11/21/05
MWG

22.38 PROBABILITY AND ITS APPLICATIONS TO RELIABILITY, QUALITY CONTROL AND RISK ASSESSMENT

Fall 2005

PROBLEM SET #9

Due December 6, 2005

1. For the component testing program discussed in the class of November 10, which change of 10% is the value of t_t, t_R, f_R and Q_o, respectively, would be most valuable in reducing the value of <Q> (use the numerical parameter values employed for in-class illustrative calculations as the base case)?

2. Consider a two-component parallel system consisting of identical components. Each component has two failure modes, mode 1 and 2, having frequencies, λ_1 and λ_2, respectively. Mode 1 failures can be repaired at frequency, μ, and mode 2 failures cannot be repaired. Formulate the possible system states and corresponding state transition diagram, and state rate of change matrix. What are the absorbing states of the system? Why?

3. Consider a component subject to loads that are normally distributed (with mean, $\mu_L = 8$, and standard deviation, $\sigma_L = 2$). The component's capability is also normally distributed (with mean, $\mu_c = 15$, and standard deviation, $\sigma_c = 5$). What is the reliability of the component?

4. Consider a system consisting of three parallel identical components where success of a single component is sufficient for system success. Use the β-factor method to quantify the contribution of common cause failures to overall system unreliability. At what value of β is the reliability of the three-component parallel system equal to that of a two-component system, for which only independent failures are considered? Let the independent failure probability of single component be equal to 10^{-3}.

5. The reliability of a component is governed by the exponential distribution, $f_T(t) = \lambda e^{-\lambda t}$, where t is the time of component failure. The prior distribution of λ is uniform over the interval $\lambda = [10^{-3}, 10^{-2}]$ hr^{-1}. The new evidence consists of component failures at times of 300, 400 and 800 hours, respectively. What is the posterior distribution of λ?