The University of Michigan
College of Engineering
Curriculum Committee

Agenda
November 20, 2012
1:30-3:00 p.m.

Room 265 Chrysler Center

1. Approval of Minutes
2. Course Approval Forms
3. IOE Masters Program: Concentration in Healthcare Engineering and Patient Safety ("HEPS")

Course Approval Forms

IOE 425	Modification—Adding MFG 426 X-Listing; Changing Title from: Manufacturing Strategies ***to: Lean Manufacturing and Services***; Changing Description
IOE 508	New Course

THE UNIVERSITY OF MICHIGAN -- COLLEGE OF ENGINEERING
Course Approval Request
College Curriculum Committee, 1420 Lurie Engineering Center Building

Form Number: 2358
Date: 10/4/2012
Effective Term: Winter 2013
Course Offer Freq: ☒ Indefinitely ☐ One term only

Action Requested
- ○ New Course
- ◉ Modification of Existing Course
- ○ Deletion of Course

Complete the following sections:
New Courses - B & C completely
Modifications - A modified information, B & C completely
Deletions - A & C completely

A. CURRENT LISTING	B. REQUESTED LISTING
Home Department: IOE Industrial & Operations Engin	Home Department: IOE Industrial & Operations Engin
Course Number: 425	Course Number: 425
☐ Cross Listed Course Information:	Cross Listed Course Information: Mfg 426
☒ Course Title: Manufacturing Strategies	Course Title: Lean Manufacturing and Services
TITLE ABBREVIATION — Time Sched Max = 19 Spaces: Manufacturing Strategies	TITLE ABBREVIATION — Time Sched Max = 19 Spaces: Lean Mfg & Services
TITLE ABBREVIATION — Transcript Max = 20 Spaces: Manufacturing Strategies	TITLE ABBREVIATION — Transcript Max = 20 Spaces: Lean Mfg & Services
☒ Course Description: Review of philosophies, systems, and practices utilized by world-class manufacturers to meet current manufacturing challenges, focusing on "lean production" in the automotive industry, including material flow, plant-floor quality assurance, job design, work and management practices. Students tour plants to analyze the extent and potential of the philosophies.	Course Description for Official Publication (Max = 50 words): Review of philosophies, systems, and practices utilized by world-class manufacturing and service organizations focusing on "lean management," including material and information flow, in-process quality assurance, standardized work, continuous improvement, visual management, and lean leadership. Practical examples and in-class exercises bring concepts to life.
PROGRAM OUTCOMES: ☐ a ☐ b ☐ c ☐ d ☐ e ☐ f ☐ g ☐ h ☐ i ☐ j ☐ k	PROGRAM OUTCOMES: ☐ a ☒ b ☒ c ☒ d ☐ e ☒ f ☐ g ☐ h ☐ i ☒ j ☐ k
Degree Requirements: ○ Degree Requirement ○ Core Course ○ Free Elective ○ Tech Elective ○ Other	Degree Requirements: ○ Degree Requirement ○ Core Course ○ Free Elective ○ Tech Elective ○ Other
☐ Prereq: Senior Standing; ◉ Enforced ○ Advised	☐ Prereq: Senior Standing or Graduate Standing; ◉ Enforced ○ Advised
☐ Credit Restrictions:	Credit Restrictions:
☐ Level of Credit: ☐ Undergrad only ☐ Rackham Grad ☐ Non-Rckhm Grad ☐ Ugrad or Rckhm Grad ☐ Ugrad or Non-Rckhm Grad ☐ All Credit types ☐ Rckhm Grad w/add'l Work; Credit Hours Min Max: ; Contact Hrs/Wk: ; Number of Wks:	Level of Credit: ☐ Undergrad only ☐ Rackham Grad ☐ Non-Rckhm Grad ☐ Ugrad or Rckhm Grad ☐ Ugrad or Non-Rckhm Grad ☒ All Credit types ☐ Rckhm Grad w/add'l Work; Credit Hours Min 2 Max 2; Contact Hrs/Wk 4; Number of Wks 7

Repeatability (Indi Research, Dir. Study, Dissertation: Is this course repeatable? ○ Yes ○ No Max Hours? ____ Max Times? ____ Can it be repeated in the same term? ○ Yes ○ No

C.

☐ Class Type(s): ☒ Lec ☐ Rec ☐ Sem ☐ Lab ☐ Dis ☐ Ind ☐ Other ____
Graded Section: ☒ Lec ☐ Rec ☐ Sem ☐ Lab ☐ Dis ☐ Ind ☐ Other ____
Grading: ☒ A-E ☐ CR/NC ☐ P/F ☐ S/U
Location: ☒ Ann Arbor ☐ Biological Station ☐ Camp Davis ☐ Extension
Course is Y Graded ☐

Cognizant Faculty Member: Jeffrey Liker
Title: Professor
Grad Course: Attach nomination if Cognizant Faculty is not a regular graduate faculty

Approval Info / Approved by Name / Approved Date
- ☐ Curriculum Comm. ____
- ☐ Faculty ____
- ☐ Cross listed Unit 1 ____
- ☐ Cross listed Unit 2 ____

Submitted By: ☒ Home Dept. ☐ Cross-listed Dept.
Department Chair Name / Chair Signature
Home Dept. [IOE] Mark S. Daskin
Cross-listed Dept(s). [MFG] J. Judy Jin

Form Number

2358

SUPPORTING STATEMENT

This change is requested to better reflect current course content

Are any special resources or facilities required for this course? ☐ Yes ☒ No

Detail the Special requirements

THE UNIVERSITY OF MICHIGAN -- COLLEGE OF ENGINEERING
Course Approval Request
College Curriculum Committee, 1420 Lurie Engineering Center Building

Form Number 2362
Date 10/23/2012
Effective Term Winter 2013
Course Offer Freq ☒ Indefinitely ☐ One term only

Action Requested
◉ New Course
○ Modification of Existing Course
○ Deletion of Course

Complete the following sections:
New Courses - B & C completely
Modifications - A modified information, B & C completely
Deletions - A & C completely

A. CURRENT LISTING		B. REQUESTED LISTING	
Home Department	Course Number	Home Department	Course Number
		IOE Industrial & Operations Engin	568
☐ Cross Listed Course Information		Cross Listed Course Information	
☒ Course Title		Course Title	
		Statistical Learning & Applications in Quality Engineering	
TITLE ABBREVIATION — Time Sched Max = 19 Spaces		TITLE ABBREVIATION — Time Sched Max = 19 Spaces	Stats Learning & Appl
TITLE ABBREVIATION — Transcript Max = 20 Spaces		TITLE ABBREVIATION — Transcript Max = 20 Spaces	Stats Learning & Appl
☒ Course Description		Course Description for Official Publication (Max = 50 words)	
		Statistical learning and data transformation methods to advance quality control techniques for variation reduction. Focus on feature extraction of waveform signals, change point detection for system monitoring, data pattern recognition for fault diagnosis, and Bayes/reinforcement learning for decision making.	
PROGRAM OUTCOMES: ☐ a ☐ b ☐ c ☐ d ☐ e ☐ f ☐ g ☐ h ☐ i ☐ j ☐ k		**PROGRAM OUTCOMES:** ☐ a ☐ b ☐ c ☐ d ☐ e ☐ f ☐ g ☐ h ☐ i ☐ j ☒ k	
Degree Requirements ○ Degree Requirement ○ Core Course ○ Free Elective ○ Tech Elective ○ Other		**Degree Requirements** ○ Degree Requirement ○ Core Course ○ Free Elective ◉ Tech Elective ○ Other	
Prereq		Prereq IOE 466 or Stats 500	
☒ ○ Enforced ○ Advised		◉ Enforced ○ Advised	
☐ Credit Restrictions		Credit Restrictions	
Level of Credit ☐ Undergrad only ☐ Rackham Grad ☐ Non-Rckhm Grad ☐ Ugrad or Rckhm Grad ☐ Ugrad or Non-Rckhm Grad ☐ All Credit types ☐ Rckhm Grad w/add'l Work		**Level of Credit** ☐ Undergrad only ☐ Rackham Grad ☐ Non-Rckhm Grad ☐ Ugrad or Rckhm Grad ☐ Ugrad or Non-Rckhm Grad ☒ All Credit types ☐ Rckhm Grad w/add'l Work	
☒ Credit Hours Min ___ Max ___ Contact Hrs/Wk ___ Number of Wks ___		☒ Credit Hours Min 3 Max 3 Contact Hrs/Wk 3 Number of Wks 14	

Repeatability (Indi Research, Dir. Study, Dissertation: Is this course repeatable? ○ Yes ◉ No Max Hours? 3 Max Times? 1 Can it be repeated in the same term? ○ Yes ◉ No

C.

☒ **Class Type(s)** ☒ Lec ☐ Sem ☐ Dis ☐ Other ___ ☐ Rec ☐ Lab ☐ Ind

Graded Section ☐ Lec ☐ Sem ☐ Dis ☐ Other ___ ☐ Rec ☐ Lab ☐ Ind

Grading ☒ A-E ☐ CR/NC ☐ P/F ☐ S/U

Course Is Y Graded ☐

Location ☒ Ann Arbor ☐ Biological Station ☐ Camp Davis ☐ Extension

Cognizant Faculty Member: J. Judy Jin
Title: Professor

Grad Course: Attach nomination if Cognizant Faculty is not a regular graduate faculty

Approval Info	Approved by Name	Approved Date
☐ Curriculum Comm.		
☐ Faculty		
☐ Cross listed Unit 1		
☐ Cross listed Unit 2		

Submitted By: ☐ Home Dept. ☐ Cross-listed Dept.

Department Chair Name [IOE] Mark S. Daskin
Chair Signature

Home Dept. ___
Cross-listed Dept(s). ___

Form Number

2362

SUPPORTING STATEMENT

see attached documentation

Are any special resources or facilities required for this course? ☐ Yes ☒ No

Detail the Special requirements

IOE591- Statistical Learning and Applications in Quality Engineering (3credits)

Instructor: Judy Jin (IOE)

Winter 2013 (9:30am~11am Tu/Th)

Course justification and description:

The wide deployment and applications of automatic sensing devices and computer systems have resulted in a temporally and spatially dense data-rich environment, which provides unprecedented opportunities for quality improvement in various engineering systems. However, conventional SPC (statistical process control) techniques that mainly focus on sampling theory and control charting techniques do not fulfill the needs due to complex variation patterns concealed in high dimensional heterogeneous data collected from disparate sources. Therefore, there are increasing interests in integrating advanced statistical learning and data transformation methods to advance conventional SPC techniques for improving monitoring, diagnosis and decision making performance. This course aims to provide graduate students with the knowledge and skilis necessary to understand and apply statistical learning and data transformation methods to advance quality control techniques for variation reduction in complex system operations. Topics covered will include the selected statistical learning and data transformation methods for feature extraction from high dimensional functional waveform data, changes detection for online system monitoring, data pattern recognition for fault diagnosis and knowledge discovery, and Bayes and reinforcement learning for decision making.

Pre-requite courses:

Probability and statistics (Equivalent to IOE265, IOE366, or Stats 500)
Statistical Process Control (Equivalent to IOE466)

Textbook and Software:

- Required textbook: Duda, R. O., Hart, P. E., and Stork, D. G., *Pattern Classification, 2nd ed.*, Wiley, 2001.
- Required software skill: Matlab will be used in the course for homework and projects.

- Optional reference book: "The Elements of Statistical Learning" by Hastie, Tibshirani and Friedman (2001). Springer-Verlag.
- Optional Matlab program reference: Stork, D. G. and Yom-Tov E., *Computer Manual in MATLAB to Accompany* Pattern Classification, Wiley, 2004.

Additional lecture notes will be provided for FFT/short time frequency analysis and wavelets on ctools course website

Tentative course outline

		Winter 2013: starts on Jan 9th Wednesday
week	Date	Topic
1	10-Jan	Course introduction (course overview and requirements)
2	15-Jan	overview of advance quality control topics
		Improve online process monitroing decision
	17-Jan	MLE and Bayesian Estimation
3	22-Jan	Bayesian classifer and Naïve Bayes
	24-Jan	discriminant functions vs multivariate monitoring
4	29-Jan	Minimum error classification vs optimal process monitoring
	31-Jan	Bayesian estimation and adaptive process monitoring
		Extract informative featuers for data dimension reduction (nonparametric approach)
5	5-Feb	variation pattern analysis via Principal Component Analysis (PCA)
	7-Feb	ossilation signal analysis via FFT /short time frenquency analysis
6	12-Feb	nonstationary irregular signals using wavelets (I: wavelets transform basis)
	14-Feb	nonstationary irregular signals using wavelets (II: wavelets thresholding)
7	19-Feb	Feature selection/search methods
	21-Feb	multivariate process monitoring using transformed features
8	26-Feb	multivariate process monitoring using mixed effect model of transformed features
	28-Feb	Exam 1
9	5-Mar	vacation
	7-Mar	vacation
		Data pattern identification for variation inference, diagnosis, and knowledge discovery
10	12-Mar	SVM classifier
	14-Mar	Kernel methods
11	19-Mar	decision trees
	21-Mar	K-mean clustering
12	26-Mar	unspervised Bayessian learning
	28-Mar	cluster metric and diatance measures
13	2-Apr	criterion functions for clustering
	4-Apr	hierarical clustering
14	9-Apr	Exam 2
		Introduce other selected topics depend on class students' interests
	11-Apr	logistic regressin / B-spline regression
15	16-Apr	Complex PCA, Multiple linear PCA, ICA, Sparse components analysis
	18-Apr	rule based learning, reinforcement learning
16	23-Apr	students' project presentation

Course grading (3credits): Total=100%

Homework	= 40%
Exam 1 and Exam 2	= 30% (15% each)
Team project	=30%
(Report + Presentation + programming	= 10%+10%+10%)

Homework (Limited collaboration):

You may discuss this homework assignment with your fellow students at the conceptual level, but must complete all calculations and write-up, from scrap to final form, on your own. Verbatim copying of another student's work is forbidden. You may not consult homework solutions from a

previous term unless they are made available in a publicly accessible form (no unfair advantage can be sought).

Exams:

Each student must complete the exam solely by her or his own effort. The exam must be completed within the specified time. Open book and open notes in the exams.

Group Project Work:

All group work is to be completed only within your own group. The group members are self-formed. The group size will be determined later based on the class registration.

Project Requirement

The total project grade will be 30% of your final grade, which includes 3 parts: report, presentation, and Matlab programming and documentation (each 10%.)

1. **Report Requirements (Last day of the class)**

The contents of the report must include:

- Introduction (i.e. background, objectives, and a brief summary of the results)
- Description of the proposed approaches/methods/analysis procedures/flowchart
- Detailed data analysis results, comparison with traditional methods, and justification of you new findings/contributions
- Conclusions (your method's advantages and limitations)
- Future work

2. **Presentation Requirements**

- All students are required to attend and provide the grade for other groups' presentation.
- Each group will give a 25 minute presentation, plus additional 5 mins for questions.

3. **Matlab code and program documentation (electronic files)**

- Matlab codes with essential comments in your codes about the purpose/ functions;
- provide flowcharts by listing your major modules/functions, and their relationships
- Provide the documentation to explain how to install and run your program
- Provide the data documentation to explain your data structures
- Provide your data set used in the project.

Additional references

Linear/nonlinear profile monitoring

1. Kang, L., and Albin, S. L. (2000) On-line Monitoring When the Process Yields a Linear Profile. *Journal of Quality Technology*, 32, 418-426.
2. Kim, K., Mahmoud, M. A., and Woodall, W. H. (2003) On the Monitoring of Linear Profiles. *Journal of Quality Technology*, 35, 317-328.
3. Mahmoud, M. A. and Woodall, W. H. (2004) Phase I Analysis of Linear Profiles with Calibration Applications. *Technometrics*, 46, 380-391.
4. Mahmoud, M. A., Parker, P. A., Woodall, W. H., and Hawkins, D. M. (2006) A Change Point Method for Linear Profile Data. *Quality and Reliability Engineering International*, 23, 247-268.
5. Paynabar, K., Jin, J., and Yeh, A. "Phase I Risk-Adjusted Control Charts for Monitoring Surgical Performance by Considering Categorical Covariates," to appear in *Journal of Quality Technology.*
6. Walker, E., and Wright, S. P. (2002) Comparing Curves Using Additive Models. *Journal of Quality Technology*, **34**, 118-129.
7. Williams, J. D., Woodall, W. H., and Birch, J. B. (2007) Phase I analysis of nonlinear product and process quality profiles. *Quality and Reliability Engineering International,* 23, 925–941.
8. Williams, J. D., Woodall, W. H., and Birch, J. B. (2007) Phase I analysis of nonlinear product and process quality profiles. *Quality and Reliability Engineering International,* **23**, 925–941.

Monitoring and diagnosis using clustering/classification

9. Ding, Y., Zeng, L., Zhou S., (2006) Phase I analysis for monitoring nonlinear profiles in manufacturing processes. *Journal of Quality Technology*, **38**, 199-216.
10. Jin, J., and Shi, J. (2001). Automatic feature extraction of waveform signals for in-process diagnostic performance improvement. *Journal of Intelligent Manufacturing*, **12,** 140-145.
11. Lei, Y., Zhang, Z., and Jin, J. (2010) "Automatic Tonnage Monitoring for Missing Part Detection in Multi-Operation Forging Processes," *ASME Transactions, Journal of Manufacturing Science and Engineering,* Vol. 132, No. 5.
12. Yang, Q. Jin, J., and Chang, T. (2010) "Automatic Feature Extraction and Classification of Surface Defects in Continuous Casting," *Transactions of the NAMRI/SME,* Vol.38, pp.563-570.
13. Zhang, H., and Albin, S. (2007) Determining the number of operational modes in baseline multivariate SPC data. *IIE Transactions-Quality and Reliability Engineering*, **39**, 1103-1110.

14. Ertoz, L., Steinbach, M., and Kumar, V. (2003) Finding clusters of different sizes, shapes and densities in noisy high dimensional data. Presented at the SIAM International Conference on Data Mining, San Francisco, CA, USA, May 2003.

15. Fraley, C., and Raftery, A. (1998) How many clusters? Which clustering method? Answers via model-based cluster analysis. *The Computer Journal*, **41**, 578–588.

16. Kothari, R., and Pitts, D. (1999) On finding the number of clusters. *Pattern Recognition Letters*, **20**, 405–416.

17. Zou, C., Tsung, F., and Wang, Z. (2008) Monitoring Profiles Based on Nonparametric Regression Methods. *Technometrics*, **50**, 512-526.

Wavelets denoising and nonlinear profile monitoring

18. Chicken, E., Pignatiello, J. J., and Simpson, J. R. (2009) Statistical process monitoring of nonlinear profiles using wavelets. *Journal of Quality Technology,* 41, 198-212.

19. Donoho, D. L., and Johnstone, I. M. (1995) Adapting to unknown smoothness via wavelet shrinkage. *Journal of American Statistical Association*, **90**, 1200–1224.

20. Fan, J. (1996) Test of Significance Based on Wavelet Thresholding and Neyman's Truncation. *Journal of the American Statistical Association*, **91**, 674-688.

21. Jeong, M. K., Lu, J. C., and Wang, N. (2006) Wavelet-based SPC procedure for complicated functional data. *International Journal of Production Research*, 44, 729-744.

22. Jin, J. and Shi, J. (1999) Feature-preserving data compression of stamping tonnage information using wavelets. *Technometrics*, 41, 327–339.

23. Jin, J., and Li, J. (2009) "Multiscale Wavelet Analysis for Mapping Aggregated Signal Features to Embedded Operations," *IIE Transactions on Quality and Reliability,* Vol. 41 (7), pp. 615-625, 2009.

24. Lei, Y., Paynabar, K., Jin, J. and Agapiou, J. (2009) "Cyclic Waveform Signal Analysis for Online Monitoring of Valve Seat Assembly Processes," *Transactions of the NAMRI/SME,* Volume 37.

25. Paynabar, K., Jin, J. (2011) "Characterization of Nonlinear Profiles Variations using Mixed-effect Models and Wavelets," *IIE Transactions on Quality and Reliability Engineering*, 43, 275–290.

Complex PCA, multilinear PCA, ICA

26. Colosimo B. M., and Pacella M. (2009) Complex PCA as an Exploratory Tool for 3-Dimensional Profiles. *Submitted to the Journal of Quality Technology.*

27. Lu, H., Plataniotis, K. N., and Venetsanopoulos, A. N. (2008). MPCA: Multilinear Principal Component Analysis of Tensor Objects, *IEEE Transactions on Neural Networks*, 19, 18-39.

28. Lu, H.; Plataniotis, K. N.; and Venetsanopoulos, A. N. (2006). "Multilinear Principal Component Analysis of Tensor Objects for Recognition," *In Proceedings of the*

International Conference on Pattern Recognition (ICPR 2006), pages 776~779, Hong Kong, China.

29. Lu, H.; Plataniotis, K. N.; and Venetsanopoulos, A. N. (2008b). Uncorrelated Multilinear Principal Component Analysis through Successive Variance Maximization. *In Proceedings of the International Conference on Machine Learning (ICML 2008)*, pages 616~623, Helsinki, Finland.
30. Paynabar, K., Jin, J., and M. Pacella, "Uncorrelated Multilinear Principal Component for Analysis of Multi-Channel Sensing Data." *IIE Transactions on Quality and Reliability Engineering* (*under review*).
31. Yang, Q. and Jin, J. (2011) "Separation of Individual Operation Signals from Mixed Sensor Measurements," to appear in *IIE Transactions on Quality and Reliability Engineering* (received the Best Paper Award in the Annual IE conference).
32. Zhou, S. and Jin, J. (2005), "Automatic Feature Selection for Unsupervised Clustering of Cycle-based Signals in Manufacturing Processes," *IIE Transactions on Quality and Reliability*, Vol. 37 (6), pp.569-584.

Mixed models

33. Demidenko E. (2004) *Mixed Models: Theory and Applications*, Wiley, New York, NY.
34. Jensen, W. A., and Birch, J. B. (2009) Profile monitoring via nonlinear mixed models. *Journal of Quality Technology*, 41,18-34.
35. Jensen, W. A., Birch, J. B., and Woodall, W. H. (2008) Monitoring Correlation Within Linear Profiles Using Mixed Models. *Journal of Quality Technology*, 40, 167–183.
36. Mosesova, S. A., Chipman, H. A., MacKay, R. J., Steiner, S. H. (2006) Profile monitoring using mixed-effects models. *Technical report RR-06-06*, University of Waterloo.
37. Paynabar, K., Jin, J., Agapiou, J., and Deeds, P. (2011) "Robust Leak Tests for Transmission Systems Using Nonlinear Mixed-Effect Models," Accepted by *Journal of Quality Technology*.
38. Qiu, P., Zou, C., and Wang, Z. (2010) Nonparametric Profile Monitoring By Mixed Effects Modeling, *Technometrics*, 52, 265-277.
39. Shiau, J. H., Huang, H., Lin S., and Tsai M. (2009) Monitoring nonlinear profiles with random effects by nonparametric regression. *Communications in Statistics—Theory and Methods*, **38**, 1664–1679.

MLE for change point detection

40. Sullivan, J. H. (2002) Estimating the Locations of Multiple Change Points in the Mean. *Computational Statistics*, **17**, 289-296.
41. Sullivan, J. H., and Woodall, W. H. (1996) A Control Chart for Preliminary Analysis of Individual Observations. *Journal of Quality Technology*, **28**, 265-278.

42. Sullivan, J. H., and Woodall, W. H. (2000) Change-Point Detection of Mean Vector or Covariance Matrix Shifts Using Multivariate Individual Observations. *IIE Transactions-Quality and Reliability Engineering*, **32**, 537-549.

43. Worsley, K. J. (1979) On the likelihood ratio test for a shift in location of normal populations. *Journal of the American Statistical Association*, **74**, 365-367.

44. Zamba, K. D., Hawking, D. M. (2006) A Multivariate Change-point Model for Statistical Process Control. *Technometrics*, **48**, 539-549.

45. Zou, C., Qiu, P., and Hawkins, D. (2009) Nonparametric Control Chart for Monitoring Profiles Using Change Point Formulation and Adaptive Smoothing. *Statistica Sinica*, **19**, 1337-1357.

46. Zou, C., Zhang, Y., Wang, Z. (2006) A Control Chart Based on a Change-Point Model for Monitoring Profiles. *IIE Transactions-Quality and Reliability Engineering*, **38**, 1093-1103.

Multivariate monitoring and causal decomposition

47. Li, J. and Jin, J. (2010) "Optimal Sensor Allocation by Integrating Causal Models and Set-covering Algorithms," *IIE Transactions on Quality and Reliability,* Vol. 42, No. 8, pp. 564-576.

48. Li, J., Jin, J., and Shi, J. (2008) "Causation-based T^2 decomposition for Multivariate Process Monitoring and Diagnosis" *Journal of Quality Technology*, Vol. 40 (1), pp. 46-58.

COURSE PROFILE

Degree Program: IOE MS & PhD **Date:** October 20, 2012

Prepared by: J. Judy Jin

COURSE #: IOE5xx	**COURSE TITLE:** Statistical Learning and Applications in Quality Engineering
TERMS OFFERED: Winter	**For each prerequisite below, "E" denotes Enforced and "A" denotes Advised.**
TEXTBOOKS/REQUIRED MATERIAL: Required textbook: Duda, Hart, and Stork, *Pattern Classification*, Wiley, 2001. Additional reference book: Hastie, Tibshirani and Friedman, The Elements of Statistical Learning, Springer-Verlag. Second edition Douglas C. Montgomery "Introduction to Statistical Quality Control", 6th edition. Selected bibliography in the advanced quality control topic	**PREREQUISITES: IOE 466 or Stats 500 (E)**
INSTRUCTOR(S): J. Judy Jin	**COGNIZANT FACULTY:** J. Judy Jin
CoE BULLETIN DESCRIPTION: To provide graduate students with knowledge and skills necessary to apply statistical learning and data transformation methods to advance quality control techniques for variation reduction, which include feature extraction of waveform signals, change point detection for system monitoring, data pattern recognition for fault diagnosis, and Bayes/reinforcement learning for decision making.	**COURSE TOPICS:** Overview of advanced quality control topics on profile data monitoring and variation diagnosis; Maximum likelihood estimation, Bayes estimation, mixed model, change point detection methods; Selected supervised, unsupervised, and reinforcement learning methods for variation pattern interference and diagnosis; Feature extraction via data transformation and feature selection methods
COURSE STRUCTURE/SCHEDULE: Lectures & discussion 2 per week @ 3 hours	

COURSE OBJECTIVES	Provide knowledge and skills necessary for 1. understanding basic principles and strategies for the advancement of quality control techniques in complex system operations using massive operational data 2. selecting and applying appropriate data transforms for feature extraction of high dimensional data for system monitoring and decision making 3. using supervised and unsupervised learning methods for improving system monitoring, diagnosis, and knowledge discovery,. 4. applying Bayes learning and reinforcement learning for continuously improving system decision making 5. using Matlab in data analysis and problem solving
COURSE OUTCOMES For each course outcome, links to the Program Outcomes are identified.	1. Use data classification and clustering methods to analyze data variation patterns for identifying the opportunity of quality improvement (1,2,3,5, 2. Apply data transformation methods to extract low dimensional informative features from high dimensional functional data for system monitoring, variation inference, and fault diagnosis (1, 2, 3. Apply Bayes learning and reinforcement learning for improving system modeling and decision making (1,2,3,5, 4. Use Matlab program to implement the data analysis methods (2,8,9,10,11) 5. Formulate and present a topic for improving a conventional quality control method (5,8,9,10) 6. Team project and presentation (4,6,7,11) 7. Read and understand literature in applying statistical learning methods to advance quality control techniques (1,5,6,8,9,10, 11)

ASSESSMENT TOOLS For <u>each</u> assessment tool, links to the course outcomes are identified.	1. Homework assignments about every two weeks (1, 2, 3, 5, 6, 11) 2. Midterm Exam (1, 2, 3, 5, 3. Final team project: report and oral presentation (1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11)

Revised 11 11 04

University of Michigan
Office of the Registrar - Evaluations
ro.umich.edu/evals/

Winter 2010 Final
9 students responded out of the total enrolled 9

Instructor Report

2010-04-09 - 2010-04-21 Report ID: MSR04732

Instructor: Jin,Judy
IOE 591 023

		Responses from your Students**							Other Users of This Item*					
									University Wide			School/College		
		5 SA	4 A	3 N	2 D	1 SD	NA	Your Median	75% Above	50% Above	25% Above	75% Above	50% Above	25% Above
1	Overall, this was an excellent course.	7	2	0	0	0	0	4.86	3.83	4.17	4.60	4.08	4.33	4.67
2	Overall, the instructor was an excellent teacher.	7	2	0	0	0	0	4.86	4.00	4.50	4.81	4.20	4.55	4.80
3	I learned a great deal from this course.	7	2	0	0	0	0	4.86	3.95	4.25	4.67	4.17	4.42	4.71
4	I had a strong desire to take this course.	6	2	1	0	0	0	4.75	3.53	4.02	4.50	4.09	4.38	4.64
121	I gained a good understanding of concepts/principles in this field.	6	2	0	0	0	0	4.83	3.93	4.17	4.50			
140	I deepened my interest in the subject matter of this course.	7	2	0	0	0	0	4.86	3.81	4.17	4.58			
160	I participated actively in class discussion.	4	4	0	0	0	0	4.50	3.88	4.13	4.50			
201	The instructor gave clear explanations.	6	3	0	0	0	0	4.75	4.00	4.38	4.75			
202	The instructor made good use of examples and illustrations.	7	2	0	0	0	0	4.86	4.00	4.31	4.70			
205	The instructor put material across in an interesting way.	6	3	0	0	0	0	4.75	4.00	4.42	4.78			
207	The instructor appeared to have a thorough knowledge of the subject.	8	1	0	0	0	0	4.94	4.42	4.75	4.92			
211	The instructor was sensitive to student difficulty with course work.	8	1	0	0	0	0	4.94	4.00	4.40	4.71			
217	The instructor treated students with respect.	7	2	0	0	0	0	4.86	4.50	4.75	4.89			
218	The instructor encouraged constructive criticism.	6	3	0	0	0	0	4.75	4.09	4.50	4.78			
219	The instructor was willing to meet and help students outside class.	7	2	0	0	0	0	4.86	4.30	4.66	4.83			
229	The instructor used class time well.	7	2	0	0	0	0	4.86	4.00	4.38	4.70			
230	The instructor seemed well prepared for each class.	8	1	0	0	0	0	4.94	4.23	4.63	4.83			
232	Work requirements and grading system were clear from the beginning.	5	4	0	0	0	0	4.60	4.00	4.25	4.60			
241	The instructor set high standards for students.	6	3	0	0	0	0	4.75	4.13	4.43	4.71			
319	Writing assignments were interesting and stimulating.	5	3	0	0	0	1	4.70	3.55	3.94	4.27			
327	Reading assignments were interesting and stimulating.	4	4	0	0	0	1	4.50	3.50	4.00	4.25			
340	The textbook made a valuable contribution to the course.	4	3	1	1	0	0	4.33	3.50	4.00	4.33			
365	Grades were assigned fairly and impartially.	5	4	0	0	0	0	4.60	3.93	4.17	4.50			

* The quartiles are calculated from Winter 2010 data. The university-wide quartiles are based on all UM classes in which an item was used. The school/college quartiles in this report are based on graduate level students in College of Engineering.

** SA - Strongly Agree, A - Agree, N - Neutral, D - Disagree, SD - Strongly Disagree, NA - Not Applicable.

E&E Office of Evaluations & Examinations
The University of Michigan

Instructor Report

Winter 2008

Instructor: Jin, Jionghua

IOE 591, Section 023 (272-591-023-1)

	Item	Responses from Your Students							Other Users of This Item *					
									University Wide			School/College		
		5 SA	4 A	3 N	2 D	1 SD	NA	Your Median	75% Above	50% Above	25% Above	75% Above	50% Above	25% Above
1	Overall, this was an excellent course.	7	2	0	0	0	0	4.86	3.86	4.19	4.63	4.00	4.32	4.67
2	Overall, the instructor was an excellent teacher.	8	1	0	0	0	0	4.94	4.04	4.50	4.79	4.08	4.50	4.80
3	I learned a great deal from this course.	7	2	0	0	0	0	4.86	3.89	4.21	4.63	4.06	4.39	4.68
4	I had a strong desire to take this course.	7	2	0	0	0	0	4.86	3.36	3.92	4.39	4.00	4.22	4.63
121	I gained a good understanding of concepts/principles in this field.	8	1	0	0	0	0	4.94	3.93	4.15	4.46			
140	I deepened my interest in the subject matter of this course.	7	2	0	0	0	0	4.86	3.81	4.11	4.50			
160	I participated actively in class discussion.	6	3	0	0	0	0	4.75	3.77	4.00	4.33			
201	The instructor gave clear explanations.	8	1	0	0	0	0	4.94	3.95	4.26	4.65			
202	The instructor made good use of examples and illustrations.	9	0	0	0	0	0	5.00	4.00	4.30	4.67			
205	The instructor put material across in an interesting way.	7	2	0	0	0	0	4.86	3.98	4.33	4.69			
207	The instructor appeared to have a thorough knowledge of the subject.	9	0	0	0	0	0	5.00	4.50	4.78	4.92			
211	The instructor was sensitive to student difficulty with course work.	8	1	0	0	0	0	4.94	4.00	4.29	4.63			
217	The instructor treated students with respect.	9	0	0	0	0	0	5.00	4.50	4.75	4.90			
218	The instructor encouraged constructive criticism.	8	1	0	0	0	0	4.94	3.94	4.30	4.67			
219	The instructor was willing to meet and help students outside class.	8	1	0	0	0	0	4.94	4.25	4.61	4.81			
229	The instructor used class time well.	5	4	0	0	0	0	4.60	4.00	4.30	4.64			
230	The instructor seemed well prepared for each class.	8	1	0	0	0	0	4.94	4.25	4.63	4.83			
232	Work requirements and grading system were clear from the beginning.	8	1	0	0	0	0	4.94	3.98	4.25	4.59			
241	The instructor set high standards for students.	8	1	0	0	0	0	4.94	4.00	4.25	4.61			
319	Writing assignments were interesting and stimulating.	6	1	0	0	0	1	4.92	3.69	4.00	4.32			
327	Reading assignments were interesting and stimulating.	7	1	0	0	0	1	4.93	3.44	3.86	4.20			
340	The textbook made a valuable contribution to the course.	6	2	0	1	0	0	4.75	3.31	3.86	4.23			
365	Grades were assigned fairly and impartially.	7	2	0	0	0	0	4.86	3.91	4.17	4.55			
431	Overall, the GSI was an excellent teacher.	6	3	0	0	0	0	4.75	3.83	4.07	4.23			
432	The GSI motivated me to do my best work.	7	2	0	0	0	0	4.86	3.50	3.81	4.04			
433	The GSI gave clear and understandable explanations.	6	3	0	0	0	0	4.75	3.80	3.95	4.22			
434	The GSI appeared to have a thorough knowledge of the subject.	7	2	0	0	0	0	4.86	3.98	4.15	4.31			
435	The GSI graded papers (exams, homework) fairly.	6	3	0	0	0	0	4.75	3.93	4.06	4.24			

Number of students responding to questionnaire: 9

*The quartiles are calculated from Fall 2007 data. The university-wide quartiles are based on all UM classses in which an item was used. The school/college quartiles in this report are based on graduate level classes with an enrollment of in the College of Engineering.

**There were too few classes in this category to generate meaningful comparative statistics.

Proposal for a Concentration in Healthcare Engineering and Patient Safety in the IOE Masters

Amy Cohn, November, 2012

Proposal: We propose to introduce a *Concentration in Healthcare Engineering and Patient Safety* as an option to accompany the IOE Masters program. This concentration would, in addition to fulfilling all Rackham requirements for the IOE Masters, have additional requirements with respect to the course selection of the students. It would also have a mandatory year-long multi-disciplinary open-ended project. Finally, community-building activities would help these students to engage with members of both the IOE and healthcare communities, include faculty and students from the Medical School, School of Public Health, etc. with the goal of being able to immediately begin a high-impact career in the healthcare industry upon graduation.

Motivation and Target Audience: This program is the first step towards fulfilling the educational mission of the Center for Healthcare Engineering and Patient Safety. It is targeted towards students who desire a solid grounding in IOE fundamentals, with the aim of applying these tools in a healthcare environment upon graduating.

Course Requirements: The course requirements are outlined in the attached document. This is based on the input of several faculty members from IOE as well as faculty members from Medicine, Public Health, etc. We are intentionally striving to be very flexible in the beginning, with many options to design a program. Students will be closely mentored in their course selection to ensure a coherent program of study. We recognize that, especially in the first years of the program, changes will need to be made as we become aware of additional courses of relevance, as new courses are introduced, and as we gain better into insight into the courses currently on the list.

Project: In all of our discussions about the proposed concentration, it has been unanimously agreed that an in-depth, hands-on project is essential for creating a highly successful, stand-out academic program. We propose a structure in which students within the concentration would be paired with an engineering faculty member, a clinician or other subject-matter expert, a medical student or resident (or student of nursing, public health, etc.), and possibly others. The concentration would run three semesters (Fall, Winter, Fall), with the project beginning in Winter (3 credits), then full time on-site in the summer, then completing in the second Fall (3 credits).

Request: We request permission to add “Concentration in Healthcare Engineering and Patient Safety” to the transcript

Attachments:

- Program announcement
- Program requirements
- Sample course of study
- Draft text for CoE Bulletin