Preface

Engineered objects (products, plants, infrastructures) are built to meet the needs of individuals, businesses and societies. These objects are getting more complex, and also more expensive, to meet the ever-increasing demands.

The performance over time (reliability) of an engineered object is of great interest to its owners. Every object is unreliable in the sense that it degrades with age and/or usage and ultimately fails (when it is no longer capable of performing as expected). Maintenance actions are actions to control the degradation process and to restore a failed object to normal operation. These are termed preventive and corrective maintenance actions respectively.

Maintenance actions can be done by the owner (in-house maintenance) or by an external agent (outsourcing of maintenance). There is a growing trend towards outsourcing. In the case of products, a warranty (or more precisely a base warranty) requires the manufacturer to rectify any failure occurring within the warranty period as long as the owner operates as per the terms of the warranty. There is no cost to the customer as the warranty is integral to the sale and the manufacturer has factored the maintenance cost into the sale price. Customers can buy extended warranties either at the time of purchase or just before the base warranty expires by paying an additional amount. For plants and infrastructures, the owners can outsource some or all of the maintenance to an external service agent through a maintenance service contract. The contract specifies the tasks to be carried out by the service agent and the payments made by the owner to the service agent.

Maintenance outsourcing raises new challenges as it involves two (or more) parties each with several players and the objectives (or goals defined through outcomes) of each player are different. Each player has more than one choice and the decision of each player affects the outcomes of the others. If one assumes that the players are acting in a rational manner, they need to take into account these effects. A proper framework is needed to arrive at the optimal decisions for the parties involved.

Game theory provides the most appropriate framework for determining the optimal decisions (strategies) for the different players. An issue that plays a crucial role in obtaining the optimal decisions is the information available to the different players. This includes the usage profile of the object, the competence of service provider, assessing the condition of the object and so on. When there is asymmetry

in information (different players having different information) this can lead to adverse selection (wrong choice of the service agent) or moral hazard (cheating by the owner of the object or the service agent providing the maintenance). These issues need to be addressed in determining the optimal strategies for the different players.

Over the last few decades, there has been a growing trend towards leasing rather than owning where the lessee (the user or operator) leases an object from a lessor (owner of the object) under a lease contract. In this case, the maintenance of the object can be the responsibility of either the lessee or the lessor depending on the terms of the contract. Here again we have two parties (with several players in each party) with different objectives or goals. Again, game theory provides a framework to determine the optimal decisions with players acting rationally.

This book deals with three topics—extended warranties, maintenance outsourcing and leasing. For each, we first give an overview of the issues involved and then review the different game-theoretic models that have been proposed to assist in the decision-making process of the different players involved.

The book is aimed at three groups of people.

1. People from industry to get a better understanding on how decisions should be made.
2. Students in Master's and Doctoral programmes to get an appreciation of extended warranties, maintenance service contracts and lease contracts.
3. Researchers working in extended warranties, maintenance service contracts and lease contracts as there is a need for a lot more new research—theoretical as well as applied (to bridge the gap between theory and practice).

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