ABSTRACT

OPTIMUM INSPECTION POLICY FOR A PROTECTIVE DEVICE

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Almost all systems install a protective device to prevent shocks which occur suddenly from outside or inside. A typical example is transformers with a surge absorber and computer systems with a C.V.C.F. device. It is extremely serious if the device has failed when a shock occurs. To avoid such an unfavourable situation, we need to check whether the device is good or not.

This paper considers a system with the device which fails by shock or by myself. The device has a failure time distribution $F(t)$, and shocks occur randomly in time, i.e., according to an exponential distribution $(1 - e^{-\alpha t})$. If the device is good, then it prevents shocks with probability $1 - p$, otherwise a system becomes failure by any shock. We inspect the device at periodic times $k\ell$ $(k = 1, 2, \dots)$ under these assumptions.

Costs c_1 and c_2 are suffered for failures of both system and device and of only device, respectively, and c_3 is for one inspection. Then, using the usual calculus method of probability, the expected cost rate is

$$C(\ell;p) = \frac{c_1 - (c_1 - c_2)\sum_{n=0}^{\infty}\int_{n\ell}^{(n+1)\ell} e^{-\alpha[(n+1)\ell-(1-p)t]}dF(t) + c_3\sum_{n=1}^{\infty} e^{-\alpha pn\ell}\bar{F}(n\ell)}{\int_0^{\infty} e^{-\alpha pt}\bar{F}(t)dt + (1/\alpha)\sum_{n=0}^{\infty}\int_{n\ell}^{(n+1)\ell}\{e^{-\alpha pt} - e^{-\alpha[(n+1)\ell - (1-p)t]}\}dF(t)},$$

where $\bar{F} \equiv 1 - F$. It is difficult to compute an optimum inspection time ℓ^* which minimizes $C(\ell;p)$.

In particular case of $F(t) = 1 - e^{-\lambda t}$, we discuss an optimum inspection policy for $0 \le p \le 1$. We finally show figures which give an optimum time ℓ^* and its effect $[C(\infty;p) - C(\ell^*;p)]/C(\infty;p)$, for two cases where the mean failure time $(1/\lambda)$ of the device and the mean interval $(1/\alpha)$ of shocks are changed.