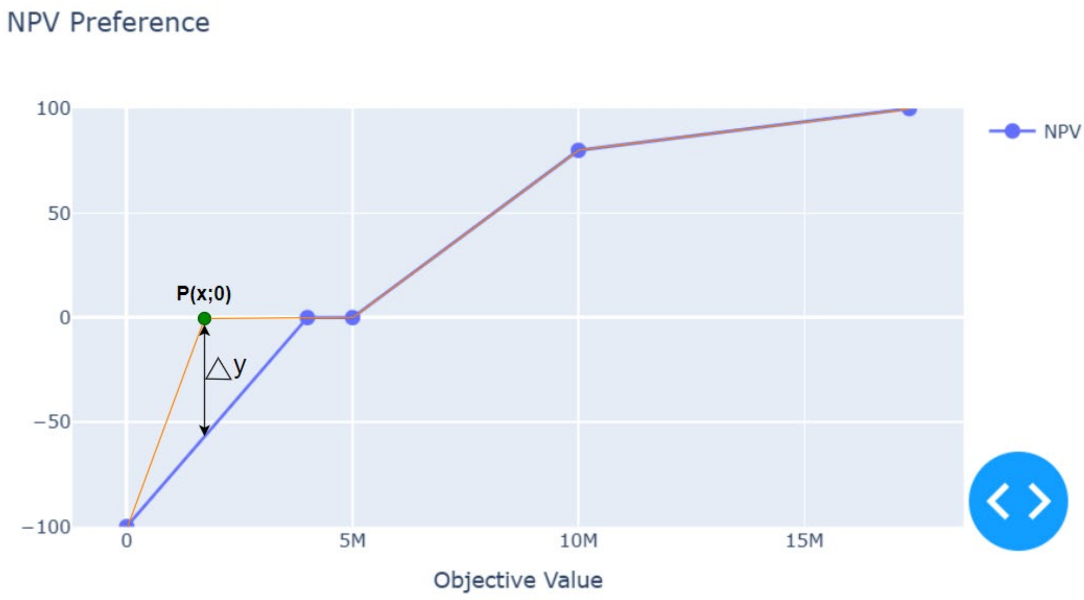

Figure 1 Example preference curve

P then becomes one of the points in the preference curve, creating a new preference curve, shown in orange in Figure 1. This is then performed for all preference curves involved in the decision process. This extends the range of feasible solutions and thus allows to generate new constructive alternatives outside of the stalemate. The goal is then to find all x for all curves to minimize the sum of Δy, with the constraint that using the new curves must produce an IMAP (group preference maximization) result that scores 0 or above on all preference curves.

Implementation

This calculation is implemented via a simulated annealing optimization algorithm. Simulated annealing is a stochastic optimization algorithm. The very simplified idea is that it starts with a certain "temperature value" and then bounces around the solution space of the function picking random solutions. Every time a solution is chosen, it is compared to the most optimal one found yet and is either skipped if it is sub-optimal or taken on if it is more optimal. The higher the "temperature" value, the more likely it is that the algorithm will pick a sub-optimal solution to the one that is considered optimal, which is done to help the algorithm escape local optima in search of the global optimum. As the algorithm runs, the "temperature" decreases, accepting less sub-optimal solutions.

On top of this, even if the optimization does not find the global optimum and terminates due to a runtime limit, it will still output the most optimal solution that was found. Considering that the result is used to kick-start a discussion during which the decision-makers can make preference adjustments themselves, the breadth of coverage is more important than accuracy. This is why usage of this algorithm is relevant.

The main problem with this approach is the time it takes to arrive to any worthwhile solution. This is because for every solution selected by the algorithm, the Preferendus has to run. Since the algorithm evaluates hundreds of solutions, this becomes very costly in terms of time. From experimenting, a run of about 1.5 hours is necessary to arrive at a decent solution. This also includes adjusting the Preferendus settings to make it run faster, but more likely to arrive at a sub-optimal solution, causing more decreases in accuracy.