King Fahd University of Petroleum and Minerals

Department of Mathematics & Statistics

STAT 590 Special Topics in Statistics (Title: Multivariate Statistical Process Control (SPC))

Semester 2, 2014-2015 (142)

Instructors: Dr. Mohammad Riaz, Office: 5-332, Phone: 7622, email: riazm@kfupm.edu.sa

OBJECTIVES

The aim of this course is to develop the foundations of statistical process control, implementation of different memory and memory-less structures and their applications in different disciplines The memory and memory-less process monitoring techniques will be discussed both in univariate and multivariate setups. The applications of these techniques will be presented using some real problems from different disciplines including engineering, medical, environmental sciences, agriculture and industrial processes.

RATIONALE

In any practical scenario of manufacturing/non-manufacturing processes, a number of factors play role simultaneously and a separate dealing with each in an independent capacity may mislead in an opposite direction. This phenomenon necessitates the use of multivariate statistical process control for an efficient monitoring of process parameters. This course is designed for the same purposes.

COURSE DESCRIPTION/WEEKLY BREAKDOWN

In this course, we will cover the foundations of multivariate process monitoring techniques and their applications will be presented using some real problems. The univariate methods will be discussed as special cases. We will consider both memory and memory-less structures for effective monitoring of parameters such as shape, association, location and dispersion.

A weekly break down of the topics is given below:

Week	Topics
1-2	Introduction to Statistical Process Control (Background of process monitoring, Magnificent seven, SPC tool=-kit covering Pareto charts, check sheets and control charts)
3-4	Multivariate statistical process control (Multivariate data matrix, mean vector and variance—covariance matrix, Mahalanobis distance, Hotelling statistic)
4-6	Memory-less multivariate process monitoring techniques Hotelling T^2 chart, chi-square chart, generalized variance chart, Limitations of multivariate charting techniques)
7-10	Memory Structures for efficient monitoring (multivariate exponentially weighted moving average (EWMA) charts, multivariate cumulative sum (CUSUM) charts, mixed charting structures based on EWMA and CUSUM schemes)
11-13	Some SPC issues (inertia, robustness, ARL biasedness, monotonicity)
14-15	Practical Applications (applications in the areas of industry, medical, agriculture and different disciplines of engineering)

Credit: 3 credit hours
Pre-requisite: Graduate Standing
Expected Number of Students: at least 5 students of MS Applied Statistics
Approximate percentage overlap with existing courses: Below 15%

Grading:

The distribution of grade is as follows:

Class test I, II	20%	
Class work (homework assignments)		20%
Final Exam		30%
Project	30%	
Total		100%

Text Books and Other References:

Books

Santos-Fernández, E. (2013). *Multivariate Statistical Quality Control Using R*, Springer New York.

Montgomery, D. C. (2009). *Introduction to statistical quality control*. 6th ed. New York: Wiley.

Relevant References

da Costa Quinino, R., Ho, L. L., & Trindade, A. L. G. (2014). Estimation in X-bar control charts: effects and corrections. *The International Journal of Advanced Manufacturing Technology*, *72*(1-4), 101-106.

McCracken, A. K., & Chakraborti, S. (2013). Control charts for joint monitoring of mean and variance: an overview. *Quality Technology & Quantitative Management*, *10*, 17-35.

Additional Readings:

Kim, J., Al-Khalifa, K. N., Jeong, M. K., Hamouda, A. M. S., & Elsayed, E. A. (2014). Multivariate statistical process control charts based on the approximate sequential χ 2 test. *International Journal of Production Research*, (ahead-of-print), 1-14.

Teoh, W. L., Khoo, M. B., Castagliola, P., & Chakraborti, S. (2014). Optimal design of the double sampling chart with estimated parameters based on median run length. *Computers & Industrial Engineering*, *67*, 104-115

Khoo, M. B., Wong, V. H., Wu, Z., & Castagliola, P. (2012). Optimal design of the synthetic chart for the process mean based on median run length. *IIE Transactions*, *44*(9), 765-779.

We will be supplementing our course with more latest articles on the topics under discussion.