Info-Gap Modelling: Why More is Less

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Abstract

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Gauss and Legendre independently invented the method of least squares for modelling planetary orbits based on noisy astronomical data. Since then, least squares, maximum likelihood, maximum entropy and other optimization criteria have become methodological pillars for empirically modelling complex systems. In this paper will argue that these optimization techniques are adequate when the only challenge is noise in the data whose stochastic properties are known. However, when the probabilistic model is imprecisely known, or when the underlying processes are incompletely understood, then one needs a strategy which balances between fidelity to the data on the one hand, against immunity to gaps in our understanding on the other. We use info-gap decision theory to formulate such a strategy, based on the concept of robust-satisficing. We show that models which are optimal based on the best (but uncertain) understanding, have minimal robustness against errors in that understanding. Sub-optimal models have greater robustness. Fidelity to data and understanding trades-off against robustness to errors. This explains why "more is less" when modelling complex poorly understood systems. We apply the theory to linear regression with info-gap-uncertain data. We discuss the relation between robust-satisficing and min-maxing.

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More references, links to international workshops on info-gap theory, and other sources, can be found on my website: http://www.technion.ac.il/yakov

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