Competing risk models in reliability systems, a weibull distribution model with bayesian analysis approach

Ismed Iskandar[1] and Yudi Satria Gondokaryono[2]

[1]Faculty of Manufacturing Engineering, Universiti Malaysia Pahang, Malaysia
E-mail address: ismed_iskandar@yahoo.com

[2]School of Electrical Engineering and Informatics, Institut Teknologi Bandung, Indonesia
Email address: ygondokaryono@stei.itb.ac,id

Abstract. *In reliability theory, the most important problem is to determine the reliability of a complex system from the reliability of its components. The weakness of most reliability theories is that the systems are described and explained as simply functioning or failed. In many real situations, the failures may be from many causes depending upon the age and the environment of the system and its components.*
Another problem in reliability theory is one of estimating the parameters of the assumed failure models. The estimation may be based on data collected over censored or uncensored life tests. In many reliability problems, the failure data are simply quantitatively inadequate, especially in engineering design and maintenance system. The Bayesian analyses are more beneficial than the classical one in such cases. The Bayesian estimation analyses allow us to combine past knowledge or experience in the form of an apriori distribution with life test data to make inferences of the parameter of interest .
In this paper, we have investigated the application of the Bayesian estimation analyses to competing risk systems. The cases are limited to the models with independent causes of failure by using the Weibull distribution as our model. A simulation is conducted for this distribution with the objectives of verifying the models and the estimators and investigating the performance of the estimators for varying sample size. The simulation data are analyzed by using Bayesian and the maximum likelihood analyses.
The simulation results show that the change of the true of parameter relatively to another will change the value of standard deviation in an opposite direction. For a perfect information on the prior distribution, the estimation methods of the Bayesian analyses are better than those of the maximum likelihood. The sensitivity analyses show some amount of sensitivity over the shifts of the prior locations. They also show the robustness of the Bayesian analysis within the range between the true value and the maximum likelihood estimated value lines.

***Keywords*:** *Competing risks, Likelihood function, Posterior/prior function, Hazard function, and Net/Crude/partial crude probability*

1. Introduction

Reliability theory concerns the ability of a component or a system, either a life creature or an equipment, to be functioning during its expected length of life. The studies of reliability theory become more important because they are generally more expensive than measurement data in most quality control process.

In reliability theory, the most important problem is to determine the reliability of a complex system from the reliability of its components. The weakness of most reliability theories is that the system and its components are described and explained as simply functioning or failed. In many real situations, the failures may be from many causes depending upon the age and the environment of the system and its components.

In physical systems, the failure may be a phenomenon within a single item such as the tread wear, puncture, or defective side walls of an automobile tire. Or it can happen in physically distinct components of a system such as the CPU, hard-drive, or monitor, of a computer system. In bio-medicine, the failures may be the deaths of human beings caused by heart diseases, accidents, pulmonary diseases, pneumonia, or other causes of deaths. In engineering, this phenomena is commonly called as *competing risks*. The competing