“Commonly used models for reliability growth data analysis and prediction: Using the Weibull Function to Validate Product Life”

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This presentation discusses methods to validate products before they go into production. Reliability engineers and scientific people want to know how long their products will continue to function properly. That is, we want to know at what time they start to fail. This leads to finding where the failure distribution begins on a given time line. There are two parts to this presentation. Part A discusses a Reliability Demonstration Test: How to show that a large percent of the product population lives beyond the target life. And Part B concerns how to show that two populations are nearly the "same."

For a lab test of reliability we need to know these four elements: (1) the function this product should perform for our customers. (2) The percent of the population we want to survive past the target life. This is the reliability number such as 95% surviving (5% failing) which is a probabilistic term. Also, we need to know (3) the target life or time at which this reliability number is evaluated. This may be in hours or number of stress cycles. And lastly, we must carefully specify (4) the conditions under which the product is subjected.

Counting failures leads to the analysis of the failure distribution. Most often, we are using a small sample size and yet we desire to predict when a large population will begin to fail. Because many life distributions are skewed with a long tail to the right, the Weibull function has been found to be very useful as it handles skewed distributions quite well. This presentation shows several ways to compute the test reliability number from a small group of failures.

In Part B we discuss the situation where we'd like to show that two products coming from two processes have essentially the "same" life. We can run two samples through the same lab conditions and then compare the two failure distributions. If the two Weibull lines plot nearly on top of each other, it suggests that the two product populations have nearly the same lives. A slightly clearer view can be obtained by plotting contour plots on the same graph. Because the Weibull function has two variables, this becomes a bivariate problem involving both the slope (beta) and the characteristic life (theta). Contour plots represent the many possible combinations of these two parameters as solutions to represent our data. These plot as approximate ovals. When the ovals are far apart we conclude that the two populations are quite different. But if they overlap greatly, we conclude that the populations are essentially the "same." At least, the differences are small enough to not be important. This presentation is meant to be a concise package that can be used by many reliability engineers as a guide for analyzing their reliability situations.

Speaker Biography

Dr. Jerry Roslund is an independent consultant specializing in the Design of Experiments (DOE) and Reliability Methods. Prior to retiring from GM, he provided leadership as a GM Technical Fellow for Statistical Methods & Reliability and as a Validation Technical Integration Engineer in Vehicle Engineering. Specifically, Dr. Roslund conducted seminars on the Key Aspects of Quality, Reliability and Durability (QRD), Weibull Analysis, and Design of Experiments (DOE) for leaders and engineers within both GM and GM Suppliers.

In 1970, Dr. Roslund joined General Motors at Detroit Diesel Allison where he worked on the development of electronic fuel injections systems. In 1983, he began full-time work promoting the use of statistical methods via seminars and case studies in the areas of statistical problem solving, Weibull Analysis, and the Design of Experiments. Later, he transferred to Saturn in 1987 where he continued for 12 years as a quality professional guiding both Saturn powertrain and vehicle engineers. During his last years at GM he worked in Vehicle Validation providing leadership to managers, validation engineers and suppliers with a special focus on HVAC and Powertrain Cooling.

Not only did Dr. Roslund spend 24 years at General Motors solving problems using statistical methods and providing in-house consulting on a daily basis, but also he developed numerous course textbooks and conducted over 200 seminars providing a wealth of experience and a vast number of case studies.

Dr. Roslund is a member of SAE, ASQ, and the Deming Study Group. He received his B.S. degree in Mechanical Engineering from the University of Nebraska, M.S.M.E. from Cleveland State University, and Ph.D. in Systems Engineering from Oakland University.