Game Theoretical Analysis of Material Accountancy

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Abstract

Game theoretical models and analysis are provided for the sequential material accountancy problem. We model the *n*-period problem as a general sequential game played between the Operator and the Inspector. The game is analyzed through the solution concept of (Nash) equilibrium. We study several versions of the game corresponding to various assumptions on the payoffs and the strategy sets. The first model solved is what we refer to as *the static game*. This is a game in which detection time is unimportant and the operator has to decide about his diversion plan at the beginning of the game (and he cannot deviate from it in a later stage). The solution of this game is obtained by its decomposition into two simpler games: a zero-sum game which determines the diversion plan and the statistical test (which turned out to be the *CUMUF*test) and a second, non zero-sum game which determines the diversion probability and the false alarm probability.

Next we return to the sequential game and prove that under the assumptions underlying the statistical analysis, the *CUMUF*test emerges as part of the solution of the game i.e., as the inspector's strategy in equilibrium. Then we consider a 'really sequential' game in which early detection is important and in which the operator can *retreat* (in view of high observed intermediate *MUF*) from completing a diversion plan that he has started. We find the structure of the equilibrium and the equilibrium equations of this game. These equations turn out to be too complex to be solved analytically, hence we provide numerical solutions which give interesting insight into the problem.