AMIS 3100H Quantitative analysis in accounting
Spring 2023
2:20-3:40 TR
330 Schoenbaum Hall
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
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; <br> Lagrangian, Karush-Kuhn-Tucker conditions | Ralph's probability assignment; <br> Ralph's density assignment; <br> ch. 4 Maximum entropy distributions, appendix H. 2 <br> Ralph's equilibrium probability assignment; <br> Information Synergy: Part 1 |
| 17-18 | Optimization - linear regression \& projections; Prediction | Ralph's estimate; <br> Ralph's optimal accruals; <br> 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 |


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| :---: | :---: | :---: |
| 22 | Classical information analysis - Bayes <br> normal | Ralph's accounting information; <br> appendix C, notes |
| $23-25$ | The future of science: <br> Structural causal modeling | Ralph's technology A \& C; <br> Ralph's back-door adjustment; <br> Ralph's path coefficients |
| $26-28$ | Quantum information theory; <br> everything is information, <br> Bell's inequality, <br> pure and mixed state systems | Ralph's teleportation; <br> Ralph's inequality; <br> Ralph's density operator; <br> appendix I |

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[^0]:    Final exam and project due
    Wed, 4/26/23
    2:00-3:45 pm

