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Benson's algorithm

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Not to be confused with [Benson's algorithm \(Go\)](#), a method to find the unconditionally alive stones in the game [Go](#).

Benson's algorithm, named after **Harold Benson**, is a method for solving [linear multi-objective optimization](#) problems. This works by finding the "efficient extreme points in the outcome set".^[1] The primary concept in Benson's algorithm is to evaluate the upper image of the [vector optimization](#) problem by [cutting planes](#).^[2]

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Idea of algorithm [\[edit\]](#)

Consider a vector linear program

$$\min_C Px \text{ subject to } Ax \geq b$$

for $P \in \mathbb{R}^{q \times n}$, $A \in \mathbb{R}^{m \times n}$, $b \in \mathbb{R}^m$ and a polyhedral convex ordering cone C having nonempty interior and containing no lines. The feasible set is $S = \{x \in \mathbb{R}^n : Ax \geq b\}$. In particular, Benson's algorithm finds the [extreme points](#) of the set $P[S] + C$, which is called upper image.^[2]

In case of $C = \mathbb{R}_+^q := \{y \in \mathbb{R}^q : y_1 \geq 0, \dots, y_q \geq 0\}$, one obtains the special case of a multi-objective linear program ([multiobjective optimization](#)).

Implementations [\[edit\]](#)

Bensolve - a free VLP solver (C programming language) [\[edit\]](#)

- www.bensolve.org [↗](#)

References [\[edit\]](#)

- ↑ Harold P. Benson (1998). "An Outer Approximation Algorithm for Generating All Efficient Extreme Points in the Outcome Set of a Multiple Objective Linear Programming Problem" [↗](#). *Journal of Global Optimization* **13** (1): 1–24. doi:10.1023/A:1008215702611 [↗](#). Retrieved September 21, 2013.
- ↑ ^{***a***} ^{***b***} Andreas Löhne (2011). *Vector Optimization with Infimum and Supremum*. Springer. pp. 162–169. ISBN 9783642183508.

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