AMIS 3100H Quantitative analysis in accounting

Spring 2022
2:20-3:40 TR
2040 Fontana Lab
2:20-3:40 F 305 Gerlach Hall (recitation)

Office: Fisher 424
1:00-2:00 TR
schroeder.9@osu.edu
phone: 292-6427

Description: Accounting information system applications of linear algebra are explored including a subspaces representation of double entry accounting structure, a probability assignment description of a decision maker's uncertain state of knowledge, and Bayesian belief updating description of information processing including projections for the case of linear or Gaussian conditional expectations.

Accounting structure is modeled as a linear system composed of four fundamental subspaces: rowspace, columnspace, nullspace, and left nullspace. Efficient information system design draws on nonlinear and/or linear optimization. Consistent information analysis is predicated on probability theory (Bayes theorem). Accounting accruals are statistics whose properties merit study.

Objectives: The course aims to build strong foundations for the study of accounting as an information science. Linear and nonlinear modeling are valuable tools for disciplining and deepening our understanding of accounting – in other words, the pursuit of accounting information science.

Textual materials: Notes and example problems are posted on the course web page.
http://u.osu.edu/schroeder.9/amis-3100h/

Recommended but optional texts include
Christensen and Demski (CD), Accounting Theory: An Information Content Perspective, McGraw-Hill Irwin, 2003.
Demski (D), *Managerial Uses of Accounting Information*, Springer, 2008.
Strang, *Introduction to Linear Algebra*, Wellesley-Cambridge Press, 2009.
Nielsen and Chuang, *Quantum Information and Quantum Computation*, Cambridge University Press, 2000.
Pearl, Glymour, and Jewell, *Causal Inference in Statistics: A Primer*, Wiley & Sons, 2016.

Classroom approach: Students are expected to actively engage in discussion of topics with an emphasis on recognizing the intersection of the various topics. That is, we will attempt to reinforce commonalities across topics and not start from scratch with each topic. Each session tests our understanding and active participation is expected.
The final project is a directed graph analysis of a public, private, or imagined firm (see Ralph's financial statement analysis for a template).
The course concludes with a final written exam during the university exam period.

Evaluation:

Classroom participation, positive contribution to learning environment, quizzes, homework	80%
Final project	10%
Final exam	10%

tentative outline:

Session	Topic	Assignment
1-2	Introduction – incidence matrix, directed graph, aggregate accounts	Ralph's structure; Appendix A
3	Linear systems of equations – fundamental theorem of linear algebra; matrix operations (addition, multiplication, vector inner & outer products, transposition)	Ralph's subspaces; appendix A.2
4-5	Identities & inverse operations	Ralph's inverse; appendix A.3
6-7	Triangularization – LU factorization	Ralph's decomposition; appendix A.3, A.4
8-9	Diagonalization – eigenvalues & eigenvectors	Ralph's equilibrium; appendix A.4
10-11	Diagonalization – Cholesky & spectral decomposition	Ralph's symmetry; appendix A.4
12-13	Singular value decomposition & pseudo-inverse and QR decomposition	Ralph's row component; appendix A.4, A.5
14	Optimization – fundamental theorem of linear programming, duality theorems, framing, theorem of the separating hyperplane,	Ralph's aggregate accounts; D ch. 8, appendix A.1, H.1 Ralph's derivatives
15-16	Introduction – uncertainty and optimization; Lagrangian, Karush-Kuhn-Tucker conditions	Ralph's probability assignment; Ralph's density assignment; ch. 4 Maximum entropy distributions, appendix H.2 Ralph's equilibrium probability assignment; Information Synergy: Part 1
17-18	Optimization – linear regression & projections; Prediction	Ralph's estimate; Ralph's optimal accruals; ch. 2, appendix D.1
19	Optimization – linear regression & projections & conditional expectations, GLS & Cholesky decomposition	Ralph's double residual regression; Ralph's GLS; ch. 2.7, appendix D.2
20	Bayes theorem (sum & product rules, law of total probability, iterated expectations, variance decomposition)	Ralph's Bayesian accruals; Appendix C
21	Bayes theorem (sum & product rules, law of total probability, iterated expectations, variance decomposition)	Bayesian Ralph; CD ch. 5; appendix B, C

Session	Topic	Assignment
22	Classical information analysis – Bayes normal	Ralph's accounting information; appendix C, notes
23-25	The future of science: Structural causal modeling	Ralph's technology A & C; Ralph's back-door adjustment; Ralph's path coefficients
26-28	Quantum information theory; everything is information, Bell's inequality,	Ralph's teleportation; Ralph's inequality; Ralph's density operator;

	pure and mixed state systems	appendix I

Final exam and project due
Wed, 4/27/22
2:00-3:45 pm