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Treshold moving average model [Abstract of thesis]

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ABSTRACTS OF CSc. (Candidatus Scientiarum) THESES IN MATHEMATICS defended recently at Charles University, Prague.

CONTRIBUTIONS TO THE RENEWAL THEORY OF THE THINGS IN OPERATION

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The thesis deals with the preventive replacement of machine parts in the case, when the distribution function $F(x)$ of their failure times is specified excepting an unknown parameter α. Optimality of the policy consists of minimalization of the average cost $t^{-1}C_t$.

In the first part the quasi-variational inequalities for the average cost (I)-(III) are investigated

(I) $w'(x) + g(x)(c_1 - w(x)) - \theta \geq 0$

(II) $c_2 - w(x) \geq 0$

(III) $(c_2 - w(x)).(w'(x) + g(x)(c_1 - w(x)) - \theta) = 0$,

where $w(x)$ is the cost potential, $w(0) = 0$, $g(x)$ the failure rate, $c_1 (c_2)$ the cost of service (preventive) replacement and $\theta = \theta(d)$ the average cost per unit time corresponding to the policy with constant critical age $d = d(\alpha_0)$.

There are proved theorems of existence and uniqueness of the solution $w(x)$

$$w(x) = \begin{cases} (-c_1 F(x) + \theta \int_0^x \bar{F}(y)dy)/\bar{F}(x), & x \in [0,d] \\ c_2, & x \geq d. \end{cases}$$

In the further part the asymptotic behavior of the average cost is investigated. We find the assumptions under which the maximum likelihood estimation of the parameter, $\hat{\alpha}_t$ converges to the true value of parameter α_0 almost surely by $t \to \infty$.

In the last part a more precise statement about the convergence of $\hat{\alpha}_t$ to α_0 is presented (by the law of iterated logarithm). The given conditions guarantee the best attainable convergence of the average cost $t^{-1}C_t$ to the optimum θ.

Corollary. In parametric situation it holds

$$\overline{\lim_{t \to \infty}} \pm (C_t - \theta.t)/\sqrt{2t \log \log t} = \sigma \qquad \text{a.s.},$$

where $\sigma^2 = \int_0^d (c_1 - w)^2 f_0 dy / \int_0^d \bar{F}_0 dy$ and $w(y)$ is the solution of quasi-variational inequalities (I)-(III).

THRESHOLD MOVING AVERAGE MODEL

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