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V. S. Sampath Kumar
Department of Statistics, Manonmaniam Sundaranar University, Tirunelveli-627012, India
sampathk112001@yahoo.com

K. V. S. Sarma
Department of Statistics, S. V. University, Tirupati-517502, India

K. Sekhar
Department of Statistics, S. V. University, Tirupati-517502, India

The Least Cost Testing Sequence Problem

The "Least Cost Testing Sequence" (LCTS) problem is a special case of the "Weighted Shortest Processing Time" (SPT) sequencing problem. A manufactured item has to pass each of n tests at the final inspection, where the i-th test has an associated cost C_i of inspection and the item has a non zero probability p_i of passing that test. The testing will be terminated if the item fails on any one test. When there is no constraint on the technical ordering of conducting the tests, it has been established that the optimal sequence that minimizes the expected inspection cost is obtained by sequencing the tests such that

$$\frac{C_1}{(1-p_1)} \leq \ \cdots \ \leq \frac{C_n}{(1-p_n)}$$

holds. The new aspect studied in this paper is the provision for rework. We admit a non-zero probability r_i of rework for the i-th test and a maximum of $m-1$ reworks allowed for the item. The probability of termination of the testing process at the end of the i-th test is the sum of probabilities of normal fail, fail after rework and that of reaching the m-th rework. This probability will become the weight W_i to be given for the i-th test. An interesting probability structure is identified to derive W_i under the condition that the probabilities are non identical. An array called "Probability Position Matrix" (PPM) is developed and a spreadsheet is designed to work out the W_i and the sequence. This model may be applied to project evaluation studies, final testing in satellite launching cases etc.