Inference for Repairable Systems with Application to Exchange Rates

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Abstract

Application of Non-homogeneous Poisson processes to model successive failures of a repairable system undergoing minimal repair is well known. Let $N(s)$ be the number of failures undergone by a repairable system under consideration up to time s. The repairs are either instantaneous or the repair times are ignored for the purpose of analysis in this paper. Then we assume $N(s)$ to be a Non-homogeneous Poisson process (NHPP) with cumulative intensity function $\Lambda(s)$.

For such two independent NHPPs with unknown intensities we propose a test for testing the hypothesis that the ratio of the intensities is constant versus it is increasing on $(0, t]$. The existing test procedures for testing such relative trends are based on conditioning on the numbers of failures observed in $(0, t]$ from the two processes. The proposed test is unconditional and is based on the original time truncated data which enables us to have meaningful asymptotics. We obtain the asymptotic null distribution (as t becomes large) of the proposed test statistic and show that the proposed test is consistent against several large classes of alternatives. We also propose a test for the k-sample case for testing the hypothesis, $H_0 : \Lambda_1(t) = \Lambda_2(t) = \ldots = \Lambda_k(t)$, $\forall t$.

We apply these techniques to analyse the major fluctuations in the daily exchange rates (in Indian Rupees) of four major foreign currencies in India. These are US-Dollar, British Pound, German Deutsch Mark and Japanese Yen. We wish to model the stochastic process $N(t)$ which counts the number of major changes upto time t by an NHPP, with intensity $\lambda(t)$. We would like to compare these processes pairwise through their intensity functions.