Comparisons of the Educational Outcomes from Distance Delivered versus Traditional Classroom Instruction in Principles of Microeconomics

Tricia L. Crouse

Thesis submitted to the Faculty of
Virginia Polytechnic Institute and State University
In partial fulfillment of the requirements for the degree of

Master of Science
In
Agricultural and Applied Economics

Approved by:
Kurt Stephenson, Committee Chair
Dixie Watts Reaves
Michael Ellerbrock

June 4, 2002
Blacksburg, VA

Keywords: Teaching economics, comparing instructional methods, distance education, Internet courses, student learning, attitudes, and interest

Comparisons of the Educational Outcomes from Distance Delivered versus Traditional Classroom Instruction in Principles of Microeconomics

Tricia L. Crouse

Kurt Stephenson, Committee Chair
Associate Professor of Agriculture and Applied Economics

(ABSTRACT)

Recent advancements in the speed and availability of the Internet have catapulted distance education into the forefront of possible economic education alternatives. Distance learning courses are taught exclusively over the Internet. Economics distance courses provide alternatives for economics students to traditional classroom instruction, and also invite new students to the discipline who may not have otherwise enrolled. An increase in the number of distance courses in the economics field has sparked a debate over the ability of distance courses to provide equivalent educational outcomes as traditional in-class courses.

This study evaluates educational outcomes from a traditional section and two distance sections of introductory agricultural microeconomics courses, Economics of the Food and Fiber System (AAEC 1005), taught at Virginia Tech. The study compares student learning, attitudes and interests in economics, and perceptions of instructor effectiveness between traditionally taught students and those taught through distance education. Average exam scores, and common exam questions given to students in both course types, are the measures of student learning used in this study. Attitudes and interest are measured by student survey, and perceptions of instructor effectiveness are measured by student course evaluations. A variety of statistical tests are conducted comparing distance and traditional students in order to determine the influence of delivery method on educational outcomes. Results indicate that traditional students generally obtain higher grades on tests, and have a higher opinion of course instruction than distance students, suggesting that distance education is not an equivalent educational alternative to traditional classroom instruction.

Acknowledgements

I have been in school non-stop since I was four years old. Childhood family and friends have made me the person I am today. From my childhood until now, there have been two people who have taught me to be who I am, to try as hard as I can, and to achieve all that I desire, my parents, Jim and Marlene. To you I owe everything, and I gratefully Thank You.

I would like to thank my advisory committee, Kurt Stephenson, Dixie Watts Reaves, and Michael Ellerbrock for their guidance, support, and input throughout my research.

I want to especially thank my committee chair, Kurt Stephenson, who put a great deal of time and effort into advising and motivating me from the beginning to the end of this project.

Thank you.

Table of Contents

List of Multimedia Objects

Tables

Equations

Chapter One – Statement of the Problem

I. Introduction

Recent advancements in the speed and availability of the Internet have catapulted Internet, or distance, education into the forefront of possible economic education alternatives. Internet technology is now directly impacting and changing the way courses are taught and how students learn (Wiens and Gunter). In 1999, Internet education was a 2.6 billion dollar market (Green). Over 700,000 students took courses taught over the Internet and that number is expected to triple in 2002 (Green). Distance learning courses, also referred to as Internet courses, are taught exclusively over the Internet. Students access lecture materials from a course web page. Depending on the sophistication of a course's construction, lectures may contain written and graphical information as well as audio explanations and links to related web sites for further material. Currently, 75 percent of two and four year colleges offer some form of distance education (Green). The current evolution of the Internet as an educational tool has caused great debate over its ability to educate as compared to traditional lecture courses.

The use of distance education in economic pedagogy is increasing along with the other disciplines. Few studies have measured the impact that distance education has on student learning, attitudes and perceptions of economics (Agarwul and Day). Traditionally, economics courses are taught in lecture halls, by a "chalk and talk" format, the professor lecturing while the students take notes (Navarro, Becker 1997, Becker and Watts 2001). Internet technology has opened up a whole new arena for student learning. Economics distance courses provide alternatives for economics students to traditional lectures, and also invite new students to the discipline who may not have otherwise enrolled in an economics course. Since more and more distance courses are emerging in the economics field, it is important to evaluate the capabilities of the Internet as an educational tool.

To analyze the capabilities of the Internet to deliver courses, one must first look at the defining characteristics of the learning process. Pedagogy is the study of teaching methods, including the outcomes of education and the ways in which such goals are achieved. The field relies heavily on educational psychology that develops theories about the ways in which learning takes place. Advocates of pedagogical change in the economics discipline believe teaching

practices which stress lecturing and note taking do not do enough to develop students' cognitive learning skills (Simkins). Incorporating visuals, analysis, and discussion into courses emphasizes greater active and collaborative learning exercises that encourage students to take greater responsibility for their education (Becker 1997, Simkins).

Active learning in the education process is achieved when students assume an active role in their education. Active learning stresses a student's active involvement in the educational process, by participation, analysis, and collaboration with others, and not by solely note taking which is a passive learning activity. Guidelines developed in a study by Lawrence Ragan (2000) set forth five elements of active learning:

1. Active use of writing, speaking, and other forms of self-expression.
2. Opportunity for gathering, synthesis, and analysis in solving problems and in critical thinking.
3. Participation in collaborative learning and teamwork.
4. Application of intercultural and international competence.
5. Dialog pertaining to social behavior, community, and scholarly conduct.

Ragan's research claims incorporating three or more of these elements into course content will induce active learning by the students. Active learning is especially important in economics where often the main goal of the professor is to get students to "think like economists" (Salemi et al., Becker 2000). The easiest way for an instructor to achieve this goal is by providing structured opportunities for students to apply economic concepts to real world examples (Salemi et al., Becker 2000).

Supporters of distance education feel that active learning can be directly incorporated into the multimedia design of the course, and may be the key to stimulating economic education (Navarro and Shoemaker 1999). Today, the most interactive Internet courses use digitized lectures, audio supplementation, discussion boards, and interactive software to incorporate the active use of writing, problem analysis, and collaborative learning into the lessons (Navarro). The students are actually guiding themselves through the course, being actively involved in their education. Furthermore, proponents of web instruction stress that multimedia courses can better accommodate different learning styles and provide more individualized instruction to each

student than can the traditional classroom (Sosin, Navarro and Shoemaker 2000). This is because students have more control over their own learning in a distance course. Learning styles are part of a personal makeup unique to each student (Grasha and Yangarber-Hicks). Distance courses enable a student to focus on the type of educational media they favor to learn from because the course is structured to cater to different sensory, social, and thinking styles of individual students (Grasha and Yangarber-Hicks). Students are in control of the amount of time spent on a lesson and are able to stress areas of weakness.

Pedagogical research of online courses and Internet-supplemented courses has provided evidence of student benefits (Leisure and Thievan, Agarwul and Day). These benefits include less time constraints, faster access to information, and more control of course pace. Agarwul and Day (1998) conclude that "the Internet represents an information revolution, and its use in pedagogy is beneficial whenever interaction, discussion, research, or transmission of information are involved". A study of computers and pedagogy reported that students thought the use of computer technologies made classes and assignments more enjoyable (Conrad). Also, the Internet is full of real-life headlines and data that can be accessed at the click of a button when incorporated or linked directly into distance course applications to arouse student interest in economic topics (Becker 2000).

Speed of Internet communication and easy access to information also allows instructors and students to save time in preparing and completing assignments (Conrad). Distance courses may provide educational benefits by liberating shy students who would otherwise not speak out in the classroom (Conrad). Students in distance courses may not be able to meet personally with instructors for help, but can interact with them or other students through email, discussion boards, or private course chat rooms. Advocates of distance education feel that supportive teacher-student relationships can be obtained in distance education because instructors get to know student minds and not just faces (Lesniak and Hodes, Navarro). Also, through email and discussion boards, more thoughtful discussions can be evoked from students than in a traditional in-class discussion because they have time to formulate responses before speaking aloud (Grasha and Yangarber-Hicks).

Most importantly, distance courses open up economic education to a whole new group of nontraditional students. Through the convenience of the Internet, distance education courses are able to reach a greater number of students who otherwise may not have been able to participate in a traditional economics course (Navarro). The asynchronous network established by distance courses allow the barriers of time and space to be removed so students can study when it best fits their schedule. Unlike past technologies such as radio, television, and teleconferencing, students in distance courses are actively involved in learning because they can control their learning environment to best suit their needs (Becker 2000). Nontraditional students include full time employees, at home mothers, and those who live in remote areas. Economic education in a distance course is especially beneficial to students who would not participate or enroll if the course was traditionally taught.

Not all educators are supporters of distance education. Many educators are skeptical of the educational value of Internet courses. Opponents of using the Internet taught distance courses in economic pedagogy argue that the technology is "a time-consuming way to add glitz and entertainment rather than substance to teaching" (Sosin). Many economics instructors feel education on the Internet creates "digital diploma mills" that lack in personal interactions between students and teachers (Navarro and Shoemaker 1999). They also view the courses as having empty pedagogy that stresses memorization rather than synthesis and analysis (Navarro and Shoemaker 1999). Critics declare that, particularly in the discipline of economics, answering student questions would be difficult by email since explanation usually involves mathematical equations or graphs (Conrad).

Most skeptics of distance learning feel that Internet courses cannot adequately engage students in an active learning environment of the same caliber as live interactive traditional instruction. Opponents feel discussion board chats cannot provide students with as thorough an understanding of, and benefit from, course materials as the instant feedback and interaction classroom discussion can provide (Navarro and Shoemaker 1999, Sosin). It is also felt that distance courses cannot adapt to student inquiries and needs as quickly or completely as a live instructor who can tailor the lecture to fit the rhythm of student response (Sosin). Skeptics of Internet education additionally feel it is important to distinguish between access to information and the ability to use information correctly to educate. It is important to realize that more

information does not imply more education, and that students must comprehend and use information in purposeful ways in order to learn from it (Sosin).

Another factor to consider in opposition of distance education is student motivation, and whether or not college students are disciplined enough to adequately keep up with work and pace themselves properly. Open access to a distance course could cause students to procrastinate or to overwhelm themselves with too much information at once (Sosin). Others feel there is lack of evidence that computers improve student learning as compared to traditional educational technologies (Conrad).

Further research on the effectiveness of distance education is needed to determine how the supporters' and skeptics' opinions of distance education measure up to actual student performance. Assessing the effectiveness of education is centered on student learning (Becker; 1983). Student learning is largely measured through grades received on exams and assignments. A course is often judged as being effective or not effective in educating based on the overall class performance through grades achieved by the students. In addition to grades as a measure of effective education, measures of increased interest and positive changes in student attitudes towards a subject also provide evidence of effective instruction (Navarro and Shoemaker 2000, Agarwul and Day). Sparking students interest in a discipline or improving their attitude towards a subject matter is considered effective instruction because it increases the likelihood of the student to retain what was learned and apply it to real-life issues (Volery).

Despite the support and criticisms of distance learning in economics courses, questions of whether or not distance courses can actually improve student learning, improve student attitudes, and increase interest toward the subject has not been researched thoroughly, even though the number of Internet distance courses in economics is increasing (Simkins, Agarwul and Day). The lack of empirical evidence on the effectiveness and limitations of internet instruction on student learning, attitudes, and interest is mostly due to the fact that the technology is so new and constantly advancing (Sosin, Simkins, Salemi et al.). Information is also lacking on how students in distance courses perceive the effectiveness of the instructor as compared to traditional students who have live interaction with the instructor (Agarwul and Day, Angulo and Bruce).

One of few empirical tests in the economics discipline, by Navarro and Shoemaker (1999), compares online with traditional students in a graduate level microeconomics course. The two sections of the course received almost identical course content, with the online class having CD-Rom lectures performed by the same instructor of the traditional class. The traditional class was also given the CD-Rom to supplement their lecture notes. There were no significant differences between the online versus the traditional groups upon entering the course. The results of the research indicated, in terms of students learning as measured by exam scores, the online and traditional groups achieved at approximately equal levels (Navarro and Shoemaker 1999).

The Navarro study also contained an attitudinal survey pertaining to course content and administration. Both the online and traditional students had positive attitudes concerning use of the CD-Rom lectures, and traditional learners admitted they picked up additional information they otherwise would have missed in the live lecture. The only measure that was statistically significant in the Navarro study was that almost 80 percent of distance learners preferred CD-Rom lectures to only 17 percent of traditional learners. This information suggests that there are differences in learning styles between students in distance and traditional courses and that those differences could have played a role in which course type a student chose to enroll. Other reports from the economics discipline discuss the impacts of distance courses on economics pedagogy, and the use of Internet courses to promote active student learning. Sosin (1997) outlined various advantages and disadvantages that could be associated with distance courses and how they may affect economics education, while Simkins (1998) suggests that distance courses can be used to promote active learning by students and increase awareness and interest in economics.

II. Problem Statement

The limited evidence provided by previous works in distance education lead to preliminary findings that the use of the Internet in economic pedagogy results in neutral or slightly beneficial outcomes in student learning. However, the gap in economic literature calls for more empirical research to compare the educational effectiveness of distance courses to

traditional lectures to determine the capabilities of distance education in classes taught exclusively online.

This study will evaluate educational outcomes from three introductory agricultural microeconomics courses (AAEC 1005) taught in 2001 at Virginia Tech. The study will compare student learning, attitudes and interests in economics, and perceptions of the course between traditionally taught students and those taught through distance education. The distance and traditional courses were very similar other than the manner of instruction. The distance delivered and traditional course students were both provided with the similar lecture presentations, materials, and testing procedures. The same primary instructor taught both courses. Traditional learners attended lectures supplemented with visuals and had a required course text for supplemental reading. Distance learners had a website devoted entirely to the class. From the site students accessed weekly assigned digitized text lectures, augmented with graphs and charts, and supplemented by optional audio lecturing. Also, from the website, distance learners had access to email and a class discussion board. Discussion questions were posted and students created threads of responses building from and contrasting the thoughts of other Internet course students. Traditional learners were given problem set homework assignments, while the distance learners took weekly quizzes. The problem sets and quizzes covered comparable information. Both course types were also given four exams throughout the semester in which 44 of the questions across three exams were identical.

This study will measure the educational effectiveness of the distance section of AAEC 1005 course compared to the traditional section by evaluating student learning based on individual student grades. Effectiveness will also be measured by determining differences in student attitudes and interest in economics, and perceptions of the course, depending on student course type. This research will attempt to determine if certain types of students (based on background academic and demographic information) are more likely to take and succeed in an online course versus a course taught in traditional lecture format. Based on student grades, background information, and measures of attitude and interest, the instructional advantages and limitations of the distance course will be determined.

III. Objectives

The purpose of this research is to assess the educational effectiveness of an introductory agricultural microeconomics course taught exclusively over the Internet as compared to a similar course taught in a traditional classroom setting. The objectives are to assess educational effectiveness by determining whether:

1. Student learning differs between students taught in a distance course versus a traditional course – measured by common exam questions and total exam averages.
2. Student attitudes and interest in economics differ depending on course type as seen through the results of surveys.
3. Student evaluations of the introductory agricultural microeconomics course content and the instructor's effectiveness differ between students in a distance versus a traditional course.

IV. Procedures

Chapter two will outline the conceptual framework behind the assessment of differing instructional methods. Chapter three will discuss the course content of both the distance and traditional courses, as well as describe the types of data to be used in the analysis, and the methods by which these data are obtained. The general measures to be used in the analysis of the distance and traditional sections of AAEC 1005 will also be developed in this chapter. Chapter four discusses and interprets the results from the analysis. Chapter five presents conclusions and recommendations from the research, outlining and interpreting any significant findings in the comparison of student learning, attitudes and interest in economics, and perceptions of the course content and instruction between the distance and traditional sections of the AAEC 1005 course.

Chapter Two – Conceptual Framework

I. Introduction

Instructors alter teaching methods and adapt to new teaching technologies in order to improve the quality of instruction. Before new methods of teaching are adapted into the mainstream educational process, it is common practice to determine whether or not the new instructional method will improve the educational outcomes of the students. Formal comparative studies and informal analysis are generally conducted to determine how a new instructional method measures up to current ones in terms of students' educational outcomes.

A recent increase in the use of the Internet in distance education has given rise to a heightened interest in studies comparing the educational outcomes between Internet distance courses and traditional classroom lecture courses. This study compares the educational outcomes between distance delivered and traditional AAEC 1005 principles of microeconomics courses. In order to conduct a comparative study on the educational outcomes from these two instructional methods, the framework behind the formal assessment of instructional change must be further developed. Formal assessment consists of three general steps.

The first step in the assessment of instructional change is to have clearly defined student educational outcomes that an instructor wishes to attain. The main desired outcome from education is to facilitate learning (Mehrens and Lehmann). Most instructors are also concerned with other outcomes of education beyond how much a student learns. Educators wish to evoke a more positive attitude, interest, and appreciation for their discipline from the students as a result of completing the coursework (Linn and Gronlund).

The second step in assessment of instructional change is to develop quantifiable measures of the desired educational outcomes. Measures of educational outcomes are indicators that allow instructors to evaluate whether instruction has been improved by an instructional change. Student achievement in a course, or student gains in knowledge from pre-course to post-course, is a frequently used indicator of student learning (Stronge and Tucker). Student learning is most often measured by student achievement through test scores or final course grades. Quantifiable

measures of student attitudes, interest, and appreciation for a discipline are achieved through student survey responses and course evaluations.

The final step in assessing an instructional change involves developing methods to explain the observed changes in educational outcome measures. Based on the educational outcomes discussed above, procedures will be developed which explain patterns of change in student learning, attitudes, interest, and appreciation outcome measures. Many different factors can influence these educational outcomes, such as student ability and past achievement. To effectively assess how an instructional change influences the desired outcomes of education, methods used must attempt to separate out the individual influences on educational outcomes, in order to isolate the key influence of interest, which is the method of instruction.

This chapter will examine the way economists have implemented the process of assessing instructional change in order to compare student outcomes between traditional and distance courses. The chapter will describe: 1) which educational outcomes are of importance to economic instructors and why, 2) how economists measure these outcomes, and 3) how economists explain observed changes in educational outcomes and what factors are important to consider in determining what influences educational outcomes.

II. Outcomes of Education

II.A. Learning

The most apparent educational goal of interest to an educator is to promote student learning (Mehrens and Lehmann). Simply stated, students' learning is equal to their final knowledge after the completion of a course minus any entry knowledge they had prior to the course (Becker 1982). Student learning encompasses knowledge and understanding of the discipline as well as being able to apply information and use thinking skills to solve problems (Linn and Gronlund). In economics, a common goal of instructors is to enable students to "think like economists", by being able to understand and use economic principles and concepts in order to analyze real world economic issues (Becker 2000). For a student to be able to think like an economist requires that the student acquire important educational criteria associated with

learning: knowledge and understanding of economic concepts, and the ability to apply those concepts and use critical thinking skills in solving economic problems. When evaluating student learning in conjunction with an instructional change, it is important to determine if there are differences in student knowledge, understanding, application, and critical thinking skills depending on which method of instruction the student received.

II.B. Attitudes, Interest, and Appreciation

Another educational outcome of relevance to educators is a student's attitude towards a discipline (Linn and Gronlund). Positive student attitudes have known benefits including: lower student attrition, increased student motivation, and greater commitment and loyalty to a program or discipline (Angulo and Bruce). Particularly in economics, measurement of attitudinal change as a result of exposure to an economics course has become an increasingly important area in research (Soper and Walstad, Agarwul and Day). A more positive attitude about economic concepts and issues resulting from course exposure could motivate a student to continue with more courses in the field, or retain and use economic concepts in real world situations (Becker 2000). These positive attitudes may in turn promote long-run retention and gains in learning. This makes student attitudes a relevant factor in educational outcomes research.

Two other types of educational outcomes that an educator wishes to evoke from students are interest and appreciation for their discipline (Linn and Gronlund). Just as positive attitudes towards a discipline can promote continuing education or application of ideas and concepts to real life, interest and appreciation increases as a result to exposure to a course can have much the same effect (Becker 2000). How students perceive a course and its instruction have been linked to student appreciation and interest in the discipline (Becker 1997, Angulo and Bruce).

In economics, studies comparing web-enhanced courses to traditional economics courses have shown positive increases in student perceptions from the web-enhanced course as compared to the traditional course (Agarwul and Day, Angulo and Bruce). Research comparing student attitudes, interest and perceptions in economics between traditional classroom instruction and Internet taught distance courses, however, is lacking. This study will provide information on how distance education influences student appreciation of economics as compared to traditional

learners, and how this appreciation influences students' attitudes and interest in economics, and perceptions of the discipline.

III. Measures of Educational Outcomes

III.A. Measures of Learning

The main purpose of a formal assessment of student achievement is to measure improvements in student learning (Heady, Gronlund). Student achievement in a course has long been considered the best assessment of student learning. Various assessment instruments are used to evaluate student achievement. In economics, instruments that have most commonly been used to measure student learning are the Test of Understanding of College Economics, common exam questions, and overall course grades.

III.A.1. The Standardized TUCE

The TUCE, or the Test of Understanding of College Economics, is a multiple-choice test developed in 1968. The TUCE is a two-part test, which tests both micro and macroeconomics. The test is intended to measure learning, with over two-thirds of the questions designed to assess student aptitude in the application of economic concepts (Becker 1997). The TUCE has served as the outcome measure for several hundred studies measuring student learning in economics.

When measuring differences in student learning due to a change in the method of instruction, the TUCE can be used in several ways. Instructors typically use the TUCE to measure student learning gains in an individual course by administering the exam both pre-course and post-course, then assessing the changes in student achievement. When comparing instructional methods between two different courses, instructors compare differences in TUCE scores across the two course types. This allows instructors to compare either the aggregate pre-TUCE scores, the post-TUCE scores, and/or the changes from pre-TUCE to post-TUCE scores of the two courses with differing instructional methods.

Current research, however, has moved away from the standardized test analysis of learning due to some perceived limitations: general purpose tests are not likely to conform to the

purpose and content of a particular economics course, and not all questions on standardized tests are considered satisfactory by all educators (Siegfried and Fels, Becker). The TUCE may not correctly assess the content of a particular economics course, causing the measurement of student learning from the TUCE to be inaccurate. In studies since 1968, the only significant influences affecting students' post-TUCE scores were the students' pre-TUCE scores and SAT scores (Becker 1997). The TUCE test may not provide much insight into student learning in economics, but only shows that students with higher aptitudes for standardized tests score higher on the TUCE test. Another limitation of standardized tests is that no multiple-choice test can accurately measure all the educational objectives of instruction.

III.A.2. Course Grades and Common Test Questions

Recent studies have relied on using more course specific measures of learning, such as students' course grades or percent correct on exams (Agarwul and Day, Navarro and Shoemaker 1999, Navarro and Shoemaker 2000, Stephenson et al.). Students' overall course grades can be used to compare overall student achievement between courses with nearly identical content, but with two different instructional methods. This allows for direct comparisons between different methods of instruction to be made.

Comparing student test scores or scores on common test questions is another way to measure changes in student learning due to different instructional methods. Navarro and Shoemaker (2000) compare student outcomes between two different instructional methods by giving students in both course types identical exam questions. This measure allows them, like the standardized TUCE, to compare learning outcomes by using identical questions; unlike the TUCE it enables them to use a variety of question styles and to focus on material that specifically meets their desired educational outcomes of the course. By using common exam questions in courses with different instructional technologies, comparisons of student achievement can be made between the two different methods of instruction.

Instructor-prepared test questions allow for the use of a variety of testing questions besides multiple-choice, such as short answer and problem solving questions. However, using test scores of any kind as the only output measure of learning is too narrow (Becker 1997).

Research has shown that tests asking a variety of types of questions, besides just multiple-choice, still essentially measure the same outcomes from education (Becker 1997). Test scores and course grades can be effective measures of student learning, but should not be used as the sole method of assessing educational outcomes (Becker 2000). This is because there are many desired outcomes of education that a multiple-choice test, or any type test, cannot possibly measure completely (Becker 1997). Tests can be used as indicators of how much information a student has learned or retained in a course, but it cannot measure a student's appreciation for, interest in, or attitude towards a discipline. These educational outcomes are also important influences in the educational process that are worthy of assessment, but cannot be measured in test scores.

III.B. Measures of Student Attitudes, Interest, and Perceptions

Student attitudes towards economics have become an important issue of discussion in terms of how attitudes may affect learning. In 1979, the then Joint Council of Economic Education, now know as the National Council of Economic Education, commissioned a survey to measure student attitudes towards economics as a result of exposure to economic instruction (Soper and Walstad). The result was the development of a 28-item survey with a five-point Likert scale. The survey is divided into halves, with the first half questioning student attitudes towards economics as a discipline or subject of study. The second half attempts to quantify the complexity of a student's economic attitude using opinion statements from several economic topic areas. These economic issue statements are designed to see if students hold similar opinions as those in the economics profession. A 1983 study conducted by Soper and Walstad, using the survey, found evidence that student attitudes are much more difficult to change than student cognition. Since attitudes are considered to be a relevant outcome of education in economics, research is needed to identify what factors cause student attitudes towards economics to change.

Recently, the half of the survey measuring student attitudes towards economics as a discipline was used in Agarwul and Day's (1998) quantitative study comparing traditional to web-enhanced economics courses. The results of the study were mixed about the effect of web-based enhancements on attitudes toward economics (Agarwul and Day). However, Angulo and Bruce (1999) found that positive student attitudes can be beneficial by lowering student attrition

and increasing motivation, thus making student's economic attitudes an important area in research. Student attitudes are relevant to this study in determining how a distance delivered economics course may affect student attitudes towards economics and how these attitudes may influence student learning.

Another topic of importance in economic education is increasing student interest and appreciation for economics after completion of a course, and determining how interest and appreciation may relate to student achievement. Student interest in economics is often thought of as being related to a student's attitude. The second half of the attitudinal survey commissioned by the National Council of Economic Education, which quantifies the complexity of students' economic attitude, is comprised of opinion statements, which are current event topics of the time (Soper and Walstad). These statements are targeted to gauge how well student opinion, or interest, coincided with an overall consensus of economists. Little research has been conducted in the area of student interests on economic topics, how they are affected, and how they may affect student learning in economics courses.

Student appreciation and interest in a discipline are also associated with student perceptions of course content and its instruction. Student perceptions are frequently measured by course evaluations. Student perceptions about the effectiveness of instruction may itself be an important indicator of student learning and attitudes (Becker 1997). Economics departments generally rely heavily on these evaluations as the measure of the instructional product (Becker and Watts 1999). Although heavy reliance on these evaluations is controversial, they cannot be disregarded as a measure of educational outcomes from instruction (Becker 1997).

Agarwul and Day (1998) use course evaluations of instructor effectiveness in their study comparing traditional courses to web-enhanced courses. By taking the difference of the mean responses to evaluation questions, they were able to determine that the web-enhanced course resulted in more positive opinions of the course on evaluations than did the traditional course evaluations (Agarwul and Day). Course evaluations can similarly be used in comparing distance and traditional courses.

IV. Evaluation of Educational Outcomes

This research will measure the observed changes in the educational outcomes of students in distance delivered economics courses as compared to a traditionally taught section. In order to measure differences in educational outcomes between two methods of instruction, the influences that cause differences in outcomes must be clearly identified. It is impossible to identify and control for all factors which influence the educational outcomes of students. However, the purpose of this research will be to separate such influences as a student's ability, background, attitude, and any other factor that may be influential in their education, from the method of instruction each student received. Attempting to isolate the instructional method allows for determination of the influence the instructional method alone has on students' outcomes from education.

In order to gain a clear perspective on educational outcomes in economics, researchers have attempted to model student learning by incorporating a set of variables they believe influence how much learned knowledge a student gains from an economics course (Siegfried and Fels, Becker 1983, Manahan, Agarwul and Day, Navarro and Shoemaker 1999). These models have typically taken the form of production functions.

Economists use production functions to measure the amount of output received from a specific amount of inputs. For example, the output of production could be bushels of corn yielded, where the inputs to production generally fall into the three categories of land, labor, and capital. This production function would take the form of: Corn yield = f (land, labor, capital). In general production functions include one output which is influenced by a series of variables or inputs, $y = f(w, x, z)$, where y is the output and w, x, and z are the inputs influencing the amount of output produced.

Economists tend to characterize student learning in much the same way. In this case, the output of production is learning, which is measured by test scores or course grades. Student production of grades is a function of several inputs, these inputs being the variables that influence student learning. Determining which inputs are necessary to accurately explain student

learning is essential. Necessary inputs are the variables that significantly influence a student's learning potential.

Economists have developed three categories of explanatory variables: human capital variables, utilization rates, and technology (Siegrfried and Fels). With these variables, the production function for measuring student learning is:

(1) Student Learning = *f (human capital variables, utilization rates, technology)*

Human capital variables are a measure of a student's aptitude for learning. Through years of studies, human capital variables have remained relatively consistent, focusing on measures of student ability while also incorporating a variety of socioeconomic variables, and attitude and interest variables as well. A student's SAT/ACT score and grade point average (GPA) have long been measures of student ability, whereas gender, age, and ethnicity have also frequently been used in learning studies (Manahan, Becker 1983, Siegfried and Fels, Navarro and Shoemaker 2000, Stephenson et al., Agarwul and Day). SAT/ACT scores are generally associated with student potential ability, whereas GPA is a measure of ability, as well as student effort.

Studies comparing educational technologies in economics instruction have also begun to discuss and incorporate more complex human capital variables into their models. A student's experience or background in math courses such as calculus and algebra is seen as a possible influence in student learning in economics, as well as previous economics courses taken by students (Becker 1997, Jensen and Owen, Becker and Watts 2001). Math ability is deemed a relevant influence due to the amount of graphical analysis and mathematical calculations involved in the discipline. In comparing Internet distance education to traditional education, computer experience and Internet expertise may also be relevant variables to consider.

Attitudes and interest towards economics as a result of a particular learning technology are relevant variables. It is important to determine if a more positive attitude or interest in the economics discipline results in better performance. Furthermore, it is important to know if there are differences in attitudes and interest based on a student's level of achievement and which course type they are enrolled.

The utilization rate, or time spent studying in a course, has been found to increase a student's achievement in that particular course, as well as other related courses (Becker 1982). Becker used a constrained utility maximization model in his 1982 study, to determine the effect that time spent studying had on learning. He found that increasing time spent studying economics or related fields, such as math, resulted in positive benefits in student learning.

Other important issues involving time are the number of course hours in which a student is enrolled, and the number of hours a student is involved in extracurricular activities or work. In an attempt to measure student effort in economics courses, the number of course hours a student is enrolled in per semester is a variable given attention in recent literature (Becker 1997). This is thought to be helpful in determining if a weaker course load will result in a student having more time, and applying more effort towards each individual course as compared to a student with more classes to study for. Constraints on a student's time, whether studying for other courses, participating in non-academic extracurricular activities, or working a job, should be considered as possible factors that could affect a student's achievement in an economics course. In this study it is also important to identify if there are differences in time constraints between the distance and traditional sections of AAEC 1005.

The technology variable in this research will be the learning technology in which students were enrolled: either a traditional lecture version of AAEC 1005, or the distance delivered version of AAEC 1005 taught entirely over the Internet. The primary goal of this study is to determine if these differing instructional methods result in different educational outcomes between the students. The efficiency, or how fast, distance courses transform effort into knowledge as compared to traditional courses is not an issue. For this study, determining if the two differing instructional methods result in different levels of student learning, attitudes and interest in economics, and perceptions of the AAEC 1005 course is of the highest importance.

Chapter Three – Methods

I. Introduction

This chapter will describe measures of student learning, attitudes, interest, and perceptions of instructor effectiveness used to compare the educational value of AAEC 1005 distance courses with their traditional counterpart. When comparing two methods of instruction, the instructional methods must be clearly defined and the attributes of these methods should be described based on how they can contribute to educational outcomes (Smith and Dillon). Differing delivery methods of course materials result in the processing, learning, and appreciation of course content in different ways (Smith and Dillon). For this study it is important to determine if different instructional methods can influence students' abilities to achieve the educational objectives for the course.

This chapter describes the content of both the distance courses and the traditional course used in this study, describes the methods by which data are collected on the indicators of educational outcomes relevant to this research, and develops the analytical methods used to test for differences between the two course types. Results from testing will provide insight into the debate surrounding distance education, helping to determine whether distance education provides an equivalent alternative for students, or as skeptics believe, stresses memorization and lacks the interactive quality of live instruction.

II. Course Descriptions

This study compares data on the educational outcomes between three sections of AAEC 1005, Economics of the Food and Fiber System, an introductory agricultural microeconomics course taught at Virginia Tech. Two of the AAEC 1005 courses were distance courses, taught entirely over the Internet through a course website. The distance courses were taught in the spring and fall semesters of 2001. The third AAEC 1005 course was taught in the spring semester of 2001 in traditional classroom lecture format. Although the traditional and distance courses are quite similar in content, and taught primarily under the same instructor, the method of delivery of the material is quite different between the two course types.

II.A. Distance AAEC 1005

II.A.1. Course Construction and Content

Distance learners have a website devoted entirely to the course. From the website, students can access all the materials and assignments needed to successfully complete the course. The website provides constant access to the course syllabus as well as a course introduction which highlights class administration, grades, and a course overview. A student manual is also accessible from the website to enable unfamiliar students to become accustomed to the online learning environment.

The course content for AAEC 1005 is broken down into four major topics: supply, demand, markets, and special topics. Special topics lectures consist of environmental and resource economics, and rural and community development. Within each of the four main topics of the course, lectures are organized into weekly assigned sections. There are a total of fifteen weeks in the course. The weekly lectures for the four main topics are divided across the fifteen weeks as follows: five supply lectures, four demand lectures, three market lectures, and two special topics lectures. The same instructor as the traditional course taught the supply, markets, and special topics sections of the distance course. However, a different instructor taught the distance demand section. The lectures are in slide format using digitized text, augmented with graphs and charts. Each lecture slide is accompanied by an audio explanation. Students have the option of printing out lecture note pages prior to viewing these lectures. Distance students are also given the option of purchasing a textbook to supplement their studies. This text was identical to the required text of the traditional students.

II.A.2. Testing

Students are required to take and submit a weekly quiz corresponding to each week's lecture every Friday by five pm. The quizzes are accessed and taken from the course website and are in multiple-choice format. They are considered "take home" assignments, where open notes and book are permitted. Quizzes are assigned for each weekly lecture and are designed to ensure students are keeping up with the material.

Upon completion of each of the four main topics of the course, the students are tested on that topic. Tests include multiple-choice definition and graphical analysis questions as well as problems and short answer questions. Students can work out problems on scratch paper, but all responses to test questions are entered into the computer test form, and then submitted by the student electronically when complete. The tests for the distance courses are in a proctored and timed setting. All students taking the distance courses are required to take each test on the same day, in an on-campus computer lab, within a nine-hour testing period. Students are required to show their student ID's and sign in before given the test instruction sheet with an access password. The test is timed: once students enter the password and gain access to the questions, they have one hour to complete the test. The questions for the tests are pooled from a test bank at random, giving no two students an identical test, thereby reducing the chance of cheating.

A student who cannot come to campus for testing due to distance or time constraints must locate an appropriate area to take the test. The student also must identify and secure a suitable proctor to verify that they took a valid test. Student-secured proctors are required to fill out and sign a proctor form made available on the class website. The proctor must submit the form to the course instructor when the exam is complete.

II.A.3. Communication

Three graded discussion questions are also posted on the course website throughout the semester. The discussion topics are based on current issues of interest in the economics discipline and included the Microsoft anti-trust case, deregulation of the electricity industry in California, and rural poverty. Students are required to either submit there own original responses to the discussion topic, or to respond to what other students have already submitted. This enables one discussion question or statement to create threads of responses from students building on and contrasting the thoughts of other distance course students. The responses to the discussion questions constituted ten percent of students' final grades.

Distance students are able to contact each other through email in order to discuss or help each other with course materials. The instructor can also be reached by email directly from the course website. Through the communications section of the website, the students can select

groups of students, the instructors, or teaching assistants and send an email to a group of individuals. To aid students in their studies, old quizzes are provided in the course materials. Also, because all of the course grading and administration is done electronically, students have the ability to check their course grade after each completed assignment.

II.B. Traditional AAEC 1005

II.B.1. Course Construction and Content

Students in the traditional AAEC 1005 course attended classes taught in the conventional lecture format. Since the primary instructor for the distance and traditional courses are the same, the course content is organized into the identical four major topics of: supply, demand, markets, and special topics. With the exception of the demand section, which is taught by a different instructor in the distance sections of the course, the lectures in the traditional course use nearly identical information and slide visuals as the distance courses. Slide graphs and charts, which are used in the distance lectures, are turned into overheads to be used during the traditional course lecture periods.

II.B.2. Testing

Traditional learners are assigned problem sets, one to cover each of the four course topics, instead of the weekly quizzes the distance learners must take. However, since the supply, market, and special topics lectures covered the identical material in both course types, the traditional student problems sets are comparable in scope and content to the quizzes taken by distance students in these topic areas.

Four tests are administered at the end of each of the four main topics of the course for the traditional course students. The tests are similar in format as those given in the distance courses, consisting of multiple-choice definition and graph analysis questions, as well as problems and short answer questions. For the purposes of this study, forty-four of the test questions from the supply, markets, and special topics sections are identical for the traditional and the distance students.

II.B.3. Communication

The AAEC 1005 traditional lecture course allows for in-class discussions to take place during the progression of the lecture period. Traditional students are able to interact with the instructor, as well as each other, during the course of the lecture in order to ask questions or further discuss the topics of particular interest. Students are encouraged to speak out and raise questions as needed during each lecture.

Traditional students also have access to a class website designed specifically for traditional learners. This website provides students with definitions, overviews, and examples of many supply, demand, market, and special topic concepts covered in the course (Stephenson et al.). It also contains direct email links to the course instructor. This website is designed to supplement, not substitute for, attending the traditional lectures.

II.C. Comparison of Distance and Traditional Sections

The distance and traditional sections of AAEC 1005 cover virtually the same content. Both course types are comprised of four main sections: supply, demand, markets, and special topics, with an exam given on each section topic. The distance and traditional sections of AAEC 1005 are also taught under the same primary instructor. However, the delivery methods used by the distance and traditional courses are very different, presenting the course content to students in two very different ways.

The most apparent difference between the distance and traditional sections is the amount of feedback that can be given to students. The traditional students, who attend live lecture presentations, have the ability to instantaneously interact with the instructor and other students in order to ask questions, or clarify points in the lecture. In the traditional section the instructor has the ability to tailor and divert the discussion to coincide with student interests, and to adjust the presentation based on student comprehension of the material.

Distance students "attend" lectures individually by accessing the lecture on the course website and navigating their way through the material at their own pace. Any questions about

points in the lectures must be submitted through email, and the student must wait for the instructor's response. Immediate feedback and interaction with the instructor and other students to help clarify problem areas is not possible with distance instruction; however, students can review the lecture material as many times as needed to help with any confusion they may have. The lectures are presented as they are originally prepared and formatted by the instructor. In the distance section the instructor does not have the ability to tailor lectures specifically to the students' needs, and for the most part, is not given feedback from the students in order to have knowledge of those needs.

The distinct difference in the amount and type of feedback provided to the distance students as compared to the traditional students, in addition to the overall differences in the delivery methods used in each section, could cause differences between the two course types in how the lecture content is interpreted. Differences in interpretation and understanding of the course content lead to differences in student learning. It is important in this research to determine if the different delivery methods of the distance and traditional sections cause significant differences in student learning, attitudes and interest in economics, and perceptions of the instruction.

III. Data Collection Methods

This section describes the methods by which student background information and data were gathered in order to be used in the measurement of the educational outcomes as discussed in Chapter Two. The data collected for this research will be used as measures of the educational outcomes, or indicators, that allow for evaluations and comparisons to be made between the distance and traditional students' outcomes from education. The outcomes of education deemed relevant to this research include: student learning, attitudes and interest in economics, and perceptions of the AAEC 1005 course.

Data were collected for this research in several different ways. A background survey conducted in the beginning of the semester collected information on student demographic and background characteristics. Student learning indicator data was collected relating directly to student performance, measured by grades, in the AAEC 1005 courses. Pre-course and post-course attitude and interest surveys were also administered. Course evaluations are given to

students at the end of the semester to collect information on student perceptions of the course and instructor. Additional information on students was obtained from the university registrar's office, which included: student age, gender, GPA, SAT scores, and major.

III.A. Background Survey

In the beginning of the course, identical background surveys are administered to the students in both the distance sections and the traditional section of the AAEC 1005 course. This survey is designed to gather background information and a variety of student personal characteristics. Survey questions ask for general background information such as age and semesters in college, as well as for more detailed information such as study methods, instructor interaction, extra-curricular activities, and computer use/experience. The complete background survey can be found in Appendix A.

Students are asked to provide information on how they spend their time studying, which forms of instructional media they feel are most conducive to their learning, and if they have ever taken a prior internet course. They are also asked how many hours per week they spend either working or participating in extra-curricular activities. This information will be useful in determining if there are compositional differences between the two course types based on the background information provided by the students.

III.B. Measures of Student Learning

Learning is measured by student test performance. The principle way in which student learning is measured and analyzed in this study is by common test questions. Students in the distance and traditional courses are given questions pooled from the same subset of forty-four test questions. The common questions covered three course topics: Supply, Markets and Special Topics. Since the demand section is taught by a different instructor for the distance sections, there are no common questions for this test. The analysis of common test questions allows for direct student performance comparisons of student learning to be made between the distance and the traditional AAEC 1005 students. All of the students in the traditional course have the forty-four common questions as a part of their exam. The distance classes test questions are pooled

from a test bank, with test questions selected randomly from a large set of possible questions, so all of the common questions are not received by all of the distance learners. On average, the distance students received about two-thirds of the common questions. A full listing of the forty-four common questions can be found in Appendix B.

In order to closely analyze differences in performance between course types, the common questions are further broken down into definition and analysis categories. A definition question is categorized as one in which a term is directly defined, such as "The Marginal Product is defined as…". Analysis questions were considered to be those that involved application of course concepts, an example being: "What factor could cause an upward shift in the demand for corn?" Skeptics of distance education feel distance learning stresses memorization rather than understanding and synthesis of concepts (Navarro and Shoemaker 1999, Sosin). Separate testing of definition and analysis type questions will help determine whether distance students can only succeed in memorizing economics facts (success with definition questions) as the skeptics suggest, or if they are able to analyze and interpret economic problems (success with analysis questions). Student learning for definition and analysis common questions will be measured by the percent of common questions answered correctly by each student, across the three exams, by either course type.

Since course content is very similar for both course types, comparisons can be made between classes not only for common test questions, but also total exam performance. A measure of overall exam performance for the supply, markets, and special topics exams will allow for comparisons of student learning on overall exam performance. Student total exam performance will include: the average of the percent correct each student received on the supply, markets, and special topics exams. The total exam averages for the students will include the common test questions, as well as questions that were unique to each course type. Examining how well students performed overall on these exams will provide an additional measure of student learning between the distance and traditional course types.

III.C. Measures of Attitudes and Interest in Economics, and Course Perceptions

Students in the distance and traditional sections of AAEC 1005 completed surveys to measure their: 1) attitudes about economics as a discipline; 2) interest in current economic topics; and 3) opinion of the course and effectiveness of instruction. Attitude and interest surveys are administered to the students before and after the course. The attitude survey aims to assess student opinion of economics as a discipline, whereas the intent of the interest survey is to assess student opinion of current issues relevant to economics. Student evaluations of the effectiveness of instruction are taken anonymously at the end of the semester. These are university-generated evaluations; therefore both course types received the same form. The full attitude survey, interest survey, and student evaluation form can be found in Appendix C, D, and E, respectively.

III.C.1. Attitudes

The survey measuring student attitudes is adapted from the attitudinal survey developed by the National Council on Economic Education in 1979. Nine questions are selected from that survey. A one through five Likert-type scale, one being strongly agree and five being strongly disagree, is used to rank attitudes. The students also have the option of choosing to be undecided. Out of the total of nine attitudinal questions, four express positive attitude statements (e.g. I like economics, or economics is easy), and five express negative statements (e.g. Economics is dull, or studying economics is a waste of time). The complete attitude survey questions are listed in Table 3.1.

III.C.2. Interest

The interest survey asks students to rate their likelihood to read an article on a particular current economic issue. The subjects listed are economic issues ranging from gas prices, to the Microsoft anti-trust case, to farm policy issues. Students rate their likeliness to read an article on each particular subject from one to three: very likely to read, will sometimes read, and very unlikely to read, respectively. Five of the economic issues in the survey are discussed in both the

distance and traditional course lectures. There are a total of thirteen economic issues on the survey. The complete list of economic interest statements is found in Table 3.2.

Table 3.1 Student Economic Attitude Statements*

1. Economics is easy for me to understand.
2. Economics is dull.
3. I enjoy economics.
4. Studying economics is a waste of time.
5. Economics is one of my most dreaded subjects.
6. Economics is a very difficult subject for me.
7. Economics is one of my favorite subjects.
8. I use economic concepts to analyze current events.
9. Economic ideas are too abstract to be useful to me.

*Students rate on a one through five scale, one strongly agree, five strongly disagree, or undecided

III.C.3. Student Evaluations

The final indicator of educational effectiveness is student evaluations of the effectiveness of instruction. The university requires every instructor to administer student evaluations at the end of the semester. The evaluation questions include instructor knowledge and teaching effectiveness, whether the subject matter was made stimulating and relevant, the adequacy of materials, and student perceived gains in knowledge from the course. The actual student evaluation questions are listed in Table 3.3, and the full University issued student evaluation form is provided in Appendix E. Students rate each of the seven evaluation statements as either poor, fair, good, or excellent. Student evaluations are administered anonymously so that student responses can remain confidential. The student evaluations are used to measure and compare student perceptions of the instruction between the distance and traditional learners.

Table 3.2 Student Interest Toward Economic Reading Topics

How likely are you to read an article about…*
1. Why gas prices are increasing.**
2. The government's anti-trust case against Microsoft.**
3. The impact of lifting the trade sanctions against Cuba.
4. Competing reasons for falling agricultural commodity prices.**
5. Congressional debate about future farm policy.
6. OPEC's oil production plans for next year.**
7. Environmental criticisms of the World Trade Organization.
8. Debate about EPA's calculations of the costs and benefits of raising natural air quality standards.**
9. Efforts to create new employment opportunities in the Appalachian region.
10. Recent financial performance of a new high tech company.
11. The financial impact of tobacco lawsuits on Virginia's tobacco farmers & the local economy.
12. Plans to preserve habitat for an endangered species.
13. The impact of suburban growth on the financial viability of farms near my home.

* All questions were rated Very Likely to Read, Will Sometimes Read, or Very Unlikely to Read

** Topics which were discussed in both course types

Table 3.3 Student Course Evaluation Questions

How would you rate the instructor in the following categories?*
1. Success in communicating or explaining the material
2. Degree to which subject matter was made stimulating or relevant
3. Administration of the class and organization of materials
4. Apparent knowledge of subject matter
5. Concern and respect for students as individuals
6. Fairness in assigning grades
7. Overall rating of the instructor

* All questions were rated Poor, Fair, Good, or Excellent

IV. Testing for Differences in Educational Outcomes

The main objective of this study is to compare the educational value of AAEC 1005 distance courses to a traditionally taught section of the same course. A variety of statistical tests are used to determine whether course type explains any differences observed in the measures of educational outcomes. These measures, as described previously, include: student learning (measured by test performance), attitudes and interest in economics, and student perceptions of instructor effectiveness.

IV.A. Learning Outcomes

The assessment of student learning will focus on determining whether test performance (measured by the percent correct of definition and analysis common test questions, as well as the average percent correct on exams) differed between the two course types, holding other factors constant. Three separate explanatory regression models are specified, based on the three dependant variables discussed above. Informed by the discussion in Chapter Two, identical sets

of independent variables will be used to explain student test performance. The general forms of the learning models to be used in this analysis are as follows:

(2) COMQUESTD = $$f\left(\begin{array}{l} CRSTYPE, GPA, SAT, AGE, GENDER, HOURSEC, \\ HOURSWK, ECONHS, REQUIRED, PREATTITUDE \end{array}\right)$$

(3) COMQUESTA = $$f\left(\begin{array}{l} CRSTYPE, GPA, SAT, AGE, GENDER, HOURSEC, \\ HOURSWK, ECONHS, REQUIRED, PREATTITUDE \end{array}\right)$$

(4) AVGEXAM = $$f\left(\begin{array}{l} CRSTYPE, GPA, SAT, AGE, GENDER, HOURSEC, \\ HOURSWK, ECONHS, REQUIRED, PREATTITUDE \end{array}\right)$$

Where:

COMQUESTD = % Correct of common definition exam questions

COMQUESTA = % Correct of common analysis exam questions

AVGEXAM = average % correct across Supply, Markets, and Special Topics exams

CRSTYPE = enrolled in distance or traditional course (1 = distance, 0 = traditional)

GPA = student's overall GPA at the start of the semester in which the course was taken

SAT = the student's total score on the SAT exam

AGE = age at the beginning of the course

GENDER = male or female (1 = female, 0 = male)

HOURSEC = hours per week of extracurricular activities

HOURSWK = hours per week at a job

ECONHS = whether economics was taken in high school or not (yes = 1, no = 0)

REQUIRED = whether the course was required for major or not (yes = 1, no = 0)

PREATTITUDE = a measure of a student's pre-course attitude

The first independent variable in the models, CRSTYPE, represents which course type each student is enrolled, either in the traditional section of AAEC 1005, or one of the distance sections. The CRSTYPE variable is represented as a dummy variable, with 0 = traditional and 1 = distance. This is the most crucial variable in the study, because it will determine if the different learning technologies resulted in different educational outcomes between the students. The main goal of the research is to determine if distance AAEC 1005 courses result in different levels of student learning, as measured by grades, than the traditional section of AAEC 1005. Based on past research, the expected outcome of this variable will be for the coefficient to have a

negative sign, indicating that the traditional students perform better than the distance students in the AAEC 1005 course.

The variables GPA, SAT, and ECONHS represent student academic ability and student academic history variables. The student's GPA may measure academic effort and ability during the semester the course was taken. This is a current measure of their college academic achievement up until the semester the AAEC 1005 course was taken. Another academic ability variable is student performance on the SAT exam. This variable characterizes a student's ability to achieve in academics. Students' GPA and SAT data was obtained through the University Registrar. ECONHS is an academic history variable, describing whether or not a student has had economics in high school. This variable is represented as a dummy variable with 0 = no economics in high school, and 1 = economics in high school. The ECONHS data was obtained from the student background survey.

The variables GPA, SAT, and ECONHS will help to determine how past achievement and course experience may affect student learning. GPA is expected to be positive: the higher a student's GPA, the more academically successful the student will be in AAEC 1005. The same is true for the SAT variable. Students who achieved higher scores on their SAT exam are expected to perform better on tests in AAEC 1005 than students who had lower SAT scores. It is also expected that students who have had economics course experience in high school will perform better in AAEC 1005, making the sign of the ECONHS coefficient positive.

Time constraints on the students will be measured by the variables HOURSWK and HOURSEC. These variables represent the student's estimate of the number of hours each student works per week, and the number of hours each student is involved in extra-curricular activities per week, as reported in the background survey. Time spent in extracurricular activities and work hours detract from the time a student can devote to course study. Measures of the hours a student spends in such activities will be used to determine how non-academic activities affected student performance in AAEC 1005. The expected outcome from these variables is that students who spend larger amounts of time involved in extra-curricular or work activities will have lower grades than students with less time constraints, resulting in a negative sign on the HOURSEC and HOURSWK coefficients.

Student effort will be measured by the variable REQUIRE. The variable REQUIRE represents whether a student took the class because it was required within their major, or as a restricted or free elective. The REQUIRE variable is represented as a dummy variable, with 0 = not required within major, and 1 = required within major. The information for the variable was taken from the background survey. This variable will determine if there are significant differences in student effort, as shown through grades, depending on whether the course was needed by the student or not. The expected sign of the REQUIRE variable is more ambiguous than the others discussed so far. Students who are required to take the course for their major have an incentive to perform adequately and put forth a good effort, because not doing so will result in having to repeat the course. However, students who are taking the course as an elective may have more experience with, or an interest in, economics. Student interest might drive the student to perform well in the course whether it is a requirement or not. Because students who are required to take this course have more invested in it, the expected result from the REQUIRE variable is that students who are required to take AAEC 1005 will out perform those who are not, thus the REQUIRE coefficient's sign will be positive.

The variables AGE and GENDER account for student demographic differences. These variables will be used to control for the influence of a student's age or gender on test performance in AAEC 1005. The data source for the AGE and GENDER variables was the university registrar, as well as the background survey. In this research it is assumed that with age comes experience, whether it is economics experience, or just college experience in general. Because of this, the AGE variable is expected to result in older students performing better than the younger students. The general consensus in economic educational research is that males, in general, achieve at higher levels in economics courses than do females (Jensen and Owen, Agarwul and Day, Lumsden and Scott, Cohn, Cohn, and Bradley, Borg and Stranahan). For this reason, the GENDER variable is expected to be negative, showing that males perform at higher levels than females in AAEC 1005.

The variable PREATTITUDE is developed from the attitude survey in order to analyze how students pre-course attitude might have affected their learning in the course. The PREATTITUDE variable is an aggregate measure of the nine attitude survey statements the students are asked to rate. The variable can range from negative nine to nine; where each

statement a student with a positive attitude is marked a plus one, a negative attitude is marked a negative one, and a neutral attitude given a mark of zero. For example, if a student rates all nine statements so that they have a positive attitude towards economics, their PREATTITUDE variable would be a positive nine, however, if a student rates all the statements so that they have a negative attitude, their PREATTITUDE score will be a negative nine. The PREATTITUDE variable is expected to be positive, showing that students who enter AAEC 1005 with more positive attitudes towards economics perform better than students who have a negative economic attitude.

IV.B. Measuring Attitudes

The pre-course and post-course survey design allows for comparisons of student attitudes toward economics to be made from the pre-course data, the post-course data, and the changes that occurred from pre-course to post-course. The responses to attitude survey questions can be used to determine if course type has a significant influence on student attitudes at the completion of AAEC 1005, and if course type significantly influenced a change in student attitudes from pre-course to post-course. Attitude statements on the survey were broken into two categories of positive type attitude questions and negative type attitude questions. Students rate the degree in which they agree with each statement on a Likert scale from one to five, one being strongly agree and five being strongly disagree.

Chi-square testing is the primary method of analysis used for student attitude and interest survey data, and for student evaluations. A chi-square test is used to test for independence between categorical data. The null hypothesis of the test is that there is no systematic difference between the responses in differing categories. In this research, chi-square testing is used to test for differences in the distributions of the attitude and interest surveys, and the student evaluation responses for the two categories of distance students and traditional students. The general form of the chi-square test statistic is as follows:

$$(5) \qquad c^2 = \sum_i \sum_j \frac{\left(O_{ij} - E_{ij}\right)^2}{E_{ij}}$$

Where:

O_{ij} = the observed count in row i and column j

E_{ij} = the expected value of row i and column j under the assumption of independence

E_{ij} is calculated by multiplying the probability of each observation being in row i and column j, times the total number of observations. The chi-square test statistic resulting from the above equation is compared to a critical value, which is based on the degrees of freedom in the calculation and the level of significance desired.

The pre-course and post-course data will be analyzed using chi-squared analysis to test for differences in student attitude survey responses between the distance and traditional students. This will provide evidence as to whether student attitudes towards economics as a discipline differed between course types at the beginning of the course, and/or at completion of the course. This analysis provides a benchmark for comparing how student attitudes changed.

Chi-square analysis will also be used to analyze changes in student attitudes from pre-course to post-course as measured by survey responses. Two separate tests are conducted: one test measures for distributional differences of distance student responses to pre-course and post-course attitude surveys, and the other test measures for distributional differences of traditional student responses to pre-course and post-course attitude surveys. This analysis will show, individually for each course type, whether student attitudes towards economics changed from pre-course to post-course. The results from these separate tests can also be compared, to determine how changes in economic attitudes of distance students from pre-course to post-course measure up to changes in the economics attitudes of traditional students from pre-course to post-course.

Hypothesizing the outcomes from the attitude analysis is more difficult than with the learning models due to that fact that prior research is lacking in this area. However, assuming that the traditional student's academic performance is either equal to or greater than the distance student's performance, the expected outcome from attitudinal analysis is that the traditional student's attitudes towards economics will be more positive than those of the distance students.

IV.C. Measuring Interest

The pre-course and post-course design of the interest survey allows for comparisons between course types in student's interest in economic topics to be made from the pre-course data, the post-course data, and in the changes in interest from pre-course to post-course. This allows for analysis very similar to that of the attitude survey to determine if course type has a significant influence on student interest in economic topics. The student interest portion of the survey consists of thirteen current topics of interest in the economics/agricultural economics disciplines. Students were to rate their likelihood to read an article on each of these topics from one to three, one being very likely to read, two being will sometimes read, and three being very unlikely to read.

As with the attitude analysis, chi-square testing will be used in testing the interest survey data. Pre-course and post-course data will be analyzed using chi-squared analysis to test for differences in student interest survey responses between course types. This will provide evidence as to whether student interest in economics topics differed at the beginning of the course, and/or at completion of the course, depending on whether the student is in the distance section or the traditional section of AAEC 1005.

Chi-square analysis will also be used to analyze the changes in student interest in economics from the pre-course to post-course as measured by survey responses. Just as in the attitude analysis, two separate tests are conducted: one test measures for distributional differences of distance student responses to pre-course and post-course interest surveys, and the other test measures for distributional differences of traditional student responses to pre-course and post-course interest surveys. This analysis will show, individually for each course type, whether student interest in economics topics has changed from pre-course to post-course. The results from these separate tests can also be compared to determine how the changes in student interest in economic topics of distance students from pre-course to post-course measure up to the changes in student interest in economic topics of traditional students from pre-course to post-course.

The outcomes from the interest analysis are difficult to predict, just as with the attitude analysis, because research is lacking in this area. However, as with the attitude analysis,

assuming that traditional student's academic performance is either equal to or greater than the distance student's performance, the expected outcome from the student interest analysis is that the traditional student's interest in current economic topics will be greater than those of the distance students.

IV.D. Measuring Perceptions

The examination of the student evaluations of instructor effectiveness will also be completed using chi-squared analysis. Testing will illustrate if there are significant differences in the distribution of responses to evaluation statements between the distance course students and the traditional students. This analysis will determine if students had more or less favorable opinions of the instruction of the AAEC 1005 course depending on whether they were a distance or traditional learner. Since the distance and traditional courses cover almost identical course content, and are taught by the same instructor, it is expected that the student opinions of AAEC 1005 instruction will be the same for the distance and traditional sections of the course.

Chapter Four – Results

I. Introduction

This chapter presents the results comparing the educational outcomes of distance delivered AAEC 1005 courses to that of a traditionally taught course. The material is presented in three sections. The first section describes the student compositions in each of the two course types, followed by a section with the results of the estimation of the student learning models. Finally, the results on the testing of student attitudes, interest, and perceptions about economics are presented.

II. Course Composition

The traditional section of AAEC 1005 was completed by a total of 108 students in spring 2001. Twenty-two students completed the spring 2001 distance section of AAEC 1005, and thirty-six students completed the fall 2001 distance section of the course. Even though all of these students completed AAEC 1005 and received a grade for the course, full information could not be obtained on all students. A complete student observation consists of a student who completed and submitted a student background survey, attitude and interest surveys, as well as the three exams (supply, markets, and special topics) used in this analysis. The spring 2001 traditional section of AAEC 1005 contains eighty complete student observations. The spring 2001 and fall 2001 distance sections of AAEC 1005 each contain twenty complete student observations.

Table 4.1 presents the compositional data, including survey response rates, for the traditional students and the distance students. The two distance sections are presented separately so that their compositions may also be compared. The information in this table is compiled from the background survey as well as the university registrar. Traditional students on average tend to be younger with less college experience than the distance students. The traditional student, however, has a slightly higher average overall GPA than the distance student. The traditional section also contains a notably larger amount of students in College of Agriculture and Life Sciences majors (CALS) than the distance sections of AAEC 1005, with twenty percent more

CALS majors than the spring distance section, and over thirty-five percent more CALS majors than the fall distance section. The traditional and distance students tend to participate in extracurricular activities at fairly similar rates, but the traditional students tend to work four or more job hours less per week than the distance sections. The sections of distance students also tend to have far greater experience with online courses and previous economic experience than the traditional student section. With enrollment open to all students for both the traditional and distance sections of the course, the large difference in the compositions of the traditional section as compared to the distance sections of AAEC 1005 is unknown. These findings pose an interesting question as to why different attributes of the distance verse the traditional course drew a different mix of students.

The average ages, semesters in college, and overall GPA's of the spring and fall distance students are extremely similar (see Table 4.1). The distance sections also have similar percentages of students who are required to take the course, and who have previous online course experience and economics experience. The only notable difference between the two distance sections is a fifteen percent difference in the number of students with majors in CALS. Both distance sections contain twenty students with complete student observations, but their survey response rates are very different, with a thirty-five percentage point difference in the rate between the two sections. The reason for large the difference in the response rate is unknown. Based on the overall high comparability of the spring and fall distance sections, the student data of the distance sections will be combined.

Notable differences have also been found between the distance and traditional students in the reasons for which a student enrolled in the course. Table 4.2 shows the three different reasons each student could be enrolled, and the percentages of distance and traditional students enrolled as each type of student. Conducting chi-square testing shows significant differences between the distribution of distance and traditional students in their course enrollment type. Eighty-five percent of traditional students enrolled in AAEC 1005 because it was required for their major, but the course is only required for about thirty percent of the distance students. The majority (39%) of distance students enrolled in AAEC 1005 as a free elective.

Table 4.1 AAEC 1005 Student Compositional Data by Course Type and Section

Class Composition Data	Spring 2001 Distance	Fall 2001 Distance	Spring 2001 Traditional
Students Completing Course	22	36	108
Complete Surveys (pre and post)	20	20	80
Survey Response Rate	90.9%	55.6%	74.1%
Age[1] (avg)	21.14	21.60	18.85
Semesters in College[2] (avg)	4.62	4.80	1.7
Overall GPA[1] (avg)	2.62	2.62	2.83
Major in CALS[1]	40.0%	25.0%	61.3%
Extracurricular activity[2] (hr/wk)	6.4	8.9	7.4
Job[2] (hr/wk)	9.5	13.6	5.8
Previous Online Course(s)[2]	40.0%	45.0%	13.8%
Economics in High School[2]	25.0%	30.0%	12.5%

[1] Data obtained from the university registrar
[2] Data obtained from the background survey

Table 4.2 Student Reasons for Enrolling in AAEC 1005

Course Enrollment Type*:	Distance	Traditional
Requirement	29%	85%
To fulfill a requirement	32%	9%
Free elective	39%	3%

*Significant at the 5% level, df = 2

The reason why the vast majority of those taking AAEC 1005 as a free elective chose to take the course online is unknown, though flexibility is a possible reason. A distance course does not restrict students to a scheduled class time like a traditional course does. The reason why a large majority of those obligated to take the course chose to take it in a traditional setting cannot be determined based on the evidence available. These results raise the following questions: did students taking the course as an elective feel there would be more leniency or academic freedom in the distance section of the course; and did those taking AAEC 1005 as a required course feel they would perform better and stay more focused in the traditional setting? Although these questions are unanswerable in this research, the results do provide insight into the large differences between the number of CALS majors enrolled in the distance and traditional

sections. Since AAEC 1005 is a course within CALS, those students in the traditional section, with a large percentage of CALS majors, are likely to have AAEC 1005 as a required course (all CALS majors except Bio-Chemistry are required to take AAEC 1005), where the students in the distance sections, where the number of CALS students is much less, are not likely to be required to take AAEC 1005.

Despite the differences between the distance and traditional students in enrollment type, students in both course types display very similar study habits and classroom behavior. Table 4.3 summarizes results from background survey questions pertaining to the study habits and plans of the students. The distance and traditional students give similar responses on how they prepare for exams, the time it takes them to complete an exam, and on the frequency with which they ask questions. Chi-square testing conducted on these survey responses found no significant differences between the distance and traditional students. Significant differences are found between course types in their future graduate school plans. Forty percent of traditional students plan on attending veterinary school, while nearly half of the distance students plan on getting a Master's degree (either and MS, MA, or MBA).

The reason for the differences in graduate school plans again falls back on the number of students enrolled in CALS majors. A large percentage of CALS majors are pre-veterinary students studying Animal and Poultry Sciences. All pre-veterinary students are required to take AAEC 1005, thus the large number of traditional students which are CALS majors is reflected in the large percentage of the traditional students planning to attend vet school.

Background survey results show differences between the course types in student computer usage and in their location to campus. Table 4.4 summarizes the responses to these survey questions. Although not found to be statistically significant, distance students, on average, appear to spend more hours on the Internet per week than the traditional students. Chi-square testing suggests significant differences between the distance and traditional students in how they rate their computer skills and in their distance from the Virginia Tech campus. Over seventy-five percent of distance students rate their computer skills as either above average or higher, where as sixty-five percent of traditional students rate their skills as being only average.

The majority (49%) of distance students commute from one to eight miles to campus, while three-fourths of traditional students live on the Virginia Tech campus.

Table 4.3 Student Study Habits and Plans

Survey Questions	Distance	Traditional
Do you prepare for exams:		
Review after each class	27%	29%
Study the night before exam	93%	93%
Study right before exam	44%	45%
Do you finish testing:		
Before most students	29%	24%
Same time as most students	51%	55%
After most students	20%	21%
Do you ask questions in class:		
Never	15%	10%
Almost Never	37%	49%
Sometimes	41%	38%
Frequently	7%	4%
Do you ask questions outside class:		
Never	10%	5%
Almost Never	29%	51%
Sometimes	59%	41%
Frequently	2%	3%
Considering graduate school in which area*:		
MS / MA	25%	17%
MBA	23%	8%
MD	2%	3%
PHD	9%	6%
EDD	5%	1%
Vet	16%	40%
Other	7%	3%
Not	14%	21%

*Significant differences found in chi-square testing at 5% level. n = 120 df = 7

The differences between the distance and traditional students in their computer skills, usage, and distance to campus may help provide an explanation for the compositional differences between the two course types found in Table 4.1. Students who consider themselves more skilled in the use of a computer would be more likely to feel comfortable taking a distance course. Also, student who lives off-campus may find it more convenient to take a class from home in order to avoid a commute, or the hassle of finding a parking space, whereas students

who live on-campus can simply walk to a traditional class. Over fifty-five percent of distance students live off-campus. Off-campus student populations tend to be older, with more college experience. The larger percentage of distance students living off-campus helps provide explanation for some of the data presented in Table 4.1, which shows distance students to be older and have more college experience than the traditional students. Also, the compositional data reports that distance students have far greater experience with previous online courses, probably due to the fact that they are more experienced, and as Table 4.4 shows, more confident in their computer skills than the younger traditional students.

Table 4.4 Student Computer Use and Location

Survey Questions	Distance	Traditional
Hours spent on Internet per week		
1 to 5	17%	39%
6 to 10	41%	31%
11 to 14	20%	11%
Over 15	22%	19%
Do you rate your computer skills as* (df = 4):		
Very High	17%	1%
Above Average	59%	26%
Average	22%	65%
Below Average	2%	5%
Very Low	0%	3%
Distance to Campus* (df = 2):		
Live On	44%	75%
Live 1-8 miles	49%	25%
Live 9-15 miles	0%	0%
Live 16+ miles	7%	0%

*Significant differences found in chi-square testing at 5% level. n = 120

The background survey data presented in this section helps to provide a baseline comparison of the distance and traditional sections of students. The results show that the average distance and traditional student is different. The most pronounced differences in the distance and traditional students are their ages, college experience, location in relation to campus, their computer skills, and whether or not they are enrolled in a CALS major. No further explanation for the compositional differences found between distance and traditional students can be offered from the data collected in the background survey.

III. Evaluation of Learning Outcomes

Data from the student background survey, the pre-course attitude survey, and the registrar's office is used to estimate the student learning models developed in Chapter Three [equations (2) - (4)]. The general models of student learning aim to identify the factors explaining student learning. Student learning is measured by three dependant variables: COMQUESTD (percent correct on definition common questions), COMQUESTA (percent correct on analysis common questions), and AVGEXAM (the overall average of three exam grades).

Due to the many data sources used to compile the variables used in this analysis, many variables have a number of missing student observations. Missing SAT scores and incomplete survey information are the two main sources of incomplete data. The students' SAT scores for both course types are obtained from the Virginia Tech Registrar. Only one hundred and twenty-two SAT scores have been obtained out of total of one hundred and sixty-six students (26.5% of total observations are missing SAT scores). Out of the SAT scores obtained from the registrar, eighty-six SAT scores are those of traditional students and thirty-six are distance student SAT scores. The reason for the forty-four missing SAT scores is unknown and could not be explained by the registrar's office.

Student survey information is the other main constraint on the number of student observations used in the estimation of equations (2), (3), and (4). The variables HOURSEC, HOURSWK, ECONHS, REQUIRED, and PREATTITUDE are all derived from survey information. Many observations could not be included in the analysis because of missing background and attitude surveys. One hundred and twenty students completed the surveys out of the total one hundred and sixty-six students enrolled in either course type (72% response rate). Thirty-three percent of complete survey observations are of distance students and sixty-six percent are of traditional students. Traditional students most likely failed to complete the surveys because of adding the course late, missing class when the survey was administered, or simply failing to respond. The distance students' most likely reasons for not completing the survey are adding the course late, and failure to electronically submit the survey.

The one hundred and sixty-six total students that completed AAEC 1005 can be broken down into one hundred and eight traditional students and fifty-eight distance students. After compiling and matching the complete SAT student data and complete student survey data, a total of ninety-seven student observations (58% of total) have complete SAT and survey information and are capable of being used in the estimation of the outcomes of student learning models. Of these complete observations, twenty-nine percent are of distance students and seventy-one percent are of traditional students.

A total of sixty-nine student observations have been eliminated because of incomplete data. The student learning models [equations (2) – (4)] can be estimated using the ninety-seven complete observations. Depending on the outcomes of the estimations, the models of student learning may be modified, if possible, in order to increase the number of observations used in the analysis.

The student learning models, identified as equations (2), (3), and (4), are estimated by OLS. The results of these regressions are summarized in tables 4.5, 4.6, and 4.7 respectively. The R^2 value in these models is consistent with other research and all of the F statistics are significant at the five percent level (Agarwul and Day). High R^2 values indicate that a large percentage of the variation in outcomes of student learning (the dependant variable) is explained by the independent variables in the regressions. Significant F statistics indicate the overall regression is significant. The R^2 value and F statistic of equation (2) is substantially lower than those of equations (3) and (4). This indicates that the variation in student learning as measured by definition common questions [equation (2)] is not being explained as well by the explanatory variables as the estimations of equations (3) and (4). These results suggest that variables not included in this analysis may be needed to more accurately explain student outcomes from definition type questions.

Table 4.5 provides results for the explanatory model for performance on definition common test questions [equation (2)]. The results show significant differences in student performance on definition questions between the distance and traditional students as indicated by the significant level of the CRSTYPE variable. The sign on the coefficient of this variable indicates that the traditional students on average performed over six percent better on the

definition common questions than did the distance students. This supports skeptics claims that distance education sacrifices student comprehension and understanding of the material. GPA and SAT are also significant in the estimation of equation (2). A one-point increase in student GPA results in over an eleven percent increase in score on definition type questions. SAT scores are a significant influence, however, they do not directly impact student performance on definition questions. No other variables are found significant in the estimation of equation (2).

Table 4.5 Summary of Equation (2) Estimation Results: Definition Common Questions with Complete Survey Data

Variables	Coefficients	Standard Error	Test Statistic
CRSTYPE*	-6.5143	2.8490	-2.2865
GPA*	6.1267	1.6364	3.7440
SAT*	0.0320	0.0084	3.7971
AGE	1.4612	0.9099	1.6059
GENDER	-4.0645	2.1293	-1.9089
HOURSEC	-0.0676	0.1360	-0.4967
HOURSWK	-0.0502	0.1200	-0.4183
ECONHS	-2.1196	2.8305	-0.7488
REQUIRED	0.2877	2.4731	0.1163
PREATTITUDE	0.0731	0.2972	0.2460
R^2 = 0.3486			
n = 97 Distance = 28 Traditional = 69			
F statistic = 4.6015			

*Significant at 5% level

Table 4.6 shows the results for the explanatory model of performance on the analytical common test questions [equation (3)]. These results show the CRSTYPE variable to be insignificant in the regression. Based on these results, student performance between course types on the analytical common questions is not statistically different from zero. This result fails to support the skeptics of distance education who believe that a distance course cannot adequately engage students in exercises that involve the synthesis and analysis of economic concepts. GPA and SAT are significant in the estimation of equation (3) as they are in equation (2). A student's SAT score, again, does not have a direct impact on their performance. GPA, however, does play a role in student performance on analysis questions. For the analysis questions, a one-point increase in GPA results in a six percent increase in the percent correct.

Two other variables are significant when equation (3) is estimated: the AGE and GENDER variables. The AGE coefficient shows that a student that is one year older than another is likely to perform nearly two and a half percent greater on analysis type questions. This result is most likely due to the fact that the older student is more experienced than the younger student; and that experience is a valuable asset to performance on analysis questions. The GENDER coefficient indicates that males out perform females by over seven percent on analysis questions. This result is unsurprising in that it has been found in several other studies (Jensen and Owen, Heady, Agarwul and Day, Cohn, Cohn, and Bradley, Lumsden and Scott, Borg and Stranahan).

Table 4.6 Summary of Equation (3) Estimation Results: Analysis Common Questions with Complete Survey Data

Variables	Coefficients	Standard Error	Test Statistic
CRSTYPE	-1.6224	3.4031	-0.4767
GPA*	11.6529	1.9547	5.9616
SAT*	0.0480	0.0101	4.7604
AGE*	2.4020	1.0869	2.2100
GENDER*	-7.3413	2.5434	-2.8864
HOURSEC	-0.0898	0.1624	-0.5530
HOURSWK	0.0354	0.1433	0.2471
ECONHS	-4.9457	3.3810	-1.4628
REQUIRED	4.1937	2.9541	1.4196
PREATTITUDE	0.2513	0.3549	0.7080
R^2 = 0.5180 n = 97 Distance = 28 Traditional = 69 F statistic = 9.2420			

*Significant at 5% level

Table 4.7 presents the results for the explanatory model of average performance on the supply, markets, and special topics exams [equation (4)]. These results show the CRSTYPE variable to have a significant influence on student performance. Students in the traditional section of AAEC 1005 performed an average of about eight and a half percent better on the exams than did the distance students. This result supports skeptics of distance education by showing that overall student test performance suffers in distance courses. The GPA and SAT variables are again significant in the regression. The results are much the same as in the estimation of equations (2) and (3). A higher GPA results in a better overall exam performance,

and SAT scores are significant, but do not directly impact a student's exam scores. The AGE and GENDER variables are found to be significant in this regression with much the same results as in equations (3). The older students generally perform better on exams than did the younger students, and males out performed females on overall exam averages.

Table 4.7 Summary of Equation (4) Estimation Results: Exam Averages with Complete Survey Data

Variables	Coefficients	Standard Error	Test Statistic
CRSTYPE*	-8.6688	2.2172	-3.9098
GPA*	9.0040	1.2735	7.0703
SAT*	0.0329	0.0066	5.0139
AGE*	2.0768	0.7081	2.9327
GENDER*	-5.4565	1.6571	-3.2929
HOURSEC	-0.0624	0.1058	-0.5900
HOURSWK	-0.0910	0.0934	-0.9749
ECONHS	0.1771	2.2028	0.0804
REQUIRED	0.6178	1.9247	0.3210
PREATTITUDE	0.1099	0.2313	0.4752
$R^2 =$ 0.5864 n = 97 Distance = 28 Traditional = 69 F statistic = 12.1908			

*Significant at 5% level

As shown in the summary tables of equations (2), (3), and (4), the students' GPA and SAT scores are found to be statistically significant in all three estimations. The GPA results can be interpreted as, for a one-point increase in GPA, the percent correct of the dependent variable increases by the coefficient amount as indicated in each respective table.

The overall results of the estimation of equations (2), (3), and (4) indicate that course type does have a significant influence into the outcomes of student learning. Traditional students appear to learn more, based on their performance on definition type questions and on overall average exam performance. The reason why course type is not significant for the analysis common questions [equation (3)] is not clear, although age and experience may factor into these results since the AGE variable was found to be significant, and distance students are on average three years older than traditional students. The results also show general trends for the GPA, SAT, and GENDER variables. Tables 4.5 through 4.7 indicate that on average, students who achieve higher grades (higher GPA's) have better student learning outcomes than those with

lower grade point averages. SAT scores are also significant influences on student learning in all three estimations, however their coefficients indicate that SAT scores do not directly impact the level of student performance. Finally, as the GENDER variable indicates, males generally exceed the performance of females.

The results from the estimation of equations (2), (3), and (4) also show that the variables obtained through student survey: HOURSEC, HOURSWK, ECONHS, REQUIRED, and PREATTITUDE, do not provide much, if any explanatory power into the outcomes of student learning. Because of these results, a modified set of models can be formed in order to increase the number of student observations to be used in the analysis, and to focus on the variables that appear to have the most explanatory power. A simplified model specification eliminates the survey data, and allows for all of the students with complete SAT data to be used in the analysis, increasing student observations from ninety-seven to one hundred and twenty-two (73.5% of all students who completed one of the three AAEC 1005 courses). The simplified models to be estimated take the form:

(6) COMQUESTD = $f(CRSTYPE, GPA, SAT, AGE, GENDER,)$

(7) COMQUESTA = $f(CRSTYPE, GPA, SAT, AGE, GENDER,)$

(8) AVGEXAM = $f(CRSTYPE, GPA, SAT, AGE, GENDER,)$

Equations (6), (7), and (8) are estimated by OLS, with the results of these regressions being summarized in tables 4.8, 4.9, and 4.10 respectively. The R^2 values of these estimations are very similar to those found in the estimation of equations (2), (3), and (4), suggesting that a similar percentage of the variation in outcomes of student learning (the dependant variables) is explained by the independent variables used in these regressions. The F statistics in equations (6), (7), and (8), however, are significantly higher than those found in the first set of models. The higher F statistics indicate that the overall significance of the regression is greater in the new simplified set of models. This is probably due to the fact that the number of observations increased, and the previously deemed insignificant survey variables were removed from equations (6), (7), and (8).

Table 4.8 provides results from the explanatory model for performance on definition common questions excluding survey-derived variables [equation (6)]. The results show the

variable CRSTYPE to be significant, with the sign of the coefficient indicating traditional students out perform the distance students by over six percent on the definition type questions. This result, the same as with the previous definition question analysis [equation (2)], implies that even on questions that stress simple memorization of concepts and definitions, the traditional students have greater success than distance students. GPA and SAT are also significant in the estimation of equation (6), providing similar results as seen equation (2) results. The additional observations and the model simplification did not significantly alter these conclusions. GENDER is a significant variable in equation (6), with males performing about four percent better than females on definition questions.

Table 4.8 Summary of Equation (6) Estimation Results: Definition Questions with excluded Survey Data

Variables	Coefficients	Standard Error	Test Statistic
CRSTYPE*	-6.1670	2.0620	-2.9908
GPA*	6.4810	1.4554	4.4530
SAT*	0.0336	0.0074	4.5138
AGE	1.0037	0.6184	1.6232
GENDER*	-3.9175	1.7750	-2.2070
$R^{2 =}$ 0.3582 n = 122 Distance = 36 Traditional = 86 F statistic = 12.9468			

*Significant at 5% level

Table 4.9 shows the results for the simplified explanatory model for performance on analysis common questions [equation (7)]. The results from this estimation did not find the variable CRSTYPE to be a significant factor on student performance, just as in the analysis question estimation of equation (3), with the sign and magnitude of the coefficient being similar in both equations (3) and (7). This result implies that the distance students were able to learn and perform equally well as the traditional students on the analysis common questions. Also, just as in the equation (3) results, the AGE variable, for equation (7), is found to be a significant influence on student performance on analysis questions. This further stresses that a student's age, and possibly experience, influence their ability to achieve on analysis type questions more so than which course type they are enrolled. GPA, SAT, and GENDER continue to be significant in the estimation results, with their influences continuing to be the same throughout.

Table 4.9 Summary of Equation (7) Estimation Results: Analysis Questions with excluded Survey Data

Variables	Coefficients	Standard Error	Test Statistic
CRSTYPE	-4.5730	2.5442	-1.7974
GPA*	9.0831	1.7957	5.0581
SAT*	0.0513	0.0092	5.5828
AGE*	1.6200	0.7630	2.1233
GENDER*	-5.6975	2.1901	-2.6015
$R^{2 =}$ 0.4276 n = 122 Distance = 36 Traditional = 86 F statistic = 17.3302			

*Significant at 5% level

Table 4.10 presents the results for the simplified explanatory model of student average test performance [equation (8)]. These results show the variable CRSTYPE to be significant on a student's performance. Traditional students perform nearly eight percent better on exams than the distance students. The results of the estimation of equation (8) are very similar to the results from the estimation of equation (4), both evaluating overall exam averages. As before, GPA, SAT, and GENDER are also significant in this regression.

The reduction of explanatory variables and increase in sample size, as implemented in equations (6) through (8), create more statistically significant models based on the large increases in the F statistic from those reported for equations (2), (3), and (4). Differences in student performance between the distance and traditional students (as measured by the variable CRSTYPE) are made apparent in the definition common question models [equations (2) and (6)] and the overall exam average models [equations (4) and (8)]. The traditional students consistently perform on a higher level than the distance students in all of these estimations, indicating that student learning outcomes are affected by course type.

However, a student's course type was not found to be a significant influence on their performance on the analysis common questions [equations (3) and (7)]. Instead, the AGE variable was found to be significant in both of these equations. Older students are found to typically perform better on the analysis type questions than younger students. Thus, a student's age appears to have greater impact on analysis question performance, than does the course type a

student is enrolled in. Distance students' age and experience most likely benefited them on their performance on the analysis common questions.

Table 4.10 Summary of Equation (8) Estimation Results: Exam Averages with excluded Survey Data

Variables	Coefficients	Standard Error	Test Statistic
CRSTYPE*	-7.9074	1.6171	-4.8898
GPA*	9.1036	1.1414	7.9758
SAT*	0.0341	0.0058	5.8371
AGE	0.9108	0.4849	1.8781
GENDER*	-5.3375	1.3920	-3.8343
$R^{2 =}$ 0.5809 n = 122 Distance = 36 Traditional = 86 F statistic = 32.1530			

*Significant at 5% level

A general trend for significance in the variables GPA, SAT, and GENDER exists in all six of the student learning models. Students with higher GPA's are expected to perform better than students with lower GPA's. SAT scores are significant, but the impact they have on student performance is very small. The GENDER variable indicates that males consistently perform better than females. These effects are shown to be of a lesser degree on the equation (2) and (6) results. This implies that the GPA, SAT, and GENDER variables have a lesser impact on student learning outcomes of definition type questions.

IV. Evaluation of Student Attitudes, Interest, and Perceptions

IV.A. Attitudes

The student attitude surveys, which measure student attitudes towards economics as a discipline, are administered both pre-course and post-course. For this study, comparing the distance and traditional students' educational outcomes from the AAEC 1005 course, the major function of the attitude survey is to determine if there are any differences in student attitudes depending on course type. The attitude survey data is analyzed in order to establish if distance student attitudes and traditional student attitudes are similar at the beginning of the course, how students in each course type's attitude changes as a result of taking AAEC 1005, and finally if distance student attitudes and traditional student attitudes are similar after completing the course.

The student attitude data are analyzed using chi-square analysis to test for differences in the distribution of responses. Students respond to the attitude statement topics by either rating then from one to five (one being strongly agree, five being strongly disagree) or by marking undecided. Because of a large shift of responses from undecided in the pre-course survey to providing an opinionated rating on the post-course survey, the attitude data is analyzed in two ways: by including the undecided category, and by excluding the undecided category. By omitting the undecided responses, comparisons can be made of the students with formed opinions about the attitude statement topics.

Table 4.11 provides a summary of the distance and traditional students pre-course attitude towards economics. According to the pre-course survey results, student attitudes towards economics are very similar between the distance and traditional students. Chi-square testing results in significant findings in only two categories. The attitude statement "Economics is dull" received significantly different responses between the course types both with and without the undecided category included. Table 4.11 shows larger percentages of traditional students agreeing with this statement prior to taking AAEC 1005, implying that more traditional students than distance students thought economics was dull prior to taking the course. The attitude statement "Economics is one of my favorite subjects" also is significant, but only with the undecided category included in the analysis. This topics is most likely found to be significant because nearly thirty percent of traditional students were undecided about this statement pre-course, as compared to only seven percent undecided distance students.

Tables 4.12 and 4.13 provide summaries of the distance student's pre-course and post-course attitudes, and the traditional student's pre-course and post-course attitudes respectively. The greatest change in results from pre-course to post-course, for both course types, can be seen in the undecided category. Nearly all students who were undecided about their opinion towards one of the attitude statements in the pre-course survey had formed a solid opinion about the statement upon completion of the AAEC 1005 course.

Table 4.11 Summary of Student Pre-Course Attitudes Towards Economics

Attitude Statement Topics	Distance (n = 41)						Traditional (n = 80)					
	1 = strongly agree 5 = strongly disagree U = undecided											
	1	2	3	4	5	U	1	2	3	4	5	U
Easy	5%	39%	29%	12%	2%	12%	4%	30%	26%	8%	0%	33%
Dull[1,2]	2%	12%	27%	29%	17%	12%	4%	14%	30%	31%	0%	21%
Enjoy	2%	24%	37%	20%	2%	15%	3%	19%	36%	11%	6%	25%
Waste	2%	2%	5%	44%	41%	5%	0%	0%	9%	35%	45%	11%
Dread	5%	2%	10%	37%	32%	15%	1%	6%	19%	23%	35%	16%
Hard	2%	2%	29%	41%	12%	12%	1%	6%	14%	29%	18%	33%
Favorite[1]	0%	20%	24%	37%	12%	7%	1%	15%	25%	14%	15%	29%
Useful	7%	20%	34%	20%	12%	7%	4%	16%	29%	20%	9%	23%
Abstract	0%	0%	12%	41%	32%	15%	1%	0%	18%	35%	20%	26%

[1] Statistical differences in the distribution of responses including undecided category at 5% level

[2] Statistical differences in the distribution of responses excluding undecided category at 5% level

Table 4.12 shows that there is no significant difference found in the distribution of responses to the attitude survey from pre-course to post-course for the distance students. This is true of all nine of the attitude survey statements, whether the undecided category is omitted or not. This suggests that distance student attitudes towards economics do not change significantly from before taking AAEC 1005 until after completion of the course.

With omission of the undecided responses, no significant differences are found in traditional student responses from pre-course to post-course as well. However, Table 4.13 shows that with the inclusion of the undecided responses, distributional differences in responses are found in all nine of the attitude statements. The major reason for the differences in attitude changes from pre-course to post-course between the distance and traditional students is because of the large percentage of traditional students responding as undecided to the pre-course attitude survey. Comparing the percentages of traditional students that are undecided in the pre-course attitude survey for a particular statement to the percentages of undecided distance students, shows that there are far more undecided traditional students in each of the nine statements. However, in the post-course attitude survey, the traditional students' responses show zero percent of the students as being undecided for eight out of nine of the statement topics. The large shift by the traditional students, from being undecided in the pre-course survey, to having a

clear opinion on each statement on the post-course survey, is the reason for the significant differences in the distributions of responses of the traditional students.

Table 4.12 Summary of Distance Student Economic Attitudes Pre-Course and Post-Course

Attitude Statement Topics		Distance Student Responses (n = 41)					
		1 = strongly agree			5 = strongly disagree		U = undecided
		1	2	3	4	5	U
Easy	Pre	5%	39%	29%	12%	2%	12%
	Post	12%	49%	15%	12%	10%	2%
Dull	Pre	2%	12%	27%	29%	17%	12%
	Post	7%	20%	27%	32%	12%	2%
Enjoy	Pre	2%	24%	37%	20%	2%	15%
	Post	5%	24%	39%	20%	10%	2%
Waste	Pre	2%	2%	5%	44%	41%	5%
	Post	5%	5%	12%	34%	44%	0%
Dread	Pre	5%	2%	10%	37%	32%	15%
	Post	10%	5%	20%	27%	34%	5%
Hard	Pre	2%	2%	29%	41%	12%	12%
	Post	10%	10%	22%	34%	22%	2%
Favorite	Pre	0%	20%	24%	37%	12%	7%
	Post	7%	7%	39%	29%	15%	2%
Useful	Pre	7%	20%	34%	20%	12%	7%
	Post	12%	44%	29%	7%	7%	0%
Abstract	Pre	0%	0%	12%	41%	32%	15%
	Post	2%	10%	20%	29%	37%	2%

[1] Statistical differences in the distribution of responses including undecided category at 5% level
[2] Statistical differences in the distribution of responses excluding undecided category at 5% level

Comparing post-course attitude survey results between the distance and the traditional students shows that the student responses are generally the same. Table 4.14 summarizes the post-course responses of the distance and traditional students. Significant differences between the course types for post-course attitudes are found in only two categories. The post-course survey shows a significant difference in distributions between the distance and traditional student responses, both with and without the undecided category, for the statement "Economics is easy for me to understand". The results show that traditional students tend to agree more with this statement in the post-course survey than the distance students. When the undecided category is included in the analysis, the statement "Economics is one of my most dreaded subjects" is

significant. The data show that ten percent of distance students strongly agree with this statement, where as zero percent of traditional student strongly agree, indicating a more negative opinion of economics has been formed by the distance students for this attitude topic.

Table 4.13 Summary of Traditional Student Economic Attitudes Pre-Course and Post-Course

Attitude Statement Topics		Traditional Student Responses (n = 80)					
		1 = strongly agree			5 = strongly disagree		U = undecided
		1	2	3	4	5	U
Easy[1]	Pre	4%	30%	26%	8%	0%	33%
	Post	18%	46%	26%	10%	0%	0%
Dull[1]	Pre	4%	14%	30%	31%	0%	21%
	Post	4%	16%	33%	41%	6%	0%
Enjoy[1]	Pre	3%	19%	36%	11%	6%	25%
	Post	11%	29%	38%	19%	4%	0%
Waste[1]	Pre	0%	0%	9%	35%	45%	11%
	Post	0%	1%	13%	35%	51%	0%
Dread[1]	Pre	1%	6%	19%	23%	35%	16%
	Post	0%	6%	21%	36%	36%	0%
Hard[1]	Pre	1%	6%	14%	29%	18%	33%
	Post	1%	11%	14%	40%	34%	0%
Favorite[1]	Pre	1%	15%	25%	14%	15%	29%
	Post	10%	20%	36%	24%	10%	0%
Useful[1]	Pre	4%	16%	29%	20%	9%	23%
	Post	8%	31%	31%	20%	10%	0%
Abstract[1]	Pre	1%	0%	18%	35%	20%	26%
	Post	3%	3%	20%	36%	35%	4%

[1] Statistical differences in the distribution of responses including undecided category at 5% level
[2] Statistical differences in the distribution of responses excluding undecided category at 5% level

Overall, the attitude analysis indicates that distance students and traditional students tend to have very similar economic attitudes both pre-course and post-course. By including the undecided category in the analysis, significant differences were found from pre-course to post-course in all nine of the attitude statements for the traditional students, however no significant differences were found from pre-course to post-course in the statements for the distance students. The large shift in traditional student responses from undecided, to a clear opinion about the attitude statement is the reason for these differences. The findings show that distance students are more likely to have already formed an attitude towards economics prior to taking AAEC

1005. This is likely due to the average older age and more college experience of the distance students.

Table 4.14 Summary of Student Post Course Attitudes Towards Economics

Attitude Statement Topics	Distance (n = 41)						Traditional (n = 80)					
	1 = strongly agree 5 = strongly disagree U = undecided											
	1	2	3	4	5	U	1	2	3	4	5	U
Easy[1,2]	12%	49%	15%	12%	10%	2%	18%	46%	26%	10%	0%	0%
Dull	7%	20%	27%	32%	12%	2%	4%	16%	33%	41%	6%	0%
Enjoy	5%	24%	39%	20%	10%	2%	11%	29%	38%	19%	4%	0%
Waste	5%	5%	12%	34%	44%	0%	0%	1%	13%	35%	51%	0%
Dread[1]	10%	5%	20%	27%	34%	5%	0%	6%	21%	36%	36%	0%
Hard	10%	10%	22%	34%	22%	2%	1%	11%	14%	40%	34%	0%
Favorite	7%	7%	39%	29%	15%	2%	10%	20%	36%	24%	10%	0%
Useful	12%	44%	29%	7%	7%	0%	8%	31%	31%	20%	10%	0%
Abstract	2%	10%	20%	29%	37%	2%	3%	3%	20%	36%	35%	4%

[1] Statistical differences in the distribution of responses including undecided category at 5% level

[2] Statistical differences in the distribution of responses excluding undecided category at 5% level

IV.B. Interest

The student interest surveys, which measure student interest in reading about economic topics, are administered both pre-course and post-course. In order to compare the distance and traditional students' educational outcomes from the AAEC 1005 course, the major function of the interest survey is to determine if there are any differences in student interest in the likeliness to read about economic topics depending on course type. The interest survey data are analyzed in order to establish if distance student interests and traditional student interests are similar at the beginning of the course, how students in each course type's interest changes as a result of taking AAEC 1005, and finally if distance student interests and traditional student interests are similar after completing the course.

Table 4.15 provides a summary of the distance and traditional student pre-course interest in economic reading topics. The table shows that student pre-course interest in economic reading topics is very similar between the two course types. Significant differences in the distribution of responses between the distance and traditional students is found in only one

category; interest in reading about "competing reasons for falling agricultural commodity prices". The data show that a significantly larger percentage of traditional students were likely to read about this subject than distance students, which is hardly surprising given to the much greater percentage of CALS students in the traditional class.

Table 4.15 Summary of Student Pre-Course Interest in Economic Reading Topics

Economic Reading Topics	Distance (n = 41)			Traditional (n = 80)		
	Likely	Somewhat Likely	Unlikely	Likely	Somewhat Likely	Unlikely
Gas Prices[1]	59%	39%	2%	55%	38%	8%
Microsoft[1]	24%	51%	24%	15%	39%	46%
Trade	12%	39%	49%	6%	36%	58%
Ag Prices[1,2]	5%	51%	44%	28%	41%	31%
Ag Policy	15%	34%	51%	23%	43%	35%
OPEC[1]	35%	40%	25%	23%	44%	34%
WTO	27%	46%	27%	24%	38%	39%
Air Quality[1]	27%	37%	37%	29%	46%	25%
Jobs	17%	49%	34%	23%	53%	25%
Stocks	32%	39%	29%	15%	38%	48%
Tobacco	27%	39%	34%	24%	45%	31%
Habitat	46%	44%	10%	68%	28%	5%
Urban	27%	46%	27%	43%	41%	16%

[1] Topics discussed directly in the AAEC 1005 course content

[2] Statistical differences in distributions of responses at the 5% level

Tables 4.16 and 4.17 provide summaries of the distance student's pre-course and post-course reading interests, and the traditional student's pre-course and post-course reading interests respectively. The overall finding from these two tables is that student interest in economic reading topics did not change greatly from pre-course to post-course for either the distance or traditional students. In fact, there are no significant changes in student reading interest for the distance students as shown in Table 4.16. The traditional students' show a significant change in reading interests from pre to post course in only two categories. Table 4.17 indicates that the reading topics of "The government's anti-trust case against Microsoft" and "OPEC's oil production plans for next year" both show significant increases in traditional student interest for

the likely to read category from pre-course to post-course. The Microsoft topic and the OPEC topic were both topics discussed as a part of the AAEC 1005 course. This result indicates that the traditional course's presentation of the Microsoft and OPEC topics increased student interest more than the distance course's presentation of the material, where no significant differences are found.

Table 4.16 Summary of Distance Student Interest in Economic Reading Topics Pre-Course and-Post Course

Economic Reading Topics		Distance* (n = 41)		
		Likely	Somewhat Likely	Unlikely
Gas Prices[1]	Pre	59%	39%	2%
	Post	56%	39%	5%
Microsoft[1]	Pre	24%	51%	24%
	Post	29%	51%	20%
Trade	Pre	12%	39%	49%
	Post	17%	44%	39%
Ag Prices[1]	Pre	5%	51%	44%
	Post	15%	41%	44%
Ag Policy	Pre	15%	34%	51%
	Post	17%	32%	51%
OPEC[1]	Pre	35%	40%	25%
	Post	37%	41%	22%
WTO	Pre	27%	46%	27%
	Post	20%	50%	30%
Air Quality[1]	Pre	27%	37%	37%
	Post	17%	41%	41%
Jobs	Pre	17%	49%	34%
	Post	24%	46%	29%
Stocks	Pre	32%	39%	29%
	Post	29%	41%	29%
Tobacco	Pre	27%	39%	34%
	Post	22%	39%	39%
Habitat	Pre	46%	44%	10%
	Post	46%	34%	20%
Urban	Pre	27%	46%	27%
	Post	22%	49%	29%

[1] Topics discussed directly in the AAEC 1005 course content

* No statistical differences in distributions of responses are found

Table 4.17 Summary of Traditional Student Interest in Economic Reading Topics Pre-Course and Post-Course

Economic Reading Topics		Traditional (n = 80)		
		Likely	Somewhat Likely	Unlikely
Gas Prices[1]	Pre	55%	38%	8%
	Post	69%	26%	5%
Microsoft[1,2]	Pre	15%	39%	46%
	Post	36%	50%	14%
Trade	Pre	6%	36%	58%
	Post	11%	41%	48%
Ag Prices[1]	Pre	28%	41%	31%
	Post	26%	46%	28%
Ag Policy	Pre	23%	43%	35%
	Post	25%	38%	38%
OPEC[1,2]	Pre	23%	44%	34%
	Post	46%	38%	16%
WTO	Pre	24%	38%	39%
	Post	26%	36%	38%
Air Quality[1]	Pre	29%	46%	25%
	Post	40%	38%	23%
Jobs	Pre	23%	53%	25%
	Post	26%	44%	30%
Stocks	Pre	15%	38%	48%
	Post	13%	41%	46%
Tobacco	Pre	24%	45%	31%
	Post	24%	51%	25%
Habitat	Pre	68%	28%	5%
	Post	64%	28%	9%
Urban	Pre	43%	41%	16%
	Post	41%	40%	19%

[1] Topics discussed directly in the AAEC 1005 course content

[2] Statistical differences in distributions of responses at the 5% level

A summary of distance and traditional post-course interest survey responses are provided in Table 4.18. Overall, the post-course interest in economic reading topics is nearly the same between the distance and traditional students. Chi-square testing finds significant differences in only two of the thirteen interest reading topics. These differences are in the reading topics of "Recent financial performance of a new high tech company", or the Stocks category as

summarized in the table, and "Debate about EPA's calculations of the costs and benefits of raising natural air quality standards", labeled as Air Quality in Table 4.18. The distance students display a much larger reading interest in the Stocks topic than do the traditional students. The reason for this difference in student interest is unknown. For the Air Quality reading topic, the traditional students have a much larger interest than the distance students. This topic was one covered directly in the course content of AAEC 1005 for both course types. The reason why traditional students are more interested in this topic than distance students is unkown.

Table 4.18 Summary of Student Post-Course Interest in Economic Reading Topics

Economic Reading Topics	Distance (n = 41)			Traditional (n = 80)		
	Likely	Somewhat Likely	Unlikely	Likely	Somewhat Likely	Unlikely
Gas Prices[1]	56%	39%	5%	69%	26%	5%
Microsoft[1]	29%	51%	20%	36%	50%	14%
Trade	17%	44%	39%	11%	41%	48%
Ag Prices[1]	15%	41%	44%	26%	46%	28%
Ag Policy	17%	32%	51%	25%	38%	38%
OPEC[1]	37%	41%	22%	46%	38%	16%
WTO	20%	50%	30%	26%	36%	38%
Air Quality[1,2]	17%	41%	41%	40%	38%	23%
Jobs	24%	46%	29%	26%	44%	30%
Stocks[2]	29%	41%	29%	13%	41%	46%
Tobacco	22%	39%	39%	24%	51%	25%
Habitat	46%	34%	20%	64%	28%	9%
Urban	22%	49%	29%	41%	40%	19%

[1] Topics discussed directly in the AAEC 1005 course content
[2] Statistical differences in distributions of responses at 5% level

Overall, the analysis of student interest in economic reading topics indicates that distance students and traditional students tend to have very similar economic interests both pre-course and post-course. The majority of findings that are found to be significant are for topics that were directly discussed in the AAEC 1005 lectures (both distance and traditional). For the significant topics discussed in class, the traditional students display a greater interest than the distance students. This indicates that the traditional course presentation of these topics evokes more interest from students than the distance course presentation. This is probably due to the fact that

traditional students have the ability to interact and discuss the topics with each other as they are presented in the lecture, whereas the distance students cannot interact in this manner.

IV.C. Perceptions

Student perceptions of the AAEC 1005 course are measured by the student responses on course evaluation forms. Table 4.19 summarizes the distribution of responses to the evaluation questions between course types. For all seven course evaluation statements, the traditional AAEC 1005 students show significantly higher opinions of the course content and instructor effectiveness than did the distance learners. Major differences in distributions can be seen in the following evaluation statements: success in communicating or explaining subject matter, degree of material made stimulating or relevant, fairness in assigning grades, and in the overall rating of the instructor.

Seventy-four percent of traditional learners felt the instructor's success in communicating and explaining subject matter was excellent, where as only a little over a fourth of distance learners felt this way. A large percentage of distance learners (20%) felt that the explanation of the subject matter was poor to fair. Sixty percent of traditional learners rated the degree of stimulating and relevant subject matter as excellent. Less than twenty percent of distance learners felt the same. About one-third of the distance learners rated the degree of stimulating and relevant subject matter as either poor or fair.

A large majority of both traditional and distance learners felt that the fairness in which grades were assigned was either good or excellent. However, a sizeable percentage (21%) of distance students considered the fairness in assignment of grades to be rated as only fair. Finally, the overall rating of the instructor was much higher in the traditional course than in the distance course. Eighty-one percent of traditional learners rated the instructor as excellent where as only forty-two percent of distance learners considered the overall instruction to be excellent. The results of the chi-square analysis of the student evaluation responses show that the traditional students have a significantly higher opinion of the AAEC 1005 course's instruction than do the distance students.

Table 4.19 Results of Chi-Square Analysis: Comparison of Evaluation Responses Between Distance and Traditional AAEC 1005 Courses

Student Evaluation Statements	Course Type	Poor	Fair	Good	Excellent
1. Successful communicating or explaining material*	Distance (n = 45)	2%	18%	53%	27%
	Traditional (n= 90)	0%	2%	23%	74%
2. Degree of stimulating/relevant subject matter*	Distance (n = 44)	7%	23%	52%	18%
	Traditional (n= 90)	2%	3%	34%	60%
3. Administration/ organization of class and materials*	Distance (n = 43)	2%	7%	51%	40%
	Traditional (n= 90)	0%	0%	24%	76%
4. Knowledge of subject matter*	Distance (n = 42)	0%	7%	50%	43%
	Traditional (n= 90)	0%	1%	14%	84%
5. Concern/respect of individual students*	Distance (n = 42)	0%	17%	26%	57%
	Traditional (n= 90)	0%	2%	28%	70%
6. Fairness in assigning grades*	Distance (n = 43)	0%	21%	40%	40%
	Traditional (n= 90)	2%	0%	29%	69%
7. Overall rating of the instructor*	Distance (n = 45)	0%	11%	47%	42%
	Traditional (n= 90)	0%	1%	18%	81%

* Statistical differences in distributions of responses at the 5% level

Chapter Five – Conclusions and Implications

I. Results Summary

The results from the analysis comparing the educational outcomes of distance versus traditional students in AAEC 1005 provide several key findings. The compositional data from the two course types indicates that the average distance student and the average traditional student are different people. Distance students tend to be older, have more college experience, and work a job more hours per week than traditional students. Distance students are also more likely to be majoring outside of CALS, have more computer expertise, and to have had previous experience with economics in high school than the traditional students. Despite distance students' age and experience, the traditional students average a higher GPA than students in the distance sections.

The models of student learning [equations (2), (3), (4), and (6), (7), (8)] result in significant differences in student performance between course types on the definition common question [equations (2) and (6)] and on overall average exam performance [equations (4) and (8)]. These results indicate that the traditional students consistently performed better than the distance students in these areas. Course type was not found to be significant in the models of analysis common questions [equations (3) and (7)]. Alternatively, age was found to be a significant influence on performance of analysis questions, with older students performing at higher levels. The GPA, SAT, and GENDER variables are found to be significant throughout the learning models, with higher GPA and SAT scores being indicative of better student performance than lower marks, and with males generally performing better than females.

The overall results of the attitude and interest survey analysis illustrate that the attitudes and interests of distance and traditional students are very similar. Only one major significant finding is apparent in the comparison of the course types. There is a large shift of traditional students who omitted responses on the pre-course attitude survey, but then responded with a clear opinion of the attitude statement on the post-course survey. This results in significant differences in the distribution of responses of the traditional student from pre-course to post-course when the omitted category is included in the analysis. No significant differences were

found in distance student attitude survey responses from pre-course to post-course when the omitted category is included.

Student evaluations of the instructor consistently show that traditional students have a higher opinion of AAEC 1005 course instruction than the distance students. All seven of the evaluation statements result in significant differences in the distribution of responses between the two course types.

II. Interpretation and Conclusions

The results from the comparative analysis conducted on the distance and traditional sections of AAEC 1005 provide some interesting findings as related to the debate over the ability of distance courses to educate students. Distance students' lesser performance on the definition common questions and average exam scores, while controlling for influences such as GPA, SAT scores, age, gender, etc., indicates that distance students are not learning or interpreting the course materials as well as the traditional students. This result supports skeptics who claim that distance courses do not or cannot produce the same student learning outcomes as traditionally taught courses. Also supporting the skeptics of distance education are the results of the student evaluations of AAEC 1005 instruction. Even though the primary instructor was the same, and the course content very similar, students in the distance AAEC 1005 course rated the quality of instruction lower in all categories than the traditional students.

Lower overall student performance and lower opinions of course instruction by the distance students lead one to believe that an educational component must be missing in distance education that is provided in a traditional course. The most obvious, and probably the most significant, element missing from the distance course is the ability for students to immediately interact with the instructor and each other. The only link distance students have to the instructor and other students is email and discussion boards. Traditional students have the ability to interact with the instructor and other students in order to ask questions, clarify points, and to discuss the material during the lecture period. In the traditional section the instructor can tailor and divert the discussion according to student interest, and adjust the presentation based on student comprehension of the material.

The lack of interaction involved in the distance course prevents distance students from engaging completely in active learning. Active learning is seen as an essential part of learning in economics (Salemi et al, Becker 2000). Active learning stresses students' active involvement in their education by participation, analysis, and collaboration with others. Distance students can actively guide themselves through lectures and are able to analyze and interpret the material presented to them, but they are not able to actively engage in class discussions of the material as it is presented, as is done in the traditional course. Missing student and instructor interactions could be the key link to the lower performance of the distance students and the lower ratings given to the instructor.

The results from the testing of the analysis common questions go against the beliefs of those opposed to distance education. Skeptics feel that distance courses stress memorization rather than synthesis and analysis (Navarro and Shoemaker 1999). However, distance students and traditional students performed equally as well on the analysis common questions, suggesting that teaching students how to analyze and interpret economic concepts can be achieved equally as well in a distance course as in a traditional course. This result is surprising given that distance students did not perform as well as traditional students on the definition common questions, which do tend to stress memorization of the concepts.

Given the differences in the compositions of the distance and traditional sections of AAEC 1005, it is surprising how similar student attitudes towards the economics discipline, and student interest in economic reading topics are between the course types. The lack of change in student attitudes and interest supports Soper and Walstad's (1983) finding that student attitudes are much more difficult to change than student cognition. The significant differences that are found from pre-course to post-course in the traditional student attitude survey are due to the large numbers of traditional students who omitted many or all of the attitude survey statements in the pre-course survey, and then responded with a rating for each attitude statement in the post-course survey. Traditional student age and inexperience in college courses are the most likely reasons why so many respondents chose to omit answers on the pre-course survey. The majority of traditional students are freshman level students who have little or no prior experience with

economics; therefore they likely chose to omit responses instead of making uninformed judgments.

Distance students, on the other hand, have more college experience and are more likely to have a better understanding of economics before taking AAEC 1005. Prior experience is the most likely reason why no significant differences are found from pre-course to post-course for the distance students. The results of the distance student attitude and interest surveys indicate that, for the most part, distance students already have established attitudes towards, and interest in, economics prior to taking the course, and these attitudes and interests are not significantly changed after completion of AAEC 1005.

The overall results of this analysis show that the distance and traditional student groups are different. Distance students are older, have more college experience, and tend to have already established attitudes and interest in economics. However, despite their age and experience, distance student performance in AAEC 1005, as measured by test performance and grades, is lower than the traditional student group. The obvious differences in the distance course's and traditional course's compositions and performance levels raise the question of what attributes of students influenced them to choose the learning option they selected.

This research does not provide definite answers to the reasons why students chose to take AAEC 1005 by traditional or distance instructional methods; only speculations can be made. A student's age, college experience, work or extracurricular activities, computer experience, and prior online course experience can all be interpreted as possible student attributes that influence a student's decision to enroll in a distance course. The older, more experienced student may feel more comfortable having control over the pace of his/her education than an inexperienced freshman level student. A distance course may be more convenient to the older student who is more likely to have a course load of upper level courses. Distance courses may also seem convenient to those with constraints on their time such as the extracurricular activities they are involved in, or the number of hours they work per week. Additionally, a student more skilled in the use of a computer is less likely to have any anxieties about enrolling in a course that is taught exclusively online. Anxiety and reservations about taking a distance course will also be less for those who already have prior experience with distance learning.

The results of this research indicate that the distance students who enrolled in AAEC 1005 are older, more experienced, work more hours per week, rate themselves higher in computer skill level, and have more prior distance course experience than those who were enrolled as traditional students. How influential these characteristics were in their decision to choose a distance course, though, is unknown. This analysis provides interesting insights into how distance students learn from a course as compared to traditional students, and what may cause a student to choose the distance option, however, further research is needed to clearly identify why distance students perform at lower levels than the traditional students and to further explore the reasons behind choosing a distance course.

III. Implications for Future Research

Further research in comparing student learning outcomes of distance and traditional courses could help to further advance and improve distance education and improve our understanding of educational outcomes. A few of the variables discussed in Chapter Two, which could be relevant in comparing distance and traditional economics courses, were not used in this study due to data restrictions. These variables include: the number of credit hours each student was enrolled in while taking AAEC 1005, the number of previous college level economics courses, and the number of previous college level math courses. However, these variables should be considered in future research to provide additional explanatory power to student learning models as measures of student effort (credit hours), experience, and knowledge (prior economics and math).

This research did not provide much insight into how student attitudes and interest may affect student learning. The research did provide findings showing that younger, less experienced students are more likely to have attitude changes from pre-course to post-course than older, more established students. This is an important area of research when comparing instructional methods and should not be disregarded because of lack of significant findings in this study or others. New measurement tools, or methods, to quantify student attitudes and interests may be needed to aid in better identification, measurement, and quantification of

attitudes and interest, so they can be more fully incorporated into the analysis of student learning outcomes.

More research is also needed on what types of students choose the distance learning option and why. A possible area to explore in order to get answers to this question is student personality type. Research has indicated that different personality temperaments prefer to receive and process information differently (Ziegert, Borg and Shapiro, Borg and Stranahan). It will be valuable to determine if students with certain personality types are more likely to enroll in a distance course than others. Also, analysis should be conducted to establish what personality types succeed the most in either a traditional or distance learning environment. Information on how certain personality types learn and succeed could help instructors to better prepare, organize, and present course materials to students in both distance and traditional courses. Understanding which personality types are more likely to enroll in an economics distance course, and are able to master the material, will lead to more effective instruction in economics distance education.

Reference:

Agarwal, R. and A. Day. "The Impact of the Internet on Economic Education." Journal of Economic Education. 29(Spring 1998): 99-110.

Angulo, A. and M. Bruce. "Student Perceptions of Supplemental Web-Based Instruction." Innovative Higher Education. 24(Winter 1999): 105-125.

Becker, W. "Economic Education Research: Part I, Issues and Questions." Journal of Economic Education. 14(Winter 1983): 10-17.

Becker, W. "The Educational Process and Student Achievement Given Uncertainty in Measurement." American Economic Review. 72(March 1982): 229-236.

Becker, W. "Teaching Economics in the 21st Century." Journal of Economic Perspectives. 14(Winter 2000): 109-119.

Becker, W. "Teaching Economics to Undergraduates." Journal of Economic Literature. 35(September 1997): 1347-1373.

Becker, W., and M. Watts. "How Departments of Economics Evaluate Teaching." American Economic Review. 89(May 1999): 344-349.

Becker, W., and M. Watts. "Teaching Economics at the Start of the 21st Century: Still Chalk-and-Talk." American Economic Review. 91(May 2001): 446-451.

Borg, M., and S. Shapiro. "Personality Type and Student Performance in Principles of Economics." Journal of Economic Education. 27(Winter 1996): 3-25.

Borg, M. and H. Stranahan. "Personality Type and Student Performance in Upper Level Economics Courses: The Importance of Race and Gender." Journal of Economic Education. 33(Winter 2002): 3-14.

Bosshardt, W. and M. Watts. "Comparing Student and Instructor Evaluations of Teaching." Journal of Economic Education. 32(Winter 2001): 3-17.

Cohn, E., S. Cohn, and J. Bradley Jr. "Notetaking, Working Memory, and Learning in Principles of Economics." Journal of Economic Education. 4(Fall 1995): 291-307.

Conrad, C. "Computers and Pedagogy: Lessons from Other Disciplines." Paper presented at Allied Social Science Association annual meeting, New Orleans LA, 4-6 January 1997.

Debertin, D. and L. Jones. "Application of Computer Graphics to Undergraduate Instruction in Agricultural Economics." American Journal of Agricultural Economics. 73(February 1991): 25-35.

Etheridge, D. *Research Methodology in Applied Economics: Organizing, Planning, and Conducting Economic Research*. Iowa: Iowa State University Press, 1995.

Grasha, A., N. Yangarber-Hicks. "Integrating Teaching Styles and Learning Styles with Instructional Technology." College Teaching. 48(Winter 2000): 2-10.

Gronlund, N. *Assessment of Student Achievement,* 6th. ed. Boston: Allyn and Bacon, 1998.

Gujarati, D. *Basic Econometrics 3rd Edition*. New York: McGraw Hill, Inc., 1995.

Heady, J. "Assessment – A Way of Thinking About Learning – Now and in the Future." Journal of College Science Teaching. 29(May 2000): 415-421.

Jensen, E., A. Owen, "Pedagogy, Gender, and Interest in Economics." Journal of Economic Education. 32(Fall 2001): 323-343.

Leasure, R., L. Davis, and S. Thievon. "Comparison of Student Outcomes and Preferences in a Traditional vs. World Wide Web-Based Baccalaureate Nursing Research Course." The Journal of Nursing Education. 39(April 2000): 149-154.

Lesniak, R., and C. Hodes. "Social Relationships: Learner Perceptions of Interactions in Distance Learning." Journal of General Education. 49(2000): 34-43.

Linn, R., and N. Gronlund. *Measurement and Assessment in Teaching,* 7th. ed. Englewood Cliffs NJ: Prentice Hall Inc., 1995.

Lumsden, K., and A. Scott. "The Economics Student Reexamined: Male-Female Differences in Comprehension." Journal of Economic Education. 18(Fall 1987): 365-375.

Manahan, J. "An Educational Production Function for Principles of Economics." Journal of Economic Education. 14(Spring 1983): 11-16.

Mehrens, W., and I. Lehmann. *Measurement and Evaluation in Education and Psychology,* 4th. ed. Fort Worth: Harcourt Brace Jovanovich, 1991.

Navarro, P. "Economics in the Cyberclassroom." Journal of Economic Perspectives. 14(Spring 2000): 119-132.

Navarro, P. and J. Shoemaker. "Economics in Cyberspace: A Comparison Study." Unpublished, University of California-Irvine, 2000.

Navarro, P. and J. Shoemaker. "The Power of Cyberlearning: An Empirical Test." The Journal of Computing in Higher Education. 11(Fall 1999): 29-54.

Ragan, L. "Good Teaching is Good Teaching: The Relationship between Guiding Principles for Distance and General Education." Journal of General Education. 49(2000): 10-22.

Salemi, M., J. Siegfried, K. Sosin, W. Walstad, M. Watts. "Research in Economic Education: Five New Initiatives." New Research in Economic Education. 91(May 2001): 440-457.

Siegfried, J., and R. Fels. "Research on Teaching College Economics: A Survey." Journal of Economic Literature. 17(September 1979): 923-969.

Simkins, S. "Promoting Active-Student Learning Using the World Wide Web in Economics Courses: Theory and Practice, With Examples for Teaching and Learning." Paper Presented at Advancing the Integration of New Technologies into the Teaching of Undergraduate Economics Conference, 28-30 May 1998.

Smith, P., C. Dillon. "Comparing Distance Learning and Classroom Learning: Conceptual Considerations." The American Journal of Distance Education. 13(1999): 6-22.

Soper, J. and W. Walstad. "On Measuring Economic Attitudes." Journal of Economic Education. 1(fall 1969): 4-17.

Sosin, K. "Impacts of the Web on Economics Pedagogy." Paper presented at the Allied Social Sciences Association annual meeting, New Orleans LA, 4-6 January 1997.

Stephenson, K., D. Reaves, A. McGuirk, and H. Deskins. "Assessments of the Educational Value of Web-Based Instructional Tools for Introductory Agricultural Economics." Review of Agricultural Economics. 23(Fall-Winter 2001): 492-509.

Stronge, J., and P. Tucker. *Teacher Evaluation and Student Achievement.* National Education Association of the United States, 2000.

Volery, T. "Online Education: An Exploratory Study into Success Factors." Journal of Educational Computing Research. 24(2001): 77-92.

Wiens, G., G. Gunter. "Delivering Effective Instruction Via the Web." Educational Media International. 35(1998): 95-99.

Ziegert, A. "The Role of Personality Temperament and Student - Learning in Principles of Economics." Journal of Economic Education. 31(Fall 2000): 307-322.

Appendix A – Background Survey

PRE-COURSE SURVEY

The following questionnaire will be used for research purposes only and will in no way affect your grade in this course.

Name: _____

Age: _____

How many semesters have you completed at Virginia Tech? (*replace number with a "X"*)

0 1 2 3 4 5 6 7 8+

PART I. General Information about how you study and your planned time commitments

1. When preparing for an exam, do you generally (select all that apply)

__ Study/review the material after every class
__ Study the night before the exam
__ Sudy right before the exam

2. Please rank the material you rely most on when studying for an exam (1= highest, 4=lowest)

_____ Class notes
_____ Textbook
_____ Study groups with other students
_____ Old quizzes/tests

3. When taking an exam, do you generally (select one)

___ Finish the exam before the majority of the other students
___ Take about the same amount of time as the majority of the other students
___ Take longer to complete the exam than the majority of other students

4. Which types of exam questions do you prefer: (select all that apply)

____Multiple choice
____Short answer
____Essay
____T/F
____Calculations/Problems

5. How often do you ask questions in a conventional class setting? (select one)

___Never
___Almost never
___Sometimes
___Frequently

6. How often do you visit your instructor outside of class to ask questions or seek help? (select one)

___Never
___Almost never
___Sometimes
___Frequently

7. Which extra-curricular activities do you plan to be involved with this semester? (select all that apply)

___Greek life
___Athletics
___Clubs
___Student government
___Other (please specify) _____

8. How many hours per week do you to plan to spend doing extra-curricular activities?

____/wk

9. If you have a job during the semester, how many hours do you plan to work each week?

_____/wk

10. How many hours do you spend on the Internet each week? (select one)

___1-5 hours
___6-10 hours
___11-15 hours
___15+ hours

11. Have you previously taken a course over the Internet? (select one)

___NO
___YES If YES, list the course (s) _____

_____

12. Why did you decide to take this course? (select one)

___Requirement for my major
___Not a major requirement but the course fulfilled a core area requirement
___Free elective

13. Did you have an economics class in high school?

___NO
___YES

14. Are you considering pursuing graduate school in one of the following areas? (select one)

___MS/MA
___MBA
___MD
___PhD
___EdD
___Vet School
___Other
___Not at all

15. How far do you live from campus? (select one)

___Live on campus
___1-8 miles
___9-15 miles
___+16 miles

16. How would you rate your computer skills? (1= very high, 2=above average, 3= average, 4= below average, 5= very low)

_____

17. Did you have access to a computer in your home before attending Virginia Tech? (select one)

___YES
___NO

18. Are you a native English speaker? (select one)

___YES
___ NO If NO, What is your native language? _____

Appendix B – Forty-four Common Test Questions

I. Definition Questions

1. The additional output produced by adding another unit of a variable input is called:

2. The long-run is defined as

3. The law of diminishing marginal returns says:

4. The value of the next best alternative that must be sacrificed (given up) to use a resource (or input) is called:

5. The graph below is a production function. Using the information from this graph, at the boundary between Region B and C (the dashed vertical line),

6. Marginal value product is calculated by

7. Adding total fixed costs (TFC) to total variable costs (TVC) equals

8. Economists assume the primary objective of a rational firm is to

9. The process in a competitive market where innovators buy the assets of firms who fail to adopt new technology and lower per unit costs is called

10. According to Julian Simon, the ultimate resource is

11. In competitive markets, market prices tend to

12. Circle all of the statements about American agricultural change that are *TRUE* (1 point each):

13. Identify the U.S. statute that makes it illegal for firms to conspire to restrain trade, fix prices, or to monopolize interstate trade.

14. Microsoft has been found guilty by a federal judge of

15. In describing markets, a "network effect" can be defined as

16. From an economic perspective, overfishing can be a persistent problem because

17. Wetlands provide a number of valuable services to society. Which of the following is NOT one of those services?

18. When people buy and sell a sulfur dioxide allowance, they are trading

19. A public good is a good or service in which the provider

II. Analysis Questions

1. What would shift a production function (the TPP curve) upward?

2. Suppose a farmer is producing 120,000 bushels of corn. Variable cost per bushel is $2.00 and fixed cost per bushel is $.50 at this output level. The cost to produce the last bushel (MC) is $2.50 when producing 120,000 bushels. Given this information, you can conclude

3. Which of the following will result in a decrease (leftward shift) in the supply of milk?

4. In California, vegetable farmers must purchase water rights to use water for irrigation. An increase in the price of water rights will

5. What would best explain the following shift in the supply curve for corn?

6. Suppose you are using 3 workers to collect and store square bales of hay. When using three workers, you can pick up and stack in the barn 600 bales a day. If you hire an additional worker, you can put up an extra 100 bales a day. Given this information, what is the average physical product when employing three workers? (3 points)

7. Suppose a farmer is considering applying a side dressing of nitrogen fertilizer per after the corn sprouts. An additional 20 pounds of nitrogen per acre will cost $3.00 in per pound to apply. The farmer expects the additional fertilizer will increase corn yields from 160 to 178 bushels per acre. If the market price for corn is $4.00 per bushel, should the farmer apply these extra 20 pounds of nitrogen? (assume the farmer wishes to maximize profits) (4 points)

8. Using the information in the cost table below, what is total fixed cost when producing 40 units of output?

9. Using the information in the cost table below, what is average variable cost when producing 50 units of output?

10. Using the information in the cost table below, what is average total cost when producing 60 units of output?

11. Which of the graphs correctly depicts cost curves?

12. According to this graph, what are total costs (TC) when producing 100 units of output?

13. Given the price and cost information on the graph to the left, how many gadgets should this firm produce if the firm wishes to maximize profits (or minimize losses)?

14. According the information on costs and revenues in the following graph, this firm is

15. Which of the following factors would cause an increase in the equilibrium price of corn?

16. What could cause the following change in the beef market?

17. A market characterized by inelastic supply and demand is likely to

18. The U.S. breakfast cereal market is best characterized as a:

19. In the technological treadmill in agriculture, early adopters of new technology:

20. The graph to the right represents costs and revenues for a monopolist. The shaded rectangle represents

21. The cost of producing fiber optic cables has gone down (represented as a downward/rightward shift in the supply curve for fiber optic cable). Given this change, what changes can you expect in the copper cable market? (you may assume fiber optic firms do not produce copper cables and visa versa).

22. If a pig farm moves in next to your home and the smell reduces your property values, you are experiencing

23. Consider the private supply and demand curve for agricultural produce. Suppose farming production practices impose costs on other people but these costs are not paid by the farmer. If the farmer were required to pay these costs then the:

24. Which of the following would be considered a marginal damage cost associated from increasing sulfur dioxide emissions by a given increment?

25. Which of the following is an external benefit supplied by a farm?

Appendix C – Attitude Survey

Attitudes About Economics

Answer the following questions according to the key below. Remember, there are no right or wrong answers!

Please replace the number with an "X":	*strongly agree=1*				*strongly disagree=5*	*U=undecided*
1. Economics is easy for me to understand.	1	2	3	4	5	U
2. Economics is dull.	1	2	3	4	5	U
3. I enjoy economics.	1	2	3	4	5	U
4. Studying economics is a waste of time.	1	2	3	4	5	U
5. Economics is one of my most dreaded subjects.	1	2	3	4	5	U
6. Economics is a very difficult subject for me.	1	2	3	4	5	U
7. Economics is one of my favorite subjects.	1	2	3	4	5	U
8. I use economic concepts to analyze current events.	1	2	3	4	5	U
9. Economic ideas are too abstract to be useful to me.	1	2	3	4	5	U

Appendix D – Interest Survey

Interest In Economics

If you are looking through a newspaper or magazine, how likely are you to read an article about ...

Please replace the number with an "X":	Very likely to read	Will sometimes read	Very unlikely to read
1. why gas prices are increasing.	1	2	3
2. the government's anti-trust case against Microsoft.	1	2	3
3. the impact of lifting the trade sanctions against Cuba.	1	2	3
4. competing reasons for falling agricultural commodity prices.	1	2	3
5. congressional debate about future farm policy.	1	2	3
6. OPEC's oil production plans for next year.	1	2	3
7. environmental criticisms of the World Trade Organization	1	2	3
8. debate about EPA's calculations of the costs and benefits of raising natural air quality standards.	1	2	3
9. efforts to create new employment opportunities in the Appalachian region.	1	2	3
10. recent financial performance of a new high tech company.	1	2	3
11. the financial impact of tobacco lawsuits on Virginia's tobacco farmers & the local economy	1	2	3
12. plans to preserve habitat for an endangered species	1	2	3
13. the impact of suburban growth on the financial viability of farms near my home	1	2	3

Appendix E – Student Evaluation Statements

Mark NA when a question is not applicable or inappropriate.

Mark either P = Poor, F = Fair, G = Good, E = Excellent otherwise

How I rate the Instructor compared with others I have had a Virginia Tech:

1. Apparent knowledge of subject matter.	P	F	G	E	NA
2. Success in communicating or explaining subject matter.	P	F	G	E	NA
3. Degree to which subject matter was made stimulating or relevant.	P	F	G	E	NA
4. Concern and respect for students as individuals.	P	F	G	E	NA
5. Fairness in assigning grades.	P	F	G	E	NA
6. Administration of the class and organization of the materials.	P	F	G	E	NA
7. Overall rating of this instructor	P	F	G	E	NA

VITA

Tricia L. Crouse

Personal

Birth	October 9,1978	Cub Hill, Maryland
Parents	James B. Crouse	Marlene P. Crouse

Education

2002	M.S. Agricultural and Applied Economics Virginia Polytechnic Institute and State University
2000	B. S. Animal and Poultry Sciences Virginia Polytechnic Institute and State University

Employment

2001 – present	Graduate research assistant Virginia Polytechnic Institute and State University