On the best maintenance policy for a repairable system

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Abstract. We consider a repairable system that is subject to repair actions after each failure. While these repair actions can be either minimal or imperfect, the operator may decide to perform a perfect maintenance action at any time. In order to obtain the best maintenance policy, in the sense of minimizing expected cost per unit of time, we assume that the decision maker has access to the failure history of the equipment, thus departing from the usual periodic, fixed-age policy introduced by Barlow and Hunter (1960). We define the concept of *continuous wear-out* of a repairable system and show that, under this set up, the best policy maintains the equipment whenever the current intensity of failures goes above the current cost per unit of time. This policy is extremely simple to implement in practice, requiring only an estimate of the intensity of the failure process. Somewhat surprisingly, this policy can incur in considerable smaller costs even when the system is subject to minimal repair. For the special case of the *Power Law Process*, we completely characterize the distribution of the *time to maintenance* and the resulting cost per unit of time. This leads to a new discrete distribution whose probabilities are the terms of the McLaurin expansion of $e^{-kW_0(x)}$, where $W_0(x)$ is the main branch of the Lambert's W function defined by $W_0(x)\, e^{W_0(x)} = x$ for $x > -1$.

Keywords. Continuous wear-out, counting processes, exponential martingales, Lambert's W distribution, non homogeneous Poisson processes, optimal stopping time.

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