

AMRE 2008

FirstEnergy

Project Title: Forecasting Monthly Peak Demands
Student Participants: Rishabh Bhandari Corbin Boisvert, Mary Rhollans
Faculty Advisor: Dr. John Ramsay (Mathematics)

This research focused on the following seven companies under FirstEnergy:

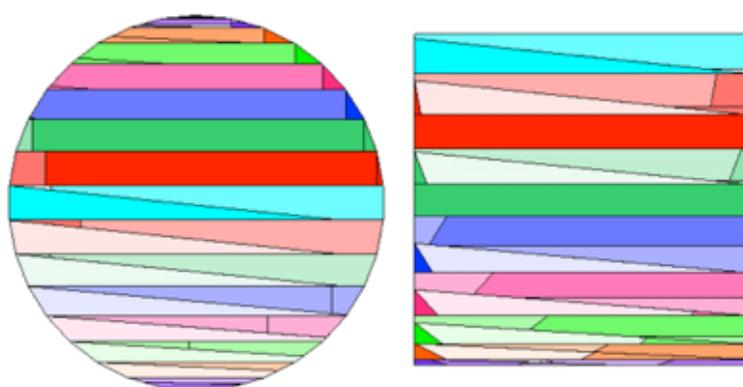
- Ohio Edison (OE)
- Toledo Edison (TE)
- The Illuminating Company (CEI or CE)
- Penn Power (PP)
- Penelec (PN)
- Met-Ed (ME)
- Jersey Central Power & Light (JCPL or JC)

The purpose of this study is to create a model to forecast monthly peak energy consumption for each of the seven FirstEnergy companies. We began our research by analyzing and interpreting different historical data sheets from 2002-2007. We analyzed customer data sheets that detail the number of households that fall under FirstEnergy's energy supply. Hourly load data sheets helped us understand 'load' terms of the energy industry. We familiarized ourselves with definitions and forecasting methods pertinent to this project. We analyzed energy consumption corresponding to different weather and economic variables, and examined the effects of price changes on energy usage. Our final model takes two distinct approaches. The first is a weather-driven probabilistic simulator. Second, we have developed a seasonal binary regression model.

College of Wooster Mathematics (HHMI Grant)

Project Title: Undergraduate Research in Analysis
Student Participants: Jeffrey Willert and Wenyuan Wu
Faculty Advisor: Dr. Pamela Pierce (Mathematics)

Tarski's Circle-Squaring problem asks whether it is possible to decompose a circle into finitely many pieces and form a square. In 1990, Laczkovich showed that this was theoretically possible, but the upper bound given for the number of pieces required is large 1050 and the pieces are very difficult to describe. During the 2007 summer research program, Jeffrey Willert '09 and Mary Rhollans '10 developed a visual approach for squaring an approximate circle, and began their work by looking at dissections of even



A Squared 34 - gon looks nearly like a circle with only 0.568 % error. It takes 64 pieces to square the 34 - gon.

sided regular polygons.

During the 2008 summer research program, Jeffrey Willert and Wenyuan Wu '11 continued developing a visual approximation of the circle squaring process. By considering a variety of possible cases, they developed an algorithm that would accurately describe the location of the cuts needed to dissect the regular polygons and count the number of pieces required for any n-gon. This algorithmic approach was crucial as they worked with the computer science team to animate the process of dissecting the polygons and translating the pieces to form a square. They worked to answer other questions as well, including those dealing with boundary and vertex issues which must be answered when completing a decomposition.

College of Wooster Computer Science (HHMI Grant)

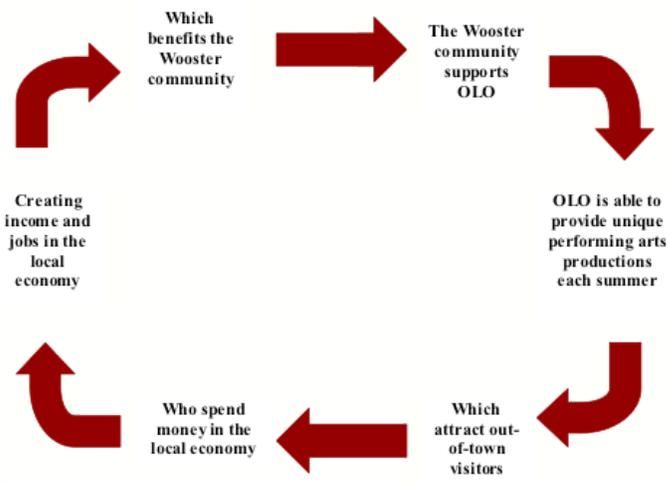
Project Title: Undergraduate Research in Analysis
Student Participants: Sarah Anderson and Mike Liberatore
Faculty Advisor: Denise Byrnes (Computer Science)

In 1925, Alfred Tarski posed the question of whether or not a circle could be cut into finitely many pieces to be rearranged to form a square. In an attempt to solve the problem, 2007 summer research students Jeffrey Willert and Mary Rhollans developed an algorithm that could approximate the process of squaring a circle. Our goal for the summer was to create an educational animation of this approximate circle-squaring algorithm. The purpose of the animation is to thoroughly communicate the concepts and procedures of the algorithm in order to assist the viewer’s understanding. As a result, we did extensive research on algorithm visualization to find how to optimize the viewers understanding of the algorithm through our animation. We discovered that there are key factors in an animation that increase the benefit of the animation for the viewer. Using these key factors, we implemented the visualization of the circle-squaring algorithm as effectively as possible. The animation of the approximate circle-square algorithm is available on the web along with additional information and completed work.

Ohio Light Opera

Project Title: Assessing Economic Value of The Ohio Light Opera
Student Participants: Jacqueline Rau and Chad Setliff
Faculty Advisor: Dr. James Hornsten (Economics Department)

Ohio Light Opera (OLO) is an internationally renowned artistic and educational enterprise and the only performance company in the nation dedicated to art of operetta. Not only does it offer an opportunity for Wooster residents to experience the arts, but it also attracts patrons from all over the world. These outside visitors spend money on OLO tickets, dining out, retail, lodging and other expenses in the local economy. This infusion of external spending makes a substantial contribution to the local economy of Wooster. In other words, beyond its obvious cultural role in the community, OLO has an important economic impact. The purpose of this project was to estimate the value of the economic benefit that OLO brings to the residents of Wooster each summer.



We designed and distributed surveys to OLO patrons to estimate visitor spending in Wooster that would not exist if not for OLO. Then, we estimated the extent to which this spending cycles through the economy, creating additional economic activity, jobs, and income.

Prentke Romich AAC

Project Title: Enhancement and Maintenance of PRC Software Tools

Student Participants: Daniel Norris and Matthew Snively

Faculty Advisor: Denise Byrnes (Computer Science)

Progressive Insurance

Project Title: : Approximating Credit Based Insurance Scores

Student Participants: Rob Ashmead, Aung Maw Myo Lwin, Itai Njanji

Faculty Advisor: John Ramsay and Pam Pierce (Mathematics)

The purpose of this project was to approximate a model that calculates credit-based insurance scores. Secondly we were to compare our approximated model to a second model to make comparative analysis. To approximate the model, we created definitions for variables and wrote an excel program to calculate the scores for large amounts of data. We performed analysis on such areas as the weighting of the variables and how different variables affected the scores. Our results will give Progressive Insurance a better understanding of the similarities and differences between the two credit based insurance models.

AMRE 2007

Main Street Wooster

Project Title: Main Street Wooster Phase II

Student Participants: Anoop Parik, Jason Berry, Carolyn Ciriego

Faculty Advisor: Dr. Jon Breitenbucher (Mathematics) and Dr. Michelle Johnson (Communication)

The primary purpose of this project was to acquire detailed information about downtown Wooster consumers and business owners. We used the 2003 study as a springboard to further investigate ways in which downtown Wooster could be made more appealing to consumers. The main areas of study were consumer and business owner needs, habits, and expectations regarding downtown. We focused on areas such as the success of current advertising methods, the impact of special events, and the improvements that both consumers and business owners would like to see downtown.

Surveys were conducted across four groups: business owners, consumers who visit downtown, consumers who never visit downtown, and COW students. Our goal was to create an action plan for the downtown area based on the result of the data analysis.

Along with this aspect of the project, we worked on developing a website prototype for businesses downtown. We worked with Treasures by the Pound and created a website that focuses primarily on providing information to consumers and advertising. Treasures by the Pound can potentially set up e-commerce through the website. In the future, other downtown businesses can use the Treasures by the Pound website as a model for developing their own web presence. We also worked towards finding ways to allow Main Street Wooster to increase web presence and finding ways to utilize the web as best as possible. Our report included a set of recommendations regarding website development for MSW.

Ohio Agricultural Research and Development Center (OARDC)

Project Title: Tomato Genetic Database Finalization
Student Participant: Traian Andrei
Faculty Advisor: Dr. Denise Byrnes (Computer Science)

The AMRE team finalized the tomato mapping resource by adding all remaining tomato data to the database. The existing database structure was analyzed to determine if renormalization is necessary before the new data was added. The existing software was restructured and documented where necessary. Additional features were added in order to expand the usefulness of the current application; as an example, the ability to add tomato data from the user interface.

College of Wooster Mathematics

Project Title: Undergraduate Research in Analysis
Student Participants: Jeffrey Willert and Mary Rhollans
Faculty Advisor: Dr. Pamela Pierce (Mathematics)

For the very first time, the 2007 AMRE program had one team working on a research project in pure mathematics. Students on this team were funded by a college grant from the Howard Hughes Medical Institute, but were incorporated into the AMRE program and presented their research alongside the other groups working on applied problems in business and industry. This provided a unique opportunity for all AMRE participants to see the interplay between research in pure and applied mathematics.

The purpose of our project was to research the history and solutions of Tarski's circle squaring problem: can a circle be sliced into finitely many pieces that can be rearranged to form a square of equal area? Delving into topics on equidecomposability, isometric-motions, and constructibility lead to the development of an algorithm that can be applied to the dissection of any regular 2n-gon into a square of equal area, using translations only. This process provides a visual approximation for Tarski's problem, and serves to highlight Laczkovich's remarkable proof. The project culminated in a research article which we hope to publish in a mathematics journal.

College of Wooster Social Entrepreneurship

Project Title: Social Entrepreneurship Program Evaluation
Student Participants: Alex Balloon, Emily Blackie, and Erik Larson
Faculty Advisor: Dr. Heather Fitz Gibbon (Sociology)

This research measures the outcomes of the Social Entrepreneurship program with respect to its primary stakeholders: the nonprofit agencies, the students, and the faculty. The evaluators also interviewed some other parties of interest to the program including Friendtique (a local social entrepreneurship venture), the executive director of United Way of Wayne and Holmes Counties, and a local bank executive. We measured community impact by evaluating: secondary outcomes, networking, mission-related gains, entrepreneurial and business thinking, and effects on non-profit culture.

Progressive Insurance

Project Title: : Market Competitiveness Metric Analysis
Student Participants: Arniko Singh, Natalie Offen, Ben Strecker
Faculty Advisor: Dr. John Ramsay and Dr. Pamela Pierce (Mathematics)

The purpose of this project was to find ways to improve Progressive's calculation of competitiveness and to find an optimal number of competitors to use in that calculation. For a measure of competitiveness, we assume that a company who gives a lower rate to a customer is more competitive than when they give a higher rate. Thus, if Progressive is lower than the rest of the insurance companies, we want a metric that will make them look more competitive. We also want to take into consideration customers' knowledge of a given company, so a low rate from a well known company is weighted more than a low rate from a company who is not well known.

FirstEnergy Inc.

Project Title: Investigating the Price Elasticity of the Demand for Electricity
Student Participants: Muhammad Ahsan Siddiqui, Sam Hickey, Robert Ashmead
Faculty Advisor: Dr. John Ramsay (Mathematics)

The goal of the 2007 FirstEnergy AMRE project was to determine the relationship between electricity usage and changes in electricity price. To examine this relationship we conducted extensive research of energy demand models and price elasticity literature. We then created ordinary least squares econometric models and performed linear regressions on historical electricity data. We performed this analysis for residential and commercial consumers of electricity at the national and state level. Our results will give FirstEnergy a better understanding of consumer behavior in response to electricity price changes.

AMRE 2006

First National Bank

Project Title: Survey of Small Businesses in FNB Market Area
Student Participants: Erik Larson, Ahsan Siddiqui, Russ Dieringer
Faculty Advisor: Dr. Jim Hornsten (Economics)

The purpose of the 2006 First National Bank (FNB) AMRE project was to conduct market research focusing on the local commercial banking market. One of the problems that FNB struggled with was their limited knowledge of their competitors and the satisfaction of their current customers.

To address this problem we designed a telephone survey that focused on businesses overall satisfaction with their bank, the services they used, and their borrowing experience. This phase of the project lasted approximately four weeks, which included doing research at The Ohio State University's Fisher Business Library. The following two weeks were spent conducting the phone calls to approximately 1,850 businesses. The final two weeks of the project were used to analyze the data and prepare a final report for FNB.

With this report, we were able to make recommendations on areas in which FNB could expand. Also, FNB will be able to use the report to develop marketing strategies for its commercial banking services. Finally, FNB will be able to use the report to identify customers that may be currently unhappy with their bank. Overall, this was FNB's first step in becoming more aware of the market in which it operates.

The Goodyear Tire & Rubber Co.

Project Title: Modeling Parameter Modification in Tire Product Pricing Analysis
Student Participants: Rick Drushal, Matt Snively, Andy Nicol

Faculty Advisor: Dr. Dale Brown (Computer Science)

Our goal was to create a prototype for The Goodyear Tire & Rubber Company to figure the actual cost of a tire based on its material composition and the price of the materials. The program we created was to develop a methodology and approach to solving the problem, as the company would be using a different database system from our implementation. We received a Microsoft Access database containing tire production, tire composition, and material price data. From that, we created a Microsoft Excel front end that uses ActiveX Data Objects and SQL queries to retrieve information from the database.

The basic calculator provides three levels of detail. The first is a basic summary that only provides information on the entire tire, comparing the actual cost to an estimated standard cost. The second divides the cost between different groups of materials, and the third breaks down the cost by individual materials. The user is also able to input a date from which the most recent data previous to that date is used for material prices and composition, as well as an arbitrary volume to preview the difference between actual and standard cost with larger numbers of a single tire.

An extension of the basic calculator is a forecasting model that can be used to estimate a new cost of the tire, based on changes to the current cost of material groups or individual materials. The user is able to create multiple forecast scenarios for a single tire, for comparison purposes, and can enact material price changes across multiple tires using a joined list of materials.

A final aspect of the calculator allows for the basic calculator to be applied and summed for an entire population and volume of tires. The available populations are all tires produced in a single plant in a month's time.

The Goodyear Tire & Rubber Company

Project Title: Tire Test Center Job Scheduling
Student Participants: Andrew Sage, Will Morrison, Elizabeth Stroud
Faculty Advisor: Dr. John Ramsay (Mathematics)

The group worked with the Goodyear Tire Test Center to develop a program in Microsoft Excel using Visual Basic that projects a schedule for tire testing on all of Goodyear's human-operated machines. The program reads information from Goodyear's database to update a list of tests waiting to be run. It proceeds to run a series of checks that determine which tests are ready to schedule and which machines can run each test. The program then projects a schedule for all of the jobs on the list or for a specific machine.

After the schedule is created, the projected completion date for each test is recorded and can be compared to the date that the tire is needed. If tests are not being completed in time, users can modify the run-time percentages for different machines in the program in order to analyze the projected effect of increasing labor resources on a machine.

Using the program, Goodyear will be better able to determine how frequently each of its dedicated machines needs to run in order to minimize backup. Additionally, Goodyear will be able to inform clients of projected completion times for their tests as soon as tires are submitted, which they are currently unable to do.

The College of Wooster Maple Project

Project Title: Instructional Technology in Introductory Mathematics Courses
Student Participants: John Gamble, Sam Hickey, Natalie Offen
Faculty Advisor: Dr. Derek Newland (Mathematics)

Our project consisted of rewriting, revising, and creating Maple labs for The College of Wooster math department. Maple is a computer algebra system used in Wooster's calculus and linear algebra courses. When we began the project, the labs existed in varying formats with out of date content. The expectations of the students in many of the labs were very unclear. Our goal was to fix these shortcomings. In addition, Maple has a history of frustrating math students. As a result, we strove to simplify Maple in the introductory calculus labs, and we tried to make the expectations for all students more clear. By researching Maple's new features and taking into account input from students and faculty, we revised the old labs and created new labs to produce a total of thirty-five labs that will be used in Wooster's calculus and linear algebra courses.

Ohio Agricultural Research and Development Center (OARDC)

Project Title: Tomato Analyzer Software Development
Student Participants: Ellen Wagner, Nancy Dujmovic, David Sullivan
Faculty Advisor: Dr. Simon Gray (Computer Science)

This project was a continuation of last year's AMRE project "Tomato Analyzer Software Development." Researchers at the Ohio Agricultural Research and Development Center (OARDC) are interested in which genotypes correlate with which phenotypic traits. To do this, they use an application called Tomato Analyzer. Researchers scan slices of tomatoes and the software calculates various attributes, such as area, perimeter, fruit shape index, and eccentricity. Our team focused on adding new features such as an algorithm to find a tip on a tomato, an algorithm to find points for morphometrics, a new algorithm to calculate the proximal angle, implementing user settings, implementing an internal ellipse to measure various internal fruit attributes, and adding a color calibration tool. Our new features ended up breaking old features due to the interconnectedness of the code, so we ended up spending time fixing those old features as well as fixing bugs as we came across them.

Progressive Insurance

Project Title: Pricing, Segmentation and Decision Metrics Model Simulation
Student Participants: Scott Britton, Jeff Willert, Tim Presto
Faculty Advisors: Dr. Pam Pierce, Dr. John Ramsay (Mathematics)

The purpose of the 2006 Progressive AMRE project was two-fold. The primary objective of this project was to create a simulation of the auto insurance market via a program in Microsoft Excel. Secondary and supplementary to this task is providing a user friendly support system through the User's Manual, which is provided as both a link within the program and a hard copy resource. The simulation provides the user with the ability to manipulate various aspects of the market within the Excel spreadsheet, which allows the individual to make predictions on the outcomes of a variety of events before they happen in the real world market. These events may include competing pricing strategies, the effects of independent, external variables such as brand preference, or the introduction of a new product by an insurance company into the market. Furthermore, Progressive has expressed an interest in using this simulation to supplement its on site "universities", which will utilize this tool as an aid in teaching its employees on the causal relationship between pricing strategy and competitive outcome.

College of Wooster Computer Science

Project Title: Seeing the Coding Process: Increasing Novice Program Development Skills through Video-enhanced Case Studies
Student Participants: Traian Andrei
Faculty Advisor: Dr. Simon Gray (Computer Science)

AMRE 2005

Ohio Agricultural Research and Development Center (OARDC I)

Project Title: Tomato Analyzer Software Development
Student Participants: Ben Strecker, Rick Drushal, Nancy Dujmovic
Advisor: Professor Simon Gray (Computer Science)
OARDC Liaison: Dr. Esther van der Knaap

Researchers of the Department of Horticulture and Crop Science at the Ohio Agricultural Research and Development Center (OARDC) are concerned with finding which genotypes correlate with certain phenotypic traits. The phenotypic traits can be calculated using an application called Tomato Analyzer. Researchers can scan cross sections of tomatoes and open these JPEGs in Tomato Analyzer, which calculates various measurements, such as the area, indentation angle, and taperedness. We concentrated on developing algorithms that capture obovateness/ovateness (bottom and top heaviness), asymmetry, heart shape, and color analysis. We also fixed some of the bugs in Tomato Analyzer, such as finding shoulder points correctly and calculating indentation area more precisely. We also added features, such as auto rotation, which can automatically align scanned objects north-south on their vertical axis.

Ohio Agricultural Research and Development Center (OARDC II)

Project Title: Tomato Genetic Database Development
Student Participant: John McCreight
Advisor: Professor Dale Brown (Computer Science)
OARDC Liaison: Dr. David Francis

The purpose of the genetic database project was to create a website allowing for researchers studying tomato genetics to look up markers, tomato varieties, and associated information between the two. Further, the project demanded an easy way to input data into this database. To these ends, a new web interface was devised to allow for the viewing and export of data, written in Perl. The database interface includes several search types, which lead to table representations of the data stored and additional information. For data input, a number of small utility scripts were also written in Perl to assist in the conversion of data from native scientific formats to those which are useful to the database. Finally, the open source project phpMyAdmin was installed on site to allow for any kind of data manipulation desired, including future expansion. The end result was a simple, but full featured, website able to act as a bridge between tomato traits, and the genes behind those traits.

College of Wooster Social Entrepreneurship

Project Title: Social Entrepreneurship
Student Participant: Jeremy DeGroot, Desi Dimitrova
Advisor: Professor John W. Sell (Economics)

The Social Entrepreneurship Team of the AMRE program concluded the first stage of a three-year program funded by the Burton D. Morgan Foundation. The overall three-year goal is to establish the "Burton D. Morgan Venture Capital Fund at the College of Wooster" and associated academic programs designed to facilitate the development of for-profit ventures in support of non-profit (charitable) organizations. The overall goal of this summer's AMRE project was to determine the structure and detail of the following two years of the program. The primary specific goals of the project were: With respect to the overall program:

- Catalog and evaluate current volunteer and non-profit activities in Wayne County.
- Assess the current resource base of students/faculty at the College and determine the best ways to contact and motivate potential participants.
- Catalog and assess current social entrepreneurship programs elsewhere and develop a "best practices" model for the seminar component of Wooster's program.

- Determine external keynote speakers.

With respect to the venture capital fund:

- Develop a methodology for calculating, "social return on investment" to blend the profit- and non-profit elements of the investment decisions.
- Select an existing social entrepreneurship project and "field test" the model.
- Develop a set of ex post criteria for evaluating funded projects.
- Design and implement software to facilitate the funding/evaluation process and promote the Venture Capital Fund.
- Document the software and its use.

We accomplished these goals and have established a solid platform for the next two years of this program and beyond.

College of Wooster User Services

Project Title: Pansophy Contact Manager

Student Participants: Alex Chvatal and Joel Wietelmann

Advisor: Professor Jon Breitenbucher (Mathematics)

This project is a continuation of last year's AMRE project "DOS Call Tracking System" by Joel Wietelmann and Jeremy DeGroot. The goal this year was to upgrade the Call Tracking System's MySQL database structure, expand functionality in the Contact Manager and increase usability in the PHP web interface. Much of the underlying technology was improved, and many new features were added.

ProQuest Business Solutions

Project Title: Database Discrepancy Identification, XY Report Generator

Student Participants: Brian Conaway and Thomas Lincoln

Faculty Advisor: Dr. Dale Brown (Computer Science)

The main goal of this project was to develop a database analysis tool for ProQuest's automotive parts catalogs. The application is meant to produce a report detailing errors contained within a database. Specifically there are two common types of errors that occur in these databases, entries containing parts that lack descriptions and descriptions that don't correspond to an existing part. These reports are referred to as X/Y reports, simply a listing of all pages within the database that contain such errors.

In the production environment these databases can consist of terabytes of data, much to large to be checked by hand. Although there is already an analysis tool available it is outdated and has limited functionality.

The team developed three independent applications for ProQuest. Two are considered production level and the third was mainly a research exercise. The first application is a web based JSP/ Bean application that provides a user friendly graphical interface for generating X/Y reports. It interacts with an Oracle database to present a menu driven system for creating reports. The second program uses pure Java and is meant to be run at the command line. It provides the same functionality as the web application while providing an implementation that is capable of running large batch jobs.

The third application is a Java Struts implementation of a basic report generator. It lacks the full functionality of the first two programs, however it makes use of a more sophisticated approach on the programming side. The main purpose of this implementation is to act as an example Struts application. This example application will aid ProQuest's effort to migrate their current work flow system to a struts based interface.

Smith Dairy

Project Title: Production Scheduling System Design and EOQ Analysis

Student Participants: Tyler Bosch, Genevieve Luken, Tim Presto

Advisor: Professor John Ramsay (Mathematics)

The purpose of the 2005 Smith Dairy AMRE project was two-fold. The primary component of this project consisted of a Microsoft Excel program aimed at increasing the efficiency in production scheduling at the Wayne Dairy plant. Wayne Dairy is the subsidiary branch of Smith Dairy located in Richmond, Indiana. This Excel Program uses a forecasting model derived by the team to improve product demand prediction. In addition, the program will update material automatically after information is entered into the company's database. This allows for accurate production planning that can be communicated electronically among members of Wayne Dairy. Furthermore, the program approximates production times on the fillers and processors at the plant to help estimate production start-up times for the various product groups. The program will further distribute information among employees with its capability to print machine sheets for employee reference.

The second major component of this product is more mathematical and economic in nature. The AMRE team took a thorough look at Wayne Dairy's production cycles to suggest optimal lot sizes for each product group. The general outcome included a lengthened production cycle on a couple product groups. As a result, the team conducted in depth inventory analysis to account for these larger production batches resulting from the lengthened production cycles. The final goal was to help Wayne Dairy more efficiently manage their inventory space through more accurate production lot sizes and safety stock percentages suggested by the inventory analysis and the demand forecasts mentioned above.

AAC Institute

Project Title: Migration of U-LAM and Other Software
Student Participants: Jim Rohal, Kenda Albertson, Jeff Adamson
AAC Liaison: Barry Romich, P.E.. The Prentke Romich Company

Three subprojects were developed during this AMRE project. Jeff Adamson modified the existing ULAM (Universal Language Activity Monitor) for a version on a Pocket PC. ULAM's purpose is to facilitate a speech language pathologist in recording a conversation on an augmentative alternative communication device into time-stamped records. It also records and plays audio clips and produces a file that can be used by the Performance Report Tool. A version of this program for the Pocket PC would allow speech language pathologists a more portable ULAM that would still be able to retrieve files from the alternative communication device. Jim Rohal added functionality to the Self-Study Site which was designed for the AAC (Augmentative and Alternative Communication) Institute so speech language pathologists, family members, and others who wanted to learn about AAC devices and practices could do so in their own time.

Kenda Albertson revised the Performance Report Tool (PeRT). PeRT is designed to aid speech therapists in their study of patients and their usage of the AAC devices by allowing the therapists to set goals for their patients and measure the outcomes in a quantitative manner. The tool creates an AAC Performance Report from the data collected using the Language Activity Monitor (LAM) format. Along with creating the Performance Report itself, it generates several appendices including an alphabetic word list, a frequency word list, LAM data, and a list of utterances.

Progressive Insurance

Project Title: Forecasting Conversion
Student Participants: Julie Meredith, Andy Nicol, Ali Nau
Progressive Liaison: Robin Harbage

Progressive Insurance was looking for a model which would predict if a customer would convert to Progressive Insurance. We were looking at multiple different variables and their relation to the probability of one buying auto insurance. We studied many different statistical models, such as: linear and logistic regression, logit and probit analysis, correlation analysis, and

our most complex method, Bayesian Nets. We also tried to model Progressive's price compared with its competitors. After looking at the data in many different ways, we found a probit regression model that predicted the probability that one would switch but not the absolute “Yes” or “No.” We also concluded that with the data we had the absolute answer is not possible to find because there are so many immeasurable factors which contribute to one buying auto insurance.

AMRE 2004

ProQuest Automotive

Project Title: Imaging Analysis
Student Participants: Kenda Albertson, Peggy Winkler, Jesse Smith
Faculty Advisor: Dr. Denise Byrnes (Computer Science)

ProQuest develops and distributes a PARTS database for the automotive industry. The database is distributed on CD or DVD and in Web based form. The PARTS database (for our purposes) consists of 2D, raster based, black and white line drawings of automobile parts. ProQuest has developed a proprietary image viewer that provides fast and accurate imaging of parts, but the viewer only deals with 2D raster images.

Some automotive companies are currently providing ProQuest with part images in vector form. ProQuest would like to

- Identify the top three vector based image formats in terms of
 - Support for color
 - Size of image
 - Quality of viewed image
 - Speed of download/imaging
- Identify the top three vector image viewers in terms of
 - Size of viewer
 - Quality of image produced
 - Speed of download/imaging
- Investigate 3D image formats and the possibility of moving toward a 3D imaging system

After researching vector image formats we decided to look further into SVG (Scalable Vector Graphics), CGM (Computer Graphics Metafile), and DXF (Data eXchange File). SVG and CGM had already been received by ProQuest and DXF was a natural choice if ProQuest was thinking of moving to 3D images in the future. We analyzed the formats and compiled information related to the criteria described in the problem. We also analyzed and rated multiple viewers for each formats. This research was designed to get an accurate picture of the advantages and disadvantages of each format so that ProQuest would be able to choose a format that would best suit the company's needs. Our investigation of 3D formats began with a sample images provided by ProQuest that was in XVL (eXtensible Virtual world description Language or eXtended VRML Language). We also found that X3D and WRL, which are both VRML-based, are formats that we felt were worth looking into. We provided ProQuest with information about these 3D formats to consider if they choose to adopt 3D images for their parts catalogue.

ProQuest Business Solutions

Project Title: Database Development
Student Participants: Kathy Haines, Matt Sykes, Nancy Dujmovic
Faculty Advisor: Dr. Dale Brown (Computer Science)

ProQuest is a very large company with several major divisions, including Media Solutions. Media Solutions is in turn hired by companies to help them manage and access their databases. Our AMRE project worked with a Media Solutions team that needed to load databases and set up a website for a new company.

At the onset, we set up a database management system, MSSQL Server 2000. We were initially given two datasets to use for the creation of the databases. The two databases were very different in size and quality. The first database was a product registration database and the second was birth records of parts. The dataset for the product registration database was given to us in a flat format from which we needed to create a relational database design. Even though the dataset itself was relatively small, making a design based on a dataset that had few previously enforced rules can be challenging. The birth records data turned out to be nearly clean but also could be cumbersome to manage because of its much larger size.

Through much feedback with the team and the customer, we made a relational database design for both databases. To help this process, the team and the customer used a Product Requirements Document to describe in detail problems, solutions, and requirements related to the project.

We also started the creation of the frontend website, which was to be written with ColdFusion pages, *.cfm. During the official eight weeks of AMRE, this aspect was mostly an educational one. Both student members of the team had no previous experience building ColdFusion pages. Ultimately, this project continued for the rest of the summer and into the fall semester. The student incorporation into this project ended upon one of the final releases of the webpage.

The College of Wooster Student Affairs

Project Title: DOS Call Tracking System
Student Participants: Jeremy DeGroot and Joel Wietelmann
Faculty Advisor: Dr. Simon Gray (Computer Science)

The goal of this project was to create an easy-to-use web-based contact management software system for the College of Wooster's Student Affairs Department. The problem this was intended to solve was that Student Affairs is a large umbrella department encompassing many subdepartments whose offices are scattered throughout campus. They needed a way to easily share information regarding each subdepartment's interactions with students. Requirements for the software included ease of use, portability, and security. The resulting product, Pansophy Contact Manager, is a web-based application written in the PHP scripting language and designed to run on top of a MySQL database. It provides an intuitive interface for recording and retrieving information about interactions between the College's Student Affairs Department and its students. Pansophy contains a variety of security mechanisms and supports encrypted data transfer over a network when placed on an HTTPS-enabled web server.

Progressive Auto Insurance

Project Title: Elasticity Segmentation Analysis
Student Participants: Adam Hanley, Lauren Gruenebaum, Ali Nau
Faculty Advisor: Dr. Jim Hartman (Mathematics)

This project examined customer retention and price elasticity across various segments of Progressive auto insurance customers, with the purpose of determining which factors make a customer more or less price sensitive. The first part of the project involved extensive background research on why customers choose whether or not to renew their insurance policies, and general information on customer price sensitivity. Part of this included looking at complaints regarding general customer service and the handling of claims. Data analysis comprised the second half of this project. Using SPSS, the Statistical Package for the Social Sciences, statistical analyses, including linear and logistic regression, in addition to descriptive statistics, were completed for each variable. The relationships between variables were also analyzed using the Cramer's V statistic. Variables were then examined in conjunction with each other, creating several distinct segments which varied across individual variables; there was significant variation in the price elasticity of these segments.

The City of Wooster

Project Title: The Economic Impacts of Rubbermaid's Departure from the City of Wooster
Student Participants: Gerry Ockers, Liz Whittam, Becky Young
Faculty Advisor: Dr. Jim Burnell (Economics)

The goal of this project was to provide information to both the city of Wooster and Wayne County public officials in estimating the effects of Rubbermaid's departure from the Wooster area. The three areas of focus were the impacts on jobs, the housing market, and the tax implications. Techniques used include Location Quotient, Shift-Share Analysis, and Input-Output Analysis.

AMRE 2003

Main Street Wooster Inc.

Project Title: Market survey analyses and development of an "Economic White Paper" presenting cost of living and quality of life issues relevant to downtown Wooster
Student Participants: Kyle Kindbom, Daniel Tzonev, Bryan Whiting
Faculty Advisor: Dr. John R. Ramsay (Mathematics)

The work for Main Street Wooster, Inc. had two distinct components. The first and largest undertaking was the design, implementation and analysis of marketing surveys intended to provide information to Main Street Wooster, Inc. to be used in developing ways to strengthen downtown Wooster's competitive position and appeal. Market surveys were developed and implemented for the following four groups:

1. Downtown retailers (written surveys to 107 retailers)
2. Downtown users (137 responses primarily through intercept surveys)
3. Wooster/Wayne County community (telephone surveys – 264 respondents)
4. Students at The College of Wooster (email surveys – 172 responses)

An importance/performance analysis was performed on the retailer responses and usage and perception were the primary targets of the other three surveys. The second component of this project was to collect and organize demographic data relevant to downtown Wooster. The results of the study provide information that can help Main Street Wooster determine how to best be competitive in their efforts to improve and strengthen the downtown. The final product of this portion of the project took the form of an "economic white paper" which is used in long-term planning of Main Street Wooster, and in recruitment of business to the downtown.

Wayne Center for the Arts

Project Title: Market Survey Analysis

Student Participants: Kyle Kindbom, Daniel Tzonev, Bryan Whiting

Faculty Advisor: Dr. John R. Ramsay (Mathematics)

The AMRE team designed and implemented marketing surveys aimed at providing information to Wayne Center for the Arts to be used to better understand both existing active clients as well as the potential marketplace. Market surveys were developed and implemented for the following two groups:

1. The current Wayne Center for the Arts membership
2. The Wooster/Wayne County community

The membership surveys were distributed by email and U.S. mail to most of the current membership. 81 responses (a yield of approximately 25%) were received. The community was surveyed through random telephone surveys. Of approximately 600 household called, 90 responses (15% yield) were obtained. Perceptions of, usage of and interests in programming provided by Wayne Center for the Arts were broken down into a variety of demographic categories in order to help the Center understand how they are currently serving and how they might better serve various groups in the Wayne County community.

AAC INSTITUTE

Project Title: Performance Report Tool (PeRT) and Universal Language Activity Monitor (ULAM)
Student Participants: Jeff Adamson, Adam Anthony, Jaymie Strecker
Advisor: Self-Advised

Jaymie, Adam and Jeff worked on two projects this summer. Adam and Jeff worked on the Universal Language Activity Monitor. The purpose of this MS Windows program is to facilitate a speech language pathologist in recording a conversation on an augmentative alternative communication device into time-stamped records. The reason the recordings must be time stamped is so that patterns of conversation can be analyzed for speed and other performance measures. It can record events via audio input, or by serial input. When recording audio ULAM has the capability to allow the user to transcribe on the screen what is heard from the speakers when the sound clip is played back. Finally, ULAM is also designed to export its files into a format that can be used by PeRT.

PeRT is a tool designed for speech language pathologists to assist them in collecting data and analyzing it in such a way that conclusions can be made about usage of an augmentative alternative communication device. It inputs a text file of a specific format that allows a user to see each individual time-stamped statement as it was recorded from a device. A speech language pathologist is then able to select portions of these records and group them into full sentences which then have measurable statistics and options for analysis. PeRT most significantly frees a speech language pathologist from performing so many tedious tasks by hand. The vision is that a larger volume of data will be collected and analyzed, thereby allowing manufacturers and therapists to assist people with verbal disabilities more efficiently, because the functionality of PeRT makes data collection so much simpler.

Ohio Agricultural Research and Development Center

Project Title: Modeling Water Flow in Putting Green with Hydrus-2D
Student Participant: Jun Ma
Advisor: Dr. Ed McCoy, OARDC

The project is the theoretical continuation of an experiment conducted by Dr. Ed McCoy during 2000 and 2002. The goal of the experiment is to explore the water soil and turf response resulting from the amendments on high sand root zones and to help solve the water storage problem caused by green contours. As the theoretical extension of the experiment, my project aims to:

1. Test the validity of the experiment with a theoretical and scientific approach
2. Establish a consistent and reasonable protocol for solutions of inverse problem.
3. Provide data, background information and experience for future research, which can be conducted in a computer-simulated environment and thus saves money and time.

All work was done with Hydrus-2D, a Microsoft Windows based modeling software for analysis of water flow and solute transport in variably saturated porous media. The model used in the project is an one-dimensional, vertical water flow system with two layers and one homogeneous mass balance. The main mathematics idea behind the model is using the Galerkin type linear finite element method to solve a partial differential equation known as Richard's Equation. The major part of the project is to solve the inverse problem with the iterative parameter optimization algorithm for inverse estimation of soil

hydraulic properties. After solving the inverse problem, I plugged those optimized parameters back into the objective function and ran the simulation. The final step is to calculate the root mean square error (RMSE) of water content using both predicted and observed data. It determines whether the simulation reflects the experiment well enough or not. Given the data of RMSE, my conclusion is the simulation reflects the real world reasonably well and all the information and data collected from the simulation are good enough for future research use.

The College of Wooster Financial Services

Project Title: Web Development for the College of Wooster Financial Services
Student Participant: Anshuman Bagaria

The project consisted of designing a website for The College of Wooster Financial Services to allow users easy access to the relevant information online. Microsoft FrontPage and HTML were used to design the website. It is a website in progress – some of the information was pulled from the Business Office website but more information is being added. PHP, a web processing language, is being used to make budget reports available online. In the near future, faculty and staff will be able to view their account transactions online.

AMRE 2002

Critchfield, Critchfield, and Johnston, LTD

Project Title: Cost of Living/Quality of Life Analysis and Lawyer Profile
Student Participants: David Bordeaux, Kyle Kindbom
Faculty Advisor: Dr. John R. Ramsay (Mathematics)

The AMRE team hired by the law firm of Critchfield, Critchfield and Johnston performed a cost of living/quality of life analysis on middle class professionals in Wooster and other designated areas of the U.S. In addition, the team did a "lawyer profile" study for Critchfield.

The goal of the project was to give Critchfield information that could be used in recruiting new lawyers for their firm. The cost of living and quality of life information was used to create a better comparison between a lawyer position at Critchfield and one at firms in large city areas. Columbus, Cleveland, New York, Washington, DC and Chicago were included in the study. The cost of living analysis investigated the following factors:

- Insurance (auto, health and home)
- Transportation (commute, parking)
- Housing
- Private school tuition
- Daycare
- Taxes (income, property, sales)
- Groceries
- Club Membership
- Utilities

The quality of life analysis looked at crime rate, school quality, and commute times.

The team constructed the lawyer profile from a questionnaire completed by lawyers at Critchfield as well as a firm in Cleveland and one in Columbus. The lawyers responded to questions related to their decision to accept an offer at their current firm as well as to questions that provided general background information.

The Prentke Romich Company/AAC Institute

Project Title: Speech-Language On-Line Education System
Student Participants: Naveed Ahmad, Byron Peebles, Jaymie Strecker
Advisor: Dr. Amon Seagull (Computer Science)

The primary goal of the project was to develop an Internet-based course system so that speech language pathologists (SLPs) around the world can learn new methods in evaluating subjects using augmentative and alternative communication (AAC) devices. We created a web interface for both the administrators and the students. Students are able to select a course, then progress through the modules of a course by passing quizzes. When the student completes a course, a diploma is generated. Administrators are able to create and edit courses and modules, as well as manage the list of students. The web site also provides a search mechanism, enabling anyone with a web browser to find SLPs (who are registered as students in the system) in a desired geographic area. We also worked on a software tool that facilitates the annotation, by an SLP, of language data collected from a subject utilizing an AAC device. The tool was begun the previous summer. In our time remaining this summer, We made many improvements to it in efficiency, usability, and functionality.

AMRE 2001

Goodyear Tire and Rubber Company I

Project Title: Materials Testing Lab Job Scheduling
Student Participants: Dan Bates, Sarah Haile, Danny Welker
Faculty Advisor: Dr. John Ramsay (Mathematics)

The Dynamic Testing Lab at Goodyear is responsible for testing various rubber compounds, by request of a number of compounders. The DTL begins by mixing the compounds (in a sequential fashion) and then proceeds to send all compounds to testing, which can occur simultaneously. Over the past year, the number of tests on hand had increased dramatically, increasing cycletime. The goal of the AMRE team was to find ways that the DTL could: 1) return to an appropriate number of tests on hand, and 2) reduce overall cycle time. In addition, an effort was made to simulate the DTL.

After spending a considerable amount of time at the DTL, the AMRE team came up with some simple analyses, such as the length of cycletime if there was no backlog and the ratio between time spent on preparation and time spent on testing. The team explored the effects of added prep time and increased number of employees on the level of TOH, creating a tool which Goodyear can use to make decisions regarding time allotments and number of technicians. A simulator was created which outputs the cycle time for a given set of jobs, with a specific number of employees, who are trained on specific tasks.

The deliverables included a final presentation to the company, tools to aid in decision-making, and the simulator.

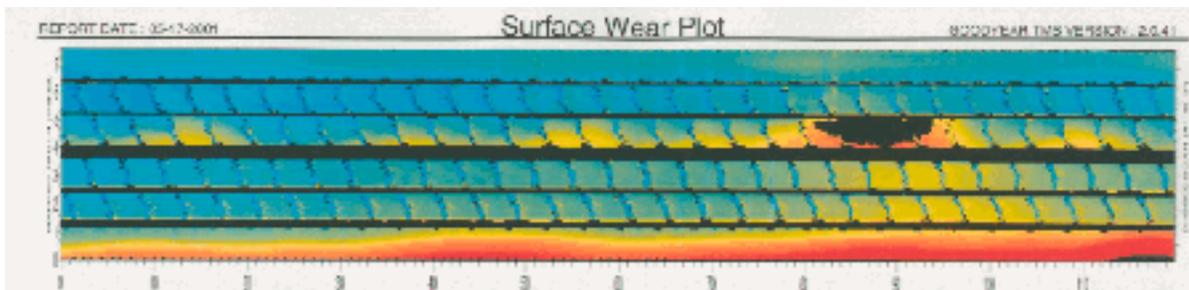
Goodyear Tire & Rubber Company II

Project Title: Investigating the Initiation and Propagation of Wear on Truck Tire Surfaces

Student Participants: Hussain H. Bandukwala & Nghia Tran

Faculty Advisor: Dr. Dale Brown (Computer Science)

This AMRE computer science team launched an investigation into the possibility of training an artificial neural network (ANN), a category of non-linear regression tools that uses historical data to predict results on new data, to predict tire geometric surfaces at different time-intervals. Goodyear has been using a laser device to "map" the surfaces of their truck tires for a period of time. The data was recorded into raw data files and handed to us. Our first job was to create a C++ program to decode these massive databases, to compress and to cut them into smaller files, which contained geometric information of unit sections of tire surfaces. Then each training ANN would take in and "learn" the historical data of the corresponding surface section. Finally, a Windows MFC application was developed to host the trained ANNs, in form of Dynamic Linked Libraries (DLLs), and provide prediction on excessive surface wear. The findings from this project brought back a lot of interests from our Goodyear client on the application of ANNs in data-analysis.



The College of Wooster Physical Plant

Project Title: Workflow Analysis at The College of Wooster Physical Plant

Student Participants: Eric Knauss, Hien Thu Le

Faculty Advisor: Dr. Pamela Pierce (Mathematics)

The goal of our Applied Mathematics Research Experience (AMRE) project was to research the workflow process in order to discover a way for the service center to run more efficiently. Our research consisted of conducting interviews with the participants involved in the workflow process as well as gathering information from two companies, TMA and Bi-Tech, which sell facility management software. We have decided that incorporating more technology, through the following recommendations, is the best solution:

1. Upgrade from TMA Powerbase to TMA Workgroup.
2. Purchase more software licenses.
3. Write a program, which can take the TMA data and then read it into Bi-Tech.

In our final report, we summarize the current workflow process and explain how our recommendations can help the facility run more efficiently by saving time and keeping better records.

The Prentke Romich Company

Project Title: Web Database Project to Facilitate Collection and Retrieval of Language Sample Data

Student Participants: Abishek Dadoo, Kaizad Gotla, Dustin Welty

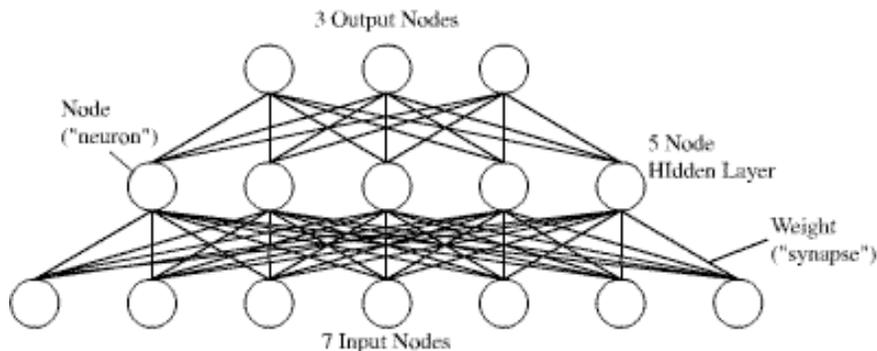
Advisor: Dr. Amon Seagull

Goodyear Tire & Rubber Company I

Project Title: Computerized Analysis of Gas Chromatography Results to Determine Percentage of Certain Monomers in Tire Rubber

Student Participants: Wei Wei Gao, Joseph Jaquette, Hussein Shamsher

Faculty Advisor: Dr. Dale Brown (Computer Science)



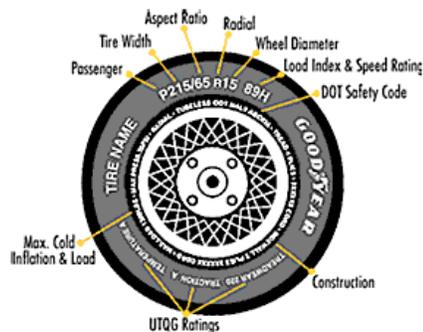
Goodyear researchers needed to better understand unknown peaks in gas chromatography data run on tire rubber samples. To affect this, the AMRE team applied artificial neural networks, genetic algorithms, and linear regressions to the gas chromatograph data. Artificial neural networks are essentially a computer process that creates a non-linear function, based on known data, to predict outputs in new situations. Genetic algorithms enabled the AMRE researchers to reduce the number of inputs to a more manageable size. The team used linear regressions to approximate linear planes to the shaved data. Results from all three methods look very promising. The techniques used work well on any problem where knowledge of the makeup of the inputs is not needed. This sort of approach is known as a "black box" technique. In this specific case, Goodyear was able to provide only a limited amount of data. Artificial neural nets and genetic algorithms permitted analysis of the limited data and focused the efforts on a small number of input variables, thus enabling the use of linear regression techniques that would not work with the full set of inputs.

Goodyear Tire & Rubber Company II

Project Title: Analyzing and Predicting Tire Design Data

Student Participants: Dilip Raghavan, Rob Sweeny, Ivan Terziev

Faculty Advisor: Dr. John Ramsay (Mathematics)



The project pursued dealt with the determination of adequate methods for utilizing Light Truck tire database information for making future tire design decisions. The physical significance of the data lay in the capturing of changes to the tire design and their resultant effects on computer simulated responses. Data interpolation techniques including linear regression and

artificial neural networks were explored for the prediction of needed tire geometry specifications given targeted tire footprint information. After only limited success in this direction, the team shifted to the use of artificial neural networks in the "forward direction", predicting the footprint information given geometrical information. This approach proved to be very successful and a prediction tool was developed which is being used at the beginning of the tire design process at Goodyear.

Ohio Agricultural Research and Development Center (OARDC)

Project Title: Creating User-Friendly Decision Making Tools for Predicting Insect and Weed Phenology
Student Participants: Nikita Sharma, Amit Singhal
Faculty Liaison: Dr. John Ramsay (Mathematics)

The goal of this project was to create an interactive web site that will enable a producer anywhere in Ohio to input his/her 5-digit zip code and obtain information related to insect/pest control. Due to environmental concerns, the US government is currently trying to reduce the number of sprayings made by commercial growers. Presently growers spray their nurseries on an average of every five days in order to cover whatever insect pests might be occurring at the time. With this web site, the growers can obtain a list of the phenological events that are occurring at a particular time so that they can make better pest management decisions.

Observing the life cycle patterns of certain plants and the insects and pests associated with them has revealed that certain life cycle stages of these so-called indicator plants and the insect pests correspond to a certain Growing Degree Day value. Growing Degree Day (GDD) is a measure of the growth and development of plants and insects and it is directly related to the daily maximum and minimum temperatures occurring during the growing season. The GDD of any zip code location in Ohio is estimated using the GDD of ten OARDC weather stations situated around the state. Using the latitude and longitude of the zip code location entered and that of the ten weather stations, the distance of the site is calculated from each of the 10 weather stations. The distance formula used is weighted to include factors like the difference between North-South and East-West variation in temperature. These individual distances and the GDDs of the 10 weather stations are then used to estimate the GDD of the site. Combining the database of lifecycle pattern information of indicator plants and insects and the daily growing degree day value calculated, the web site is able to make a fairly accurate estimation of all the phenological events that are likely to occur on or around a particular day.

The College of Wooster

Project Title: Web Development and Restructuring Mathematics Labs
Student Participants: Devoki Dasgupta, Dustin J. Welty
Faculty Advisor: Dr. James Hartman (Mathematics)

This project was an in-house project for the Mathematical Sciences Department at the College of Wooster. The main goal of the project was to convert mathematics labs from Microsoft Word documents into interactive Maple 6 documents. This task required the group members to install the latest version of Maple 6 and convert the print manuals of Math 111, 112, 201, 202, 104, and Maple Enhanced Calculus into interactive Maple tutorial documents. The second goal was to propose and implement suggestions to redesign as well as update the Mathematical Sciences web pages and the AMRE program web pages. The software used to redesign these web sites were Macromedia Flash 4, Macromedia Dreamweaver, and Adobe Pagemill.

AMRE 1999

Goodyear Tire & Rubber Company I

Project Title: Neural Networks For Carbon Black Classification.
Student Participants: Nevin Steindam, Kaizad Gotla, Janak Parekh
Faculty Advisor: Dr. Dale Brown (Computer Science)

The project provided services to the Analytical Sciences department of Goodyear Research, a division of the Goodyear Tire and Rubber Company. The goal was to develop techniques for classifying the carbon black content of vehicle tires. Carbon black is a major tire ingredient that can be present in many different forms. The project used data taken from microscopic analysis of pyrolyzed rubber, the residue that remains after researchers burn rubber samples in a controlled environment.

A team consisting of Computer Science majors Nevin Steindham, '00, Janak Parekh, '00, and Kaizad Gotla, '02, worked with project advisor Dr. Dale Brown, Professor of Computer Science, to develop computerized techniques for predicting which of five carbon black categories most closely describe particular samples of pyrolyzed rubber. They investigated multiple potential solutions, developed using artificial neural networks, a general category of computer programs that accomplish electronic "learning" using methods that loosely model human and biological learning. The project identified several unique properties of the sample data and developed artificial neural network models for use in solving the problem.

Goodyear Tire & Rubber Company II

Project Title: Applied Mathematics in Tire Compound Science
Student Researchers: C. Elliott Strimbu, Smita Narayan, Surya Saraff
Faculty Advisor: Dr. Reuben Settergren (Mathematics)

This AMRE project can be viewed as a two part process which involved process improvement and process development. The process improvement was in the area of PVT (Pressure, Volume, Temperature) Data Analysis obtained from physical experiments involving tire compounds. Software such as C++, Microsoft Office and other packages were used to develop algorithms to expedite analysis of ingredient PVT data. The algorithms implemented to improve the efficiency of this process reduced the current time spent on such analysis by a significant amount. The results of these analyses give parameters that characterize the physical properties of the various compounds that are used in tires.

The second step of the process involved understanding the algorithms that determine binary elastomer system-multiple ingredients interactions. The algorithms were then extended to account for multiple elastomer and ingredient interactions. This expansion involved understanding and incorporating elements of graph theory, differential equations as well as theories drawn from thermodynamics and physical chemistry. The algorithms enabled computations which would reflect compound ingredient compatibility. The AMRE team created a database that will enable researchers to predict ingredient mixing, compound behavior and compound - ingredient interactions.

United Titanium

Project Title: Cost Minimization and Order Scheduling using Economic Order Quantity (EOQ) Analysis.
Student Participants: Dan Bates, Nikita Sharma, Oana Stelea
Faculty Advisor: Dr. John Ramsay (Mathematics)

It is quite difficult to predict the many varying elements of production. There are numerous variables to be considered when creating a production model for a job shop. However, there are several common approaches to producing such a model. One of the most widely used methods used to determine cost-minimizing order schedules is the Economic Order Quantity (EOQ) Analysis. One of the primary tasks of the AMRE team at United Titanium was to collect such data to perform EOQ analyses. EOQ analysis can be applied in two different situations at United Titanium. First, in determining optimal order scheduling for raw materials and second, in determining optimal batch sizing in production. With respect to raw materials, the analysis primarily considers the annual demand, the material cost per pound, and price break information. The output of a raw material EOQ is the poundage to be ordered so as to minimize the sum of holding and shipping costs. After forming an EOQ raw material ordering model, the AMRE team compared the actual 1998 total annual order costs to the predicted order costs if the EOQ order quantity had been used over the same time period.

Once the batch sizing EOQ parts production model was created, the AMRE team compared current production practices with those suggested by the model. Data was collected and the model run on 14 sample parts selected by UTI.

As part of the process of creating the EOQ models, a considerable amount of machine hour and labor hour data was collected. By collecting machine time data on various parts, the AMRE team was able to generate a rough estimate of specific product costs at each stage of production, thus establishing a procedure by which UTI can more accurately do costing analysis.

Buehler's Fresh Foods

Project Title: Commissary Package Development-BACKOS (Buehler's AMRE Collaborative Kitchen Ordering System)
 Student Participants: Robert Buckley, Charles Nusbaum, Lakshmi Sharma
 Faculty Advisor: Dr. Denise Byrnes (Computer Science)

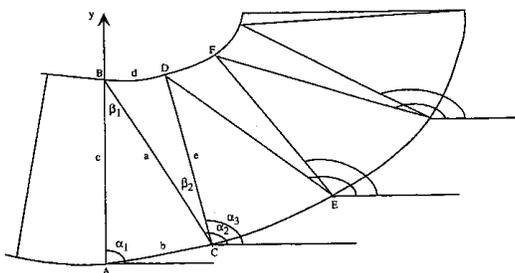
The final product of this project was the software package BACKOS (Buehler's AMRE Collaborative Kitchen Ordering System). As an electronic means of submitting kitchen orders, the application programmed by the Buehler's AMRE team designed for Buehler's Food Markets handles orders from ten stores to a central kitchen and provides options for historical data, setting special items, inventory control, shipping control, several reports and more. Robert Buckley, '00, Lakshmi Sharma ('00) and Charles Nusbaum ('02) worked closely with advisor Dr. Denise Byrnes, Professor of Computer Science, through the beginning stages of development which included database design, data flow diagrams and screen design. Considerable time was spent in the computer room of Buehler's central office working with Buehler's AS/400 computer system. The three team members taught themselves RPG/400 and learned the AS/400 operating system in order to write the over 5000 lines of code needed to complete the Kitchen Ordering System. The system is used in Buehler's Kitchen Korner as well as the Produce, Meat and Seafood Departments of all Buehler's stores.

AMRE 1998

LuK Inc.

Project Title: Turbine Blade Design
 Student Participants: Rick Hochstetler, Zeeshan Ahmed, Carey McGilliard
 Faculty Advisor: Dr. Charles Hampton (Mathematics)

The process by which LuK, Incorporated was creating turbine blades had one step which LuK felt could be improved. Part design and flow testing done on the computer produces a set of data points and spline curves which give the specifications for creating the die used in producing the actual blade. The creation of the die was done directly from the computer model but the intermediate cut to create the blank from which the blade is formed was done by a less than satisfactory trial and error method. The goal of the AMRE team was to use mathematical methods to "unwrap" the final product as designed on the computer to generate the specifications for cutting the flat blank. After devising a method to accomplish this goal, the technique was then automated in the form of a C program that can take specifications on any design and produce the specifications needed for the corresponding blank. With assistance from the AMRE team, LuK has incorporated this program into the procedural steps used in designing and creating turbine blades and are currently using the system.



Representation of the right side of a blade as it is flattened into a blank. Uppercase letters refer to two-dimensional data points, but also have corresponding three-dimensional data points. Line segment lengths are identified with lowercase letters. All Greek letters refer to two-dimensional angles.

The Gerstenslager Company

Project Title: Inventory Accuracy Analysis
Student Participants: Sohil Parekh, Jennifer Leete, Smita Narayan
Faculty Advisor: Dr. John Ramsay (Mathematics)

The AMRE team served as a pilot program of cycle counting and inventory accuracy in helping The Gerstenslager Company justify a larger, company-wide program. Focusing on only a portion of the Gerstenslager inventory, the team completed the following:

- ABC analysis to identify high and low volume parts
- Collected data on high volume parts through cycle counting
- Compared cycle count data with inventory system data to identify discrepancies
- Determined root cause of discrepancies
- Recommended procedural changes intended to reduce future similar discrepancy occurrences

The final product was an oral presentation and a report to be used as cost justification for a larger scale Inventory Control program.

Bell and Howell

Project Title: XML-based Electronic Parts Catalog Prototype
Student Participants: Siddhant Kaul, Robert Buckley, Francis Browne
Faculty Advisor: Dr. Dale Brown (Computer Science)

Bell and Howell's system for producing Electronic Parts Catalogs produces a range of products from identical data, ranging from microfiche to a high-end UNIX networked system. The AMRE project was to investigate XML (eXtensible Markup Language) as a means of creating a lower-end electronic system to be made available to Bell Howell's smaller customer that may not have the computer facilities to run the UNIX system but need to improve on the old microfiche system.

XML is a language for flexible definitions of custom data types in a manner similar to HTML, designed to facilitate electronic publishing and easy exchange of information. The AMRE team developed an XML prototype to be run on a normal PC using only a web browser (Internet Explorer 4.01) and an XML data file.

The prototype enables browsing with pull down menus, searching an entire catalog or a section of it, collecting parts into a shopping cart for printing, and printing the entire catalog. The product runs without the assistance of any external applications besides the web browser.

AMRE 1997

Bell and Howell

Project Title: Software Internalization
Student Participants: Mustafa Hasham, Rick Hochstetler, Shiv Siddhant Kaul
Faculty Advisor: Dr. Denise Byrnes

Bell and Howell creates Electronic Parts Catalogues (EPC's) for many car manufacturers in the United States and Europe. These EPC's are used in auto part stores and dealerships to look up and order parts. Bell and Howell is now moving into a

few Far East countries such as Korea and China. The problem with this new move is that the languages of these countries are not supported by any of Bell and Howell's current EPC applications.

The AMRE team investigated ways to support internationalization of programs through the use of Java. They also had to consider issues of how to enter text in the form of ideographs which current keyboards do not support. The knowledge gained from this group's research will tie into the Next Generation project which is currently underway at Bell & Howell.

Metromedia Technologies

Project Title: Hanging Banner Stress Prediction
Student Participants: Jon Drover, Divya Thadani, Stephen Boughton
Faculty Advisor: Dr. John Ramsay

METROMEDIA TECHNOLOGIES specializes in large scale printing, such as billboards and large banners. The banners, printed on vinyl coated fabric, are very large and supported at the edges using different types of fasteners, such as grommets or ratchet straps. A major concern for Metromedia is that attachment locations are such that wind created stress does not cause sign failure.

Metromedia had a model which was being used to determine the maximum distance between fasteners to avoid sign failure. This model was based on a number of simplifying assumptions which were causing the map for fastening locations to be too conservative. In addition, there was some lack of confidence in the model among users. The AMRE project was to develop a new model serving the same purpose but with fewer simplifying assumptions involved in determining the acting forces in order to produce a more accurate fastener location map.

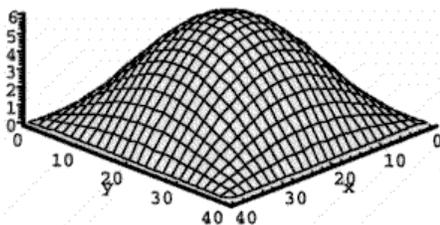
After analyzing the existing model, the AMRE team developed a new, more mathematically sound model serving the same purpose. The new model, which takes the biaxial extensions of the banner into consideration, gives more accurate prediction of actual stress at attachment points and, due to the more careful analysis, provides greater confidence among the model users. The "stretched" banner was modeled with a computer graphics program and then with a mathematical function. The function matched collected stretch and stress data comfortably within accuracy specification given by Metromedia and was then used to create a stress map along the boundary. From this, an easy calculation presents the user with banner attachment locations.

Sine Model

$$M \left(\sin \left(\frac{\pi}{span1} x \right) \right) \left(\sin \left(\frac{\pi}{span2} y \right) \right)$$

where *M* = maximum deflection,

span1, *span2* = dimensions of the banner in either direction.



Rubbermaid Inc.

Project Title: Cycle Time Prediction
Student Participants: Indradeep Ghosh, Mark Schlabach, Lisa Carter
Faculty Advisor: Dr. Jim Hartman

Rubbermaid utilizes a system of plastic production that involves injecting molten plastic into a mold, cooling it, and then releasing it from the mold. Each step of this process takes time, and the time which is required to complete one step of the process varies based on a number of variables such as type of plastic, mold size, and number of injection points. In order to make the most profit from a given product, Rubbermaid must try to maximize the number of items it can produce in a work day.

The Rubbermaid AMRE team completed an analysis of the cycle time required to produce a plastic product. (The cycle time is the time it takes for the mold to complete a cycle -- from the closing of the mold for an injection to the next closing.) The team developed methods based on linear regression and neural networks in order to provide Rubbermaid with a reliable tool for predicting future cycle times. This tool will be utilized by Rubbermaid in the planning stage of a new plastic item to help estimate the profitability of the product.

TGS (Technology Geosystems Inc.)

Project Title: GIS Community Internet Pages

Student Participants: Benjamin Adair, Anant Padmanabhban

Faculty Advisor: Dr. Denise Byrnes

Technology Geosystems Inc., or TGS Technologies, contracted with the AMRE program to develop a prototype web site at GISLink.com. This web site is meant to serve as an attractive and useful site for the Geographic Information Systems (GIS) community. The project was divided into three tasks.

Task 1: Stimulate network traffic through the site by creating "killer" content. In order to do this, the site would host the latest news, classified ads, and a directory to links within the GIS community. TGS provided design requirements and recommendations for these pages.

Task 2: Design and implement a prototype Map Store. The Map Store would allow TGS clients to interactively order maps through the web site. Clients could order a specific area from a given map and have it custom made. TGS provided technical information about digital file formats and algorithms used by the company to modify, create, and customize maps.

Task 3: Design an interactive distributed learning center (Dislecsys) for GIS. The dislecsys would allow GIS community members, and interested web surfers to interactively order or create a course of GIS study using the proposed web site.

AMRE 1996

The College of Wooster

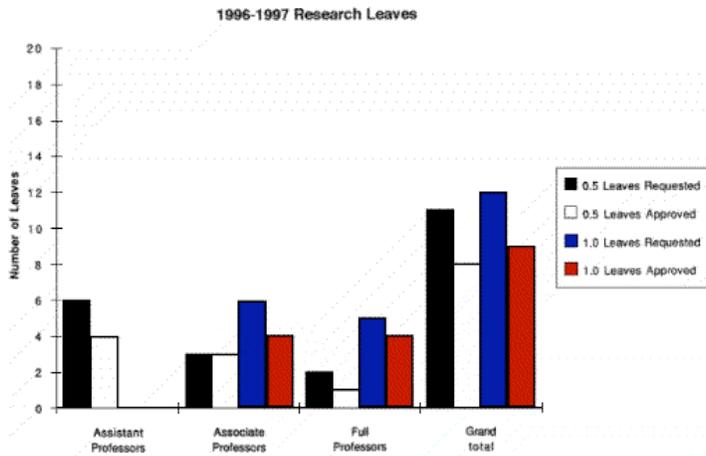
Project Title: Admissions Database Creation

Student Participant: Sohil N. Parekh

Faculty Advisor: Dr. Matthew Brahm (Mathematics)

This project consisted of four distinct parts. The first of these was the development of a program to study ten years of data regarding the trends by which students from the College of Wooster chose to fill their required distribution of courses. The information for this portion of the project was obtained from College databases through the Academic Computing Center. Because of the complexity of the project, the client's representative requested that other projects be completed before this one. While it was not completed during the course of the program, arrangements were made to allow Sohil to complete this portion of the project at a later date.

The second part of this project was a study of faculty leaves. This portion involved using Microsoft Excel to form a database of past faculty leave data. Along with the database, a series of reports and a user's manual were created, all of which were used by the administration.



The third portion of this project was related to the feeder high schools from which Wooster gathers its student population. This project entailed using the Administrative Computing service to download high school application data, and then forming a new database from which one could study this data. The data were also graphed to allow easy visual comparisons. The databases were given to administrators, admissions counselors, and others involved in the admissions process for future use in admissions.

The final facet of this project was to make a database to aid in the assigning of first year students to first year seminar classes. The database allowed the information that first year students sent in, regarding their seminar preferences, to be directly entered into the database. A number of tests and combinations of students could then be explored, in order to determine how to group students for their seminars. This database is utilized currently in the administrative offices to aid in this process.

Vermeer Manufacturing

Project Title: Production Scheduling Analysis

Student Participants: Beth Roessler, Doug Sillars, Vikas Malhotra

Faculty Advisor: Dr. John Ramsay

The [Vermeer](#) team had the following objectives from which they worked.

1. To understand the production scheduling process from summer forecasting to the monthly production decisions.
2. Perform a needs analysis. Determine overlap data in various spreadsheets/reports.
3. Incorporate ABC analysis information into the Production Scheduling spreadsheet.
4. Identify labor saving, usable approaches to spreadsheet production scheduling.

Following these objectives, the team studied the production scheduling process at Vermeer, then designed and implemented a revised production scheduling system which eliminated duplicate entry problems and created greater report generating ability. The final product for Vermeer was a written evaluation of the production scheduling process, a detailed analysis of how various factors affected production and a manual to help employees make use of the new production scheduling database.

In addition to the production scheduling work, the AMRE team also did an inventory analysis and lot sizing model for Vermeer's Agricultural Products plant.

Prentke-Romich Company

Project Title: "Material Creator" Application
Student Participants: Benjamin Adair, Indradeep Ghosh, Scott Rose
Faculty Advisor: Dr. Denise Byrnes (Computer Science)

The AMRE team worked with The [Prentke Romich Company](#) (PRC), to develop a program to assist speech therapists and clinicians in their work with the company's speaking devices. The team, with assistance from Ian Holford, a PRC engineer, helped design and implement a Macintosh program to create customized overlays for the devices and flashcards to assist with learning Minspeak. Additionally, the program provided a help facility to describe how to create overlays and flashcards.

The project centered around Minspeak, which is an iconic language that uses pictures to represent syntactic units and ideas. When these pictures are used in conjunction with each other, they represent a specific word or phrase. The primary difficulty encountered in the project involved the use of these pictures, which had to be converted into an electronic format. Specifically, decisions had to be made on how to store images, how to represent a keypad overlay on a screen that was as much as half the size of the original, and how to print them out to fit the speaking devices.

Over the course of the project, the team learned how to work independently and also as a group. Indradeep created the tutorial section. Scott assisted with the early development of the overlay editor section of the application before writing the flashcard section. Ben was primarily responsible for the overlay editor, adding the ability to save documents. Dr. Byrnes, aside from helping to coordinate with Ian and PRC, wrote the section of the program responsible for printing both overlays and flashcards. At the end of the project, we had a functional program that allowed the user to both create, save, and print out color flashcards and overlays.

AMRE 1995

LuK, Inc. I

Project Title: File Management Solutions
Student Participants: Jim Beck, Chris Guciardo, Sharif Khan
Faculty Advisor: Dr. Denise Byrnes (Computer Science)

The purpose of this project was for the AMRE team to investigate a document management package for the system of PC's in use at LuK. In order to accomplish this, the team members and the client laid out the following questions which were addressed during the study.

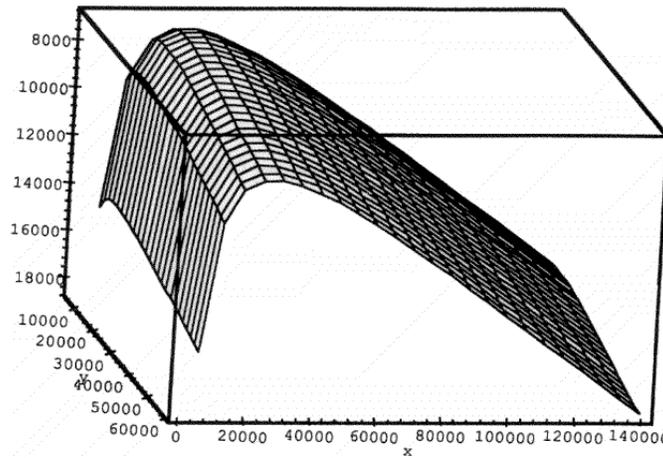
- 1. What does a document management system do?
- 2. Does a document management system address the needs expressed by the users and data processors at LuK?
- 3. What are the implications of a document management system from a network administration perspective?
- 4. What are the hardware or memory requirements of existing packages?
- 6. What are the policies and procedures for file saving to the Shared Drive?
- 7. Overall structure and Guidelines?

The AMRE team completed this program by suggesting to LuK that the corporation implement the software program Smart Files, a product of First Floor Incorporated. They made this recommendation based on the answers obtained to the above questions and input from the client. It was their opinion that "Smart File provides an integrated mechanism that manages, controls, and retrieves electronic data within a PC local work area."

LuK, Inc. II

Project Title: Component Part Lot Size Analysis

Student Participants: Joseph Kostakis, Lisa Nuzum, Atul Sethi
Faculty Advisor: Dr. John Ramsay (Mathematics)



Inverted graph of the two dimensional cost function

The AMRE team worked on determining the optimal lot sizes for manufacturing components at LuK. Problems arise in modeling the manufacturing process because the work centers at LuK are used to manufacture many different components. Not all work centers run at the same speed nor do they cost the same to setup. For most of the components, the first process, the stamp, is the fastest and most expensive work center. The rest of the work centers are relatively inexpensive and slow in comparison to the stamp. This difference in the speed of the work centers disrupts the flow of the process and creates an in-process inventory after the stamp work center. Therefore, the process of manufacturing a component should be viewed as two different yet related processes. The project was to model this two-process system and find the optimal lot sizes for both the first and second process.

The model used previously by LuK worked well for a one-process system and was based entirely on the stamp work center. The results from this model for the stamping process were close to the optimal, but the model did not take into consideration the accumulation of in-process inventory after the stamp. Therefore, this model was used as a stepping stone to develop a model that takes into consideration in-process inventory.

The new model incorporates the speed of the second process, since the second process varies from component to component. It also breaks down the total setup cost of the component machinery into two setup costs, one for the stamp process and one for the remaining processes. Also, the holding cost rates and the value of the in-process item are adjustable for every item.

As a final product, the AMRE team provided a program that incorporated the AMRE model to be used by LuK when making production lot size decisions. This model will give more a better approximation of optimal lot-sizes and annual costs.

J.M. Smucker Company

Project Title: Strawberry Crop Volume Prediction
Student Participants: Karelynn Gerber, Priyavadan Mamidipudi, Mustafa Hasham
Faculty Advisor: Dr. Matthew Brahm (Mathematics)

The goal of the project with the [J.M. Smucker Co.](#) was to produce a forecasting tool for predicting both the volume and the field price of the strawberry crop in the Oxnard, California growing area. The tool is able to make volume predictions at various times during the growing season, based primarily on the current season's weather conditions. In addition, the prediction was accompanied by a confidence interval, reflecting the uncertainty of the model, as well as the variability of the

long term forecast. Similarly, the price predictions were accompanied by a confidence level and could be tested at various times throughout the season. The price predictions depend on the volume predictions as well as some economic factors such as the volume of the Mexican and Florida strawberry harvests, and the relative size and value of the fresh vs. frozen strawberry market, and the character of the market for different varieties of strawberries. A neural network approach was used in designing the tool.

AMRE 1994

The City of Wooster

Project Title: Effectiveness and Efficiency Measurement for Service Departments
Student Participants: Diane Burtch, Priyavadan Mamidipudi, Joseph Kostakis
Faculty Advisor: Dr. Jim Hartman

Note: The 1994 summer research project was entitled Math Clinic, rather than AMRE.

This project team was asked to consider the same issues which the Governmental Accounting Standards Board (GASB) reviewed when evaluating "Service Efforts and Accomplishments (SEA)." The goal set out by the team was to create tables of SEA indicators and data pertaining to these indicators. The purpose of the data tables was to allow the City of Wooster to review budget items with greater ease, as well as compare departmental data, as each department would use the same format for reporting. The completed project became the springboard into an experimental phase as the city attempts to implement the GASB recommendations.

Smith Dairy

Project Title: Ice Cream Carton Inventory Analysis
Student Participants: Chris Guciardo, Scott Meech, Monica Renier
Faculty Advisor: Dr. John Ramsay

At the time of the AMRE project, [Smith Dairy](#) was experiencing a serious crunch on storage space for one-half gallon cardboard ice cream carton inventory. The AMRE team was asked to do an analysis of this inventory and its space utilization, and make recommendations as to how Smith's should deal with the space limitations. A production/inventory model was devised and applied (through a spreadsheet analysis) to two years of production and ordering data. The model was a modification of a standard Economic Order Quantity model, incorporating various ordering and holding trends with safety stock levels. This model enabled the AMRE team to make recommendations on warehouse utilization, safety stock levels, and batch order sizes for the different ice cream carton types. The recommendations were meant to help relieve some of the pressure on current inventory storage space.