Description of Engineering Statistics Courses at Missouri S&T

Several advisors have inquired about the difference between the three engineering statistics courses we offer. We hope that the information given below will assist in determining the course your advisees should take. The courses we offer to undergraduate engineering students are: Stat 3113 – Applied Engineering Statistics, Stat 3115 – Engineering Statistics, and Stat 3117 – Introduction to Probability and Statistics. Given below are short descriptions of the courses and a summary of the topics covered in each course.

Stat 3113: Applied Engineering Statistics

This is a course designed for the industry bound undergraduate engineering student.

In the 1980's and 90's some authors highlighted the irrelevancy of statistics courses as traditionally taught in colleges and universities to industry bound students. Stat 3113 was initially developed based on the premise (espoused by a consortium of statisticians, some working in industry) that what is taught should be relevant to the practice of engineering. The course was further developed in the subsequent years borrowing ideas from a collection of more recent authors who investigated effective ways of teaching statistics to engineers. These suggestions include the use of student projects, group learning, and the use of technology and statistical software.

This course is the only engineering statistics course we offer that requires a semester project that students carry out in groups. Students are required to design a factorial experiment, conduct it, gather and analyze data, and write a semester report.

In addition to core probability and distributional results, the course introduces the students to design of experiments (DOE), analysis of variance, and regression analysis. Students are also introduced to statistical software packages such as JMP and MINITAB.

The main topics covered are:

1. Sampling and summary statistics including graphics
2. Probability laws and conditional probability, including Bayes' Theorem
3. Random variables and probability distributions, both discrete and continuous (Binomial, hypergeometric, Poisson, uniform, normal, exponential)
4. Linear functions of random variables and the central limit theorem
5. One factor experiments
6. Two factor experiments
7. 2^n symmetric factorial experiments
8. Interpreting hypotheses tests

9. Small and large sample confidence intervals for the mean
10. Small and large sample tests for the mean
11. Small and large sample tests for the difference between two means
12. Correlation
13. Simple linear regression analysis
14. Testing least squares coefficients
15. Checking regression assumptions and transforming data
16. Multiple linear regression.

Stat 3115: Engineering Statistics

This is a generic course most suited for those in areas such as computer science as well as engineering students heading for graduate school or who plan to take additional courses in statistics.

This is the engineering statistics course that has being traditionally taught by many mathematics/statistics departments in the past. It is in fact a watered down version of the probability and mathematical statistics course we offer at the beginning graduate level. While it may not have more practical topics such as design of experiments, group activities, or a semester project, Stat 3115 offers a little more theory compared to Stat 3113 and may be more suitable to those in computer science or the student who aims to go to graduate school;a better option for a graduate school bound student, however, may be Stat 3117 or the combination of Stat 5643 and Stat 5644.

The summary of topics covered in Stat 3115 is as follows:

1. Populations, samples, and descriptive statistics
2. Probability laws (Sample spaces, axioms, properties of probability).
3. Conditional probability, independence, and Bayes' theorem
4. Random variables and probability distributions (Binomial, Poisson, Negative Binomial, Hypergeometric, Uniform, Normal, Exponential, and Gamma)
5. Joint distributions (expected values, marginal distributions, correlation, and independence)
6. Random samples, sampling distributions,
7. Central Limit Theorem and the normal approximation to the binomial
8. Parameter estimation (mainly the method of moments estimation)
9. Small and Large sample confidence intervals about the mean of a normal population
10. Large sample confidence intervals about a population proportion
11. Small and large sample tests for the mean of a normal population
12. Small and large sample tests for the difference of means of two normal populations
13. Tests about a population proportion
14. Simple linear regression (time permitting)

Stat 3117: Introduction to Probability and Statistics

This is a course that was especially designed for undergraduate students in Electrical and Computer Engineering. EE faculty had a hand in the design of the syllabus when this course was first introduced.

The objectives of this course are to introduce students to probability, distribution theory, statistical inference, and their application to physical and engineering sciences. Equal emphasis is given to both applications and basic theory.

The summary of topics covered in Stat 3117 is as follows:

1) Probability (sample spaces, axioms of probability, counting methods, conditional probability, independence, Bayes' rule).
2) Random variables, probability mass and density functions, cumulative distribution functions, Chebyshev inequality, moment generating functions.
3) Binomial, Poisson, Negative Binomial, Hypergeometric, Uniform, Normal, Exponential, Gamma, and Weibull, Lognormal distributions
4) Joint distributions (expected values, correlation and independence), functions of multiple random variables.
5) Random samples, sampling distributions, and The Central Limit Theorem
6) Maximum likelihood and Method of Moment Estimations
7) Confidence intervals for means, proportions, variance and difference of means
8) Hypothesis testing for means, proportions, variance and difference of means
9) Introduction to the basics of system reliability
10) Least squares fitting of a simple linear regression line.