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Local Sensitivity Analysis

8.1 Introduction

In engineering practice, people use mathematical models to describe their problems. However, mathematical models are not exact replicas, but simplifications of reality. Frequently, when we specify a model, we act as if the model were true and the associated assumptions were valid. Similarly, when estimating the parameters of the model we use data, which are not exact but subject to errors, lack of precision, etc. Consequently, conclusions drawn from an analysis are sensitive to models and data. In some applications, even small changes in the data can have a substantial effects on the results. It is therefore essential for data analysts to be able to assess the sensitivity of their conclusions to model and data. This is known as sensitivity analysis. Sensitivity analysis allows the analyst to assess the effects on inferences of changes in the data values, to detect outliers or wrong data values, to define testing strategies, to optimize resources, reduce costs, etc.

Sensitivity analysis is the study of how the variation in the output of a model can be apportioned, qualitatively or quantitatively, to different sources of variation, and aims to determine how the model depends upon the data or information fed into it, upon its structure, and upon the framing assumptions made to build it. As a whole, sensitivity analysis is used to increase the confidence in the model and its predictions, by providing an understanding of how the model response variables respond to changes in the inputs. Adding a sensitivity analysis to an study means adding quality to it.

In this chapter, some methods for sensitivity analysis are discussed. The chapter is structured as follows. In Sect. 8.2 the problem of sensitivity is stated. Section 8.3 derives some formulas from duality theory that are applicable to the sensitivity of the objective function. In Sect. 8.4 a general formula for obtaining all the sensitivities at once, i.e., the sensitivities of the objective function and the primal and dual variables with respect to data, is given, and all the methods are illustrated by their application to particular examples. In Sect. 8.5 interesting particular cases, including the LP case are discussed and