Accounting Structure
Preliminary Syllabus
Fall 2005

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Overview of the Course

In this course we analyze some standard accounting and auditing problems, and achieve rigorous answers to the problems stated. However, the main purpose of the course goes well beyond the particular answers achieved. Rather, it is to use the analysis of the accounting problems to access some of the finest thinking the University has to offer.

In the first part of the course simplified sets of financial statements are presented and questions are posed. Notice this reverses the order in a standard accounting cycle which starts with transactions and journal entries and ends with financial statements. One reason to reverse the order is to learn something about accounting; a good way to learn anything is to do it backwards. Also, for many users of accounting, financial statements are the natural starting point. So, for many tasks, setting up the problem with statements first is the sensible direction.

Given the financial statements, the questions we ask are of two inter-related types: an invertibility question and an auditing question. The invertibility question is of the following form: what are the transaction amounts (journal entries) which generated the given financial statements? Typically, there is not a unique set of journal entry amounts which could have generated the statements, so the task is to calculate (upper and lower) bounds on the journal entry amounts. An auditing activity supplies additional evidence about the journal entry amounts. The question then becomes the following: is the additional evidence consistent with the financial statements as presented?

The tools used for answering the questions are some important mathematical theorems based in linear algebra. In fact, arguably the two most important theorems in applied mathematics are the duality theorems (as in linear programming) used for optimization problems, and the projection theorems (of Gauss) used for estimation. The mechanics of double entry accounting offer straightforward and visually pleasing examples of these theorems.

The course does not presume any prior exposure to linear algebra; the techniques and the theorems can be learned as we apply them to accounting examples. In fact, accounting is a clean and, I think, illuminating example of linear algebra, and a study of one is an efficient way to learn the other. Besides using the linear algebra to increase our understanding of accounting, we will be using accounting to learn linear algebra.

As the theorems work just as well on large problems as small ones, we illustrate the theorems with published financial statements and ask the same invertibility and auditing questions.

A final topic explicitly considers how accounting numbers march through time: an estimation problem which evolves over time is posed and solved. A number called the "golden ratio" arises in a special case of the solution. (The golden ratio has an interesting history going back to Luca Pacioli.) The golden ratio is logically connected to the "logarithmic spiral" which, in turn, is quite useful in solving compound interest problems. Both the golden ratio and the logarithmic spiral are depicted in the art work in the entranceway of Gerson Hall.

Course Requirements

There will be an in-class midterm and a final exam. The midterm is scheduled for the end of the fourth week of class. The final will be during finals week at the time scheduled by the University. The midterm counts for 40% of the course grade, the final 50%. The remaining 10% is based on contributions to the learning environment.

Tentative Course Schedule

Week 1	Reading: *Introduction and Set-Up* We introduce a visual and algebraic representation of the accounting system. The visual (directed graph) representation is used to solve the various problems posed in the course; the algebraic representation verifies why the visual approach works.
Week 2	Reading: *Point Estimate for an Individual Transaction* Start with a simple audit problem; suppose there is additional evidence about the amount of a particular transaction. Is the additional evidence consistent with the given financial statements? The Theorem of the Separating Hyperplane is quite useful.
Week 3	Reading: *A Priori Bounds on Individual Transaction Amounts* *Review of Linear Programming (and duality)* Calculating bounds on transaction amounts is accomplished using linear programming.
Week 4	Reading: *Nearest Distance to Consistent Statements and Orthogonality* Suppose the additional audit evidence is not consistent with the given financial statements. What is the "smallest" adjustment required to the statements? A Projection Theorem is quite helpful.
Week 5	Reading: *Coldwater Creek, Microsoft* Two examples are presented which apply the techniques of optimization and estimation to sets of published financial statements.
Week 6	Reading: *An Estimation Problem and T-Accounts* *Compound Interest and the Logarithmic Spiral* Orthogonality is used to solve an estimation problem that evolves as time passes; T-accounts are a useful way to keep track of the estimates over time. The golden ratio arises which, in turn, leads to the logarithmic spiral and compound interest problems.