Optimal Mass Screening Under Constant and Threshold Test Reliabilities

ABSTRACT

This paper considers a population (composed, for example, of people, machines, or livestock) subject to a randomly occurring defect or disease. If there exist testing procedures capable of detecting the defect before it would otherwise become known, and if such early detection provides benefit, the periodic administration of such a test procedure to the members of the population, i.e., a mass screening program, may be advisable. This paper develops and analyzes two important cases of a general model of a mass screening program. In both cases, the defect arrival process is Poisson.

In the first case, the reliability of the test, i.e., the probability that the test will detect the disease, is dependent only on the type of test being administered and is constant over all values of elapsed time since the incidence of the defect. The long-run expected disutility per unit time is derived and variations of the disutility with regard to test reliability and testing frequency are presented. In addition, explicit solutions are provided for various special forms of the disutility function.

In the second case, the test will detect the defect if and only if the elapsed time since incidence exceeds a critical threshold T which characterizes the test. An expression for the long-run expected disutility per unit time is derived and decision rules to select between two alternative test types and costs are presented.