

Structural Properties of Equitable Solutions

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The equitable distribution of benefits and costs is an increasingly prevalent concern in optimization models. This poses the problem of formulating models that balance efficiency with equity or fairness. The literature contains a variety of equity-sensitive social welfare functions (SWFs) that can serve as objective functions, but one must select one with the right characteristics for a given application. Some SWFs have been characterized *ex ante* by showing how they can be derived from certain axioms or rational bargaining procedures, but these traditional characterizations tend to have limited usefulness in practice. As an alternative approach, we provide *ex post* characterizations of SWFs based on the structural properties of optimal solutions they actually deliver. The SWFs we examine include utilitarian, Rawlsian maximin, leximax, alpha fairness (and its special case of proportional fairness), Kalai-Smorodinsky, and various recently proposed threshold criteria. We also study the behavior of these SWFs in hierarchical distribution networks, as well as their ability to incentivize efficiency improvements or resource sharing among stakeholders. We believe this kind of *ex post* analysis can contribute to constructive dialog between the fields of optimization on the one hand and ethics and distributive justice on the other.