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Voting by Proportional Representation: Theory and Practice. Preliminary report.

The objective of proportional representation is clear: Voting blocs should be represented in a legislature in proportion to their fraction of the population. However algorithms have preceded analysis of the issues raised by this objective. We present a mathematical formulation of blocs as clusters (voting patterns) of full or partial preferential ballots, permitting bloc overlap and independent voters. Some reasonable mathematical objective and constraint functions are examined. Using these functions, the performance of traditional algorithms, such as Single Transferable Vote, is analyzed by comparison with a modern algorithm based on techniques of discrete and combinatorial optimization. The inevitability of voting paradoxes is reflected by the sensitivity of the set of elected representatives to details of the mathematical formulation. Robust formulations and algorithms remain a fundamental challenge, especially less arbitrary ways to resolve highly contentious outcomes. (Received July 26, 2007)