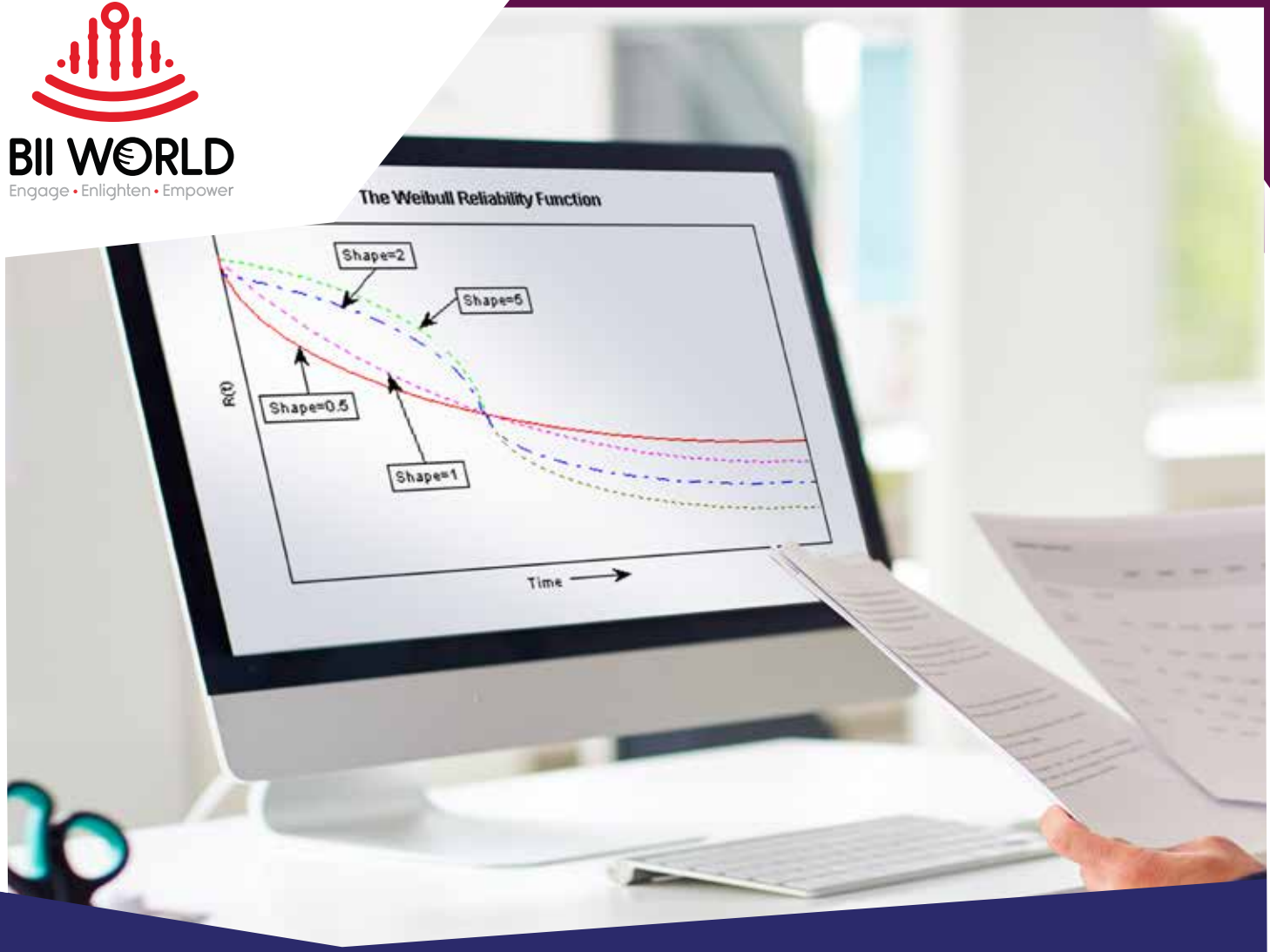
BII WORLD
Engage • Enlighten • Empower



Reliability Analysis Methods

Models and methods – Weibull, Lognormal, Loglogistic, Gamma and more

Join our global industry expert, Mr. Steven Wachs, and transform your learning experience.

18 - 22 September 2023

20 Hours Virtual Learning Experience

13:00 – 17:00 Central European Summer Time (CEST)

www.biiworld.com

Course Overview

Achieving high product reliability has become increasingly vital for manufacturers in order to meet customer expectations amid the threat of strong global competition. Poor reliability can doom a product and jeopardize the reputation of a brand or company. Inadequate reliability also presents financial risks from warranty, product recalls, and potential litigation. When developing new products, it is imperative that manufacturers develop reliability specifications and utilize methods to predict and verify that those reliability specifications will be met. This presents a difficult challenge in many industries with short product cycles and compressed product development timeframes. This course covers quantitative methods for predicting product reliability from data gathered from physical testing or from field data.

This highly interactive course will allow participants the opportunity to practice applying Reliability analysis techniques with various data sets using statistical software. The objective is to provide participants with the key tools and knowledge to be able to apply the methods effectively in their product development efforts. Participants will learn how to analyze failure data, plan reliability tests, and forecast future failures.

Learning Objectives:

- Understand reliability concepts and unique aspects of reliability data
- Understand underlying probability and statistical concepts for reliability analysis
- Develop competency in the modeling and analysis of time-to-failure data
- Understand reliability metrics and how to estimate and report them
- Handle Multiple Failure Modes
- Estimate reliability of subsystems and systems
- Become aware of system reliability activities such as Reliability Block diagramming, Reliability importance, and Reliability allocation
- Determine if reliability specifications are met (at specified confidence level) or whether design improvements are required
- Develop competency in the planning of reliability tests (sample sizes)
- Develop reliability demonstration test plans (testing time vs. number of units tradeoffs)
- Analyze existing warranty data to predict future returns
- Development awareness of advanced topics such as Accelerated Life Testing, Repairable Systems Analysis, and Stress/Strength Modeling

Day 1

We begin by defining Reliability and cover many important reliability concepts. We discuss why reliability performance is so important and the types of questions that may be answered by analyzing failure data. Different types of reliability data are reviewed. We introduce the concept of censored data which allows us to correctly utilize partial or incomplete data in the analysis of test or field data. We cover the Bathtub Curve which illustrates the types of failures that may occur over a product's lifetime. Finally, we introduce the reliability function.

In preparation for the reliability methods and tools to follow, we cover many of the fundamental building blocks. Since Reliability is a probability, we review some essential probability ideas and rules. We introduce the concept of conditional probability since it plays a role in various methods such as warranty forecasting and burn-in. We discuss probability models that may be considered in describing time-to-failure data with some emphasis on the Weibull distribution. The Weibull distribution is very popular due to its flexibility and meaningful parameters although we should not limit ourselves solely to this model. Finally, we discuss some useful discrete distribution models and their applications to reliability.

Day 2

We begin Day 2 by focusing on how we determine appropriate models for describing the time-to-failure data. We introduce Probability plots and goodness-of-fit statistics that assist in determining which distributions may provide a good fit to the data. We also learn how to handle censoring and multiple failure modes when attempting to find reasonable models for the data.

Next, we cover the details of life data analysis. We start by providing an overview of the common methods for estimating the distribution parameters (e.g. Maximum Likelihood Estimation) and provide guidance for choosing a method. Since quantifying uncertainty in our estimates is critical, we review the use of confidence intervals (or bounds) for this purpose. Applying the concepts introduced previously, we learn how to utilize selected distributions to estimate reliability statistics of interest. Treatment of censored data and multiple failure modes follow. We also look at comparing multiple groups with respect to overall reliability performance. Finally, we briefly look at nonparametric estimation which does not require any distribution assumption.

Day 3

On Day 3 we complete the discussion of life data analysis. We then extend the estimation of component reliability to the reliability estimation of a system comprised of multiple components. The system reliability depends both on the component reliabilities as well as their configuration. Redundant components allow the system reliability to achieve levels that exceed the component reliabilities. We explore the basic series and parallel structures as well as k-out-of-n parallel systems. We also introduce more complex systems and various aspects of system reliability including reliability importance and reliability allocation.

Day 4

Reliability testing is a key component for ensuring that Reliability targets are achieved. Planning for reliability tests is important to ensure that the results are likely to be useful. Here, we look at planning for both reliability estimation tests and reliability demonstration tests. Essentially, we must test enough units for long enough to be able to adequately estimate reliability or demonstrate that targets are met.

The models developed to analyze time-to-failure data may be used to develop forecasts of the number of failures that may be expected over time (i.e. Warranty Forecasts). This is useful for estimating warranty costs, estimating spare part requirements, and reacting to emerging field concerns. In this section, we learn how to use conditional failure probability to predict the number of failures during the forecast period.

Day 5

Design for Reliability is a useful methodology and structure for ensuring that reliability methods are deployed throughout the product development process to ensure that products launch with confidence that they will perform adequately over time in the field. We provide a brief overview of the DFR methodology and tools.

We complete the course with an introduction to a few topics that are covered in more advanced courses. Accelerated life testing is an import tool to support reliability estimation and understanding in an environment of ever shortening product development timeframes. Reliability methods for repairable systems are briefly introduced. Finally, stress-strength analysis is described.

Instructor:
Mr. Steven Wachs

Global Expert with 30+years industry experience in both technical and management positions.

Steven Wachs has 30 years of wide-ranging industry experience in both technical and management positions. Steve has worked as a statistician at Ford Motor Company where he has extensive experience in the development of statistical models, reliability analysis, designed experimentation, and statistical process control.

Steve is currently a Principal Statistician at Integral Concepts, Inc. where he assists manufacturers in the application of statistical methods to reduce variation and improve quality and productivity. He also possesses expertise in the application of reliability methods to achieve robust and reliable products as well as to estimate and reduce warranty. In addition to providing consulting services, Steve regularly conducts workshops in industrial statistical methods for companies worldwide.

Steve also supports expert witness work in product liability litigation. He regularly consults on cases involving failure root cause determination, risk assessment, product quality, product reliability, warranty, and process control.

Education

M.A., Applied Statistics, University of Michigan, 2002

M.B.A, Katz Graduate School of Business, University of Pittsburgh, 1992

B.S., Mechanical Engineering, University of Michigan, 1986

sarodh.panicker@biiworld.com

www.biiworld.com

Key Focus:

- Develop advanced knowledge of the concepts and methods behind reliability analysis and estimation
- Utilize software to simplify analysis without compromising understanding of key concepts
- Estimate reliability of components and systems
- Plan efficient and effective reliability tests
- Forecast future failures in the field
- Communicate results to customers, suppliers, management, and other stakeholders

TARGET AUDIENCE & INDUSTRIES

- Scientists
- Product and Process Engineers
- Design Engineers
- Quality Engineers
- Reliability Engineers
- Personnel involved in product development and validation
- Laboratory Personnel/Test Engineers & Technicians
- Manufacturing/Operations Personnel
- Process Improvement Personnel
- Project/Program Managers W

TO NAME A FEW INDUSRTIES:-

- Pharmaceutical (Medical Devices)
- Automotive
- Aerospace
- Plant & Machinery Equipment
- Computer Equipment
- Telecommunications Equipment
- Mining
- Electronics
- Foods, Drugs (Shelf Life Applications)
- Consumer Products
- Industrial Products
- Furniture (Office Chairs, Utility Desks – with moving/wearout parts)
- Solar Panels
- Utilities (Gas lines, Substation Equipment)
- Locomotive/Rail
- HVAC Equipment (Heating, Air Conditioning)

sarodh.panicker@biiworld.com

Presentations: Day 1

14:00 - Pre-Course Intro – Delegate Expectation Briefing

Reliability Concepts & Data, Probability & Reliability Statistics

Module 1: Reliability Concepts and Reliability Data

- Why Reliability and Typical Questions
- Defining Reliability
- Types of Reliability Data and Unique Aspects
- Censored Data
- The Bathtub Curve and Reliability Function

Module 2: Probability and Reliability Statistics

- Probability Basics
- Conditional Probability, Independent Events, & Exercises

Break

Module 2: Probability and Reliability Statistics (cont'd)

- Reliability Metrics/Statistics
- Common Distributions / Weibull Distribution
- Conditional Reliability & Exercise
- Review Exercises
- Useful Discrete Distributions & Exercise

Break

Module 2: Probability and Reliability Statistics (cont'd)

- Review Exercises
- Useful Discrete Distributions & Exercise

Post-Session Q &A

18:00 – End of Day 1

Day 2

Assessing & Selecting Models, Estimation of Reliability Metrics

14:00 - Pre-Session Q & A

Module 3: Assessing & Selecting Models

- Overview of Distribution Fitting & Reliability Estimation
- Probability Plots & Minitab Demonstration
- Constructing Probability Plots
- Distribution Fitting with Right-Censored Data
- Exercises
- Distribution Fitting with Multiple Failure Modes
- Exercise and Module Wrap-Up

Break

Day 2

Module 4: Estimation of Reliability Metrics

- Overview of Reliability Estimation and Methods
- Confidence Intervals & Bounds
- Using Minitab to Estimate Reliability Metrics (Demo)
- Exercise

Break

Module 4: Estimation of Reliability Metrics (cont'd)

- Reliability Estimation with Censored Data
- Comparing Multiple Groups
- Exercises

Post-Session Q &A

18:00 – End of Day2

Day 3

Estimation of Reliability Metrics & Systems Reliability

14:00 - Pre-Session Q & A

Module 4: Estimation of Reliability Metrics (cont'd)

- Handling Multiple Failure Modes & Exercise
- Nonparametric Estimation
- Other Methods for Reliability Prediction

Break

Module 5: Introduction to Reliability of Systems

- System Reliability Overview & Basic Series Systems
- Basic Parallel Systems & Short Exercise
- k-out-of-n Parallel Systems & Combination Systems
- Exercises

Break

Module 5: Introduction to Reliability of Systems (cont'd)

- Complex Systems
- Reliability Importance, Reliability Allocation & Other Concepts

Post-Session Q &A

18:00 – End of Day3

Day 4

Reliability Test Planning & Warranty Forecasting

14:00 - Pre-Session Q & A

Module 6: Reliability Test Planning

- Reliability Testing Ideas
- Reliability Test Planning & Censoring Schemes
- Reliability Estimation Test Planning
- Exercise

Break

Module 6: Reliability Test Planning (cont'd)

- Reliability Demonstration Test Planning
- Exercise
- Zero Failure Test Plans Special Case & Module Wrap-Up

Break

Module 7: Analysis of Warranty Data

- Lesson 1 – Warranty Analysis Overview and Key Concepts
- Lesson 2 – Data Setup & Calculations
- Lesson 3 – Minitab Demonstration
- Lesson 4 – Exercise

Post-Session Q &A

18:00 – End of Day4

Day 5

Design for Reliability & Intro to Advanced Topics

14:00 - Pre-Session Q & A

Module 8: Design for Reliability (DFR) Overview

- Design for Reliability (DFR) Overview
- DFR Process/Methodology Overview

Module 9: Introduction to Advanced Topics

- Types of Accelerated Life Testing (ALT)

Break

Module 9: Introduction to Advanced Topics (cont'd)

- Intro to Quantitative ALT
- Introduction to Repairable Systems Analysis

Break

Module 9: Introduction to Advanced Topics (cont'd)

- Stress/Strength Analysis

Post-Session Q &A (Day 1-5 Wrap Up)

18:00 – End of Day5

FAQs

Does BII Online Virtual Training have the same value as traditional classroom training?

Yes, BII Online Virtual Training offers participants; same training system as in-person, i.e face-to-face engagement with instructors, course material, interactive participation of all delegates, and personal support that they would expect to find in a traditional classroom.

What are main features of your online courses? Are they on-demand? Is it different content from the in-person offering?

The content of the virtual training is similar to the in-person sessions and customized presentation makes it a richer online learning experience. As always, we will share presentation materials with attendees for later reference.

The online courses are not on-demand and recordings cannot be purchased. They are set on scheduled dates, live with an instructor and co-host via webinar software. While the day is shorter than an in-person session (4hrs vs 8hrs), timing are adjusted to accommodate attendees in different time zones and allow more time for one-on-one conversations via the Q & A.

What are the technical requirements for participation in a virtual course?

All you need to participate in virtual training are:

- Desktop or Laptop or Tablet Computer, and Internet connection
- Webcam
- Headset with built-in microphone

Can I attend an online training session if I have a Macintosh computer?

Yes, Our Online training systems does allow Macintosh computers, PCs, and computers running Linux to easily enter any of our online training sessions.

What type and version of browser will I need for online classes?

It is recommended that you use the latest version of Firefox, Chrome or Internet Explorer for Windows and Firefox or Safari for Mac. Each of these is available for free download and also suggested you have the PDF Reader

How do I have access to the trainer for questions?

As in the classroom, you will see the trainer in front of you and have the opportunity to ask questions at any time - all via audio and video transmission.

Is there a mute option within an online training session to minimize background noise from my audio connection?

Yes, the Mute button will display to the right of your name as you hover your mouse over your name shown in the Participants panel on the top, right side of the Web conferencing screen.

Do I get a Certificate at the end?

Yes, you will get a PDF version of your certificate of completion

Reliability Analysis Methods

18 – 22 September 2023

BII World Limited
9616 45th Avenue
Northwest, Edmonton, AB
T6E 5Y9, **Canada**

Please complete this form and mail it back to
sarodh.panicker@biiworld.com

Event Code: OL LS 36

Delegate Details

1. Name: Mr/Mrs/ Ms .....
   .....
   Job Title: .....
   Email: .....
2. Name: Mr/Mrs/ Ms .....
   .....
   Job Title: .....
   Email: .....
3. Name: Mr/Mrs/ Ms .....
   .....
   Job Title: .....
   Email: .....

Company/Organisation Detail

Name: .....
Person to Contact:.....
Email: .....
Address: .....
.....
City: .....
Country: .....
Contact No: .....
Type of Business: .....
Website: .....

Payment Details

METHOD: CREDIT CARD ☐ OR WIRE TRANSFER ☐

Please debit my

Visa ☐ Eurocard /Mastercard ☐ Amex ☐ Diners club ☐

Card Billing Address:.....
Street: .....City.....
Zip/Postal: .....
Card Holders Name: .....
Email Address: .....
Card Holders Signature: .....
Card Number

Credit Card CVV2/ CVC / CID Number:

Visa / Mastercard (3-digit code on the back) ☐☐☐ Amex (4-digit code on the front) ☐☐☐☐

Valid from: ☐☐/☐☐ Expiry Date: ☐☐/☐☐

I agree to BII debiting my card

Authorization and Acceptance of Sales Contract & Terms & Conditions

I hereby declare I am authorised to sign this contract and terms & conditions in the name of the company/organisation:

Name:.....
Date:.....
Signature:.....

1 Delegate Fee	☐ **EUR 1299**	**PerDelegate**
2 Delegates Fee	☐ **EUR 1199**	**PerDelegate**
3 or More Delegates Fee	☐ **EUR 1099**	**PerDelegate**

20 USD administration charge and any applicable withholding or any other tax or fee will be applied

TERMS & CONDITIONS:

1. Payment terms: BII World LTD requires the full payment of the invoiced amount within 7 working days from the issue date of the invoice. BII World LTD reserves the right to refuse entry to any client who does not pay the invoice in full and on time. The registration fee includes: Training documentation and admission to all training sessions.

2. Cancellation by client: The client has the right to cancel his/her participation in the event. Cancellation must be received by BII World LTD in writing either by mail or fax. If the client cancels the event, he/she will get two options:

A. CREDIT NOTE: Choose 2-year credit note, BII World LTD will send all the schedule training event details throughout the year. Delegate has the right to choose and attend any of the training programs (valid 2 years).

B- NOMINATION: In this option delegate can nominate/refer someone from his/her group/company to attend the particular training program on behalf of the actual delegate.

3. Cancellation by BII World LTD : While every reasonable effort is made to adhere to the advertised program, circumstances can arise which may cause changes in the program, including but not limited to changes in the content, date(s), or special features of the planned event. Such circumstances include but are not limited to acts of terrorism, war, extreme weather conditions, compliance with government requests, orders and legal requirements, failure of third-party suppliers to timely deliver, and failure to register the minimum target number of attendees for a given event. BII World LTD reserves the right to change the content, date(s), and/ or special features of an event, to merge the event with another event, or to postpone it or cancel it entirely as appropriate under the circumstances. Client agrees that BII World LTD shall not be liable for any cost, damage or expense which may be incurred by client as a consequence of the event being so changed, merged, postponed or cancelled and client agrees to hold BII World LTD harmless and to indemnify BII World LTD in case of liability caused by any such changes, mergers, postponements or cancellations.

4. Cancellation of the event: In case BII World LTD cancels an event, then client can choose any of the below mentioned options:

(a) BII World LTD will refund full payment to the client within 15 business days.
(b) Client can choose the credit option for 2 years, for more details please read term no-2 part (a)

5. Postponement of the event : In case BII World Ltd postpones the event to a new date, then client can choose any of the below mentioned options.

(a) The client can attend the course on the postponed dates.

(b) Client can choose the credit option for 2 years, for more details please read term no-2 part (a)

6. Client's identification information. By signing of this sales contract and these terms and conditions the client gives full right to BII World LTD to share the client's identification information, i.e. client's name, address, email addresses, phone numbers and names of representatives and website with other clients who participated in the same event. The client has the right to opt out of this clause by written notice to BII World LTD.

7. Governing law: This contract shall be governed by and construed in accordance with the laws of the Pr ovince of Alberta, Canada. Any disputes arising under or in connection with this registr ation form shall be settled before the competent court in Canada.

8. Indemnification: To the fullest extent permitted by the law, you agree to protect, indemnify, defend and hold harmless BII World LTD, its owners, managers, partners, subsidiaries, affiliates, officers, directors, employees and agents, from and against any and all claims, losses or damages to persons or property, governmental charges or fines, penalties, and costs (including reasonable attorney's fees) (collectively "the Claims"), in any way arising out of or relating to the event that is the subject of this contract, and regardless of negligence, included but not limited to, Claims arising out of the negligence, gross negligence or intentional misconduct of BII World LTD employees, agents, contractors, and attendees; provided, however, that nothing in this indemnification shall require you to indemnify BII World LTD Indemnified parties for that portion of any Claim arising out of the sole negligence, gross negligence or intentional misconduct of the BII World LTD parties.

9. Other currencies. In case that client requests payment in other than official currency (USD), BII World LTD reserves the right to apply 5% currency risk surcharge to the actual exchange rate.

10. Other Conditions: Any terms or conditions contained in the client's acceptance which contradict or are different from the terms and conditions of this registration document shall not become part of the contract unless individually negotiated with BII World LTD and expressly accepted by BII World LTD.