Advanced Data Analysis Techniques

General Information

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Text Books:
2. Time Series and System Analysis with Applications, Pandit and Wu, John Wiley and Sons

Course Description:
This course covers advanced data analysis methods in quality and reliability engineering. There are two sets of techniques, the information reduction technique and time series analysis techniques, to be discussed in this course.

The information reduction technique includes some multivariate statistical methods, such as principal component analysis, factor analysis and discriminant analysis. These methods are very powerful in terms of extracting meaningful information from massive amount of multiple attribute data. Those methods have been successfully used in social science, biology and chemistry. The application in manufacturing is fairly new but very promising. The earlier application in quality engineering includes the multi-vari chart technique advocated by Dorian Shainin. Multivariate control charts was also developed to simplify the process monitoring and control strategy for multiple attribute manufacturing process control. Recently, these methods have been successfully applied to manufacturing data analysis, especially to automotive dimensional data analysis for variation reduction. The potential applications for the information reduction technique is very good.

Time series analysis is a very important data analysis technique. Time series refer to a sequence of data sampled at consecutive time intervals. Time series analysis is able to extract the hidden ‘dynamic’ behavior of the underline mechanism for the data so important information about the process which generates the data can be obtained. It is used widely in industrial process data analysis as well as business forecasting.
Due to the nature of those advanced topics, discussion in class is highly encouraged and the input from students’ work experience is very appreciated. Term paper is an important part of course and presentation is required.

Grading policy:

Homework: 20%
Midterm: 30%
Final Exam: 30%
Term paper: 20%

Tentative Schedule and Contents

1. Introduction, Multivariate random variables, Visual display of multivariate data  
   Yang Ch. 1-3
2. Multivariate Analysis of Variance  
   Yang Ch. 4
3. Principal component analysis  
   Yang Ch. 5
4. Factor Analysis  
   Yang, Ch. 5
5. Discriminant Analysis  
   Yang, Ch. 6
6. Cluster Analysis  
   Yang Ch. 7
7. Mahalanobis distance and Taguchi method  
   Yang Ch. 8
8. Path Analysis  
   Yang, Ch. 9
9. Multivariate SPC  
   Yang, Ch. 10
10. Introduction to time series, ARIMA model  
    Pandit & Wu Ch. 1-3
11. Modeling and forecasting  
    Pandit & Wu Ch. 4-5
12. Data dependent systems  
    Pandit & Wu Ch. 6-10