Optimization of Spare Parts Allocation by Hybrid Monte Carlo/Analytic Approach

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The system's availability in Israel Air Force (IAF), like similar organizations, is an important measure of effectiveness, and it depends, among others, on the spare parts quantities. The increase in the investment in spares always leads to increase in system availability. However, in the real world there are budget constraints. For this reason IAF is interested to purchase the optimal number of spare parts that will achieve required system availability for minimal cost or to achieve maximal availability for a given budget constraint.

IAF availability predictions are done using Monte Carlo (MC) simulation technique which is based on sampling of stochastic events. The advantage of the MC method is the ability to deal with complex systems or problems which is very hard or impossible to assess by analytical methods. Despite this, MC disadvantage is that it requires a large computational effort i.e. long calculation times. This deficiency makes the MC simulation almost irrelevant for the optimization problems solution since a large number of calculations are required. The proposed solution for this problem is the Hybrid MC/Analytic method. The proposed method utilizes the parameters derived from a small number of MC calculation in order to perform an analytical approximation of the system availability. The analytical approximation is then used to find the best spare part purchase strategy at each step which is validated by the next MC calculation. The process continues until the optimization criterion is reached (availability threshold or budget constraint).

Our case study deal with a system installed at some platforms at number of bases. The systems are divided to two sections. Our mission is to calculate the optimal number of spare parts and their allocation between the bases for the required availability thresholds. The calculation was performed for the combination of the two sections and various sensitivity studies were performed.