

University of Puerto Rico. Mayagüez Campus College of Engineering. Industrial Engineering Department



Course Syllabus

General Information

Course Number: InIn 5565

Course Title: Measurement and Prediction of Product Reliability

Credit-Hours: Three

Course Description: Introduction to reliability theory; system analysis; constant failure rate models; time dependent failure rate models; state dependent systems; availability; maintainability; complete and censored data analysis (parameter estimation and distribution fitting); prediction of reliability.

Prerequisites: InIn 4020- Applied Industrial Statistics or authorization of the Director of the Department.

Textbook and References

Text: Ebeling, C. E., 1997, An Introduction to Reliability and Maintainability Engineering. Reissued in 2005 by Waveland Press, Inc.

Dhillon, B. S., 1983, Reliability Engineering in Systems Design and Operation, Van Nostrand-Reinhold.

Gertsbakh, 1989, Statistical Reliability Theory, Marcel Dekker, New York.

Ireson, W. G., 1996, Reliability Handbook, 2nd Edition, McGraw Hill.

Jensen, F., & Peterson, N. E., 1982, Burn-in, John Wiley and Sons.

Kalbfleisch, S., & Prentice, R., 2002, Statistical Analysis of Failure Time Data, John Wiley and Sons.

Klaasen, & Van Peppen, 1989, Reliability: Concepts and Applications, Chapman: Hall, Routeledge, Edward Arnold, London.

Lawless, J. F., 2002, Statistical Models and Methods for Lifetime Data, 2nd Edition, John Wiley and Sons.

Lloyd Grosh, D., 1989, A Primer of Reliability Theory, John Wiley and Sons.

Lloyd, & Lipow, M., 1997, Reliability, Management and Mathematics, 2nd Edition, Lloyd & Lipow Assoc., Redondo Beach, CA.

Meeker, & Escoban, 1998, Statistical Methods for Reliability Data, John Wiley & Sons.

Miller, R., 1998, Survival Analysis, Wiley's Classic Library Edition, John Wiley and Sons.

Nelson, W., 2003, Applied Life Data Analysis, John Wiley and Sons.

O'Connor, P. D. T., 2002, Practical Reliability Engineering, 4th Edition. John Wiley and Sons.

Trobias, & Trindade, 1995, Applied Reliability, 2nd Edition, Van Nostrand Reinhold.

Ushakov, I.A, 1994, Handbook of Reliability Engineering. NY, John Wiley and Sons.

Journals

IEEE Transactions on Reliability (IEEE, New York) Journal of Quality Technology (ASQ, Milwaukee, WI) Technometrics (ASQ, ASA)

Purpose

This course is primarily designed for majors in Industrial Engineering at either the graduate or undergraduate level; however, it is appropriate for anyone who is interested in the field of reliability. The purpose is to provide students the theoretical and applied background needed to predict, or measure, the reliability of a system. This purpose is achieved by studying life models such as the Weibull, the log-normal, and the exponential distributions. Emphasis is given to the analysis of failure data at either accelerated or normal life conditions. This course is an elective course for graduate and undergraduate students.

Course Goals

- Use mathematical/numerical methods to estimate life distribution parameters for censored data.
- Design and analyze life test experiments for censoring and accelerated conditions.
- □ Apply failure distributions to reliability computation, use stress-strength models.
- □ Apply reliability physics to acceleration of failures & predict system/component life w/o stress.
- □ Model failure mechanisms of electronic & mechanical systems & devices.
- □ Analyze complex systems reliability and characteristic functions in transient and steady state.
- □ Allocate reliability to components to achieve a reliability design goal.

Course Syllabus

□ Apply reliability growth models to achieve a design goal.

Requirements

All students are expected to come to class on time, and prepared; do all assigned readings and related homework; actively participate in class discussions; and satisfy all assessment criteria to receive credit for the course.

Department and Campus Policies

- **Class attendance**: Class attendance is compulsory. The University of Puerto Rico, Mayagüez Campus, reserves the right to deal at any time with individual cases of non-attendance. Professors are expected to record the absences of their students. Frequent absences affect the final grade, and may even result in total loss of credits. Arranging to make up work missed because of legitimate class absence is the responsibility of the student. (Bulletin of Information Undergraduate Studies)
- Absence from examinations: Students are required to attend all examinations. If a student is absent from an examination for a justifiable reason acceptable to the professor, he or she will be given a special examination. Otherwise, he or she will receive a grade of zero of "F" in the examination missed. (Bulletin of Information Undergraduate Studies)

Final examinations: Final written examinations must be given in all courses unless, in the judgment of the Dean, the nature of the subject makes it impracticable. Final examinations scheduled by arrangements must be given during the examination period prescribed in the Academic Calendar, including Saturdays. (See Bulletin of Information Undergraduate Studies).

- **Partial withdrawals**: A student may withdraw from individual courses at any time during the term, but before the deadline established in the University Academic Calendar. (See Bulletin of Information Undergraduate Studies).
- **Complete withdrawals**: A student may completely withdraw from the University of Puerto Rico, Mayagüez Campus, at any time up to the last day of classes. (See Bulletin of Information Undergraduate Studies).
- **Disabilities**: Disabilities: According to the Americans with Disability Act (ADA), all reasonable accommodations will be coordinated with the Dean of Students according to the particular needs of the student. For more information, please contact Student Services with Disabilities at the Student Dean's Office at (Q-019), 787-265-3862 ó 787-832-4040 x-3250 ó 3258. After being recognized as a person with disabilities by both the professor and the institution, the student will receive reasonable accommodations in the course and his/her evaluations.
- **Ethics:** Any academic fraud is subject to the disciplinary sanctions described in article 14 and 16 of the revised General Student Bylaws of the University of Puerto Rico contained in Certification 018-1997-98 of the Board of Trustees. The professor will follow the norms established in articles 1-5 of the Bylaws.

Lecture	Торіс	Problems
1-2	Overview and reliability concepts. Definitions, statistical vs. deterministic approach. Statistical reliability.	Ch.1
3-4	Failure distributions: Reliability function, hazard rate, mean time to failure and the bathtub curve.	Ch. 2
5-7	Constant failure rate model and time-dependent failure-rate models	Ch. 3 & 4
8-9	Systems reliability	Ch. 5
10-12	State-dependent system	Ch. 6
13-15	Physical reliability models	Ch. 7
16-18	Introduction to design for reliability: Reliability allocation & Fault tree analysis	Ch. 8
19	Data collection and empirical methods	Ch. 12
20	Identifying distributions: Probability plotting and curve fitting	Sec. 15.1 - 15.2
21-23	Parameter estimation: Maximum likelihood. Censored data.	Sec 15.3 - 15.5
24	Goodness of fit tests	Ch. 16
25	Reliability life testing: Binomial acceptance testing & Sequential tests	Ch.13
26-28	Accelerated life testing	Ch. 13 and class notes

Each lecture is about 80 minutes long.

Revised by Dr. Noel Artiles-León on February 20, 2007