Homework

Hao Peng

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1. Exercise 1 in the handout. Pls write down the intermediate steps in your derivation.

2. The wear-out of a rotating part can be described by a a linear function, $X(t) = \theta\, t$. The time unit is one revolution/one round of rotation. The wear-out can be determined by inspections on wear debris. Based on the wear-out mechanism, θ is dependent on the hardness of the material, the radius of the rotating part, and the force between rubbing surfaces. It is a random parameter among units. The engineers collect the degradation data of 80 units. For each unit, there's an estimated $\hat{\theta}$ through regression. Then there are 80 $\hat{\theta}$ s. The engineers find out that the distribution of θ is a normal distribution with mean $\hat{\mu_\theta} = 1$ and standard deviation $\hat{\sigma_\theta} = 0.1$, based on the 80 $\hat{\theta}$ s. The failure limit of the wear-out is given as $H = 5000$. (the negative proportion of the normal distribution for θ can be ignored in the computation.)

   For this rotating part, we will apply an aperiodic inspection policy, which means we will inspect the part at time points $\sum_{i=1}^{k} \alpha^{i-1}\tau, k \in \mathbb{N}$, as illustrated in Figure 1. When the degradation level is above the control

   $(\alpha < 1)$

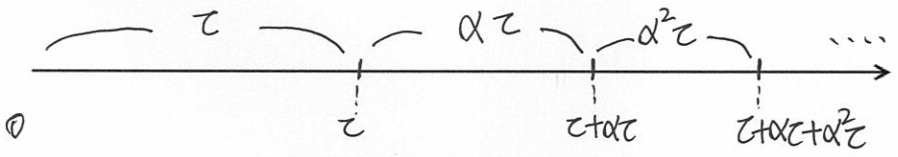

Figure 1: The inspection intervals in a renewal cycle

   limit C the component will get replaced. The degradation level can only be observed through inspections. Upon failures (self-announcing) we will also replace the part with a new one. The costs of a replacement are equal to EURO 3000. For a corrective maintenance action additional costs equal to EURO 1000 are incurred because of the disturbance of the production process that depends on the availability of the part. The inspection cost is 10 Euro. Determine the average long run cost rate of the periodic inspection policy as a function of α, τ and C. Pls write down the intermediate steps in your derivation.