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Estimating course difficulty

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Estimating course difficulty

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CHAPTER I: INTRODUCTION

Statement of the Problem

It is generally accepted throughout the academic community that differences exist among college courses in the level of difficulty of the course. Some of these differences can be attributed to the fact that courses are designed to be taught at each of the different levels of student classification. Courses designed primarily for freshmen and sophomores (course numbers in the 100-200 range at many colleges and universities) are generally considered less difficult than those designed for juniors and seniors, or for graduate students. Another component of the difficulty level can often be attributed to the course instructor. Two different instructors teaching the same course (often in different terms or even in different years) may design the course differently and/or teach the course in different ways. A third aspect of the difficulty level of courses which may vary from one course to another is the number of credit hours associated with the course. It was originally the case that courses carrying larger numbers of credits were the more difficult courses. It is not at all clear if that is still the case. It is often perceived that the number of credit hours is somehow equated with the amount of work involved in a course, but may represent nothing more than the number of hours that a course meets each week.

But there is more to the differences among courses than these instructor, classification-level, and credit-hour variations. All freshmen- and sophomore-level courses or junior- and senior-level courses do not carry the same level of difficulty. Even within a given department, it is not clear that every senior-level course would be rated as having equal levels of difficulty, and when courses are compared on an interdepartmental basis, the difference in difficulty levels is likely to be even greater.

We all have perceptions pertaining to the relative difficulty of various curricula. (This is probably also true for individual courses, although it may not be as clear a distinction since there are many more individual courses than there are curricula.) For example, it would generally be agreed that a curriculum in nuclear physics or molecular biology would be more difficult than one in physical education, education, or home economics. Thus, an individual with a GPA of, say, 3.2 in physics and another individual with a GPA of 3.2 in education, although considered equal in terms of academic achievement, would probably not be viewed as equal in the level of difficulty of the coursework completed to attain that level of achievement.

This is not a quantitative measurement of the true difficulty of the physics curriculum as compared to the education curriculum, but is based almost exclusively on one's perception of how difficult a curriculum is. Such comparisons are much harder to make when the individuals involved are not performing at the same measured level of achievement. Consider, now, comparing a student with a GPA of 2.9 in physics with an education student whose GPA is 3.2. On the surface, it would seem that the education student is performing at a higher level, but if it is actually true that the physics curriculum is more difficult than the one in education, it is conceivable that these two students could be performing at the same level of achievement. If the difficulty level of the respective curricula could be controlled, the resulting comparisons of achievement then would more truly reflect differences in student performance and would not be confounded with differences in course difficulty.

Why do we need to be concerned with differences in the difficulty levels of these different curricula? Are such interdepartmental comparisons important or even necessary in the first place? One could probably argue that these comparisons are inappropriate, that we are trying to compare apples with oranges, or that it really doesn't matter if physics is a more difficult curriculum than education. Such comparisons are indeed almost routinely made, however, and whether they are always appropriately made is not the real issue.

Students at virtually every, if not every, institution are awarded honors on the basis of academic achievement, achievement which is usually based, at least in part, on the student's grade point average. Students achieving at a predetermined level have academic honors conferred on them with little or no regard given to the difficulty level of the coursework completed. Every student who achieves at this level, i.e., has a GPA surpassing the minimum cut-off point, is considered to have performed at the same level of achievement. These students, from each of the various curricula, are all compared against the same standard of excellence.

Another example of how students from different academic curricula are compared with each other is in the area of admission to degree programs, especially at the graduate level. Most graduate degree-granting programs have minimum standards that must be met for admission. Often these criteria include having acquired a grade point average that surpasses a certain minimum value. Again, students from different academic curricula are compared with one another, particularly if more students apply for admission to a particular program than can reasonably be admitted at a given time.

A third example of the type of comparison that is typically made involving students from different curricula is in the area of employment. Prospective employers very often have a minimum GPA that they use as a discriminator between possible employees and those that will not be considered for employment.

Clearly, comparisons across disciplinary lines are being made and very likely will continue to be made. What is important, maybe even necessary, is that such comparisons be made in a manner that considers not only the level of achievement that a student attains, but that also considers how difficult it is for a student to reach that level.

The problem which shall be addressed here is one of determining the level of difficulty of the respective curricula, or more specifically the level of difficulty of the courses that make up the respective curricula.

Significance of the Study

The purpose of this study is to develop a means of estimating the difficulty levels of various courses within a university. These difficulty level estimates could then be used to adjust measures of student achievement, such as grade point average, to account for the level of difficulty of the coursework a student has completed. By using adjusted measures of student achievement, individual students could be more accurately compared as to how capable they may be for success in further education and/or future employment. It is hoped that it will be possible to improve the prediction of freshman GPA by considering the difficulty level of the courses taken in addition to the usual sets of independent variables. It is also hoped that the use of course difficulty estimates could aid in the determination of whether or not students should be admitted to a program and/or college or university. Finally, although it is not anticipated that any large-scale changes will be made in either calculation of GPA's or their subsequent use, it is hoped that more people would be aware of the inequities of using GPA's for comparing across disciplines, and, for those who desire to make adjustments in these comparisons, that the information needed to do this will be available.

Research Questions

The first concern to be addressed is determining the criteria for estimating the difficulty level of a course. One possible criterion is to use student perceptions of how difficult a course may be as the basis for assessing the difficulty level. A second criterion would be the measure of students' perceptions of the work demanded or required of a course. A third criterion is the average ACT or SAT composite of the students enrolled in a course, based on the presumption that the more difficult courses will attract the abler students. A fourth criterion is the average grade awarded in a course, in accordance with the view that the more difficult courses will have lower mean grades than those rated as less difficult. Any of these four approaches reasonably could provide indications of which courses are more difficult. This study will examine the characteristics of all four criteria as indices of course difficulty.

The following research questions will be addressed:
(1) What is the degree of relationship among the following four operational definitions (criteria) of course difficulty:

a) student perceptions of difficulty

b) average ACT composite of enrolled students

c) average grade awarded in a course

d) student perceptions of work demanded or required?

(2) Can course difficulty be predicted by the characteristics of the students,

(3) How stable are the indices of course difficulty over time, and

(4) Can course difficulty measures be used to improve the prediction of academic performance?

Assumptions and Limitations

Several assumptions have been made throughout this study pertaining to the validity and reliability of the data and the research design. In constructing the instrument which was used to obtain students' perceptions, fifty (50) subject areas were selected to be representative of "entry-level" introductory courses which college students typically take during their first year. It is assumed that this sample of 50 subjects adequately represents the population of "entry-level" courses. Secondly, since all the data were collected from students at Iowa State University, it is assumed that the courses taught here at ISU are representative of college courses taught at other publicly-funded colleges and universities throughout the country.

The instrument was administered to students selected from the entire undergraduate population at Iowa State. The sampling procedure used to select the students will be described in chapter three. It should be noted here, however, that it is assumed that the sample of students which was obtained consists of a representative cross section of the Iowa State undergraduate student body. Furthermore, it is assumed that the responses given by these students truthfully represent their perceptions of course difficulties and the amount of work required, as well as their interest level in these various subject areas, and that the demographic data about these students were honestly reported.

Much of the data used in the study were obtained from records kept by the university offices of the registrar and of institutional research. For each of the 50 subject areas which were identified on the survey instrument, one course was selected to be representative of that subject. Due to the large number of sections of many of these courses which are taught each semester, one section of each course was selected from each of the eight semesters under consideration and data were obtained from these sections. It is assumed, therefore, that these selected courses are representative of introductory-level courses in their respective subject areas, and that the selected sections adequately represent the chosen courses as well.

Finally, it is assumed that all the data were correctly recorded and that the computer files accurately contain the data as they were supplied by the above-mentioned offices and by the sample of students.

As with any study that is conducted in this manner, inferences are desired to be made from the sample of data collected to the populations from which the data came. While attempts were made to make the scope of the data collection and consequently of the study itself as broad as possible, it must always be remembered that all of the data were collected at one institution, Iowa State University. Therefore any inferences which are made from these data need to reflect this limitation. While it is certainly possible that courses and students at other institutions may be very similar to those at Iowa State, generalizations of this type should be very cautiously made if indeed they are made at all.

Terms and Definitions

There are a couple of terms which are used in this study which may not be familiar to every reader in the context in which they are used. In addition, a couple of the statistical techniques which were used may also be unfamiliar to some readers. These terms and procedures are defined below in the context in which they were used.

Mastery learning, as described by Bloom, et. al., (1981), refers to an instructional strategy designed to bring all, or nearly all, pupils to a specified level of mastery on all course objectives. A Likert-scale is a multi-point scale (often five points labelled strongly disagree, disagree, neutral, agree, strongly agree, but as used here consisting of nine points with only the end points labelled as, e. g., very easy and very difficult) in which subjects are asked to respond to questions or statements by selecting one of the points which best describes their attitude, opinion, or perception. Cluster sampling refers to a sampling procedure in which the population is divided into a large number of groups, called clusters, each of which consists of sampling units with some common property. Once the clusters have been enumerated, a sample of them is chosen and every sampling unit within the chosen clusters are selected for inclusion in the sample.

The statistical techniques utilized in this study which may be somewhat unfamiliar are factor analysis and hierarchical cluster analysis. Factor analysis is a procedure to describe the covariance (or correlational) relationships among many variables in terms of a few underlying, but unobservable random quantities called factors. Hierarchical cluster analysis is an exploratory procedure used to discover natural groupings of the variables based on a quantitative measure of the association (similarity) between the objects (often called a "distance"), using either a series of successive mergers or a series of successive divisions to arrive at "reasonable" clusters of the objects.

CHAPTER II: LITERATURE REVIEW

As was indicated in the previous chapter, differences clearly exist in the levels of difficulty among college courses. But what is it about certain courses that make them more difficult than others? This question is central to any study of difficulty levels, for, if we can satisfactorily answer it, we should be able to devise plans, strategies, or methodologies to make the difficult courses easier and thus enhance student learning. Unfortunately, this question does not have an easy answer.

Educators, psychologists, and behaviorists have been theorizing for years, attempting to explain how students learn and why differences exist in the levels of student understanding and comprehension. But, as Bereiter (1989) points out, "the constitutive problem for an educational psychology of learning . . . is how we learn things that are hard to learn." He goes on to say that behaviorist learning theories fail almost completely to explain why some things are harder to learn than others, and that cognitive theories for the most part have only been slightly more successful. We still struggle to answer the questions, "Why is mathematics as a whole so difficult compared to other subjects? Why does almost everyone eventually fail, even if they did well in earlier courses? And how do we explain those who do succeed?" (Bereiter, 1989, p. 2).

Bereiter goes on to hypothesize that the answers to these questions lie in problem-solving theory. That is, when students approach difficult learning within a problem-solving framework they are more likely to achieve the desired end than when it is approached as a routine task. He does point out, however, that students who rely on routine procedures do learn, and that they seem to learn difficult things in the same way that they learn easy things. It just takes them longer to do it and they do it with less success.

But it still isn't clear what it is that makes one course more difficult than another. Tanner (1986) shows that achievement is a function not only of cognitive level, but is also related to the abstractness of the concept. He cites research by Stoke (1929), Gorman (1961), and Paivio (1979) "in affirmation of the fact that abstract concepts are more difficult to learn than concrete concepts," defining abstract concepts as "those which cannot be perceived through the senses" (pp. 5-6). This would certainly seem to respond to Bereiter's query as to why eventually everyone experiences difficulty in learning mathematics. As an individual progresses through a mathematics curriculum, from algebra, to geometry, trigonometry, calculus, and beyond, the level of abstractness increases, as does the corresponding level of difficulty.

But abstractness of concepts does not seem to be the only characteristic of difficult courses. Horodezky (1983) showed that college professors view vocabulary as "by far the most difficult (concept) in introductory courses." This finding is corroborated by Solomon (1983), who reports a study of why students have trouble learning physics. She found that students viewed physics as easier than chemistry because the terms used for concepts in physics were familiar to them. However, when test results from these same students were examined, they actually had more difficulty with the physics concepts precisely because the familiar terminology was confused with its common everyday usage.

Another apparent characteristic of difficult courses is the time it takes students to learn the concepts. This is very likely related to the previously identified characteristics of abstractness and vocabularly, but appears nevertheless to be indicative of difficult courses. Weeks (1981) reports on a study of occupational learning difficulty for some selected Air Force specialities, with learning difficulty defined as the time it takes to learn to perform an occupation satisfactorily. Gettinger and White (1979) measured time to learn as the number of trials required to master a criterion, and found a stronger correlation between time and achievement than between measured intelligence and achievement. In addition, further study by Lyon and Gettinger (1985) showed that as the cognitive level of the material progressed along the levels of Bloom's taxonomy, from knowledge to comprehension to application, the time required to attain mastery learning increased.

There are certainly other variables as well that could impact on the difficulty level of a course. Student characteristics such as a sense of being in competition with other students, and aptitudes and prior experiences of the students, could contribute to the difficulty they experience in certain courses. It is not the purpose of this study to answer definitively the question of what makes a course difficult. It is expected, however, that by obtaining an objective determination of which courses are the most difficult, it may be possible to ascertain the characteristics that these courses have in common. By so doing some light may be shed on the problem of explaining learning difficulty. That this is an important, and maybe even essential, goal of learning theory is emphasized by Rasor (1980) in a study of why students drop classes. The reason most often given as to why students dropped a course was that the course content was too difficult!

Perhaps it is not surprising that not very much research has been done to determine course difficulty levels. Bravin (1983), a high school senior and student member of the Los Angeles school board, suggested a system of awarding varying numbers of honor points for courses with varying levels of difficulty, to provide a more equitable reflection of student achievement. He suggests that high school students may be electing to pass up more challenging college-preparatory classes, to take "easier" courses so as not to risk lowering their GPA and possibly jeopardizing their chances of admission at the college of their choice.

Andrews (1987) made use of a course difficulty index in her prediction of academic achievement. This index consisted of the multiplicative product of the credit hours awarded in a course with the average grade given in the course. The rationale for such an index is that courses which award a larger percentage of higher grades are "easier" than those which give fewer high grades. By utilizing this index to weight the courses included in the calculation of GPA, she obtained an increase in the proportion of achievement variance that was explained over that obtained without using the difficulty index weighting.

McCarger (1987) investigated the relationship of perceived course difficulty with grammar, essay examination achievement, and hours spent doing homework. He found significant positive relationships among these variables, and concluded that students learned more in courses which were perceived to be more difficult. No cause and effect relationship could be inferred from these findings. Nevertheless, students' perceptions of how difficult courses are may have a direct bearing on how students learn. However, no one, it seems, has been interested enough in the effect of course difficulty on student performance to pursue a systematic investigation of that effect.

While neither Andrews nor McCarger report any estimates of course difficulty, both have used such estimates in their predictions of academic achievement and have shown them to have an effect. Many others, as well, have investigated the prediction of academic achievement in an attempt to identify those factors which explain the majority of the variance in these predictions. Munday (1970) found that "most of the reliable variance of predictability" could be explained by range of talent, percent of students living under college supervision, size of freshman class, and ability level of the freshmen student body.

Sass and Lexmond (1981) report a relatively unsuccessful attempt to predict academic achievement by regressing college GPA on family size, birth order position, and age spacing between siblings. Mathiasen (1984) reviewed over sixty studies that investigated the predictors of academic achievement. His findings indicate that high school performance, college entrance exams, study behaviors and attitudes, and personality traits are the most commonly used predictors.

Widman (1978), Knapp (1979), and Lloyd (1980) have all investigated the effect of certain life events on the academic performance of college students, and showed negative relationships between GPA and undesirable events. Mills (1978) found that whether or not students worked either full-time or part-time did not affect the students' achievement. Malstrom (1984) investigated the effects of honors won, undergraduate GPA, full/part time student status, age, marital status, children, undergraduate institution excellence, and two levels of work experience on the prediction of performance in engineering graduate programs. Merante (1983) examined the correlation of students' high school grades, achievement test scores, and class rank with characteristics of the institution to be attended, as well as age, sex, birth order, income, parents' education, religious and ethnic background, and geographic factors in an attempt to predict college success.

It is apparent from all of these studies that there is a plethora of possible variables that could be used in an attempt to explain the variation in academic achievement. It is somewhat less apparent that, since so many different variables and combinations of variables have been and are still being tried, none of them, neither individually nor collectively, seem to be adequate for the purpose of explaining that variation.

Goldman and Slaughter (1976) point out that the problem is not with the predictors, but instead with the criterion. They suggest that differential grading standards, which lead some departments to give higher grades than others for the same level of performance, renders the grade point average a somewhat inappropriate measure of performance. The fact that differential grading standards may indeed be a problem is substantiated by Albertson (1990). This lack of strong validity in predicting GPA is due to the fact that the GPA is a composite of "decidedly nonequivalent components" (Goldman and Slaughter, 1976, p. 13). Goldman and Slaughter (1976) propose a solution to this problem as the creation of a conversion system for equating grades in one class with those in another. They point out further that this procedure has been utilized in at least some medical schools, where grades have been weighted according to the perceived difficulty of the classes.

This is precisely the point that is being addressed here: the establishment of a course difficulty index that would facilitate the converting of grades from one course to be equivalent to those in another course, so that the GPA's calculated from these converted, i.e. weighted, grades would more truly reflect the level of achievement of the students involved. Such an index could not be proposed, and likely not be adopted, however, without objections being voiced on several fronts. While it is certainly true that courses do vary in difficulty, in actuality as well as in how they are perceived, this does not provide sufficient justification for using a weighting index based on estimated difficulty parameters in calculating student grade point averages.

For instance, when considering courses that come from areas scattered throughout the entire curriculum of a university, a vast array of skills, abilities, aptitudes, and performances that may be required for success are being encompassed. Some courses, such as those in physical education, industrial technology, some engineering courses, and possibly some laboratory courses in the physical sciences, require a great amount of psychomotor dexterity on the part of the student in order to demonstrate his/her competence or excellence in these courses. Other courses, such as those in mathematics, political science, or philosophy, may require no psychomotor skills whatsoever, but require only cognitive reasoning ability on the part of the student to demonstrate his/her mastery of the subject matter. Still others may require combinations of these learning domains as well as affective behaviors in order for the student to be successful.

While some individuals may perceive that mastery achievement in some of these areas may be more difficult to attain than in some others, this perception may be nothing more than an arbitrary imposition of those individuals' value perspectives. Certainly some individuals may find it very difficult to achieve success in a course that requires a great deal of physical prowess or dexterity, while others may find this to be relatively easy. Imposing a hierarchy of difficulty levels of courses upon the calculation of GPA's, even if the hierarchy has been developed with input from a wide variety of disciplines, may be biased in favor of the courses or disciplines which are generally treated by society as being more prestigious or important. In this sense, the difficulty estimates may be more a reflection of society's values than of how difficult it is for students to achieve success in those courses.

Philosophically, according to Dewey (1938), our educational experience should be based on just that, experience. The learning that takes place should be driven by a need that requires satisfying. Knowledge just for the sake of knowledge is pointless. From this perspective, all achievement is of equal value, for it all occurs in relation to fulfilling a need. How difficult it was to acquire that knowledge or understanding is irrelevant to the fact that the knowledge was needed and has been acquired. Achievement in this context is very mastery-level oriented, and assigning of grades other than mastered/not-mastered may be difficult to do. Regardless of how the grades are assigned, the acquisition is what is important, rather than the particular need that fostered it. Weighting by a difficulty index of any kind would be inappropriate.

From an instructional viewpoint, it could be argued that differences in difficulty levels constitute only one of possibly many areas in which various courses may differ. For example, differential grading practices, as mentioned previously by Goldman and Slaughter (1976), is an area where different courses may vary considerably. What constitutes an A in one course may differ substantially from what is required to earn that grade in another one. While this may or may not be a problem in relation to the interpretation of the students' grades, weighting the GPA's by a difficulty index may not necessarily adjust for this differential in what a certain grade represents in regard to the student's level of achievement. Attempting to equate the courses on the basis of only one of several possible areas of variation may not account for all the differences between the courses, and therefore may not be any more meaningful than the unweighted comparisons.

Finally, from the measurement perspective, it must always be remembered that achievement, as measured by performance on a test or some other suitable measuring instrument, represents only a sample of an individual's behavior. As such, it is not an exact measurement of a student's ability, but only an estimate. It is subject to sampling error, in that it measures performance on the particular sample of items included in the instrument. It is also subject to measurement error, since the answers recorded also constitute only a sample of the student's possible performances and may not reflect the true level of knowledge of the student. Another day and a different sample of items may lead to different scores and possibly different conclusions about the level of achievement shown by the student. The measurement of the student's ability, as assessed by his/her performance, is never precise. Controlling only for the difficulty level of the courses may not give rise to comparisons which are more precise than those made without using the difficulty index as a weighting factor.

The preceding arguments from both the values and philosophical perspectives make valid points with regard to the issue of using a difficulty index to weight grade point averages for the purpose of comparing student performance. Nevertheless, a case can be made for the use of such a difficulty index. The fact that the methods used to determine the difficulty levels may be value-bound is not sufficient of itself to object to the use of these methods on those grounds. The values of society are very important to the educational process, and may not even be separable from that process. That these comparisons are often used as a justification for employment or admission to some educational institution and/or program points to the importance of the role of values in determining the basis for such comparisons. For it is within that society, complete with its values, that these students will function in one capacity or another. Values play a part in virtually every decision that is made. There is no reason why values should be excluded from this type of decision-making. Any objection on these grounds seems tenuous at best.

In response to the philosophical objection, it should be noted that the use of a difficulty index, as has been described above, is not an attempt to cheapen the achievement of any individual students. Any and all knowledge attained through the course of one's educational experience is certainly valuable, and none of it should be viewed as inferior or less important than the rest. However, quantifying the relative difficulty of acquiring that knowledge still can be useful as a predictor of how capable an individual may be for future study and/or employment. In a world with a limited number of employment and educational opportunities, it is inevitable that comparisons among the candidates for the available positions will be made. It is important that these comparisons be as accurate as possible. Using such a difficulty index as an aid in making these comparisons will help to increase the accuracy of those comparisons.

In response to the last two objections, it must be remembered that in any study of student performance there are many possible sources of variation that affect the desired outcome. While the use of a difficulty index is not an attempt to account for all the differences that exist among courses in different disciplines, it is an attempt to identify one heretofore unidentified source of variation and to do something about it. Adjusting for difficulty levels in courses will not eliminate all the differences that exist among the various courses which can and do affect these comparisons. However, it will attempt to eliminate one of these sources that is considered here to be a major difference that clouds the overall picture and which contributes to the extreme difficulty in making accurate comparisons between and among individual students.

CHAPTER III: METHODOLOGY

Pilot Study

A pilot study was conducted to obtain insights into the utility of student perceptions of course difficulty as a measure of the difficulty level of a course. It also provided a means for testing the form of the survey instrument in terms of format, length, and the type and amount of data to be collected.

Subjects

Three hundred eight-four (384) students enrolled in an introductory statistics course were utilized for the purpose of the pilot study. The course is divided into eight sections, with approximately fifty (50) students in each section. These sections meet once each week for a two-hour lab in addition to the weekly lecture times. The class consisted of twenty-two (22) freshmen, one hundred thirty-seven (137) sophomores, one hundred fifty-one (151) juniors, seventy-three (73) seniors, and one unclassified student. A total of two hundred twenty-two (222) females and one hundred sixty-two (162) males were identified. Students were enrolled in the colleges of agriculture, design, education, family and consumer sciences, and liberal arts and sciences. In addition, three students (two from the college of business administration and one from engineering) were included. Since most students from these colleges enroll in introductory statistics courses designed particularly for business or engineering students, no estimates or rankings were obtained for these colleges individually, but the three students were included in the analyses on the entire sample.

This sample was selected because of convenience. Students were not randomly selected for inclusion, but were chosen on the basis of being enrolled in this particular course and being present on the day the surveys were administered to the class. Consequently, it was not intended that the results be generalized to the university as a whole or to all university students in general. The focus of the pilot study was on assessing consistency regarding the measurement of course difficulty for the various student groups represented and on the interrelationships among these perceptions. Therefore, the lack of random sampling did not pose an important restriction on the usefulness of the results.

Instrument

The students' perceptions were obtained by the use of a paper form survey listing forty (40) course titles representative of those found in college catalogs. An effort was made to construct course titles from various disciplines, including engineering, mathematics, languages, education, agriculture, history, etc., typically offered in a comprehensive university. Table 1 contains the 40 course titles used on this instrument. The form utilized a Likert-type scale of 9 points for recording judgments of course difficulty from very easy to very difficult. The form also contained a similar scale to indicate the degree of interest each student had for the subject of the course ranging from uninterested to very interested. There was also a place for the student to indicate whether or not the course was required for his/her major and a place to indicate if he/she had taken such a course.

In addition, students were asked to supply certain demographic information about themselves. Included in this information were gender, year in school, major, college of enrollment, estimated undergraduate GPA, and high school class size.

Table 1. Course titles appearing on pilot study survey instrument

Architectural Drawing
Astronomy
Biochemistry
Biology
Calculus
Chemistry
Child Development
Computer Aided Design
Computer Operating Systems
Crop Production
Economics
Educational Media
Electronics
English Composition
French
General Physics
Geology
Government
Human Anatomy
Hydraulics and Pneumatics
Journalism
Macroeconomics
Mass Communications
Matrix Algebra
Metal Fabrication
Music Theory
Pascal Programming
Plant Science
Principles of Teaching
Psychology
Psychopharmacology
Religions of the World
Sociology
Spanish
Structural Linguistics
Systems of Logic
Textiles and Materials
Thermodynamics
World History

Analysis

Following the coding of the data and creation of the computer data file, the data were analyzed by (1) calculating the mean and standard deviation of course difficulty for each course, (2) calculating the Spearman rank correlation coefficient (rho) between the ranks of the course difficulty means obtained for subjects that had taken the course and the ranks of the means obtained for subjects that had not taken the course, (3) calculating the Spearman Rho value between the ranks of the course difficulty means for females and the ranks of the means obtained for males, (4) calculating the Spearman Rho values among the ranks of the course difficulty means obtained for freshmen, sophomores, juniors, and seniors, (5) calculating the Spearman Rho values among the ranks of the course difficulty means obtained for subjects enrolled in the five colleges represented in the study, (6) regressing the perceived difficulty of each course on student interest in the course, taking or not taking the course, student gender, self-reported undergraduate grade point average, size of the high school class from which the student graduated, coding vectors for freshmen through senior classification, and coding vectors for college of enrollment, (7) factor analysis of the course difficulty perceptions of students, using the maximum likelihood method with squared multiple correlation prior communality estimates, and (8) hierarchical cluster analysis of the difficulty perceptions using Ward's Minimum Variance Cluster Analysis and by the Average Linkage Cluster Analysis, with the number of clusters set at 5 and 9 respectively.

Main Study

Population and sample

The population of interest for this study is the universe of courses taught in four-year, publicly funded universities. In an attempt to limit the scope of this study, only those courses which are offered specifically to freshmen in either their first or second semester in school are considered. The sample of courses was drawn from such courses offered at Iowa State University. These courses included both those thought of as "entry-level" and those requiring only one prerequisite.

A sample of fifty (50) such courses was selected from the above-mentioned population. Again an attempt was made to include courses from across the entire curriculum of the university. Beginning with the list of courses used in the pilot study, this was trimmed down by eliminating such courses as thermodynamics and psychopharmacology which did not meet the "entry-level" criterion. Other courses, such as matrix algebra and Pascal programming, were re-labelled to remove ambiguity as to what course was being considered or to coincide with course titles presently listed in the Iowa State catalog. Finally, the catalog was used to identify other subject areas not already represented, in which at least one "entry-level" course is offered. From these course offerings, the remaining course titles were selected to ensure representation from all seven undergraduate colleges at the university and a diversity of course types and content.

Of the 50 courses selected for inclusion in the sample, twenty-nine (29) are from the College of Liberal Arts and Sciences, six from the College of Family and Consumer Sciences, four each from the Colleges of Agriculture, Design, and Education, two from the Engineering College, and one from the College of Business Administration. The business course (Accounting) was included in the sample even though students need to have sophomore classification to enroll in the Business College, because it was felt that business courses, which comprise a sizable amount of the university's curriculum, should have some representation in the sample. Thirty (30) of the courses listed on the pilot study survey were also included in this sample, with the remaining twenty (20) being added from the Business College (1), Education (1), Engineering (2), Design (3), Agriculture (3), Family and Consumer Sciences (4), and Liberal Arts and Sciences (6).

Additionally, one actual course was selected from the university catalog to be representative of each of these fifty subject areas. In some cases, there was only one suitable course that could reasonably be selected as an entry-level course in that area. In other cases, two or possibly three courses could be selected to represent that subject. In these cases, catalog descriptions were used to identify the course which seemed to be more clearly "entry-level," if there was one, and in a couple of instances one of the "equally" suitable courses was arbitrarily chosen. Table 2 contains the 50 subject areas sampled, together with the specific course used to represent that subject.

A sample of six hundred five (605) students was also selected, to obtain students' perceptions of course difficulty, perceptions of the amount of work required, and interest level in the subject for this same group of 50 courses. A pseudo-random cluster sampling technique was used to select the sample. It was desired that the sample

Table 2. Course titles used in the main study survey instrument

Subject	Course Number
Accounting	Acct 284
American Government	Pol S 215
Anthropology	Anthr 201
Architecture	Arch 102
Art History	Art H 280
Astronomy	Astro 120
Biochemistry	B B 221
Biology	Biol 109
Botany	Bot 207
Calculus	Math 165
Chemistry	Chem 163
Child Development	C D 129
College Algebra	Math 140
Community and Regional Planning	C R P 253
Computer Programming	Com S 211
Crop Production	Agron 114
Drawing	Art 130
Economics	Econ 201
Educational Computing	SecEd 101
Electronics	IEd T 140
Engineering Graphics	Fr E 170
English Composition	Engl 104
Entomology	Ent 211
Family Environment	F E 185
Food Science	F Tch 101
Forestry	For 101
French	Frnch 101
General Physics	Phys 111
Geography	Geog 100
Geology	Geol 100
History	Hist 201
Home Economics	FCSEd 205
Hotel, Restaurant, and Institution Management	HRI 204
Human Anatomy	Zool 155
Human Nutrition	F N 107
Journalism	Jl MC 201
Leisure and Recreation	L S 201
Literature	Engl 201
Mass Communications	Jl MC 101
Materials Science	M S E 170
Metal Fabrication	IEd T 130

Table 2. (continued)

Subject	Course Number
Music Theory	Music 130
Philosophy	Phil 201
Psychology	Psych 101
Sociology	Soc S 134
Spanish	Span 101
Speech	Sp Cm 211
Statistics	Stat 101
Textiles and Materials	T C 204
World Religions	Relig 250

contain a representative cross-section of the undergraduate student population, so an effort was made to distribute surveys to students in each of the twenty-eight (28) combinations for classification level and undergraduate college of enrollment. (The instrument also contained other levels of classification and other colleges besides these 28, for those students who did not fit into one of these combinations.)

It was decided that individual sections would serve as the basic sampling unit, with a cluster sample of all students in attendance on the day of administration in each selected section. Since some students could conceivably be enrolled in more than one of the sections selected for the sample, it was decided to restrict the sampling frame to only those sections which met during the 10:00 AM to 11:00 AM time slot on Mondays, Wednesdays, and/or Fridays. This would eliminate the possibility of requesting the same students to fill out the survey instrument on more than one occasion.

The sample was selected in stages, beginning with several large service-type courses that contain students from several colleges and that span all four undergraduate classification levels. After examining the make-up of the sample obtained from these courses and noting which of the 28 combinations of classification level with college of enrollment were under-represented, additional sections were selected for inclusion in the sample to try and fill in the "gaps" in these under-represented areas. Courses included in the sample were American Government, Statistics, Accounting, Computer Programming, Economics, Calculus, Engineering Graphics, Child Development, Nutrition in Growth, Entomology, Forestry, Two-Dimensional Design, Drawing, Human Perspectives in Art, and Computer Applications in Industrial Education and Technology.

Of the 605 students surveyed, three hundred fifty-six (356) were male and two hundred forty-nine (249) were female. One hundred four (104) were freshmen, one hundred forty-eight (148) were sophomores, two hundred thirty (230) were juniors, one hundred twenty-three (123) were seniors, and two (2) were classified in some other way. One hundred nineteen (119) came from the College of Agriculture, ninety-four (94) from the College of Business Administration, fifty (50) from the Design College, sixty-eight (68) from the College of Education, seventy-five (75) from the Engineering College, sixty-seven (67) from the College of Family and Consumer Sciences, one hundred twenty-seven (127) from the College of Liberal Arts and Sciences, and five (5) from some other college. Table 3 contains a breakdown of the sample, listing the number of students selected from each of the 40 combinations of classification level and college of enrollment that were represented.

Instrument

The survey instrument contained three Likert-type scales with response values ranging from 1 to 9, as in the pilot study instrument. The students were asked to rate each of the 50 courses described in the previous section with regard to their interest level in the subject (from low interest to high interest), how difficult they perceived an introductory course in the subject to be (from very easy to very difficult), and how much work they

Table 3. Breakdown of student sample by college and classification level combinations

	Fresh	Soph	Jr	Sr	Other	Total
Agriculture	55	21	26	16	1	119
Business Administration	1	26	59	7	1	94
Design	9	7	11	23	0	50
Education	5	20	21	22	0	68
Engineering	18	17	29	11	0	75
Family and Consumer Sciences	4	7	39	17	0	67
Liberal Arts and Sciences	11	47	45	24	0	127
Other	1	3	0	1	0	5
Total	104	148	230	123	2	605

perceived to be required in that introductory level course (from very little to very much). In addition, they identified which of these courses they actually had taken and responded to questions about gender, classification level, college of enrollment, and their estimated undergraduate grade point average.

Data collection

The data were collected in three phases. The first phase involved distributing the surveys to the students enrolled in the courses previously mentioned. Because of the nature of the sampling method employed, this phase took the longest to complete. The surveys were distributed to students in the large service courses (American Government, Statistics, Accounting, and Economics), and then later in the other courses which were selected in the manner previously described. This process was time-consuming as there was often a two- to three-week span from the time the instructor was contacted about using his/her section for the data collection to the time the data actually were collected and compiled to see if any of the previously under-represented areas were now adequately represented.

Phase two involved obtaining data from the Office of the Registrar. One section of each of the 50 courses identified previously was randomly selected (when more than one section was available) to be used in this phase of the data collection. Actual grade distributions were obtained for each of these sections from each of the eight (8) semesters from the fall of 1986 through the spring of 1990, excluding summer sessions. In addition, standardized test score composites (when available) were obtained for those students enrolled in these selected sections for the fall semester of 1986 and the spring of 1987. (Standardized test score composites for the other semesters were obtained from the Office of Institutional Research in the last phase of the data collection.)

However, not all of the selected courses were taught in each of these eight semesters. Some were taught only during fall semesters and others offered only during the spring. Still others were not taught at one time or another for some other reason that was not readily apparent.

In most of these cases other courses could have been substituted for the ones not available, but it was decided not to pursue this option. It was felt that using a different course for some of the semesters might introduce another source of variation into the analysis that would be very difficult to control. For example, since Spanish 101 is offered only during fall semesters, Spanish 102 could have been used to obtain data for spring semesters. It was conjectured, however, that the characteristics of the students enrolled in second-semester Spanish may be considerably different from those in the first semester, since conceivably the more capable and more interested students would go on in the study of Spanish and many others would not if it were not a required course. Using data from Spanish 101 for some of the semesters and data from Spanish 102 for the rest might not give accurate estimates of the difficulty level of introductory Spanish, for either grade distributional or standardized test score criteria. For this reason, eleven (11) of the fifty courses have grade distribution and ACT score data missing for one or more of the eight semesters. Table 4 lists these 11 courses and the semesters for which no data were available.

The final phase of the data collection involved data maintained by the Office of Institutional Research. Here each of the data files created from the data obtained in phase two, from the fall of 1987 through the spring of 1990, were matched by student identification numbers to obtain high school rank and standardized test score composite. However, in addition to missing values, data for high school rank were not available for fall 1987 and spring 1988, and none of these data were available from this office prior to the fall of 1987.

Analysis

The analyses performed in the main study can be separated into three main divisions, those done on the perceptions of difficulty and amount of work, those done on the course grade distributions and the ACT composite score distributions, and those done using the composite estimates of course difficulty which were calculated as a result of the previous analyses. Additionally, these divisions can

Table 4. Courses which were not taught in one or more of the sampled semesters and the corresponding semesters

Course	Semesters not taught
Architecture (Arch 102)	F86, F87, F88, F89
Community and Regional Planning (C R P 253)	F86, S87, S88, S89, S90
Computer Programming (Com S 211)	F86, S87
Entomology (Ent 211)	F86, S87, F87, F88, F89
Forestry (For 101)	S87, S88, S89, S90
French (Frnch 101)	S87, S88, S89, S90
Home Economics (FCSEd 205)	F86, S87, F87
Hotel, Restaurant, and Institution Management (HRI 204)	F86, F87, F88, F89
Materials Science (M S E 170)	S87, S88, S89, S90
Music Theory (Music 130)	S87, S88, S89, S90
Spanish (Span 101)	S87, S88, S89, S90

be subdivided into categories corresponding to the types of analyses performed. The principal types used were, (A) means, ranks, and correlations, (B) regressions, (C) factor and cluster analyses, and (D) analyses of variance.

<u>Perceptions</u> Initially, calculations were performed on the perceptions of course difficulty. First, (1) means and standard deviations of perceived course difficulty were calculated for each of the 50 courses, and the means were ranked in order from largest to smallest. Secondly, means, ranks, and correlations were calculated (2) for those

students who had taken the course and for those students who had not taken the course, (3) for females and for males, (4) for freshmen, sophomores, juniors, and seniors, and (5) for students enrolled in the seven colleges represented in the study.

Next, (6) the perceived difficulty level of each course was regressed on student interest in the course, taking or not taking the course, student gender, self-reported undergraduate grade point average, coding vectors for classification level, and coding vectors for college of enrollment. Finally, (7) a factor analysis of the course difficulty perceptions of students was performed using the maximum likelihood method with squared multiple correlation prior communality estimates, and (8) a cluster analysis was performed using Ward's Minimum Variance Cluster Analysis with the number of clusters set at 9, to match the number of factors obtained in the factor analysis.

Next, analyses were performed on the perceptions of the amount of work involved in each course. Here, (9) each of the first five procedures described above was repeated, and the results were compared to those obtained from the perceptions of course difficulty. Following this, the common core of 30 courses were compared (10) by calculating a Spearmen Rho value between the respective ranks of the mean difficulty levels for each course on both the pilot study and the main study, (11) by factor analyzing the perceived difficulty estimates from both studies, and (12) by using cluster analysis procedures on the difficulty estimates from both studies.

Grade distributions The grade distributions were analyzed by (13) calculating the mean and standard deviation for each course for each semester, (14) checking for departures from normality using Shapiro-Wilk statistics, stem and leaf displays, and normal probability plots, (15) calculating correlation coefficients among the means from the eight semesters, (16) using analysis of variance procedures to determine the extent of agreement across semesters, and (17) means and standard deviations were calculated for each course for all the semesters combined.

ACT composite score distributions The ACT score distributions were analyzed (18) using the procedures numbered 13 through 17 as described in the preceding paragraph.

Comparison of the separate indices The different indices of course difficulty were compared (19) by calculating Spearmen Rho values among the ranks of the means for the four different indices of course difficulty, i.e., students' perceptions of course difficulty, students' perceptions of the amount of work required, average grade given in the course, and average ACT composite of students enrolled in the course, and (20) by calculating Pearson correlation coefficients among the means from these indices. Then, (21) the two perceptions measures were combined into one measure, and (22) the two remaining indices were combined with this new one to obtain course difficulty estimates.

Predictions of academic performance Finally, (23) a subsample of students was selected which consisted of those students who had taken four or more of the courses whose grade distributions were obtained in phase two of the data collection. Partial GPA's were calculated for these students based on their grades in these courses, (24) the course difficulty estimates were used on this subsample to predict their academic achievement on this partial grade point average, (25) these predictions were compared to similar ones which were made without using the course difficulty estimates as a predictor, and (26) the utility of using the difficulty estimates to weight grade point averages was investigated and the results were compared to the models using these estimates as additional predictors.

CHAPTER IV: PILOT STUDY RESULTS

Means, Ranks, and Correlations

Means and standard deviations of the difficulty estimates were obtained for the forty (40) courses listed on the survey instrument as given in Table 1. The mean difficulty estimates were compared and the courses were ranked in order from most difficult to least difficult. Courses ranked the highest (i.e., most difficult) were Thermodynamics, Biochemistry, and Calculus. Those ranking the lowest were Speech, Child Development, and Sociology. The complete listing, in ranked order from most difficult to least difficult, is given in Table 5, together with the mean, standard deviation, and number of students responding for each course.

In general, it appears that the upper half of this list consists of courses which have a strong mathematical and/or technical nature, while the lower half contains those courses which come primarily from the "soft" sciences and the humanities. Does this reflect actual differences between the courses from these respective areas, or is it more indicative of a general "math anxiety" influence that is manifested in the students' perceptions of which courses

Table 5. Overall means and standard deviations of course difficulty, with courses ranked from most to least difficult, pilot study

RANK	COURSE	N	MEAN	STD DEV
01	Thermodynamics	349	7.87	1.39
02	Biochemistry	351	7.48	1.58
03	Calculus	373	7.47	1.81
04	Hydraulics and Pneumatics	350	7.21	1.83
05	General Physics	377	7.16	1.87
06	Psychopharmacology	345	7.06	1.75
07	Chemistry	378	6.98	1.83
08	Electronics	372	6.92	1.81
09	Pascal Programming	372	6.50	1.93
10	Architectural Drawing	352	6.44	1.89
11	Systems of Logic	355	6.41	1.81
12	Computer Aided Design	372	6.39	1.89
13	Metal Fabrication	355	6.23	1.92
14	Matrix Algebra	354	6.11	2.07
15	Structural Linguistics	350	6.00	1.69
16	Computer Operating Systems	354	5.99	1.75
17	Human Anatomy	353	5.92	1.94
18	Macroeconomics	355	5.92	1.78
19	French	352	5.76	1.97
20	Biology	375	5.58	1.72
21	Economics	378	5.54	1.86
22	Astronomy	352	5.43	2.03
23	Crop Production	351	5.35	1.95
24	Spanish	371	5.32	2.16
25	World History	373	5.31	1.85
26	Plant Science	372	5.28	1.85
27	Government	372	5.20	1.80
28	Religions of World	353	5.06	1.84
29	Mass Communication	352	4.93	1.80
30	Journalism	371	4.87	1.74
31	English Composition	380	4.86	1.93
32	Textiles and Materials	352	4.79	2.01
33	Geology	369	4.76	1.63
34	Educational Media	351	4.65	1.80
35	Psychology	378	4.47	1.82
36	Music Theory	371	4.44	2.02
37	Principles of Teaching	368	4.26	1.73
38	Speech	376	4.22	1.76
39	Child Development	353	4.21	1.87
40	Sociology	379	3.85	1.67

are more difficult? The answer is not clearly evident. It is clear, however, that, whatever the reason, students perceive those courses which are more dependent on mathematics to be more difficult than those which are not.

Does the experience of taking a course affect students' perceptions of how difficult that course is? In order to assess partially the degree to which such experiences actually affect the perceived difficulty of courses, estimates of course difficulty were obtained separately for those students who had taken each of these 40 courses and for those who had not taken such courses. The rank, mean, and number of students having taken each course are reported in Table 6, with corresponding values for those students not having taken these courses reported in Table 7.

The value of Spearman's Rho was obtained between the course rankings obtained from subjects who had taken a course and the corresponding rankings from those who had not taken the course. The Rho value of .85 indicates a relatively high degree of consistency of rankings regardless of whether or not students actually have taken a course. Some slight changes in rank can, however, be seen. For example, Computer Aided Design, which was ranked

Table 6. Estimates of course difficulty from students having taken the course, pilot study

RANK	COURSE	N	MEAN
01	Thermodynamics	8	7.13
02	Calculus	101	6.71
03	Chemistry	187	6.68
04	Biochemistry	19	6.68
05	Systems of Logic	23	6.39
06	General Physics	110	6.26
07	Pascal Programming	78	6.05
08	Electronics	19	6.00
09	Human Anatomy	148	5.86
10	Psychopharmacology	5	5.80
11	Metal Fabrication	22	5.59
12	Biology	278	5.52
13	Macroeconomics	158	5.45
14	Astronomy	38	5.39
15	Economics	245	5.34
16	Computer Operating Systems	109	5.34
17	Structural Linguistics	17	5.24
18	Matrix Algebra	136	5.22
19	Architectural Drawing	26	5.08
20	Crop Production	18	5.00
21	Mass Communications	69	5.00
22	World History	169	4.97
23	Computer Aided Design	32	4.94
24	Government	154	4.88
25	Hydraulics and Pneumatics	8	4.88
26	English Composition	358	4.86
27	Plant Science	53	4.79
28	Geology	67	4.79
29	Textiles and Materials	39	4.56
30	French	33	4.55
31	Religions of the World	48	4.52
32	Psychology	317	4.49
33	Spanish	80	4.36
34	Music Theory	67	4.25
35	Child Development	140	4.14
36	Principles of Teaching	41	4.05
37	Speech	207	3.97
38	Journalism	67	3.84
39	Sociology	312	3.80
40	Educational Media	28	3.68

Table 7. Estimates of course difficulty from students not having taken the course, pilot study

RANK	COURSE	N	MEAN
01	Thermodynamics	340	7.89
02	Calculus	270	7.76
03	General Physics	265	7.54
04	Biochemistry	331	7.52
05	Chemistry	189	7.26
06	Hydraulics and Pneumatics	341	7.26
07	Psychopharmacology	339	7.07
08	Electronics	352	6.98
09	Matrix Algebra	217	6.66
10	Pascal Programming	292	6.61
11	Architectural Drawing	325	6.54
12	Computer Aided Design	338	6.54
13	Systems of Logic	330	6.41
14	Macroeconomics	197	6.29
15	Computer Operating Systems	244	6.27
16	Metal Fabrication	332	6.27
17	Structural Linguistics	332	6.04
18	Human Anatomy	205	5.96
19	Economics	133	5.91
20	French	317	5.89
21	Biology	95	5.69
22	World History	202	5.59
23	Spanish	290	5.58
24	Astronomy	314	5.43
25	Government	217	5.42
26	Crop Production	332	5.36
27	Plant Science	318	5.36
28	Religions of the World	303	5.15
29	Journalism	301	5.07
30	English Composition	22	4.91
31	Mass Communications	281	4.90
32	Textiles and Materials	312	4.82
33	Geology	301	4.74
34	Educational Media	322	4.74
35	Speech	168	4.53
36	Music Theory	300	4.48
37	Psychology	60	4.45
38	Principles of Teaching	325	4.27
39	Child Development	212	4.25
40	Sociology	67	4.10

23rd for those having taken such a course, was ranked 12th for those not having taken it. Similar changes in rank can be seen for French, Spanish, and Journalism, where the experience of taking the course appears to have altered the perceptions of its difficulty. Changes in the opposite direction can also be seen, where courses such as Biology, Human Anatomy, and Systems of Logic were ranked higher (i.e., more difficult) by those having taken the course than by those not having taken it. However, in each of these courses, the mean difficulty level changed only slightly from one group to the other, indicating that the perceived difficulty of these courses didn't really change. What changed was the perceptions relative to the other courses.

The implication is that experience may alter, to a relatively small degree, the perceptions of difficulty. Note, however, the consistency with which Calculus is ranked the same regardless of experience. This is also the case for Government, World History, and Computer Operating Systems. In each of these courses the rank stayed the same, or nearly the same, but the mean difficulty value increased. It appears that, in general, courses are perceived to be more difficult by those students not having taken it than by those who have. Since the population of students actually having taken a course may be considerably different from that of students not having taken the course, one would need to complete a longitudinal study of perceived difficulty, where perceptions were obtained before and following completion of the course, to make definitive statements about the effect of actually taking the course on its perceived difficulty.

Even higher consistency of course difficulty rankings for subjects classified by gender, year in school, or college affiliation were obtained when separate estimates of course difficulty were obtained for these respective groups. For example, the Spearman's Rho value of .92 for rankings by males and females demonstrate few differences in perceived relative difficulty among the courses. However, some differences can again be seen. The largest differences occur in the language-related areas of English Composition (difference of 10) and Spanish (difference of 12), which were perceived to be more difficult by males than by females. This may reflect greater confidence among females for courses dealing with language (see also French and Structural Linguistics), although Speech differed little in perceived difficulty between the two groups. This might be due to components of confidence in presentation, rather than verbal fluency and knowledge acquisition per se. These rankings are given in Table 8.

As students progress through their respective degree programs, their perceptions of course difficulty may become altered by both the experience of their peers and actual course participation. Most of the difficulty levels, however, were relatively similar across student classification levels. In most of the courses where substantial differences were found (i.e., English Composition, Government, Human Anatomy, Macroeconomics, Matrix Algebra, Pascal Programming, Principles of Teaching, Systems of Logic, and World History) the rankings were very similar among sophomores, juniors, and seniors, with the freshmen's perceptions accounting for the difference. This might be an indication that freshmen lack the necessary experiences, both their own and those of their peers, to perceive accurately the difficulty level of these courses. Alternatively, it could mean simply that freshmen haven't yet fallen into the same pattern of thinking as the students in the upper classes.

The other courses that exhibit large differences in rank among these classification-level groups (i.e., Economics, French, and Plant Science) show either a gradual

Table 8. Ranks of course difficulty, by gender of respondent, pilot study

COURSE	FEMALE	MALE
Architectural Drawing	9	14
Astronomy	20	26
Biochemistry	2	3
Biology	24	20
Calculus	3	2
Chemistry	8	4
Child Development	39	36
Computer Aided Design	12	12
Computer Operating Systems	14	19
Crop Production	21	29
Economics	17	24
Educational Media	34	33
Electronics	6	8
English Composition	33	23
French	22	15
General Physics	5	7
Geology	30	24
Government	23	32
Human Anatomy	18	16
Hydraulics & Pneumatics	4	6
Journalism	31	27
Macroeconomics	15	21
Mass Communications	28	28
Matrix Algebra	16	11
Metal Fabrication	13	18
Music Theory	35	38
Pascal Programming	10	9
Plant Science	26	22
Principles of Teaching	38	37
Psychology	36	35
Psychopharmacology	7	5
Religions of the World	27	30
Sociology	40	40
Spanish	29	17
Speech	37	39
Structural Linguistics	19	10
Systems of Logic	11	13
Textiles and Materials	32	31
Thermodynamics	1	1
World History	25	25

increase or decrease in rank as the classification level changes from one year to the next. This could indicate that courses which are perceived to be more difficult or less difficult by freshmen are perceived differently as students are exposed to additional courses in subsequent years. Changes in difficulty ratings may, however, reflect differences in the populations of freshmen, sophomores, juniors, and seniors, rather than a change in perceived difficulty resulting from experience. These rankings are displayed in Table 9, with the corresponding Spearman Rank Correlation Coefficients given in Table 10.

The high consistency among rankings of difficulty for students classified in the different colleges lends support for an interpretation that perceived difficulty is largely independent of the student's selected field of study or emphasis. Because any one college may, however, offer curricula which vary widely in nature on several dimensions, such as dependence on mathematics, computing, etc., the findings in Table 11 may simply reflect the heterogeneity of those colleges. In addition, the differences which are found may reflect confounding factors such as the proportion of males and females, admission and retention standards, etc. Nevertheless, the Spearman Rho values, which ranged from .85 to .99 (see Table 12), do

Table 9. Ranks of course difficulty, by respondents' year in school, pilot study

COURSE	FR	SOPH	JR	SR
Architectural Drawing	12	10	9	12
Astronomy	23	22	23	23
Biochemistry	2	2	3	3
Biology	19	21	20	20
Calculus	5	3	2	4
Chemistry	4	7	6	7
Child Development	40	39	39	36
Computer Aided Design	9	12	12	14
Computer Operating Systems	16	15	16	19
Crop Production	27	27	22	22
Economics	17	19	21	24
Educational Media	34	34	29	37
Electronics	8	8	7	8
English Composition	20	31	28	35
French	28	20	19	10
General Physics	7	6	5	2
Geology	32	33	34	30
Government	13	26	27	26
Human Anatomy	10	16	18	18
Hydraulics and Pneumatics	3	4	4	5
Journalism	30	30	31	32
Macroeconomics	11	17	17	17
Mass Communications	26	28	32	31
Matrix Algebra	33	14	14	13
Metal Fabrication	15	13	13	16
Music Theory	35	35	37	34
Pascal Programming	24	9	10	11
Plant Science	21	23	25	29
Principles of Teaching	31	38	36	38
Psychology	38	36	35	33
Psychopharmacology	6	5	8	6
Religions of the World	29	25	30	27
Sociology	39	40	40	40
Spanish	22	29	24	21
Speech	36	37	38	39
Structural Linguistics	14	18	15	15
Systems of Logic	25	11	11	9
Textiles and Materials	37	32	33	28
Thermodynamics	1	1	1	1
World History	18	24	26	25

Table 10. Spearman's rho values for course difficulty rankings, by respondents' classification level, pilot study

	Freshmen	Sophomore	Junior	Senior
Freshmen	1.00	.86	.86	.80
Sophomore			.98	.96
Junior				.97
Senior				

demonstrate consistent perceptions of relative course difficulty.

It is interesting to note that courses which would be taken predominantly by students in one particular college were generally perceived to be less difficult by students majoring in that college than by students in the other colleges. For example, students in the College of Design perceived Architectural Drawing and Computer Aided Design to be less difficult than did students enrolled in the other colleges. The same thing can be seen for Agriculture students in how they perceived Crop Production, and for Education students in how they perceived Principles of Teaching.

Table 11. Rankings of course difficulty, by respondents' college of enrollment, pilot study

COURSE	AG	DES	EDUC	FCS	LAS
Architectural Drawing	9	22	13	10	10
Astronomy	33	25	20	23	21
Biochemistry	3	3	2	4	3
Biology	19	12	21	22	22
Calculus	6	2	3	2	2
Chemistry	4	5	6	7	7
Child Development	38	40	36	39	38
Computer Aided Design	12	19	14	12	9
Computer Operating Systems	16	24	16	16	14
Crop Production	34	29	24	21	24
Economics	24	35	23	20	19
Educational Media	36	38	35	30	34
Electronics	10	8	7	8	6
English Composition	20	23	32	32	33
French	8	13	19	18	20
General Physics	2	7	8	5	5
Geology	31	34	34	31	29
Government	27	31	26	26	27
Human Anatomy	21	14	18	13	17
Hydraulics and Pneumatics	7	4	5	3	4
Journalism	23	39	30	34	30
Macroeconomics	18	16	17	17	16
Mass Communications	26	26	31	29	31
Matrix Algebra	17	9	15	15	15
Metal Fabrication	22	18	10	14	13
Music Theory	28	27	37	37	35
Pascal Programming	14	10	9	9	12
Plant Science	29	20	28	24	23
Principles of Teaching	35	28	40	38	37
Psychology	37	30	33	35	36
Psychopharmacology	5	6	4	6	8
Religions of the World	30	32	29	27	28
Sociology	40	37	39	40	40
Spanish	15	15	25	28	25
Speech	32	33	38	36	39
Structural Linguistics	13	11	11	19	18
Systems of Logic	11	17	12	11	11
Textiles and Materials	39	36	27	33	32
Thermodynamics	1	1	1	1	1
World History	25	21	22	25	26

Table 12. Spearman's rho values for course rankings, by respondents' college of enrollment, pilot study

	AG	DES	EDUC	FCS	LAS
Agriculture	1.00	.88	.88	.88	.89
Design			.87	.86	.85
Education				.97	.97
Family and Consumer Sciences					.99
Liberal Arts and Sciences					

Regressions

Forty (40) multiple regression analyses were performed, in which the dependent variable in each case was the difficulty rating for each course. The independent variables included students' rating of their level of interest in such a course, a coding vector of 0 and 1 reflecting having taken or not having taken the course, a code of 0 if male and 1 if female, the student's self-reported undergraduate Grade Point Average, the student's high school class size, dummy variables coded 0 and 1 representing student classifications of freshmen through senior, and dummy variables for the student's college of enrollment.

These analyses were performed by first adjusting the scale value of each subject's responses to remove differences among subjects on their overall scale means. Thus the adjusted difficulty ratings for the 40 courses for each student had a common mean. Between-subject variance, due to tendencies to rate all courses as more difficult or less difficult than the total sample, was removed. Table 13 presents the results of these analyses. While the majority of the analyses resulted in a relatively small proportion of course difficulty being attributable to the independent variables, for several courses (e.g., General Physics and Matrix Algebra) the multiple correlations were moderately large (.245 and .234, respectively). For General Physics, the independent variables with regression coefficients significant at the .05 level were "interest in the course," "having taken the course," and the "high school size." For the Matrix Algebra course, significant predictors were "interest" and "having taken the course."

In the large majority of the regression analyses resulting in squared multiple correlations significant at the .05 level, the "interest in the course" measure was the most frequently significant variable, followed by "having or not having taken the course." A few analyses showed an influence of "high school size," "cumulative GPA," and

Table 13. Results of multiple regression analyses for course difficulty regressed on student characteristics, pilot study (model d.f. = 15)

COURSE	N	R^2	F	PROB>F
Architectural Drawing	311	.143	3.28	.0001*
Astronomy	312	.064	1.35	.1720
Biochemistry	311	.105	2.31	.0040
Biology	311	.098	2.14	.0085
Calculus	310	.127	2.85	.1268
Chemistry	312	.159	3.73	.0001*
Child Development	311	.047	0.97	.4904
Computer Aided Design	312	.148	3.42	.0001*
Computer Operating Systems	311	.131	2.97	.0002*
Crop Production	311	.071	1.49	.1057
Economics	312	.098	2.15	.0082
Educational Media	311	.059	1.22	.2534
Electronics	312	.174	4.15	.0001*
English Composition	312	.176	4.21	.0001*
French	310	.128	2.88	.0003*
General Physics	312	.245	6.40	.0001*
Geology	311	.067	1.41	.1415
Government	312	.156	3.65	.0001*
Human Anatomy	312	.034	0.70	.7861
Hydraulics and Pneumatics	311	.120	2.69	.0007*
Journalism	311	.175	4.16	.0001*
Macroeconomics	312	.143	3.29	.0001*
Mass Communications	310	.052	1.07	.3830
Matrix Algebra	311	.234	6.01	.0001*
Metal Fabrication	311	.085	1.82	.0317
Music Theory	311	.055	1.14	.3182
Pascal Programming	312	.170	4.03	.0001*
Plant Science	312	.035	0.71	.7701
Principles of Teaching	312	.108	2.38	.0029
Psychology	311	.050	1.03	.4227
Psychopharmacology	310	.119	2.64	.0009*
Religions of the World	310	.039	0.80	.6831
Sociology	312	.129	2.91	.0003*
Spanish	312	.195	4.78	.0001*
Speech	311	.157	3.66	.0001*
Structural Linguistics	310	.128	2.87	.0003*
Systems of Logic	310	.079	1.68	.0533
Textiles and Materials	311	.067	1.40	.1438
Thermodynamics	310	.120	2.67	.0008*
World History	311	.178	4.26	.0001*

* significant at a Bonferroni significance level of .00125

"gender," with these latter variables contributing smaller proportions of variance than did those previously mentioned.

Factor and Cluster Analyses

An examination of intercorrelations among the 40 course difficulty ratings, as well as the differences among rating means, might suggest the existence of certain groups or clusters of courses which are rated in a similar manner. Several analytic methods to "tease out" these groups of related courses may be used. For example, a hierarchical cluster analysis might be used to explore the distances among the means of course ratings and group those courses having closer proximity in the multivariate space of the 40 items (or smaller dimensionality based on the roots of the corresponding correlation matrix). Factor analysis, on the other hand, might suggest course groupings based on the correlations of the observed course rating variables with underlying theoretical variables.

Table 14 below presents a maximum likelihood analysis of the correlations among the 40 difficulty ratings. Many of the varimax-rotated factors resulting seem readily interpretable. For example, factor 1 consists of courses

Table 14. Maximum likelihood factor analysis with varimax rotation, for the 40 difficulty ratings. pilot study

FACTOR	COURSE	LOADING
I	Journalism	.578
	Mass Communication	.536
	English Composition	.497
	Speech	.493
	Human Anatomy	.464
	Child Development	.439
	Principles of Teaching	.417
	Structural Linguistics	.339
	Music Theory	.236
II	Computer Aided Design	.685
	Pascal Programming	.596
	Architectural Drawing	.562
	Electronics	.542
	Computer Operating Systems	.499
	Systems of Logic	.447
	Matrix Algebra	.280
	Calculus	.268
III	Thermodynamics	.763
	Biochemistry	.713
	Psychopharmacology	.515
	Hydraulics and Pneumatics	.399
IV	Crop Production	.618
	Educational Media	.589
	Astronomy	.480
	Religions of World	.405
V	Government	.670
	Economics	.643
	World History	.585
	Macroeconomics	.462
VI	Biology	.773
	Chemistry	.503
	Physics	.365
	Geology	.296
VII	Textiles and Materials	.698
	Metal Fabrication	.444
	Plant Science	.294
VIII	Sociology	.781
	Psychology	.668
IX	French	.644
	Spanish	.620

with a strong language facility factor. Factor 2 appears to be a computer factor. Factor 3, at first encounter, seems somewhat more difficult to interpret. Factor 3 might be labeled as an "esoteric" factor perhaps reflecting courses perceived to contain more abstractness and difficulty of content.

Factor 4 is the most difficult to label. What is in common among Crop Production, Educational Media, and Astronomy? A closer examination of these three courses revealed that they were listed sequentially toward the end of the survey instrument. It appears possible that the similar loadings on this factor might be due to a problem of response set bias on the part of students. As they neared the end of the instrument, perhaps encountering courses that didn't trigger any strong impressions, students may have responded in a similar way to these three courses.

Factors 5, 6, 8 and 9 have somewhat good "face validity," in that courses are grouped together that represent "economics and government," the "physical world," "personal and interpersonal relations," and "foreign languages." Factor 7 perhaps represents courses with greater "psychomotor" skill acquisition.

These factor analysis results performed on a sample of only 384 subjects are, of course, only exploratory. The method used and the number of factors selected, as well as the rotation method utilized, can result in quite varied suggestions of underlying structure across courses. To illustrate, Table 15 is a Principal Components analysis for the same data. Squared multiple correlations of each course with the remaining courses were used as prior estimates. Varimax rotations were performed on 9 factors with corresponding eigenvalues greater than 1.0. Again we have somewhat interpretable results with factor 1 combining the aspects of the previous factors 1 and 8, factor 2 remaining about the same as before, with the exceptions of Calculus and Metal Fabrication, factor 3 largely combining the previous factors 4 and 7 into what may be characterized as a "performance"-related factor, factor 4 approximating the previous factors 3 and 6, and factor 5 adding Geology to its previous content.

A variety of criteria are available for determining which among a number of objects are most similar. In a cluster analysis of the 40 courses, one can attempt to produce groups in which the within-group variance is minimized and the among-group variance is maximized, in a manner analogous to multivariate analysis of variance, in

Table 15. Principal components analysis of the course difficulty ratings, pilot study

FACTOR	COURSE	LOADING
I	Psychology	.608
	Sociology	.593
	Speech	.564
	Journalism	.527
	Principles of Teaching	.516
	Spanish	.483
	English Composition	.478
	Religions of the World	.389
	Human Anatomy	.375
	French	.360
	Music Theory	.321
II	Pascal Programming	.627
	Computer Aided Design	.613
	Architectural Drawing	.597
	Electronics	.542
	Computer Operating Systems	.540
	Systems of Logic	.491
	Metal Fabrication	.402
	Astronomy	.368
	Matrix Algebra	.298
III	Textiles and Materials	.617
	Structural Linguistics	.484
	Child Development	.481
	Crop Production	.474
	Mass Communication	.456
	Educational Media	.444
	Plant Science	.327
IV	Biochemistry	.643
	Thermodynamics	.574
	Chemistry	.544
	General Physics	.494
	Biology	.489
	Calculus	.423
	Psychopharmacology	.419
V	Economics	.630
	Government	.601
	World History	.494
	Macroeconomics	.459
	Geology	.278

which the within- and between-group variance components provide a test of significance. Ward's minimum-variance method was used to obtain a 5-cluster solution, which might be compared with the previous 5-factor solution obtained by factor analysis. Table 16 presents the results of this clustering, along with a Roman numeral indicating the common factor of highest loading from the previous factor analysis. Factors 2, 4, and 5 remained fairly well intact in clusters 4, 1, and 2, respectively, although cluster 2 added most of factor 3 and part of factor 1 as well. The rest of factor 1 was somewhat evenly split between clusters 3 and 5.

The Average Linkage clustering method was also used to obtain a 9-cluster solution for comparison with the previously obtained 9-factor solution using factor analysis. These results are displayed in Table 17. Here, clusters 2, 6, and 7 are identical in composition to factors 5, 4, and 9, respectively, and cluster 5 contains primarily those courses which loaded on factor 2. Clusters 3 and 4 combine factor 8 with most of factor 1, but not in the same combinations. Cluster 1 contains all of factor 3 plus half of the courses in factor 6, cluster 8 contains the rest of factor 6 and most of factor 7, and Cluster 9 contains the remaining courses from factors 1 and 2.

Table 16. Course classification obtained using cluster analysis with five clusters and principal components analysis with five factors, pilot study

CLUSTER	COURSE	FACTOR
1	Biochemistry	IV
	Thermodynamics	IV
	Psychopharmacology	IV
	Calculus	IV
	General Physics	IV
	Hydraulics and Pneumatics	II
	Chemistry	IV
2	World History	V
	Government	V
	Economics	V
	Macroeconomics	V
	Journalism	I
	Mass Communications	III
	Crop Production	III
	Educational Media	III
	Astronomy	II
	Religions of the World	I
	Biology	IV
	Plant Science	III
	Geology	V
	English Composition	I
	Textiles and Materials	III
3	Sociology	I
	Psychology	I
	Principles of Teaching	I
	Child Development	III
	Speech	I
	Music Theory	I
4	Computer Operating Systems	II
	Architectural Drawing	II
	Pascal Programming	II
	Electronics	II
	Computer Aided Design	II
	Metal Fabrication	II
	Systems of Logic	II
5	Spanish	I
	French	I
	Structural Linguistics	III
	Human Anatomy	I
	Matrix Algebra	II

Table 17. Course classification obtained using cluster analysis with nine clusters and maximum likelihood factor analysis with nine factors, pilot study

CLUSTER	COURSE	FACTOR
1	Biochemistry	III
	Thermodynamics	III
	Psychopharmacology	III
	Calculus	II
	General Physics	VI
	Hydraulics and Pneumatics	III
	Chemistry	VI
2	World History	V
	Government	V
	Economics	V
	Macroeconomics	V
3	Sociology	VIII
	Psychology	VIII
	Principles of Teaching	I
	Child Development	I
	Speech	I
	Music Theory	I
4	Journalism	I
	Mass Communications	I
	English Composition	I
5	Computer Operating Systems	II
	Architectural Drawing	II
	Pascal Programming	II
	Electronics	II
	Computer Aided Design	II
	Metal Fabrication	VII
	Systems of Logic	II
6	Crop Production	IV
	Educational Media	IV
	Astronomy	IV
	Religions of the World	IV
7	Spanish	IX
	French	IX
8	Biology	VI
	Plant Science	VII
	Geology	VI
	Textiles and Materials	VII
9	Structural Linguistics	I
	Human Anatomy	I
	Matrix Algebra	II

Although these factor and cluster solutions did not produce identical groupings, there were enough similarities to conclude that the perceived difficulty levels of courses do appear to be related to each other in terms of content, and that these similarities have a structure which is clearly identifiable.

CHAPTER V: MAIN STUDY RESULTS

The results of the analyses performed in the main study can be divided into three primary areas. First, there are the results of descriptive analyses of the data collected in phase one. These data were the students' responses on the survey instrument, and therefore the analyses performed were very similar to those done in the pilot study which were reported in the preceding chapter. Secondly, there are the results of the analyses done on the data obtained from the university's offices (phases two and three of the collection process). These are also primarily descriptive in nature. Finally, the composite estimates of difficulty level for each of the fifty courses in the sample are reported, and these results are used in an attempt to improve the prediction of academic achievement.

Analyses of Students' Perceptions

Means, ranks, and correlations of perceived difficulty

Means and standard deviations of the difficulty perceptions were calculated for each of the fifty (50) courses included on the survey instrument. These courses were listed in Table 2, page 37. As was done with the pilot study data, the mean difficulty estimates were compared and the courses ranked in order from most difficult to least difficult. Courses perceived as the most difficult, with their means given in parentheses, were Calculus (7.55), Chemistry (7.30), General Physics (7.27) and Biochemistry (7.25). These four courses were also perceived as the most difficult on the pilot study (if those courses which were omitted from the main study are excluded from the comparison), but not in the same order. In the pilot study, Biochemistry had a mean of 7.48, Calculus, 7.47, General Physics, 7.16, and Chemistry, 6.98. Courses perceived as the least difficult and their means were Child Development (4.24), Family Environment (4.02), Home Economics (3.69), and Leisure and Recreation (2.93). Of these, only Child Development was included on the pilot study, and it ranked 39th out of 40 courses with a mean of 4.21. Further comparisons between the two sets of data, the pilot study data and the main study data, will be presented later in this chapter, where the common core of thirty (30) courses are compared. The complete ranking of the 50 courses, along with their means, standard deviations, and the number of students who responded about each course are shown in Table 18.

In general, it is again the case that most of the courses which have a strong mathematical or technical basis

Table 18. Overall means and standard deviations of perceived course difficulty, with courses ranked from most to least difficult

RANK	COURSE	N	MEAN	STD DEV
01	Calculus	587	7.55	1.61
02	Chemistry	595	7.30	1.58
03	General Physics	586	7.27	1.62
04	Biochemistry	581	7.25	1.65
05	Electronics	582	6.87	1.60
06	Engineering Graphics	580	6.87	1.64
07	Computer Programming	591	6.64	1.62
08	Architecture	579	6.36	1.76
09	Statistics	586	6.33	1.88
10	French	580	6.32	1.84
11	Accounting	581	6.28	1.79
12	Human Anatomy	587	6.19	1.75
13	Spanish	577	6.18	1.83
14	Biology	585	6.13	1.65
15	Materials Science	580	6.09	1.61
16	History	590	5.93	1.69
17	English Composition	599	5.88	1.68
18	Botany	580	5.79	1.77
19	Economics	587	5.72	1.79
20	Metal Fabrication	578	5.61	1.77
21	Entomology	572	5.54	1.77
22	Literature	582	5.53	1.66
23	Philosophy	581	5.46	1.83
24	Astronomy	583	5.45	1.75
25	Anthropology	576	5.41	1.52
26	American Government	590	5.31	1.62
27	Crop Production	574	5.25	1.74
28	Journalism	576	5.22	1.62
29	College Algebra	596	5.22	2.34
30	Educational Computing	577	5.16	1.66
31	Geology	580	5.16	1.65
32	Drawing	582	5.08	2.11
33	Psychology	596	5.06	1.83
34	Community and Regional Planning	574	4.98	1.61
35	Speech	589	4.96	1.78
36	Art History	584	4.86	1.91
37	Geography	583	4.72	1.66
38	Food Science	578	4.72	1.68
39	Forestry	580	4.72	1.66
40	Sociology	593	4.68	1.70

Table 18 (continued).

RANK	COURSE	N	MEAN	STD DEV
41	Human Nutrition	585	4.64	1.72
42	Mass Communications	576	4.62	1.58
43	Hotel, Restaurant, and Institution Management	575	4.60	1.69
44	World Religions	576	4.57	1.79
45	Music Theory	582	4.51	2.01
46	Textiles and Materials	577	4.46	1.69
47	Child Development	585	4.24	1.71
48	Family Environment	579	4.02	1.65
49	Home Economics	581	3.69	1.76
50	Leisure and Recreation	582	2.93	1.57

are ranked among the top ten or fifteen courses, while those courses whose contents are more closely associated with the arts, humanities, and consumer sciences are more prevalent in the lower half of the rankings. This is clearly consistent with the pilot study results in that students tend to view courses from the hard sciences and mathematics as more difficult than those from the other disciplines.

It could also be noted that most of the courses in the top half of the list come from disciplines which are traditionally thought of as being "male-dominated", while the courses from the "female-dominated" disciplines are ranked lower. It would be inappropriate to infer from this that any gender-based differences are inherently a part of the nature of these courses. Rather, these differences in rankings are more likely to be a reflection of our society's general perceptions of which occupations and fields of study are more suitable to males and females, respectively. It should also not be inferred that these general societal perceptions are substantiated by these data, or that they are even correct. It can be noted, however, that there very likely is a relationship between those courses thought of as "mathematically-based" and those coming from the "male-dominated" disciplines.

It is also interesting to note that most of the courses had standard deviations which were relatively close to each other in magnitude (generally between 1.60 and 1.90). The most notable exception to this pattern, however, was College Algebra, with a standard deviation of 2.34, almost half as large as its mean. With a mean value of 5.22 and ranking 29th, College Algebra appears to be about a medium-level course in terms of perceived difficulty. However, when this large amount of variation is also considered, it leads to a somewhat different interpretation.

When all responses are considered together, it appears to be average in perceived difficulty. What may actually be the case, however, is that there are two decidedly different populations of students whose perceptions have been obtained. One population consists of students with relatively strong mathematical backgrounds and either a liking of or propensity for learning mathematics. These students primarily view College Algebra as a relatively easy course and rate it between 2 and 6 on the nine-point scale. The other population consists of students who dislike mathematics intensely, or suffer from math anxiety to a larger degree, and subsequently view College Algebra in virtually the same way as any other math course, as very difficult, and consequently rate it between 5 and 9 on the same scale. The result would be an average rating between 5 and 5.5, but the standard deviation would be considerably larger than for a course uniformly perceived as medium-level in difficulty by all the students responding. This same phenomenon may also be manifested in the other courses with somewhat larger amounts of variability, namely, Drawing and Music Theory, where students perceive the course principally as "either you can do it or you can't," with the two schools of thought being fairly evenly represented among the students who were surveyed.

One of the basic questions that needs to be addressed is whether the experience of taking a course alters one's perceptions of the difficulty level of that course. Very few differences were found in the pilot study when the rankings by those students having taken the courses were compared to the rankings by those students who had not taken the courses. In the main study, however, while there is still a fairly strong agreement between the two different rankings for many of the courses, there are some very marked differences as well. The complete listing of all fifty courses, together with their means, ranks, and number of students responding for those having taken the courses, is given in Table 19, while the corresponding values for those students not having taken the courses are displayed in Table 20.

One of the larger differences was found in the respective ratings of Engineering Graphics. While ranked 5th by those not having taken the course, it was ranked 22nd by those students who had taken it. The mean values were also very different between these groups, with a value of 7.11 for those not having taken it and a mean of 5.80 for those who had. The value of the test statistic, using separate estimates of the respective variances, for testing the null hypothesis that there was no difference between

Table 19. Estimates of course difficulty from students having taken the course

RANK	COURSE	N	MEAN
01	Biochemistry	42	7.98
02	Calculus	279	7.23
03	Chemistry	290	7.14
04	General Physics	192	7.07
05	Accounting	223	6.86
06	Electronics	64	6.77
07	Architecture	44	6.75
08	Computer Programming	278	6.53
09	Materials Science	70	6.29
10	Biology	318	6.17
11	Food Science	43	6.09
12	Community and Regional Planning	22	6.09
13	Human Anatomy	119	6.07
14	Spanish	90	6.03
15	Statistics	284	6.03
16	Botany	88	5.90
17	Forestry	27	5.89
18	Entomology	23	5.87
19	English Composition	540	5.83
20	Educational Computing	82	5.83
21	History	349	5.82
22	Engineering Graphics	107	5.80
23	Hotel, Restaurant, and Institution Management	29	5.79
24	Crop Production	57	5.79
25	French	59	5.73
26	Human Nutrition	94	5.65
27	Economics	391	5.63
28	Literature	141	5.57
29	Philosophy	185	5.52
30	Astronomy	69	5.52
31	Art History	111	5.51
32	Geology	92	5.41
33	College Algebra	366	5.39
34	Metal Fabrication	36	5.39
35	Drawing	114	5.39
36	American Government	204	5.24
37	Textiles and Materials	31	5.03
38	Journalism	64	5.00
39	Psychology	408	4.98
40	Anthropology	69	4.97

Table 19 (continued).

RANK	COURSE	N	MEAN
41	Geography	73	4.92
42	Music Theory	56	4.71
43	Speech	270	4.71
44	Sociology	383	4.71
45	World Religions	63	4.70
46	Home Economics	62	4.58
47	Child Development	136	4.46
48	Family Environment	82	4.41
49	Mass Communications	50	4.24
50	Leisure and Recreation	61	3.49

the mean for those students who took Engineering Graphics and the mean for those who had not was 7.62. This value is clearly statistically significant. Similarly, French, Speech, and Anthropology all showed large differences in rankings between these two groups with similar test statistic values of 2.37, 3.08, and 2.38, respectively. Each of these values is also significant at the .05 level. Metal Fabrication, Journalism, and Psychology also had large differences between their respective ranks, although none of these courses had mean differences which were statistically significant at the .05 level.

Some even larger differences in ranks occurred in the opposite direction, i.e., for those courses in which the

Table 20. Estimates of course difficulty from students not having taken the course

RANK	COURSE	N	MEAN
01	Calculus	306	7.84
02	Chemistry	304	7.45
03	General Physics	390	7.37
04	Biochemistry	534	7.19
05	Engineering Graphics	469	7.11
06	Electronics	515	6.89
07	Computer Programming	310	6.75
08	Statistics	300	6.61
09	French	517	6.39
10	Architecture	530	6.32
11	English Composition	57	6.30
12	Human Anatomy	465	6.22
13	Spanish	484	6.20
14	History	237	6.08
15	Biology	265	6.08
16	Materials Science	505	6.08
17	Accounting	357	5.91
18	Economics	195	5.88
19	Botany	489	5.78
20	Metal Fabrication	538	5.63
21	Entomology	544	5.52
22	Literature	437	5.51
23	Anthropology	504	5.47
24	Astronomy	511	5.44
25	Philosophy	392	5.43
26	American Government	381	5.34
27	Journalism	508	5.25
28	Psychology	184	5.22
29	Crop Production	510	5.20
30	Speech	318	5.16
31	Geology	485	5.11
32	Educational Computing	490	5.04
33	Drawing	463	5.00
34	College Algebra	228	4.93
35	Community and Regional Planning	546	4.92
36	Art History	470	4.70
37	Geography	507	4.68
38	Forestry	551	4.66
39	Mass Communications	524	4.65
40	Food Science	532	4.60
41	Sociology	207	4.59

Table 20 (continued).

RANK	COURSE	N	MEAN
42	World Religions	511	4.56
43	Hotel, Restaurant, and Institution Management	542	4.53
44	Music Theory	523	4.50
45	Human Nutrition	489	4.45
46	Textiles and Materials	542	4.42
47	Child Development	446	4.16
48	Family Environment	495	3.95
49	Home Economics	517	3.57
50	Leisure and Recreation	517	2.86

students who had taken the course thought it to be more difficult than did those students who had not taken it. Food Science, ranked 40th with a mean of 4.60, by those students not taking it, was ranked 11th, with a mean of 6.09, by those students who took it. Community and Regional Planning, ranked 35th and 12th respectively; Forestry, with ranks of 38th and 17th; Hotel, Restaurant, and Institution Management, ranked 43rd and 23rd; and Human Nutrition, with ranks of 45th and 26th; also showed considerable differences between the two groups in their relative position among the courses. Each of these courses had a mean difference greater than 1.00 as well, with the higher value corresponding to the group of students which had taken the course. However, these mean differences may not be as great as they at first appear. Among those courses which are ranked similarly by both groups, most have higher mean values in the data from students who had taken the course than in the data from those who had not. The exception to this is in the higher-ranked courses, those with ranks in the top fifteen or so, where the mean values are generally higher for students who had not taken the course.

The Spearman rank correlation coefficient, rho, between the respective ranks of these two groups was .75, ten percentage points lower than for a similar comparison in the pilot study. The p-value for testing the null hypothesis that there is no difference between these two correlation coefficients is .0985, indicating that the experience of having taken a course had a similar effect on the perceived difficulty levels of the sample of 50 courses in the main study as it had on the sample of 40 courses in the pilot study. But what is that effect, or is there no effect at all? To restate what was said in Chapter Four, a longitudinal study of perceived difficulty is necessary to answer this question. From these data, however, it appears that, in general, after taking a course, the more difficult courses seem less difficult and the less difficult courses seem more difficult. Perhaps all courses which are perceived to be on one extreme of the difficulty index or the other are actually closer to the middle, i.e., some average difficulty value, than they are perceived to be. That is, on the average, Calculus might not be as difficult as it is perceived to be, nor Leisure and Recreation as easy as it sounds.

As was done with the pilot study data, separate estimates of course difficulty were calculated for males and for females, and the respective means were ranked from highest to lowest. The Spearman rho value of .96 is an indication that there are few differences between the perceptions of course difficulty for females and those for males. As with the pilot data, some of the largest differences occurred in language-related areas, where males perceived such courses as Spanish (difference of 9), Literature (difference of 8), and Speech (difference of 7) to be more difficult than did the females. This is consistent with the pilot study findings, although the differences did not occur on the same set of language-related courses. Nevertheless, females appear to be more confident in these courses dealing with language, and therefore perceive them as less difficult. Males, on the other hand, perceived such courses as Drawing (difference of 9), and College Algebra (difference of 7), to be less difficult than did the females. It is unlikely that this could be evidence of a greater propensity among males for art and mathematics, but the result might be an indication of greater confidence among males in dealing with abstraction. These rankings, for both males and females, are given in Table 21.

Means for each course were also calculated for respondents classified according to year in school and college of enrollment. These means, for each level of these variables, were ranked from highest to lowest, and Spearman rho values were calculated. The pairwise correlations among the student classification levels ranged from .93, between freshmen and seniors, to .98, between juniors and seniors. As these values indicate, there is strong agreement among students classified by year in school. In a few courses, however, at least one pairwise difference exceeded ten (10) in magnitude. In some of these courses (Accounting, Drawing, Metal Fabrication, and Sociology), the freshmen's perceptions were substantially different from those of the respondents in the upper classes, indicating that the perceptions of freshmen are somewhat different from those of the rest of the student body. Mass Communications and Psychology showed gradual decreases in rank as classification level increased, which

Table 21. Ranks of course difficulty, by gender of respondent

COURSE	MALE	FEMALE
Accounting	15	9
Crop Production	26	31
Anthropology	24	25
Architecture	12	8
Drawing	35	26
Art History	37	34
Astronomy	25	21
Biochemistry	4	1
Biology	11	15
Botany	16	23
Child Development	47	47
Chemistry	2	4
Computer Programming	6	7
Community and Regional Planning	34	36
Economics	20	16
English Composition	17	19
Literature	19	27
Entomology	22	20
Home Economics	49	49
Family Environment	48	48
Human Nutrition	45	38
Forestry	36	43
Engineering Graphics	7	5
French	9	11
Food Science	41	35
Geography	40	37
Geology	29	32
History	18	13
Hotel, Restaurant, and Institution Management	44	40
Metal Fabrication	21	18
Electronics	5	6
Mass Communications	39	42
Journalism	28	30
Leisure and Recreation	50	50
College Algebra	31	24
Calculus	1	2
Materials Science	14	14
Music Theory	43	45
Philosophy	23	22
General Physics	3	3
American Government	27	28

Table 21 (continued).

COURSE	MALE	FEMALE
Psychology	33	33
World Religions	42	41
Educational Computing	30	29
Sociology	38	44
Spanish	8	17
Speech	32	39
Statistics	10	10
Textiles and Materials	46	46
Human Anatomy	13	12

might be an indication that perceptions gradually change over time as the students are exposed to more and more courses with a variety of contents, and, presumably, of difficulty levels as well. Music Theory differed only in how sophomores perceived it, for which no apparent reason is forthcoming. College Algebra showed the largest variation, with freshmen and juniors perceiving it at about the same level, while sophomores saw it as considerably less difficult (average difference of 7.5) and seniors as considerably more difficult (average difference of 8.5). However, this could be viewed as a combination of two trends which were identified earlier; first, that freshmen perceive this course somewhat differently than everyone else, and, second, that as students progress through their respective curricula, their perceptions change. The farther along they advance the more likely they are to take courses within their specific areas of interest.

These courses, because of that increased level of interest, seem to be less difficult; thus, those courses which were earlier thought of as "less difficult" are now considered more difficult by comparison. However, changes in difficulty ratings might reflect actual differences in the strata populations of students according to different classification levels, rather than changes in the students' perceptions. These rankings are given in Table 22, with the corresponding Spearman rho values in Table 23.

The high consistency among students' rankings of course difficulty levels for students classified by college of enrollment that was shown earlier for the pilot study is reinforced by similar values shown here calculated from the main study data. It was conjectured in Chapter Four that this result might indicate that perceived difficulty is fairly independent of the selected field of study or emphasis by the student. It was noted, however, that these similarities may be due to the relative heterogeneity of the colleges, since within any one college a variety of curricula would be offered which conceivably could vary widely in nature on several dimensions. Nevertheless,

Table 22. Ranks of course difficulty, by respondents' year in school

COURSE	FR	SOPH	JR	SR
Accounting	18	12	8	10
Crop Production	30	26	30	24
Anthropology	24	22	26	26
Architecture	13	10	9	8
Drawing	42	32	27	28
Art History	37	40	36	33
Astronomy	23	24	24	22
Biochemistry	4	4	2	4
Biology	10	14	14	14
Botany	15	19	19	18
Child Development	44	47	47	47
Chemistry	2	2	3	3
Computer Programming	8	7	7	7
Community and Regional Planning	39	34	31	34
Economics	16	17	20	21
English Composition	12	18	17	17
Literature	20	20	23	23
Entomology	22	23	21	25
Home Economics	49	49	49	49
Family Environment	48	48	48	48
Human Nutrition	46	45	38	40
Forestry	40	38	39	36
Engineering Graphics	5	5	6	6
French	11	9	10	11
Food Science	43	42	37	35
Geography	35	41	41	38
Geology	29	30	28	32
History	17	16	16	16
Hotel, Restaurant, and Institution Management	41	44	40	42
Metal Fabrication	34	21	18	19
Electronics	6	6	5	5
Mass Communications	36	39	44	46
Journalism	27	27	32	31
Leisure and Recreation	50	50	50	50
College Algebra	28	36	29	20
Calculus	1	1	1	1
Materials Science	19	15	13	12
Music Theory	47	35	45	45
Philosophy	21	25	22	27
General Physics	3	3	4	2

Table 22 (continued).

COURSE	FR	SOPH	JR	SR
American Government	25	28	25	30
Psychology	26	31	34	37
World Religions	45	37	43	41
Educational Computing	31	29	33	29
Sociology	33	43	42	44
Spanish	7	13	15	15
Speech	32	33	35	39
Statistics	9	8	12	9
Textiles and Materials	38	46	46	43
Human Anatomy	14	11	11	13

these Spearman rho values, ranging from .82 (between the College of Design and the College of Family and Consumer Sciences) to .97 (between the College of Liberal Arts and Sciences and the College of Business Administration) demonstrate the consistency of the relative difficulty perceptions. These rankings are displayed in Table 24, and the corresponding Spearman rho values are presented in Table 25.

There is one pronounced difference between these rankings by college and those done previously in the pilot study. In the earlier study it was found that courses which would be taken primarily by the students in one particular college, for example, Crop Production by the

Table 23. Spearman's rho values for course difficulty rankings, by respondents' classification level

	FRESHMEN	SOPHOMORE	JUNIOR	SENIOR
Freshmen	1.00	.95	.94	.93
Sophomore			.97	.96
Junior				.98
Senior				

Agriculture students, were perceived to be less difficult by them than by the students in the other colleges. This trend largely was reversed in the main study, where those students in the College of Agriculture perceived courses such as Crop Production and Botany to be more difficult than did students in the other colleges. This was also the case for Business Administration students' perceptions of Accounting, Design students' perceptions of Architecture, Drawing, Art History, and Community and Regional Planning, and Family and Consumer Science students' perceptions of Human Nutrition, Food Science, and Hotel, Restaurant, and Institution Management. This is at least somewhat counter-intuitive, in that the general perception is that students would perceive courses within their own disciplines, those in which they would presumably have a higher level of interest, to be less difficult than courses from other departments and/or colleges. This was borne out with

Table 24. Rankings of course difficulty, by respondents' college of enrollment

COURSE	AG	BUS	DES	ED	ENG	FCS	LAS
Accounting	14	5	20	10	20	7	9
Crop Production	21	31	30	29	31	36	28
Anthropology	26	25	27	25	22	32	25
Architecture	17	10	7	9	11	11	8
Drawing	46	26	25	24	29	28	32
Art History	42	40	14	38	34	38	31
Astronomy	28	27	29	22	18	23	24
Biochemistry	3	4	4	3	4	5	2
Biology	7	16	13	12	16	21	12
Botany	12	23	17	16	17	30	21
Child Development	45	47	42	44	46	49	47
Chemistry	2	2	3	2	6	4	5
Computer Programming	10	8	8	5	7	8	7
Community and Regional Planning	37	30	26	40	33	41	33
Economics	22	14	21	18	26	12	19
English Composition	13	18	18	17	14	15	20
Literature	24	20	22	21	21	27	23
Entomology	18	21	28	27	30	25	18
Home Economics	49	49	49	49	49	48	49
Family Environment	47	48	48	48	48	47	48
Human Nutrition	39	42	46	42	41	24	45
Forestry	32	36	43	45	38	45	39
Engineering Graphics	6	6	12	7	10	3	3
French	9	12	6	13	12	9	11
Food Science	41	39	47	35	45	18	36
Geography	36	41	39	41	37	39	44
Geology	29	24	44	34	24	37	30
History	16	15	9	19	19	13	16
Hotel, Restaurant, and Institution Management	43	34	45	43	44	34	43
Metal Fabrication	31	19	33	26	15	17	17
Electronics	8	7	5	6	3	6	6
Mass Communications	38	44	40	37	39	42	40
Journalism	30	28	31	32	23	35	27
Leisure and Recreation	50	50	50	50	50	50	50
College Algebra	20	37	23	20	35	19	38
Calculus	1	1	1	1	1	1	1
Materials Science	19	13	15	15	5	14	14
Music Theory	48	43	34	47	36	46	35
Philosophy	25	22	19	23	27	26	22
General Physics	4	3	2	4	2	2	4

Table 24 (continued).

COURSE	AG	BUS	DES	ED	ENG	FCS	LAS
American Government	27	29	24	28	28	22	29
Psychology	23	33	35	31	40	31	34
World Religions	44	35	38	39	47	44	41
Educational Computing	33	32	32	30	32	29	26
Sociology	34	45	37	36	43	40	46
Spanish	5	17	10	14	13	16	15
Speech	35	38	36	33	25	33	37
Statistics	11	9	11	8	9	10	13
Textiles and Materials	40	46	41	46	42	43	42
Human Anatomy	15	11	16	11	8	20	10

Engineering students' perceptions of Engineering Graphics, in that they perceived it to be less difficult than did students from the other colleges (with the exception of the College of Design), but this was the exception rather than the norm.

Means, ranks, and correlations of perceived amount of work

Means and standard deviations for the perceived amount of work were calculated for each of the fifty (50) courses as well. These mean values were ranked in order from largest to smallest, and the results are displayed in Table 26. A comparison of these rankings with the rankings of perceived difficulty (as given in Table 18), reveals a very high consistency between these two indices of students'

Table 25. Spearman's rho values for course rankings, by respondents' college of enrollment

	AG	BUS	DES	EDUC	ENGR	FCS	LAS
Agriculture	1.00	.89	.86	.93	.88	.85	.90
Business Administration			.88	.94	.93	.90	.97
Design				.91	.89	.82	.91
Education					.92	.92	.94
Engineering						.84	.94
Family and Consumer Sciences							.89
Liberal Arts and Sciences							

perceptions. It would appear that most students perceive courses which require a larger amount of work also to be more difficult, in essence equating amount of work with level of difficulty. The most notable exception to this is Drawing, which was ranked 32nd in perceived difficulty but was ranked 14th in perceived amount of work. This would seem to indicate that in certain instances students are able to separate these two concepts and perceive the difficulty of the content at one level and the amount of work at another. That is, the work was not hard, but there was a lot of it. This was also true for Speech (difference of 10) and Journalism (difference of 7), but to a much smaller degree than with Drawing.

Table 26. Overall means and standard deviations of perceived amount of work, with courses ranked in descending order

RANK	COURSE	N	MEAN	STD DEV
01	Calculus	584	7.61	1.50
02	Chemistry	592	7.38	1.53
03	General Physics	584	7.24	1.62
04	Architecture	572	7.20	1.63
05	Biochemistry	577	7.18	1.65
06	Engineering Graphics	575	7.16	1.57
07	Computer Programming	588	7.14	1.55
08	Statistics	581	6.79	1.73
09	Electronics	577	6.77	1.65
10	Accounting	575	6.69	1.82
11	English Composition	596	6.64	1.59
12	French	572	6.52	1.83
13	Spanish	573	6.39	1.77
14	Drawing	577	6.29	2.10
15	Human Anatomy	584	6.21	1.82
16	Materials Science	575	6.17	1.62
17	Literature	579	6.12	1.73
18	Biology	583	6.00	1.68
19	History	585	5.97	1.61
20	Metal Fabrication	572	5.90	1.68
21	Journalism	573	5.88	1.70
22	Botany	577	5.88	1.68
23	Economics	581	5.74	1.83
24	College Algebra	591	5.69	2.14
25	Speech	584	5.62	1.75
26	Entomology	571	5.56	1.79
27	Crop Production	565	5.51	1.75
28	Educational Computing	574	5.45	1.73
29	Astronomy	578	5.45	1.68
30	Anthropology	573	5.42	1.59
31	Philosophy	578	5.40	1.86
32	American Government	584	5.39	1.66
33	Community and Regional Planning	571	5.30	1.71
34	Geology	577	5.22	1.65
35	Psychology	593	5.01	1.86
36	Geography	577	4.97	1.64
37	Art History	577	4.92	1.91
38	Forestry	578	4.91	1.65
39	Hotel, Restaurant, and Institution Management	568	4.88	1.81

Table 26 (continued).

RANK	COURSE	N	MEAN	STD DEV
40	Textiles and Materials	573	4.88	1.80
41	Mass Communications	572	4.87	1.71
42	Food Science	573	4.81	1.74
43	Sociology	586	4.75	1.71
44	Human Nutrition	581	4.75	1.78
45	World Religions	573	4.58	1.81
46	Child Development	581	4.54	1.85
47	Music Theory	578	4.53	1.96
48	Family Environment	575	4.28	1.80
49	Home Economics	574	4.11	1.84
50	Leisure and Recreation	580	3.40	1.72

A few differences in the opposite direction can also be seen, with Philosophy (difference of 8) being the largest. This difference disappears almost completely, however, when the means for the two indices are compared. The average value of 5.46 for perceived difficulty is virtually the same as the mean of 5.40 for perceived amount of work. This is also true for American Government (difference of 6), where the means are 5.31 and 5.39 for perceived difficulty and perceived amount of work, respectively. Overall it appears that most students perceived the difficulty level of a course to be closely related to, if not the same as, the perceived amount of work. The Pearson product-moment correlation coefficient was calculated for these two samples of means. The obtained value of .96 is further indication that for these students, on this sample of courses, the perceived difficulty scale and the perceived amount of work scale were largely measuring the same construct.

Additional analyses on the perceived amount of work were performed that were identical to many of the analyses which had already been done on the perceived difficulty data. That is, means were calculated for students who had taken the courses and also for those students who had not taken them. These respective means were ranked; a Spearman rho value of .84 was calculated on the ranks. This again points to the consistency with which students perceive courses regardless of whether or not they have actually taken them. The ranked means for each of the courses for those students who took them are given in Table 27, along with the number of students who responded for each course. Similar values for those students who had not taken the courses are presented in Table 28.

For most of the courses the differences between the respective ranks is 10 or less. Of those with larger differences, Forestry (difference of 21) and Textiles and Materials (difference of 17) were the largest. However, for both of these courses, the number of students who had

Table 27. Estimates of perceived amount of work from students having taken the course

RANK	COURSE	N	MEAN
01	Architecture	42	7.86
02	Biochemistry	42	7.55
03	Calculus	277	7.41
04	Accounting	220	7.25
05	Chemistry	286	7.24
06	Computer Programming	277	7.21
07	Drawing	113	7.19
08	General Physics	193	7.11
09	Electronics	64	6.97
10	Engineering Graphics	107	6.88
11	Statistics	280	6.66
12	English Composition	538	6.63
13	Spanish	90	6.58
14	Materials Science	70	6.53
15	French	59	6.46
16	Entomology	22	6.41
17	Forestry	27	6.41
18	Metal Fabrication	37	6.38
19	Crop Production	56	6.34
20	Literature	139	6.29
21	Community and Regional Planning	21	6.24
22	Educational Computing	82	6.16
23	Textiles and Materials	32	6.00
24	Human Anatomy	119	5.99
25	Botany	88	5.99
26	Hotel, Restaurant, and Institution Management	29	5.97
27	Biology	317	5.93
28	History	349	5.93
29	College Algebra	363	5.81
30	Journalism	64	5.73
31	Food Science	43	5.70
32	Art History	110	5.67
33	Economics	387	5.58
34	Speech	268	5.56
35	Astronomy	68	5.51
36	Human Nutrition	93	5.49
37	Philosophy	180	5.44
38	American Government	203	5.42
39	Geology	92	5.35
40	Anthropology	69	5.10

Table 27 (continued).

RANK	COURSE	N	MEAN
41	Geography	71	5.10
42	Child Development	135	5.05
43	Home Economics	62	4.95
44	Psychology	406	4.90
45	Family Environment	82	4.90
46	Sociology	380	4.76
47	Music Theory	56	4.75
48	World Religions	64	4.69
49	Mass Communications	50	4.64
50	Leisure and Recreation	61	4.59

actually taken the course was rather small, 27 and 32 respectively, so the large differences may just be a reflection of the disproportionate sample sizes between the two groups. The only course with a difference larger than 10 and with sample sizes which were roughly comparable was Economics, with a difference of fourteen (14). The value of the t-statistic, using separate estimates of the variances for the two distributions, for testing the null hypothesis that there is no difference between the mean perceived amount of work for students who took Economics and the mean for those who did not take it is 3.05. This is clearly statistically significant at any reasonable significance level, but does it indicate any practical significance? With an average difference of .47, and the

Table 28. Estimates of perceived amount of work from students not having taken the course

RANK	COURSE	N	MEAN
01	Calculus	305	7.78
02	Chemistry	305	7.51
03	General Physics	388	7.31
04	Engineering Graphics	464	7.24
05	Biochemistry	529	7.16
06	Architecture	525	7.15
07	Computer Programming	308	7.09
08	Statistics	299	6.90
09	Electronics	511	6.75
10	English Composition	56	6.71
11	French	510	6.54
12	Spanish	481	6.36
13	Accounting	354	6.33
14	Human Anatomy	463	6.27
15	Materials Science	501	6.12
16	Biology	264	6.09
17	Drawing	461	6.06
18	Literature	437	6.06
19	Economics	193	6.05
20	History	233	6.03
21	Journalism	505	5.90
22	Metal Fabrication	532	5.87
23	Botany	487	5.87
24	Speech	315	5.67
25	Entomology	544	5.53
26	College Algebra	226	5.47
27	Anthropology	501	5.47
28	Astronomy	508	5.44
29	Crop Production	503	5.41
30	Philosophy	394	5.38
31	American Government	377	5.36
32	Educational Computing	488	5.33
33	Community and Regional Planning	544	5.25
34	Psychology	184	5.21
35	Geology	483	5.20
36	Geography	504	4.95
37	Mass Communications	520	4.89
38	Forestry	550	4.83
39	Hotel, Restaurant, and Institution Management	536	4.82
40	Textiles and Materials	538	4.80

Table 28 (continued).

RANK	COURSE	N	MEAN
41	Art History	465	4.75
42	Food Science	528	4.74
43	Sociology	204	4.72
44	Human Nutrition	486	4.60
45	World Religions	507	4.56
46	Music Theory	520	4.51
47	Child Development	442	4.38
48	Family Environment	491	4.17
49	Home Economics	510	4.01
50	Leisure and Recreation	516	3.26

large sample sizes, it is difficult to conclude that this represents any real difference between these values. Even if this does represent a real difference, there still is a high level of agreement between these two separate rankings of perceived amount of work.

Separate estimates of the perceived amount of work were also calculated for males and females, and again the means were ranked from highest to lowest. The Spearman rho value calculated on the respective ranks for males and females was .96, which is identical to the comparable value for the perceived difficulty data. It again appears that males and females do not differ considerably in the amount of work they perceive to be required in these courses. The largest differences were in Botany (difference of 10) and in Biology (difference of 9), with males in both cases perceiving there to be more work involved in these courses than did females. It is difficult to explain why females might find these courses to require less work than males; however, the strong agreement among the gender-based ranks on the majority of the courses would seem to indicate that in general the perceptions of males and females are in accord. The complete listing of the fifty courses and their respective ranks for males and females are given in Table 29.

It is interesting to note that the language-related differences between males and females in their perceptions of course difficulty were not present in their perceptions of the amount of work required. Apparently, what was conjectured as a greater confidence of females for the study of language-related courses is unrelated to the amount of work that they perceive to be required in these courses, since the rankings for these courses are very similar, if not identical, for males and females.

Means were also calculated for each group of respondents classified by year in school. These means were ranked from highest to lowest, as before, for each of the

Table 29. Ranks of perceived amount of work, by gender of respondent

COURSE	MALE	FEMALE
Accounting	11	8
Crop Production	25	31
Anthropology	26	33
Architecture	5	5
Drawing	19	13
Art History	39	37
Astronomy	30	28
Biochemistry	6	2
Biology	16	25
Botany	17	27
Child Development	46	46
Chemistry	2	3
Computer Programming	4	7
Community and Regional Planning	32	32
Economics	23	19
English Composition	10	10
Literature	18	16
Entomology	28	24
Home Economics	49	49
Family Environment	48	48
Human Nutrition	44	42
Forestry	35	43
Engineering Graphics	7	4
French	12	12
Food Science	43	36
Geography	37	38
Geology	34	34
History	20	21
Hotel, Restaurant, and Institution Management	42	35
Metal Fabrication	21	18
Electronics	8	11
Mass Communications	40	41
Journalism	22	17
Leisure and Recreation	50	50
College Algebra	24	22
Calculus	1	1
Materials Science	14	20
Music Theory	45	47
Philosophy	33	26
General Physics	3	6
American Government	31	30

Table 29 (continued).

COURSE	MALE	FEMALE
Psychology	36	39
World Religions	47	44
Educational Computing	29	29
Sociology	38	45
Spanish	13	14
Speech	27	23
Statistics	9	9
Textiles and Materials	41	40
Human Anatomy	15	15

four student classification levels. The ranks, for each group, are displayed in Table 30. Spearman rho values were calculated for the six pairs of student classification levels; these values are presented in Table 31. These values are at least as high as the corresponding values calculated on the perceived difficulty data. It again appears that students are generally consistent across different classification levels in the amount of work they perceive to be required in these courses.

Many of the courses which did exhibit differences among the ranks of at least 10 ordered positions across students' year in school also differed markedly in perceived difficulty. Drawing, Metal Fabrication, College

Table 30. Ranks of perceived amount of work, by respondents' year in school

COURSE	FR	SOPH	JR	SR
Accounting	10	12	9	11
Crop Production	29	27	30	25
Anthropology	30	25	31	32
Architecture	5	7	2	4
Drawing	22	15	13	12
Art History	40	40	39	36
Astronomy	25	26	32	30
Biochemistry	4	6	4	5
Biology	12	19	20	24
Botany	17	22	21	21
Child Development	45	47	46	46
Chemistry	2	2	3	2
Computer Programming	7	4	6	7
Community and Regional Planning	37	33	27	31
Economics	18	24	24	23
English Composition	8	10	11	10
Literature	15	17	18	19
Entomology	28	29	26	26
Home Economics	49	49	49	49
Family Environment	47	48	48	48
Human Nutrition	43	43	41	43
Forestry	42	46	35	35
Engineering Graphics	6	3	7	6
French	14	11	12	13
Food Science	44	45	37	41
Geography	34	36	40	38
Geology	32	34	34	33
History	19	16	19	22
Hotel, Restaurant, and Institution Management	41	39	38	40
Metal Fabrication	35	21	17	17
Electronics	13	9	8	9
Mass Communications	38	38	42	39
Journalism	20	20	22	20
Leisure and Recreation	50	50	50	50
College Algebra	23	32	25	16
Calculus	1	1	1	1
Materials Science	21	18	15	15
Music Theory	46	44	47	44
Philosophy	33	30	33	27
General Physics	3	5	5	3

Table 30 (continued).

COURSE	FR	SOPH	JR	SR
American Government	24	31	29	34
Psychology	31	37	36	42
World Religions	48	42	44	47
Educational Computing	26	28	28	28
Sociology	36	41	45	45
Spanish	11	13	14	14
Speech	27	23	23	29
Statistics	9	8	10	8
Textiles and Materials	39	35	43	37
Human Anatomy	16	14	16	18

Algebra, Psychology, and Sociology differed in the same manner on this scale as they had on the previous one. Principally these differences can be attributed to the freshmen's perceptions being different from those of the rest of the undergraduates. In addition, freshmen differed from students in the upper classes for both Biology and American Government. Sophomores differed from juniors and seniors in their perceptions about Forestry; however, it was still the case that for those courses in which the rankings were not in close harmony, it was principally the freshmen whose perceptions were different from the rest.

The final analysis done on the students' perceptions of amount of work was to compare the ranked means for

Table 31. Spearman's rho values for perceived amount of work rankings, by classification level

	FRESHMEN	SOPHOMORE	JUNIOR	SENIOR
Freshmen	1.00	.96	.94	.94
Sophomore			.97	.96
Junior				.98
Senior				

subjects classified according to college of enrollment. These ranks are displayed in Table 32. They have the same high consistency that students' perceptions of difficulty had. Additional evidence of this consistency can be seen in the pairwise values of Spearman's rho, which ranged from a low of .80 (between the College of Design and the College of Agriculture) to a high of .97 (between the College of Business Administration and the College of Liberal Arts and Sciences). These values are presented in Table 33.

Students in the College of Design perceived the courses from their discipline, including Architecture, Drawing, Community and Regional Planning, and Art History, to require more work than did students in the other colleges. Similarly, Crop Production was perceived to require more work by Agriculture students; Accounting by

Table 32. Rankings of perceived amount of work, by respondents' college of enrollment

COURSE	AG	BUS	DES	ED	ENG	FCS	LAS
Accounting	11	2	15	8	19	8	11
Crop Production	18	32	23	31	26	36	32
Anthropology	26	29	32	30	24	39	29
Architecture	10	3	1	4	8	2	2
Drawing	36	13	3	11	12	14	16
Art History	42	37	22	38	44	37	36
Astronomy	33	34	35	23	22	34	27
Biochemistry	4	6	10	5	9	3	5
Biology	13	22	28	18	14	27	21
Botany	14	26	16	19	21	29	24
Child Development	45	47	40	39	46	42	47
Chemistry	1	5	4	3	5	1	4
Computer Programming	6	7	9	2	3	7	7
Community and Regional Planning	37	31	17	34	31	33	28
Economics	23	20	29	25	28	16	25
English Composition	8	12	12	12	11	9	8
Literature	19	14	21	16	18	22	14
Entomology	21	24	34	26	34	26	22
Home Economics	49	49	45	49	49	46	49
Family Environment	46	48	48	47	48	45	48
Human Nutrition	40	41	43	46	43	35	45
Forestry	32	38	42	43	36	48	40
Engineering Graphics	5	8	7	6	6	4	3
French	12	11	8	13	16	12	12
Food Science	43	36	49	36	45	25	41
Geography	27	42	47	37	35	38	44
Geology	29	33	41	33	29	40	34
History	16	17	14	24	23	20	20
Hotel, Restaurant, and Institution Management	44	35	44	40	40	28	39
Metal Fabrication	31	18	26	22	15	17	19
Electronics	15	10	6	10	4	10	9
Mass Communications	39	44	37	32	39	44	38
Journalism	24	21	18	21	20	21	18
Leisure and Recreation	50	50	50	50	50	50	50
College Algebra	20	28	25	20	27	15	30
Calculus	2	1	2	1	2	5	1
Materials Science	22	19	19	14	7	19	17
Music Theory	48	46	36	48	41	49	43
Philosophy	35	25	20	28	33	30	33
General Physics	3	9	5	7	1	6	6

Table 32 (continued).

COURSE	AG	BUS	DES	ED	ENG	FCS	LAS
American Government	28	27	31	35	32	23	31
Psychology	34	39	38	41	38	41	37
World Religions	47	40	46	44	47	47	42
Educational Computing	30	30	27	27	30	31	26
Sociology	38	45	39	42	42	43	46
Spanish	9	16	13	17	17	13	13
Speech	25	23	30	29	25	24	23
Statistics	7	4	11	9	10	11	10
Textiles and Materials	41	43	33	45	37	32	35
Human Anatomy	17	15	24	15	13	18	15

Business Administration students; and Human Nutrition, Food Science, and Hotel, Restaurant, and Institution Management by students in the College of Family and Consumer Sciences than by students in the other colleges. This might be an indication that these students, having more direct knowledge of the requirements of these courses, are more informed as to how much work these courses actually entail. Alternatively, it could be a manifestation of the "no one else has it as rough as I do" idea, so that these differences may be related more to self-worth and ego than to actual differences among the colleges. These differences notwithstanding, the perceptions of the perceived amount of work do not appear to be different between the colleges, but are as consistent as the

Table 33. Spearman's rho values for perceived amount of work, by respondents' college of enrollment

	AG	BUS	DES	EDUC	ENGR	FCS	LAS
Agriculture	1.00	.89	.80	.90	.89	.84	.90
Business Administration			.89	.95	.92	.94	.97
Design				.89	.88	.85	.91
Education					.95	.92	.96
Engineering						.87	.95
Family and Consumer Sciences							.92
Liberal Arts and Sciences							

perceptions of difficulty.

<u>Regressions</u>

Fifty (50) multiple regression analyses, one for each course, were performed, in each of which the dependent variable was the perceived difficulty of the course. The independent variables included students' rating of their interest level in such a course, a coding vector to indicate whether or not such a course had been taken, a code of 0 if male and 1 if female, the student's self-reported undergraduate grade point average, dummy variables coded 0 or 1 representing student classifications of freshmen through senior, and dummy variables for the student's college of enrollment.

It was conjectured that tendencies on the part of some respondents generally to rate all courses as either relatively difficult or relatively easy might affect the predictability of these perceived difficulty levels. In an attempt to eliminate any such tendencies, these analyses were performed after adjusting each student's responses to remove differences among respondents on their overall mean. Thus the adjusted perceived difficulty ratings for the 50 courses for each student had a common mean and the between-subject variance was removed in the same manner as in the pilot study. (A subsequent set of regression analyses performed on the unadjusted data resulted in a few of the courses having increases of from 7 to 10 percentage points in the percentage of variance explained. Of these courses, only Food Science [an increase in R^2 of .073] and Geography [an increase of .070] had additional regression coefficients significant at the .05 level. For Food Science, "sex" and "GPA" were added to "interest in the course" as significant predictors; for Geography, "interest in the course" and "year in school" were added and "having taken the course" was dropped out; while "sex" was included as significant in both analyses. Family Environment showed the largest gain in R^2, from .137 to .231, and Hotel, Restaurant, and Institution Management increased from .144 to .231, but neither of these courses had any additional significant predictors. Most of the rest of the courses had slight changes in R^2, some increasing and some decreasing, but the overall results were very comparable, and little or no information appears to be lost by using the adjusted values as the dependent variables. The results of these regressions on the unadjusted data are given in Table 69 in Appendix A.) The results of the original analyses are presented in Table 34.

All but 7 of the 50 analyses had p-values which were significant at the .05 level, but this appears to be due largely to the large sample sizes (greater than 440 in each case). The relatively small proportions of explained variance are indicative of the general lack of predictive power for this group of independent variables. This might indicate that students' perceptions of difficulty are so variable within each of the different levels of these independent variables that difficulty levels cannot be explained by these characteristics. In other words, difficulty level might be a characteristic of the course itself, and therefore is not explainable by these differences in demographic characteristics of the students. The R^2 values ranged from .036 (American Government, with no significant predictors) to .155 (Accounting, which had only "having taken the course" as a significant predictor),

Table 34. Results of multiple regression analyses for course difficulty regressed on student characteristics (model d.f. = 15)

COURSE	N	R^2	F	PROB>F
Accounting	444	.155	5.21	.0001*
Crop Production	443	.071	2.17	.0066
Anthropology	444	.069	2.10	.0090
Architecture	444	.087	2.72	.0005*
Drawing	443	.055	1.64	.0596
Art History	444	.094	2.97	.0002*
Astronomy	445	.068	2.09	.0095
Biochemistry	443	.115	3.71	.0001*
Biology	446	.055	1.68	.0517
Botany	444	.087	2.71	.0005*
Child Development	444	.129	4.22	.0001*
Chemistry	446	.059	1.81	.0308
Computer Programming	445	.035	1.05	.4037
Community and Regional Planning	443	.124	4.04	.0001*
Economics	446	.072	2.21	.0056
English Composition	446	.080	2.48	.0017
Literature	443	.091	2.84	.0003*
Entomology	444	.053	1.58	.0750
Home Economics	444	.094	2.95	.0002*
Family Environment	446	.137	4.57	.0001*
Human Nutrition	444	.103	3.26	.0001*
Forestry	445	.123	4.02	.0001*
Engineering Graphics	446	.110	3.54	.0001*
French	446	.064	1.97	.0160
Food Science	446	.141	4.70	.0001*
Geography	444	.047	1.40	.1446
Geology	444	.079	2.44	.0020
History	444	.060	1.83	.0284
Hotel, Restaurant, and Institution Management	444	.144	4.81	.0001*
Metal Fabrication	444	.090	2.83	.0003*
Electronics	445	.081	2.51	.0015
Mass Communications	446	.112	3.61	.0001*
Journalism	444	.066	2.01	.0136
Leisure and Recreation	444	.039	1.15	.3061
College Algebra	445	.143	4.77	.0001*
Calculus	444	.065	1.97	.0162
Materials Science	443	.114	3.66	.0001*
Music Theory	444	.080	2.48	.0017

significant at a Bonferroni significance level of .001

Table 34 (continued).

COURSE	N	R^2	F	PROB>F
Philosophy	445	.028	0.83	.6398*
General Physics	445	.062	1.88	.0238
American Government	442	.036	1.07	.3788
Psychology	444	.088	2.74	.0005*
World Religions	445	.120	3.91	.0001*
Educational Computing	443	.071	2.18	.0065
Sociology	446	.080	2.50	.0015
Spanish	444	.087	2.73	.0005*
Speech	445	.057	1.72	.0453
Statistics	446	.085	2.65	.0007*
Textiles and Materials	444	.110	3.52	.0001*
Human Anatomy	444	.057	1.71	.0458

with all but fifteen (15) of them being less than .100.

Factor and Cluster Analyses

An exploratory factor analysis was performed on the perceptions of difficulty, in an attempt to identify some underlying variables which might be useful for explaining course difficulty. As was done in the pilot study, a maximum likelihood analysis was performed. It was hoped that the resulting factors would resemble those from the pilot study analysis in the number of factors identified and the nature of the courses that loaded on each factor. While the number of factors retained by the analysis was the same, nine, the "makeup" of the factors was bound to be at least somewhat different, since the sample of courses was different from those used in the earlier analysis. Both the number of courses and some of the courses themselves were different from the earlier study. The resulting factors and the factor loadings are displayed in Table 35.

A comparison of the courses loading on each of these factors with how these same courses (the common core of 30) loaded on the factors in the pilot study analysis shows that the solutions appear to be more dissimilar than alike. However, even though the factor structures vary, this solution is just as interpretable as the earlier one. For example, factor 1 contains primarily courses which have a mathematical and/or technical nature to them, while factor 2 contains those courses which deal with consumer and family relationships. Factor 3, except for World Religions, seems to be primarily courses with an "artsy" component, and factor 4 contains courses within social studies and language environments. Factor 5 seems to consist principally of courses with an earth science and/or life science nature, while factor 6 has a personal and interpersonal relationship component. Leisure and Recreation seems to be somewhat unique, although this may be due to the fact that it was almost universally seen as the least difficult of all the courses in the sample.

Table 35. Maximum likelihood factor analysis with varimax rotation, for perceptions of difficulty

FACTOR	COURSE	LOADING
I	Chemistry	.70
	Biochemistry	.59
	Calculus	.58
	General Physics	.56
	Engineering Graphics	.54
	Accounting	.54
	Computer Programming	.49
	Statistics	.49
	College Algebra	.40
	Economics	.40
	Electronics	.34
II	Family Environment	.77
	Home Economics	.67
	Child Development	.57
	Mass Communications	.54
	Food Science	.49
	Human Nutrition	.49
	Textiles and Materials	.34
	Educational Computing	.33
	Hotel, Restaurant, and Institution Management	.30
III	Art History	.59
	Music Theory	.49
	Architecture	.48
	Drawing	.47
	World Religions	.44
	Community and Regional Planning	.36
IV	Literature	.59
	English Composition	.57
	Journalism	.53
	History	.41
	Speech	.40
	American Government	.40
	Geography	.34

Table 35 (continued).

FACTOR	COURSE	LOADING
V	Botany	.52
	Forestry	.47
	Geology	.46
	Biology	.42
	Anthropology	.40
	Entomology	.39
	Human Anatomy	.38
	Astronomy	.37
	Crop Production	.34
VI	Sociology	.53
	Psychology	.50
	Philosophy	.43
VII	Leisure and Recreation	.33
VIII	Materials Science	.70
	Metal Fabrication	.55
IX	Spanish	.57
	French	.55

Factor 8 has a physical or material nature to it, and factor 9 is again composed of foreign language courses.

Several courses "loaded" at approximately the same level on more than one factor. In these cases some subjective reasoning was used to identify on which factor to include that course. Economics, for example, loaded highest on factor 1, because of its mathematical nature, but also loaded fairly highly on factor 4, which is consistent with its social studies component. In general, with the exception of a couple of courses, the factor structure seems to be reasonable. It could be conjectured that difficulty perceptions are indeed functions of these underlying traits and that courses which loaded on factor 1 tended to be perceived as the most difficult, while those on factor 2 and Leisure and Recreation (factor 7) were generally considered to be the least difficult. This accounts for about half of the courses. The remaining half are those which were usually ranked in the middle of the ordering, although there was considerable variation among the courses in this group in how they were rated, both by the overall sample of students and by the various subgroups.

Ward's minimum variance cluster analysis also was performed on the difficulty perceptions, with the number of clusters set at nine in an attempt to match the cluster solution with the factor solution. This was only somewhat successful, with the results listed in Table 36 along with the factor number from the previously mentioned maximum likelihood analysis.

Table 36. Course classification obtained using cluster analysis with nine clusters and maximum likelihood factor analysis with nine factors

CLUSTER	COURSE	FACTOR
1	Home Economics	II
	Family Environment	II
	Child Development	II
	Leisure and Recreation	VII
2	Human Nutrition	II
	Food Science	II
	Sociology	VI
	Psychology	VI
	Community and Regional Planning	III
	Mass Communications	II
	Forestry	V
	Crop Production	V
	Educational Computing	II
	American Government	IV
	Geography	IV
	World Religions	III
	Hotel, Restaurant, and Institution Management	II
	Textiles and Materials	II
	Speech	IV
3	Chemistry	I
	Biochemistry	I
	General Physics	I
	Calculus	I
	Computer Programming	I
	Engineering Graphics	I
	Electronics	I
	Architecture	III
4	Anthropology	V
	Geology	V
	Journalism	IV
	Literature	IV
	Astronomy	V
	Philosophy	VI
	Entomology	V
	English Composition	IV
	History	IV

Table 36 (continued).

CLUSTER	COURSE	FACTOR
5	Materials Science	VIII
	Metal Fabrication	VIII
6	Biology	V
	Human Anatomy	V
	Spanish	IX
	French	IX
	Botany	V
7	Statistics	I
	Economics	I
	Accounting	I
8	Art History	III
	Music Theory	III
	Drawing	III
9	College Algebra	I

Some of the resulting clusters were fairly large. For these clusters it is difficult to find a common thread in the courses included. On the other hand, cluster 5 (Materials Science and Metal Fabrication) was identical to factor 8, and cluster 7 (Statistics, Economics, and Accounting) consisted of a subgroup of factor 1 in which the courses included are not really mathematical, but are certainly mathematically based. Additionally, cluster 6 combined the foreign language courses of factor 9 with a subgroup of science courses from factor 5, but it is difficult to explain why that occurred.

Cluster 8 (Art History, Music Theory, and Drawing) consists of the "artsy" courses from factor 3 with the remaining three courses from that factor being split between clusters 2 and 3. It seems appropriate to combine Architecture with the remaining courses from factor 1 to form cluster 3, but clusters 2 and 4 seem to be comprised of courses with a variety of contents that make these groupings difficult to explain. Cluster 1 consists of those courses which were principally ranked as the least difficult in the various listings, while cluster 3 is comprised of those which were usually considered most difficult. Cluster 9 contains College Algebra alone, which might be due to the large amount of variability among the ratings of this course. There were marked differences in the perceptions of College Algebra by the four levels of student classification, and the standard deviation of 2.34 is by far the largest among the fifty courses.

A Principal Components Analysis, which was also performed on these data, resulted in a five-factor solution similar to the pilot study. However, since the number of courses in the main study was increased to fifty, the number of courses which loaded on each factor was rather large and made the interpretation of the factors extremely difficult. For this reason, the results of this analysis have been omitted, as were the results of a five-cluster solution that produced similar non-interpretable solutions.

Additionally, a non-orthogonal factor rotation was performed on the nine-factor maximum likelihood solution. This was done to investigate the possibility that correlated factors may lead to more interpretable results. However, the rotated factor structure was very similar to the orthogonal one reported previously, so the results of this analysis have been omitted as well.

Even though these factor and cluster solutions are not as "clean" as those in the pilot study, and do not show the same level of agreement, the results are still important. The factor solution was very interpretable and does indeed shed light on some latent traits that might account for differences in perceived course difficulty. At the very least, this solution is interesting in that each of the factors consists of courses which can be tied together in some way to explain a possible characteristic of perceived course difficulty. That such underlying characteristics exist at all is interesting in itself.

Analyses of the common core of thirty courses

Thirty (30) of the courses which were included on the main study survey instrument were also included on the survey instrument in the pilot study. Separate analyses of this core of common courses was undertaken to investigate further the consistency with which students perceived difficulty levels over time. The means for these courses were ranked for both studies, and the ranks were compared for consistency. The list of these common courses, together with their ranks in both of the studies, are presented in Table 37.

The obtained Spearman rho value of .89 would seem to indicate that the students' perceptions were relatively stable over time. The courses with the largest differences in ranks were English Composition (difference of 9) and World Religions (difference of 8). More striking than this, however, is the remarkable similarity shown between the ranks of such courses as Architecture, Biology, Computer Programming, Electronics, General Physics, American Government, and Human Anatomy which were ranked exactly the same in both studies. There is no evidence from these values that students' perceptions of course difficulty are changing over time. It must be noted, however, that these perceptions were obtained less than one

Table 37. Ranks of courses common to both pilot study and main study

COURSE	PILOT	MAIN
Crop Production	14	19
Architecture (Architectural Drawing)	7	7
Astronomy	13	17
Biochemistry	1	4
Biology	11	11
Botany (Plant Science)	17	14
Child Development	29	30
Chemistry	4	2
Computer Programming (Pascal Programming)	6	6
Economics	12	15
English Composition	22	13
French	10	8
Geology	24	22
History (World History)	16	12
Metal Fabrication	8	16
Electronics	5	5
Mass Communications	20	26
Journalism	21	20
Calculus	2	1
Music Theory	27	28
General Physics	3	3
American Government (Government)	18	18
Psychology	26	23
World Religions (Religions of the World)	19	27
Educational Computing (Educational Media)	25	21
Sociology	30	25
Spanish	15	10
Speech	28	24
Textiles and Materials	23	29
Human Anatomy	9	9

year apart, so they would be expected to be fairly similar. To determine conclusively that students' perceptions are relatively unchanged over time, additional studies would need to be performed where the time lapse in between administrations of the instrument was longer. This would allow for any changes that may have taken place to be detected by differences which appear in the resulting comparisons.

Maximum likelihood factor analyses were performed on the students' perceptions of course difficulty for this common set of thirty courses, first using the pilot study data and secondly using data from the main study. The results from the pilot study are displayed in Table 38 and those from the main study in Table 39.

In the pilot study seven (7) factors were retained, while the main study analysis retained only four factors. It appears, however, that the results of these two separate analyses are fairly compatible, indicating once again that students' perceptions did not change substantially from the earlier study to the later one. For the main study analysis, factor I seems to be principally comprised of the pilot study factors 1, 5, 6, and half of pilot study factor 3 without the foreign languages. Factor II contains many

Table 38. Results of maximum likelihood factor analysis on common core of 30 courses using pilot study data

FACTOR	COURSE	LOADING
1	Journalism	.54
	Mass Communications	.52
	English Composition	.52
	Speech	.51
	Child Development	.49
	Human Anatomy	.48
	Spanish	.45
	French	.40
2	Chemistry	.62
	Biology	.58
	General Physics	.54
	Biochemistry	.48
	Calculus	.44
	Botany (Plant Science)	.30
	Geology	.28
3	Crop Production	.68
	Educational Computing (Educational Media)	.63
	Astronomy	.46
	World Religions (Religions of the World)	.38
4	Computer Programming (Pascal Programming)	.65
	Electronics	.64
	Architecture (Architectural Drawing)	.48
	Metal Fabrication	.42
5	American Government (Government)	.82
	History (World History)	.62
	Economics	.48
6	Psychology	.74
	Sociology	.69
	Music Theory	.22
7	Textiles and Materials	.74

Table 39. Results of maximum likelihood factor analysis on common core of 30 courses using main study data

FACTOR	COURSE	LOADING
I	Mass Communications	.67
	Speech	.60
	World Religions (Religions of the World)	.59
	Psychology	.58
	Child Development	.57
	Sociology	.54
	American Government (Government)	.49
	Educational Computing (Educational Media)	.48
	Economics	.43
	Journalism	.39
	History (World History)	.37
	English Composition	.36
	Music Theory	.35
II	Chemistry	.70
	General Physics	.62
	Biochemistry	.61
	Calculus	.53
	Computer Programming (Pascal Programming)	.45
III	Spanish	.54
	Botany (Plant Science)	.49
	Biology	.48
	Crop Production	.45
	French	.42
	Geology	.39
	Human Anatomy	.38
	Astronomy	.31
IV	Metal Fabrication	.51
	Electronics	.43
	Textiles and Materials	.43
	Architecture (Architectural Drawing)	.33

of the courses from the pilot study factor 2 with the addition of Computer Programming (from pilot study factor 4), but without the life and earth science courses. Factor III contains the other half of pilot study factor 3, plus the courses which loaded on the pilot study's factors 1 and 2, but did not load on the main study's factors I and II. Factor IV is a combination of pilot study factors 4 and 7 without Computer Programming, which was included on factor II.

Analyses of Institutional Data

Means, ranks, and correlations of grade distributions

Means and standard deviations were calculated for the grade distributions for each of the fifty courses for each of the eight semesters. However, as noted in Chapter Three and shown in Table 4, eleven of the courses were not taught in some of the semesters, so means were not available for all the courses in every semester. These means, together with their standard deviations, are displayed in ranked order, by semester, in Tables 53-60 in Appendix A. A summary of these tables, containing the ranks for each course in each semester, is displayed in Table 40.

Table 40. Course ranks for mean grade by semester from fall 1986 through spring 1990

COURSE	F86	S87	F87	S88	F88	S89	F89	S90
Accounting	5	4	3	3	8	27	9	4
Crop Production	30	25	30	20	28	32	39	27
Anthropology	39	34	34	43	32	33	37	41
Architecture	-	8	-	6	-	21	-	15
Drawing	41	29	20	14	25	23	17	25
Art History	9	37	8	23	37	38	1	19
Astronomy	16	32	12	30	31	5	11	16
Biochemistry	33	22	32	18	35	25	25	29
Biology	4	3	4	9	10	6	8	2
Botany	36	16	26	36	30	4	4	6
Child Development	38	11	40	24	43	13	40	37
Chemistry	7	5	5	4	2	2	3	18
Computer Programming	-	-	33	22	36	18	20	10
Community and Regional Planning	-	-	22	-	38	-	15	-
Economics	35	41	46	44	42	44	43	42
English Composition	22	9	16	7	6	20	34	17
Literature	19	24	27	28	23	19	33	8
Entomology	-	-	-	33	-	43	-	31
Home Economics	-	-	-	17	16	41	45	43
Family Environment	37	17	25	37	33	40	21	24
Human Nutrition	27	6	31	21	22	34	31	33
Forestry	12	-	18	-	27	-	14	-
Engineering Graphics	42	31	35	39	41	26	12	13
French	40	-	23	-	17	-	32	-
Food Science	25	30	39	34	26	30	36	36
Geography	23	13	19	8	5	3	30	22
Geology	10	14	7	13	9	10	28	21
History	13	10	37	10	34	14	24	7
Hotel, Restaurant, and Institution Management	-	40	-	41	-	42	-	38
Metal Fabrication	8	12	14	5	20	8	22	35
Electronics	15	21	11	11	14	29	13	14
Mass Communications	21	15	21	32	40	37	27	20
Journalism	6	39	44	26	7	22	35	23
Leisure and Recreation	34	23	42	38	47	11	44	26
College Algebra	11	2	9	1	3	1	5	1
Calculus	1	1	6	15	1	7	6	3
Materials Science	24	-	28	-	18	-	19	-
Music Theory	3	-	1	-	24	-	18	-
Philosophy	29	19	29	25	44	28	16	40
General Physics	20	7	2	16	4	15	29	11

Table 40 (continued).

COURSE	F86	S87	F87	S88	F88	S89	F89	S90
American Government	28	35	36	40	21	12	23	5
Psychology	14	20	13	42	13	17	47	39
World Religions	44	33	45	27	39	39	41	34
Educational Computing	31	38	41	29	46	31	26	30
Sociology	32	26	24	19	12	16	38	9
Spanish	26	-	38	-	45	-	46	-
Speech	43	36	43	35	19	35	42	44
Statistics	17	27	17	31	29	9	10	32
Textiles and Materials	18	18	10	2	11	24	7	28
Human Anatomy	2	28	15	12	15	36	2	12

One of the primary research questions of interest was whether the estimates of course difficulty were stable over time. This question was addressed here in the context of grade distributions. That is, are the average grades given in these courses similar from one semester to another? Some information useful in addressing this question can be obtained from Table 40. A comparison of the ranks of each course, across the semesters in which it was taught, reveals that there appears to be a considerable amount of variability across semesters in the average grades. Virtually every course contains at least one pair of ranks which are substantially different from each other. Even if one rather disparate rank is ignored, about half of the courses still contain at least one pair with large differences between the ranks. Are the average grades, which are given in these courses, really this variable when compared across semesters? And, if so, why is this the case?

To answer these questions, the mean values themselves, rather than the ranks, were compared. Consider, for example, Geology, which had ranks of 10, 14, 7, 13, 9, 10, 28, and 21. The corresponding means were 2.13, 2.36, 2.15, 2.30, 2.18, 2.30, 2.63, and 2.49. While there certainly is variability within this set of means, the two extreme values, 2.13 and 2.63, represent average grades of slightly higher than C and slightly lower than B minus, respectively. With this in mind, then, eight mean values within a range of C to B minus doesn't seem near as inconsistent as did the corresponding ranks. Similarly, Drawing, with ranks of 41, 29, 20, 14, 25, 23, 17, and 25, had corresponding means of 2.98, 2.73, 2.44, 2.33, 2.55, 2.59, 2.45, and 2.68. This range of grades is effectively from C plus, 2.33, to B, 2.98, a width of the same magnitude as that for Geology above.

Some courses do still exhibit some variability across semesters, even when using the means for making the comparisons. Home Economics, for example, had means of

2.35, 2.37, 2.99, 3.22, and 3.23, a range from about C plus to about B plus, a difference of one full letter grade. None of the courses, however, show ranges among their means of anything larger than slightly more then one full letter grade, and most have ranges considerably less than this. It appears, then, that the average grades are fairly stable from one semester to another, and that the differences may be just random fluctuations.

Note also the consistency with which several courses are rated near the high end of the difficulty scale (i.e., a low average grade). Except for one semester, in which the rank was considerably different than the rest, each of the courses, Accounting, Chemistry, College Algebra, and Calculus, were all rated among the most difficult in terms of average grade. Biology, with ranks ranging from 2 to 10, was perhaps the most consistent of all the courses which were taught in each of the eight semesters.

To investigate these differences further, however, correlations among the eight semesters of average grades were calculated using Pearson's r. These correlations are presented in Table 41. Prior to calculating the correlation coefficients, the distributions of the average grades, for each semester, were examined for departures

Table 41. Correlations among the means of the grade distributions for eight semesters

	F86	S87	F87	S88	F88	S89	F89	S90
Fall 1986	1.00	.524	.613	.531	.538	.402	.503	.532
Spring 1987			.642	.695	.577	.596	.401	.579
Fall 1987				.594	.613	.444	.602	.506
Spring 1988					.626	.511	.496	.517
Fall 1988						.475	.318	.456
Spring 1989							.407	.622
Fall 1989								.609
Spring 1990								

from normality. Normal probability plots showed little or no evidence of a lack of normality, and p-values corresponding to Shapiro-Wilk statistics for testing the respective null hypotheses that the data come from a normal distribution ranged from .2830 to .9250. Lacking any substantive evidence to the contrary, the distributions were assumed to be normal. Thus, the calculation of Pearson's correlation coefficients is justified.

An examination of these coefficients supports the general perception that the grade distributions are largely consistent across semesters. There appear to be stronger relationships among the fall semesters and spring semesters separately, than when comparisons are made from one fall semester to one spring semester. This could be due partially to the fact that some courses were taught only during one semester or the other, so there exists a closer match of courses within the fall (or spring) semesters. It could also be a characteristic of these courses that the students enrolled in the course for fall semesters are different in some ways from the students enrolled during the spring semesters. Differences could conceivably exist on potentially important factors such as motivation, involvement in outside activities, adjustment to college life (particularly for freshmen), and number of credit hours taken, to mention just a few.

The smallest pairwise correlation coefficient, .318, however, occurred between the fall of 1988 and the fall of 1989. A pairwise examination of the respective means for these two semesters revealed that several courses had their two extreme values (or values close to the two extremes) in these semesters. Psychology, Home Economics, and Art History all had mean differences close to or exceeding 1.0 in these terms. Exactly why these extreme values should all occur during these two semesters is a mystery, but it does help to explain why the correlation coefficient is so low. The differences did not all occur in the same direction, however, which eliminates the possibility of some sort of uniform change in grading practices as an alternative explanation.

Analyses of Variance

As a further check on the stability of these average grades across semesters, a two-way analysis of variance was performed on the course means (a total of 357, since some courses were not taught every semester) using the different semesters as the levels of factor 1, and the courses as the levels of factor 2. The overall F-value of 8.06 with a p-value of .0001 indicates that differences do exist among the course means across the semesters. However, when testing for differences between semesters, the F-value of 0.74 is clearly non-significant. This is definite evidence that the group of 50 courses (or slightly fewer, since some were not taught each term), as a whole, do not differ appreciably from one term to the next.

Fifty (50) one-way analyses of variance, one for each course, were also performed on the individual grades, using the course grade as the dependent variable and checking for differences across the semesters, within each course. The results of these analyses (F-values, numerator and denominator degrees of freedom, and corresponding p-values) are given in Table 42. A total of twenty-five

Table 42. Analysis of variance results for comparing means of course grade distributions across semesters

COURSE	F	DF	PROB>F
Accounting	10.55	7,1154	.0001*
Crop Production	0.57	7, 303	.7837
Anthropology	1.62	7, 194	.1324
Architecture	8.79	3, 817	.0001*
Drawing	0.81	7, 150	.5829
Art History	13.22	7, 627	.0001*
Astronomy	1.16	7, 154	.3301
Biochemistry	0.76	7, 480	.6208
Biology	4.85	7,1676	.0001*
Botany	2.89	7, 165	.0072
Child Development	1.96	7, 227	.0614
Chemistry	0.49	7, 158	.8401
Computer Programming	2.70	5, 660	.0198
Community and Regional Planning	3.36	2, 165	.0372
Economics	1.77	7, 255	.0931
English Composition	1.42	7, 188	.2006
Literature	1.34	7, 208	.2347
Entomology	1.77	2, 78	.1779
Home Economics	14.65	4, 636	.0001*
Family Environment	3.22	7, 523	.0024
Human Nutrition	9.65	7,1177	.0001*
Forestry	0.72	3, 148	.5415
Engineering Graphics	1.96	7, 175	.0631
French	0.86	3, 79	.4633
Food Science	2.29	7, 292	.0279
Geography	8.01	7,1305	.0001*
Geology	2.83	7,1075	.0064
History	3.19	7, 844	.0024
Hotel, Restaurant, and Institution Management	4.97	3, 637	.0021
Metal Fabrication	3.65	7, 338	.0008*
Electronics	0.62	7, 201	.7385
Mass Communications	11.48	7,1459	.0001*
Journalism	7.34	7, 185	.0001*
Leisure and Recreation	5.59	7, 341	.0001*
College Algebra	3.57	7, 268	.0011
Calculus	1.92	7, 268	.0666
Materials Science	0.61	3, 314	.6077
Music Theory	4.31	3, 113	.0064
Philosophy	4.26	7, 419	.0001*

significant at a Bonferroni significance level of .001

Table 42 (continued).

COURSE	F	DF	PROB>F
General Physics	1.91	7, 171	.0708*
American Government	4.13	7, 786	.0002*
Psychology	8.17	7,1194	.0001*
World Religions	8.91	7, 688	.0001*
Educational Computing	0.80	7, 170	.5869
Sociology	1.17	7, 556	.3172
Spanish	2.86	3, 79	.0423
Speech	1.94	7, 167	.0666
Statistics	2.04	7, 376	.0493
Textiles and Materials	3.35	7, 180	.0022
Human Anatomy	22.27	7,2337	.0001*

hundred ten (25,210) student grades were used in these analyses, with the sample sizes ranging from seventy-nine (79) for Entomology, to two thousand three hundred thirty eight (2338) for Human Anatomy.

Approximately half of the analyses resulted in p-values which were significant at the .05 level. However, in most of these "significant" cases, the sample size was extremely large, resulting in very small values for the mean squared errors, and hence small p-values. It appears that in most, if not all, of these cases the statistically significant result can be attributed to the large number of observations within each course, rather than to differences among the means for the different semesters. The smallest sample sizes producing significant differences among the means were for Spanish ($n = 80$, $p = .0423$) and Music Theory ($n = 114$, $p = .0064$), but these samples would still be considered at least moderately large by most usual standards.

Composite Difficulty Estimates Using Means

Given the results of these various tests to determine the stability of average grades over time, it appears to be a reasonable assertion that grade distributions for individual courses do not change considerably from one semester to another. To be certain, some variation does indeed occur, and these in certain courses more so than in others. Nevertheless, there appears to be sufficient stability in these average grades to use them as estimates of course difficulty. With this in mind, the eight semesters of grade distributions were combined into one set of fifty grade distributions, and the average grade was calculated for each course. These means, together with standard deviations for each course, are given in Table 43. The means have been ranked from smallest to largest, with the smaller values representing courses having lower average grades, which, in this context, will be taken to mean that that course is more difficult than those courses having higher average grades.

Table 43. Means and standard deviations of grade distributions for eight semesters

COURSE	MEAN	STD DEV
College Algebra	1.796	1.282
Calculus	1.947	1.222
Chemistry	2.036	1.209
Biology	2.044	1.084
Accounting	2.085	1.096
Music Theory	2.171	1.194
General Physics	2.256	1.083
Geology	2.292	1.030
Textiles and Materials	2.319	0.919
Architecture	2.346	1.051
History	2.358	1.139
Geography	2.361	1.058
English Composition	2.381	0.922
Human Anatomy	2.383	1.140
Metal Fabrication	2.387	0.966
Electronics	2.388	0.970
Psychology	2.392	1.090
Forestry	2.397	0.903
Botany	2.426	1.028
Astronomy	2.473	1.118
American Government	2.495	1.049
Art History	2.497	1.021
Materials Science	2.504	0.946
Sociology	2.530	1.110
Statistics	2.538	1.073
Computer Programming	2.545	1.137
Community and Regional Planning	2.552	0.824
Literature	2.557	0.911
Drawing	2.593	0.999
Mass Communications	2.611	0.906
Human Nutrition	2.618	0.883
Journalism	2.636	0.786
French	2.647	1.127
Biochemistry	2.660	0.929
Family Environment	2.687	0.960
Crop Production	2.697	0.975
Engineering Graphics	2.734	0.898
Philosophy	2.736	0.863
Child Development	2.770	1.095
Food Science	2.786	0.842
Educational Computing	2.847	0.940
Leisure and Recreation	2.884	0.941

Table 43 (continued).

COURSE	MEAN	STD DEV
Anthropology	2.926	0.937
Speech	2.991	0.892
Entomology	2.992	0.913
Home Economics	3.003	1.100
Spanish	3.008	0.899
World Religions	3.020	0.677
Hotel, Restaurant, and Institution Management	3.100	0.801
Economics	3.231	0.966

College Algebra, Calculus, and Chemistry rank one, two, and three, respectively, as the most difficult courses, while World Religions, Hotel, Restaurant, and Institution Management, and Economics rank as the least difficult. It is interesting to note that six of the ten most difficult courses are ones which have strong mathematical and/or technical natures. This is consistent with what was found among the rankings based on perceptions of difficulty, although the trend is not as pronounced here. The remainder of the mathematical and technical courses are interspersed throughout the entire list, with the least difficult course, Economics, being one with a definite mathematical component.

Another difference between these rankings and the ranks done earlier on the perceptions of difficulty, can be found among the courses having either a consumer or family orientation. In the perception rankings, these courses were consistently rated as the least difficult. In the current rankings, some of them are still rated among the least difficult, but only two of these courses are in the bottom ten, and Textiles and Materials is ranked ninth overall.

It is also interesting to note that the courses rated as most difficult, College Algebra, Calculus, and Chemistry, were also the courses with the highest standard deviations, while two of the three courses on the other end of the scale, World Religions, and Hotel, Restaurant, and Institution Management had the two smallest standard deviations. This may indicate that the courses with the lowest average grades do not uniformly have such a low average grade, but rather have a tendency to have a very low mean grade for some semesters, thus decreasing the overall average. On the other hand, the courses with the highest average grades appear to have such a high grade more consistently, with much less variation from one semester to another.

Perhaps one of the most unexpected results is that College Algebra is rated as more difficult than Calculus. This certainly is different from how students perceived these two courses and would almost universally be thought of as counter-intuitive. Virtually anyone who has taken both of these courses would be quick to point out that Calculus is considerably more difficult than College Algebra. Why, then, would College Algebra have a lower average grade than Calculus?

There are at least two possible explanations for this. First of all, since College Algebra is a pre-requisite for Calculus, it may sometimes be used as a "weed-out" course. That is, it is used to help identify those students who have the potential for further, advanced study in mathematics, and to separate these individuals from those students who lack the necessary capability for abstract thinking that is required to be successful in higher level courses. If this course is indeed used in this manner, then the low average grade may be indicative of the large number of students who are incapable of pursuing advanced study in mathematics.

Alternatively, since many colleges require entering students to take a mathematics placement exam, those students who have experienced success in studying mathematics in general, and algebra specifically, at the high school level, may be testing out of College Algebra. These students would then move directly into a higher level course such as Calculus. This would have the effect of removing the students with the greatest potential for achieving high grades in College Algebra from enrolling in the course. Those students who are left to take the course, would, in essence, be the ones comprising the "lower portion" of the potential grade distribution. Once again, this could account for the abundance of low grades and the lack of corresponding high ones, which resulted in the average grade of 1.13 in the section sampled from the spring semester of 1990.

There may be other possible explanations as well. It seems very unlikely, though, that College Algebra is a more difficult course than Calculus. However, in relation to their respective audiences, it may indeed be more difficult for the students who take College Algebra to be successful in that course than it is for Calculus students to be successful in theirs.

Means, Ranks, and Correlations of ACT Composites

Means and standard deviations were calculated for the ACT composite score distributions for each of the fifty courses for each of the eight semesters. Average values were again unavailable for some of the courses in the same semesters as with the grade distributions. These means and standard deviations are presented in ranked order in Tables 61-68 in Appendix A. A summary of these tables containing the ranks for each course in each semester in which it was taught, is given in Table 44.

Again, the question of stability over time was addressed relative to these distributions. An examination of the ranks, given in Table 44, reveals a similarity between these ranks and those for the average grades looked at earlier. Many courses contain at least one pair of ranks which are considerably different. The ranks for Economics, for example, are 2, 4, 24, 13, 28, 3, 3, and 9, while those for Sociology are 9, 36, 36, 19, 36, 25, 33, and 14. However, when the means are compared, although differences among the means do still exist, these differences do not appear to be as great as the corresponding ranks might suggest. The mean ACT composite scores for Economics are 24.87, 24.39, 22.64, 23.27, 21.94, 25.31, 24.97, and 23.57, and those for Sociology are 23.33,

Table 44. Course ranks for mean ACT composite by semester from fall 1986 through spring 1990

COURSE	F86	S87	F87	S88	F88	S89	F89	S90
Accounting	19	24	10	21	18	17	4	13
Crop Production	18	22	28	9	27	23	26a	24
Anthropology	12	6	27	29	33	34	14	4
Architecture	-	13	-	20	-	10	-	17
Drawing	28	32b	42	14	13	40	40	18
Art History	31	37	33	35	39	37	29	27
Astronomy	32	5	19	32	17	13	22	28
Biochemistry	23	20	18	23	23	20	25	11
Biology	36	28	37	27	35	33	35	31
Botany	3	7	9	5	6	5	16	10
Child Development	43	30	46	41	45	43	39	44
Chemistry	30	15	6	17	37	9	18	36
Computer Programming	-	-	5	3	2	4	2	1
Community and Regional Planning	-	-	21	-	20	-	15	-
Economics	2	4	24	13	28	3	3	9
English Composition	34	16	34	36	42	19	30	35
Literature	26	23	14	22	10	27	5	8
Entomology	-	-	-	26	-	18	-	25c
Home Economics	-	-	-	42	44	35	44	40
Family Environment	41	38	44	43	47	36	47	41
Human Nutrition	37	40	38	33	40	42	43	38
Forestry	15	-	16	-	26	-	17	-
Engineering Graphics	5	1	2	1	3	1	8	3
French	27	-	8	-	32	-	21	-
Food Science	39	21	25	39	38	2	41	25c
Geography	16	10	11	8	11	8	13	16
Geology	33	26	39	30	41	32	38	30
History	13	9	4	18	9	15	24	5
Hotel, Restaurant, and Institution Management	-	34	-	37	-	39	-	42
Metal Fabrication	10	19	32	24	7	16	26a	15
Electronics	21	14	13	28	4	24	11	33
Mass Communications	35	29	31	15	34	31	31	22
Journalism	8	32b	17	10	22	21	12	20
Leisure and Recreation	44	41	45	38	43	38	45	39
College Algebra	11	25	7	16	8	28	9	32

a Crop Production and Metal Fabrication tied for 26th
b Drawing and Journalism tied for 32nd
c Entomology and Food Science tied for 25th

Table 44 (continued).

COURSE	F86	S87	F87	S88	F88	S89	F89	S90
Calculus	1	3	1	4	1	11	1	2
Materials Science	38	-	41	-	46	-	42	-
Music Theory	25	-	12	-	16	-	34	-
Philosophy	17	2	3	12	19	12	7	6
General Physics	4	8	15	11	5	6	6	19
American Government	22	39	26	7	21	22	28	21
Psychology	24	17	20	6	24	14	19	34
World Religions	20	11	22	2	12	26	10	12
Educational Computing	40	35	40	44	29	41	32	37
Sociology	9	36	36	19	36	25	33	14
Spanish	6	-	23	-	15	-	23	-
Speech	14	18	35	25	14	7	20	23
Statistics	7	12	29	31	25	30	37	7
Textiles and Materials	42	31	30	40	30	44	46	43
Human Anatomy	29	27	43	34	31	29	36	29

20.43, 21.33, 22.81, 21.20, 22.19, 21.70, and 22.90.

In each of the eight semesters, over half of the mean composite scores were between 21.00 and 24.00, so that variations in mean scores of less than 2.0 points could correspond to ranks that are vastly different. For example, College Algebra, with mean composite scores of 21.93 for spring 1987 and 23.91 for fall 1987, had ranks of 25 and 7, respectively. Notice also the consistency with which such courses as Computer Programming, Engineering Graphics, and Calculus are ranked across the semesters in which they are taught. This is also true for Child Development, Art History, Human Nutrition, and Educational Computing, but at different levels along the scale. It appears again that these mean ACT composites are relatively stable across semesters. What differences there are can be attributed to random fluctuation among the individual students enrolled in the course.

Further investigations of this stability were performed as before, with correlations among these mean composite scores calculated among the eight semesters. The checks for departures from normality were again negative (with p-values ranging from .2674 to .9467, and all normal probability plots as expected), so Pearson's r was used instead of Spearman's rho. These correlations are presented in Table 45. These coefficients are almost universally higher than the corresponding ones for the average grades. The lone exception is when the means for the fall of 1987 are compared to those from the fall of 1988, but both values are well within the range of the rest of the coefficients, so it appears to be a reasonable claim that the average ACT composites were more strongly related than were the average grades. The strong relationships seen among the average grade correlations for the fall semesters and spring semesters separately, do not appear to

Table 45. Correlations among the means of the ACT composite distributions for eight semesters

	F86	S87	F87	S88	F88	S89	F89	S90
Fall 1986	1.00	.659	.703	.740	.722	.681	.736	.811
Spring 1987			.721	.563	.612	.739	.704	.674
Fall 1987				.694	.733	.698	.728	.694
Spring 1988					.729	.640	.702	.716
Fall 1988						.551	.714	.673
Spring 1989							.645	.656
Fall 1989								.700
Spring 1990								

be present among the ACT score coefficients. Indeed, the single largest of the pairwise correlations, .811, is between the fall of 1986 and the spring of 1990, the two semesters which are the farthest apart in time. This further substantiates the claim that these means are relatively stable across semesters.

Analyses of Variance

A two-way analysis of variance of these mean ACT composite scores across the eight semesters was performed to verify further that these means remain relatively unchanged over time. Using the semesters as the levels of factor 1, and the courses for factor 2, the F-value of 14.81 was again significant, indicating that differences do exist. However, it is again the case that the only significant differences occur across the courses ($F = 16.79$, $p = .0001$), and that among the semesters no significant differences are found ($F = 0.85$, $p = .5436$).

Fifty (50) one-way analyses of variance were also performed on the ACT composites of the individual students enrolled in these courses. The individual composite scores served as the dependent variables, in each case, and the variability between semesters was compared to the variability within the course, for each of the fifty courses. The results of these analyses (F-values, numerator and denominator degrees of freedom, and p-values) are given in Table 46. Nineteen thousand three hundred thirty-five (19,335) ACT composite scores were used in these analyses, with the sample sizes ranging from fifty-six (56) for Entomology to one thousand seven hundred ninety-five (1975) for Human Anatomy. That these sample sizes are different from the corresponding analyses done on the student grades is due to the fact that ACT composites were not available for many of the students enrolled in the sections included in the sample. Slightly more than twenty-three (23) percent of the students, for whom course grades were available, had no ACT composite score recorded in the institutional databank from which these samples were

Table 46. Analysis of variance results for comparing means of course ACT composite distributions across semesters

COURSE	F	DF	PROB>F
Accounting	2.31	7, 924	.0245
Crop Production	0.36	7, 223	.9237
Anthropology	1.01	7, 148	.4245
Architecture	2.37	3, 638	.0693
Drawing	1.02	7, 113	.4177
Art History	1.07	7, 467	.3839
Astronomy	0.69	7, 113	.6781
Biochemistry	0.30	7, 384	.9517
Biology	1.17	7,1351	.3141
Botany	0.55	7, 117	.7987
Child Development	2.34	7, 178	.0260
Chemistry	1.23	7, 119	.2918
Computer Programming	1.01	5, 454	.4110
Community and Regional Planning	0.11	2, 121	.8966
Economics	1.92	7, 193	.0680
English Composition	0.74	7, 143	.6420
Literature	1.34	7, 175	.2324
Entomology	0.22	2, 55	.8051
Home Economics	1.55	4, 413	.1867
Family Environment	0.55	7, 392	.7968
Human Nutrition	1.77	7, 848	.0908
Forestry	0.13	3, 114	.9430
Engineering Graphics	1.20	7, 140	.3048
French	0.64	3, 60	.5901
Food Science	1.80	7, 196	.0895
Geography	1.42	7, 975	.1932
Geology	1.07	7, 807	.3782
History	2.18	7, 657	.0343
Hotel, Restaurant, and Institution Management	1.50	3, 449	.2144
Metal Fabrication	1.08	7, 255	.3793
Electronics	1.50	7, 144	.1709
Mass Communications	2.17	7,1221	.0345
Journalism	0.69	7, 141	.6819
Leisure and Recreation	1.75	7, 262	.0985
College Algebra	2.11	7, 224	.0437
Calculus	1.19	7, 222	.3073
Materials Science	0.62	3, 219	.6027
Music Theory	0.71	3, 93	.5508
Philosophy	1.74	7, 333	.0983
General Physics	0.93	7, 143	.4835

Table 46 (continued).

COURSE	F	DF	PROB>F
American Government	1.65	7, 635	.1185
Psychology	2.41	7, 986	.0189
World Religions	2.14	7, 485	.0380
Educational Computing	0.58	7, 119	.7750
Sociology	1.07	7, 450	.3839
Spanish	0.65	3, 59	.5845
Speech	0.49	7, 141	.8440
Statistics	1.91	7, 263	.0676
Textiles and Materials	1.94	7, 129	.0683
Human Anatomy	0.69	7,1794	.6835

taken. These missing values probably do not represent any systematic differences among these students, since the sample sizes for each individual course are generally still rather large, and the missing values appear to be somewhat uniformly distributed among the fifty courses.

Only six of the fifty analyses resulted in significant differences, at the .05 level, across the semesters, and of these, the smallest sample size was n = 179 for Child Development (p = .0260). This sample is still large by almost every standard, so it is again conjectured that the statistically significant differences are primarily a function of the large number of students enrolled in these courses, and do not represent actual differences in the ACT composites for different semesters. There appears to be even stronger evidence among the ACT composite scores, than among the average course grades, that little or no differences occur from one semester to another.

Composite Difficulty Estimates Using ACT Composites

As seen with the grade distributions, it appears to be the case here as well that few, if any, significant differences exist among the distributions of ACT composite scores across the semesters. It again seems reasonable, therefore, to combine the data from all eight semesters to get one combined estimate of course difficulty, for each course, based on the ACT scores. This was done, and the corresponding means, in ranked order, and their standard deviations appear in Table 47.

Calculus, Engineering Graphics, and Computer Programming rank one, two, and three, respectively, as the courses with the highest average ACT composites. On the other end of the scale, Child Development, Leisure and Recreation, and Family Environment were the courses with the lowest mean composite scores. It is interesting to look at the standard deviations as well. The three highest-rated courses were also among those with the smallest standard deviations. In fact, only General

Table 47. Means and standard deviations of ACT composite distributions for eight semesters

COURSE	MEAN	STD DEV
Calculus	25.248	3.568
Engineering Graphics	25.230	3.694
Computer Programming	25.080	3.692
Economics	23.950	4.135
Botany	23.928	3.960
General Physics	23.728	3.472
Philosophy	23.625	4.170
Geography	23.263	4.360
Architecture	23.033	4.176
History	23.033	4.245
Spanish	23.000	4.107
World Religions	22.903	4.538
College Algebra	22.901	3.877
Literature	22.869	3.769
Community and Regional Planning	22.839	3.766
Forestry	22.797	3.822
Anthropology	22.782	4.743
Journalism	22.752	4.111
Metal Fabrication	22.726	3.793
Accounting	22.720	4.050
Electronics	22.638	3.767
Speech	22.611	4.514
Music Theory	22.588	4.643
Astronomy	22.545	4.135
French	22.531	4.827
Statistics	22.528	4.338
Biochemistry	22.497	4.211
Psychology	22.478	4.277
Entomology	22.448	3.903
Crop Production	22.346	4.355
American Government	22.309	4.141
Chemistry	22.307	4.380
Sociology	22.118	4.376
Mass Communications	21.801	4.378
Drawing	21.727	4.378
Food Science	21.637	4.693
Human Anatomy	21.602	4.308
English Composition	21.530	3.954
Biology	21.486	4.290
Geology	21.388	4.183
Art History	21.312	4.387
Educational Computing	20.583	4.787

Table 47 (continued).

COURSE	MEAN	STD DEV
Human Nutrition	20.516	4.392
Materials Science	20.489	4.242
Hotel, Restaurant, and Institution Management	20.351	4.136
Home Economics	20.306	4.317
Textiles and Materials	20.088	4.050
Family Environment	19.768	4.879
Leisure and Recreation	19.681	4.440
Child Development	19.371	4.471

Physics, with a standard deviation of 3.472, had less variability among the individual ACT composites than did Calculus, Engineering Graphics, and Computer Programming. Unlike the rankings based on average grades, in this case the courses rated as most difficult also have the least amount of variability, indicating that the caliber of students enrolled in these courses is more consistent, in general, than in the rest of the courses.

Again, six of the ten highest-rated courses are ones which have strong mathematical and/or technical components, although it is not the same group of six that was similarly rated using the average grades. Perhaps the largest difference between these rankings and those based on the average grades can be found at the lower end of the list. The courses rated as the least difficult on this index are almost exclusively from the colleges of Education and Family and Consumer Sciences. This largely agrees with how these courses were rated in the rankings based on perceptions of difficulty.

One final observation on these means is that 23 of the 50 values are between 22.00 and 23.00. Almost half the courses have average ACT composites in this relatively small range, indicating perhaps that meaningful distinctions can be made only on the extremes of the distribution, and that for a large percentage of the courses the average ACT composite of the enrolled students is virtually the same.

Composite Estimates of Difficulty

Ranks and Correlations

Four separate estimates of course difficulty had now been obtained for each of the fifty courses identified in this study. These estimates were compared to determine if they were individually estimating unique aspects of course difficulty, so they could be combined into one composite estimate, or if they were in some way measuring the same things, so that only one of the indices could perhaps be used as an index of course difficulty. The ranks for each course, on each of the four indices, are given in Table 48. An examination of these ranks reveals both similarities and differences within the ranks for the various courses.

For example, Calculus, General Physics, and Architecture were consistently rated among the more difficult courses on all four indices, while Home Economics, Leisure and Recreation, Hotel, Restaurant, and Institution Management, and Child Development were rated among the less difficult. Other courses which were also somewhat consistently rated were Astronomy, History, Metal Fabrication, Journalism, and American Government. Most of the rest of the courses were rated substantially different on at least one of the four indices, with Biochemistry, Biology, Forestry, Music Theory, and College Algebra among those with the larger discrepancies.

To determine the extent to which these indices agreed, or disagreed, Spearman's rho values were calculated among the ranks for perceived difficulty, perceived amount of work, average grade, and average ACT composite. The corresponding values are given in Table 49. The strongest

Table 48. Ranks of the courses for the four indices of course difficulty

COURSE	PERCEIVED DIFFICULTY	AMT WORK	AVE GRADE	AVE ACTC
Accounting	11	10	5	20
Crop Production	27	27	36	30
Anthropology	25	30	43	17
Architecture	8	4	10	10
Drawing	32	14	29	35
Art History	36	37	22	41
Astronomy	24	29	20	24
Biochemistry	4	5	34	27
Biology	14	18	4	39
Botany	18	22	19	5
Child Development	47	46	39	50
Chemistry	2	2	3	32
Computer Programming	7	7	26	3
Community and Regional Planning	34	33	27	15
Economics	19	23	50	4
English Composition	17	11	13	38
Literature	22	17	28	14
Entomology	21	26	45	29
Home Economics	49	49	46	46
Family Environment	48	48	35	48
Human Nutrition	41	44	31	43
Forestry	39	38	18	16
Engineering Graphics	6	6	37	2
French	10	12	33	25
Food Science	38	42	40	36
Geography	37	36	12	8
Geology	31	34	8	40
History	16	19	11	9
Hotel, Restaurant, and Institution Management	43	39	49	45
Metal Fabrication	20	20	15	19
Electronics	5	9	16	21
Mass Communications	42	41	30	34
Journalism	28	21	32	18
Leisure and Recreation	50	50	42	49
College Algebra	29	24	1	13
Calculus	1	1	2	1
Materials Science	15	16	23	44
Music Theory	45	47	6	23
Philosophy	23	31	38	7

Table 48 (continued).

COURSE	PERCEIVED DIFFICULTY	AMT WORK	AVE GRADE	AVE ACTC
General Physics	3	3	7	6
American Government	26	32	21	31
Psychology	33	35	17	28
World Religions	44	45	48	12
Educational Computing	30	28	41	42
Sociology	40	43	24	33
Spanish	13	13	47	11
Speech	35	25	44	22
Statistics	9	8	25	26
Textiles and Materials	46	40	9	47
Human Anatomy	12	15	14	37

agreement was between perceived difficulty and perceived amount of work. This was not surprising, since it was apparent from earlier comparisons that many students appeared to equate difficulty with amount of work. The Spearman rho value of .954 lends strong support for this conclusion and reinforces the conclusion that these two indices of difficulty are largely measuring the same construct.

The strongest disagreement was between the ranks based on average grades and those based on average ACT composites. The Spearman rho value of .144 indicates that little relationship exists between the standardized test

Table 49. Pairwise correlations among the ranks for the four indices of course difficulty

	PERCEIVED DIFFICULTY	AMT WORK	AVE GRADE	AVE ACTC
Perceived Difficulty	1.00	.954	.343	.521
Perceived Work			.348	.490
Average Grade				.144
Average ACT Composite				

scores of students enrolled in a course and the grades given to those students in that course. It is somewhat disillusioning to realize that students with more academic potential, as measured by standardized test composites, are not achieving more academic success, as measured by the grades awarded. To be sure, a one-to-one correspondence between these two measures would not be expected, but, intuitively, one would expect more agreement than is exhibited here.

The relationships between the perceptions indices and average grades and average ACT composites respectively were in only moderate agreement. The Spearman rho values ranging from .343 to .521 indicate that the perceptions of difficulty are somewhat different from what actually transpires in terms of average grades and average ACT scores, but these coefficients are large enough to indicate that the students' perceptions have at least some basis in fact.

In addition to calculating correlation coefficients among the ranks for these indices, correlations were also investigated among the actual means themselves, after checking each of the indices for possible departures from normality. The only one of the four indices showing any non-normal characteristics was the ACT composite scores. The p-value corresponding to the Shapiro-Wilk statistic for testing the null hypothesis that the data come from a normal distribution was .0459, which is marginally significant. However, an examination of a stem and leaf plot revealed that the distribution is largely symmetric, with a couple of outliers on each end, and a large number of values in the middle, making the shape rather more peaked than normal. The normal probability plot did not exhibit any marked departures from what would be expected, so it would not be unreasonable to state that this distribution is approximately normal as well. These coefficients are presented in Table 50.

There were not any major differences between these coefficients and those previously calculated on the ranks.

Table 50. Pairwise correlations among the means for the four indices of course difficulty

	PERCEIVED DIFFICULTY	AMT WORK	AVE GRADE	AVE ACTC
Perceived Difficulty	1.00	.960	-.370	.631
Perceived Work			-.354	.607
Average Grade				-.198
Average ACT Composite				

The perceived difficulty and the perceived amount of work were still very strongly related, and the average grades and average ACT composites were not, although a slight improvement was shown. The negative signs on the values calculated using the average grades are a reflection of the scale used to measure grades. A low average grade corresponds to a more difficult course, which is the opposite of what occurs on the other three indices.

The largest differences occurred between the perceptions indices and the average ACT composites, with these values increasing at least .110 in each case. This corroborates further that the perceptions of which courses are more difficult is indeed related to the average standardized test scores for students enrolled in these courses. It is somewhat less strongly related to the average grades given in these courses, but there is some relationship there also.

Composites

Given that the two indices based on students' perceptions were so highly correlated, and that earlier comparisons of the corresponding means and ranks on these indices appeared to indicate that they were really two different measures on the same construct, these two indices were combined into one index of perceived difficulty. This was done by adding the corresponding means for each of the fifty courses and ranking them from largest to smallest. For most of the courses, this had little effect on their corresponding places among the ranks. For a few courses, for example, Drawing, which was ranked considerably differently on the two indices, this had the effect of averaging the two disparate ranks. These ordered means are displayed in Table 51.

These combined values of perceived difficulty were correlated with the average grades and average ACT composites. The Pearson r values of -.366 and .625, respectively, are very consistent with what was found with the two separate indices of difficulty perceptions. It appears that no meaningful information has been lost by

Table 51. Composite estimates of perceived course difficulty combining perceived amount of work with perceived difficulty

RANK	COURSE	PERCEIVED DIFFICULTY
01	Calculus	15.0343
02	Chemistry	14.6186
03	Biochemistry	14.3775
04	General Physics	14.3205
05	Engineering Graphics	14.1701
06	Computer Programming	13.8531
07	Electronics	13.6891
08	Architecture	13.5881
09	Accounting	13.0730
10	Statistics	12.9844
11	French	12.7584
12	Human Anatomy	12.5908
13	English Composition	12.4406
14	Spanish	12.3943
15	Materials Science	12.2461
16	Biology	11.9775
17	History	11.8546
18	Literature	11.7511
19	Botany	11.4676
20	Metal Fabrication	11.4635
21	Economics	11.4083
22	Drawing	11.3529
23	Journalism	11.1509
24	Entomology	11.0644
25	Anthropology	10.8610
26	Astronomy	10.8269
27	Philosophy	10.8109
28	Crop Production	10.7161
29	College Algebra	10.6637
30	Educational Computing	10.6113
31	Speech	10.6002
32	American Government	10.5945
33	Geology	10.3201
34	Community and Regional Planning	10.2801
35	Psychology	9.9997
36	Art History	9.6603
37	Geography	9.6042
38	Food Science	9.5087
39	Mass Communications	9.5044
40	Hotel, Restaurant, and Institution Management	9.4863

Table 51 (continued).

RANK	COURSE	PERCEIVED DIFFICULTY
41	Forestry	9.4783
42	Human Nutrition	9.3855
43	Sociology	9.3467
44	Textiles and Materials	9.3003
45	World Religions	9.2181
46	Music Theory	8.9767
47	Child Development	8.7173
48	Family Environment	8.2898
49	Home Economics	7.7081
50	Leisure and Recreation	6.1889

combining these into the one index of perceptions.

At this point, three separate indices existed for estimating course difficulty. The pairwise correlation coefficients among the three indicated that there was some agreement in the rankings, as well as among the means themselves, but none of the correlations could be described as strong. It seemed reasonable, therefore, that each of the three could be measuring aspects of course difficulty which were, to at least some degree, unique from the other two. Combining the three indices would draw upon each of these separate aspects and result in one composite index that should give reasonable estimates of course difficulty. Since each of the indices was calculated on a different scale, it was decided to standardize the means for the fifty courses on each index individually, and combine the standardized means to obtain the desired estimates of course difficulty. The resulting composites of the standardized estimates, combining perceived difficulty with average grade and average ACT composite, for each course, are given in Table 52.

Calculus, with a composite value of 6.19, was far and away the most difficult course when the three indices were combined into one. General Physics, Computer Programming, and Chemistry followed, with composites of 3.69, 3.52, and 3.49, respectively. Once again, each of the nine highest-rated courses had a definite mathematical and/or technical nature to them, while the corresponding group of courses on the lower end of the list were ones with a consumer and/or family orientation.

It is interesting to note that the two courses which were on opposite extremes of the grade distribution rankings, College Algebra and Economics, were both regressed back toward the center. College Algebra, with a composite value of 2.67, was ranked 7th overall, while Economics, with a value of -0.80, was ranked 34th. Both of these rankings seem intuitively more reasonable than their

Table 52. Composite of standardized estimates of course difficulty combining perceived difficulty with average grade and average ACT composite

RANK	COURSE	DIFFICULTY
01	Calculus	6.1894
02	General Physics	3.6918
03	Computer Programming	3.5236
04	Chemistry	3.4937
05	Engineering Graphics	3.1884
06	Accounting	2.8447
07	College Algebra	2.6652
08	Architecture	2.5028
09	Electronics	2.1263
10	Botany	1.8160
11	History	1.5685
12	Biochemistry	1.4961
13	Biology	1.4904
14	Statistics	1.1946
15	Metal Fabrication	1.0414
16	Human Anatomy	0.7991
17	Literature	0.7471
18	French	0.7289
19	English Composition	0.6741
20	Geography	0.5660
21	Music Theory	0.3485
22	Astronomy	0.3002
23	Philosophy	0.2475
24	Journalism	0.0970
25	Psychology	0.0827
26	Forestry	0.0354
27	Community and Regional Planning	-0.0178
28	American Government	-0.0664
29	Geology	-0.2417
30	Spanish	-0.2770
31	Drawing	-0.4244
32	Materials Science	-0.6004
33	Crop Production	-0.6275
34	Economics	-0.7973
35	Sociology	-0.9673
36	Anthropology	-0.9674
37	Art History	-1.2996
38	Entomology	-1.3243
39	Mass Communications	-1.3847
40	Speech	-1.4407
41	Textiles and Materials	-1.8252

Table 52 (continued).

RANK	COURSE	DIFFICULTY
42	World Religions	-2.0295
43	Food Science	-2.0673
44	Human Nutrition	-2.4261
45	Educational Computing	-2.4803
46	Family Environment	-3.7729
47	Hotel, Restaurant, and Institution Management	-4.0514
48	Child Development	-4.1172
49	Home Economics	-4.6932
50	Leisure and Recreation	-5.5598

extreme rankings based on average grades.

It is important that caution be exercised in interpreting the relative rankings of the courses within this list. The difference in composite values between the top two courses, 2.50, is about the same as the difference between the courses ranked 14th and 37th. Here almost half of the courses (24) have composite values that lie within the same range as only two courses at the extreme upper end of the scale. For this reason, it would appear to be much more reasonable to use the composite values themselves as estimates of the relative difficulty when comparing these courses and to place little or no emphasis on the respective ranks. This would be especially true for the middle range of the list, although it would likely be applicable throughout the entire range as well.

Regressions

Using the subsample of students which had been selected on the basis of having at least four different course grades for these students, a multiple regression analysis was performed to predict the composite grade point average. The composite grade point average was calculated by adding the grades received in each of the courses and dividing by the number of courses. No weights were given on the basis of number of credit hours per course, as this information was not readily available. The independent variables used in this analysis were the student's ACT composite and his or her high school rank. Of the three hundred thirty-one (331) students selected in the subsample, forty-six (46) had missing values for at least one of the independent variables and were excluded from the analysis.

The results of this analysis are displayed in the ANOVA table on the following page. The R-squared value of .1825, although not very high, is fairly indicative of the difficulty in predicting student performance on the basis of standardized test scores and high school performance.

(Iowa State University reports an R-squared value of around .25 for regressing first-term grade point average on high school rank and ACT composite for between three and four thousand cases each year.)

Source	df	SS	MS	F	Prob > F
Model	2	25.94	12.97	31.48	.0001
Error	282	116.19	0.41		
Total	284	142.13			

The estimated partial regression coefficients, all of which were significant at the .05 level, were 1.985 for the intercept, and 0.040 and -0.011 for ACT composite and high school rank, respectively.

A second analysis was performed using the same students as in the previous one. In this case, a difficulty estimate of the courses taken was used as a third independent variable. This estimate was formed by adding the composite value from Table 52, for each of the courses taken. The results of this analysis are given in the ANOVA table on the following page. The R-squared value of .2765 represents a significant increase from the previous model.

Source	df	SS	MS	F	Prob > F
Model	3	39.30	13.10	35.80	.0001
Error	281	102.83	0.37		
Total	284	142.13			

The value of the F statistic for testing the null hypothesis that the original model was adequate was 36.50, with a corresponding p-value of .0001. The estimated partial regression coefficients, which were all significant at the .05 level, were 1.497 for the intercept, and 0.057, -0.011, and -0.040 for ACT composite, high school rank, and the difficulty estimate, respectively.

Since the three indices of course difficulty appeared to be measuring different aspects of the courses, it was conjectured that using these estimates separately might result in even larger increases in the percent of variance explained. To investigate whether or not this was the case, another multiple regression analysis was performed on the same data, this time using the three individual estimates of course difficulty as independent variables in place of the composite estimate used in the previous analysis. This did indeed result in an increase in R-squared to .3104, but only two of three difficulty indices were significant predictors. Both the average course grade estimate and the average ACT composite estimate explained additional significant portions of the variability in student grades, but the difficulty perceptions did not. For this reason, one additional regression analysis was performed, using the original two predictors, ACT composite and high school rank, plus two indices of course difficulty, those based on average course grades and on average ACT composites. These results are displayed below:

Source	df	SS	MS	F	Prob > F
Model	4	44.09	11.02	31.48	.0001
Error	280	98.04	0.35		
Total	284	142.13			

The R-squared value of .3102 represents a non-significant drop of only .0002 from the model that contained all three indices of course difficulty separately. The partial regression coefficients, each of which was significant at the .05 level, were 1.043 for the intercept, 0.057 for ACT composite, -0.010 for high school rank, 0.311 for course difficulty based on average course grade, and -0.030 for course difficulty based on average ACT composite.

A comparison of this final model with the original model containing no estimates of course difficulty as independent variables revealed a significant improvement in the prediction of student performance. The F statistic for testing the null hypothesis that the original model was adequate was 25.92, which is statistically significant at any reasonable significance level.

An alternative usage of course difficulty estimates in the prediction of academic performance would be to use them as weights for the individual course grades. The utility of this method was investigated by multiplying each grade by the difficulty estimate to obtain "weighted" course grades. These weighted grades were regressed on high school rank and ACT composite score and the resulting value of R-squared was determined. The difficulty estimates were scaled before multiplying so that only positive values were used as weights. Several different scales were tried and the resulting values of R-squared ranged from .2846 to .3031, indicating that the results were largely robust to changes in scale.

There was also strong agreement between this group of regressions as a whole, and the regressions using the difficulty estimates as additional predictor variables.

The implication is that regardless of whether these course difficulty estimates are used as weights to obtain grades which reflect the level of difficulty of the course or as independent variables in the model, the proportion of the variance in academic performance which is explained by the variables in the model is significantly increased. It appears that the use of course difficulty estimates can significantly improve the prediction of student performance.

CHAPTER VI: SUMMARY AND DISCUSSION

Summary of Research Problem and Method

The problem was to determine the extent to which differences existed among the difficulty levels of introductory-level college courses and to obtain quantitative measures of these difficulty levels. To this end, two studies were undertaken. A pilot study, using a sample of forty (40) courses, collected data on students' perceptions of course difficulty. In the main study, a sample of fifty (50) courses was selected and data were collected on these courses in three distinct areas: students' perceptions, average grades given, and average ACT composite of enrolled students.

The perceptions data were analyzed to investigate similarities and differences which existed between and among various demographic subgroups of the students who were sampled. Means and ranks were calculated and compared for consistency within courses across the various student groupings. Correlations between these means and ranks were calculated to measure the extent of that consistency. Multiple regression analyses were used in an attempt to predict difficulty on the basis of student characteristics.

Factor and cluster analyses identified groups of similar courses which might be used to explain underlying characteristics or traits of difficult courses. Consistency over time was investigated by comparing the results of the pilot study with those of the main study.

The average grade and average ACT composite data were analyzed to determine whether these measures were consistent over time, both as individual courses and as a group of courses. Means and ranks were again determined for each course, for each semester in which it was taught, from the fall of 1986 through the spring of 1990, excluding summer sessions. These means, as well as the individual grades and ACT scores, were compared using analysis of variance techniques.

Finally, three separate measures of course difficulty were compared and correlated, to determine the extent to which they agreed in their estimations for the individual courses and for the group of fifty courses as a whole. These three were combined into one composite measure of course difficulty, and multiple regression was used to investigate whether the prediction of academic performance could be enhanced by using these combined course difficulty estimates as an additional predictor in the model.

Conclusions

Perceptions

As was stated in Chapter One, it is generally accepted that courses differ in their relative levels of difficulty. For what could be a variety of reasons, some courses are decidedly more difficult than others. This also appears to be the case in the perceived difficulty of the courses. Students were very consistent in their ratings of course difficulty, both in the pilot study and in the main study, and the general theme that seemed to be common to most, if not all, of the separate rankings was that courses which involve mathematics, either directly or indirectly, are more difficult than those which do not. On the other hand, courses which are more consumer and/or family oriented in nature were largely seen as the "easier" courses.

It is probably more than just coincidence that the "more difficult" courses are closely related to disciplines which society would characterize as "male-dominated," while those which are "less difficult" are compatible with the "female-dominated" disciplines. That the perceptions of the students surveyed, who were selected in a manner to be representative of the entire student population, reflect the overall perceptions of society in general, indicates that it was very likely just that, a reflection of the values and beliefs of the society of which these students are a part.

Perhaps as important as the mean ratings and relative rankings of the courses themselves was the consistency with which these means and rankings were obtained across the different subgroups that were identified. This was true with the perceptions of the amount of work involved in each course as well. To be sure, some differences existed in the various rankings produced by these different groupings of the surveyed students. However, as interesting as some of these differences were, it was really the similarities, as evidenced by the strong correlation coefficients, that should be emphasized. The fact that males' perceptions were essentially the same as females', even in regard to the courses which came from the male- and female-dominated disciplines respectively, indicates that the courses themselves possess these traits and that it is not a function of the students. The same claim can be made in relation to student classification levels, and the college of enrollment, where the pairwise correlations between the various levels of these variables were again very strong in both studies.

The only one of these demographic characteristics that appeared close to exhibiting a major difference between the rankings for different levels, was whether or not the course had actually been taken, and this was only observed in the main study. Although the correlation coefficient of .75 was relatively high, it was the lowest of all the pairwise values calculated on groups of students which differed on the levels of one of these characteristics. This represents a decrease of .10 from a similar value in the pilot study, but does not correspond to a statistically significant difference. (For the data on the perceptions of the amount of work, this value was .85, and did not indicate that differences existed in relation to whether or not students had had the experience of actually taking the course.)

The apparent conclusion is that students' perceptions are very uniform, even to the point of being relatively independent of their experiences. They appear to be stable as well, not substantially changing from one semester to the next. The implication is that the level of difficulty which these courses are perceived to have, is a function of the course. Different groups of students at the same time, as well as at a different time, essentially agreed on the relative difficulty of these courses. There seems to be little or no evidence that the students' perceptions were related to whom the particular students were, or to what particular characteristics they may have possessed. These are characteristics of the courses themselves.

Further evidence supporting this claim can be seen from the results of the regression analyses performed on these data. With only one of the R^2 values exceeding .15 (Accounting, with 15.5% of the variance in difficulty level explained by the set of predictor variables), there seems to be little basis for asserting that variance among difficulty levels can be explained by the characteristics of the students. Yet, there certainly is variability among the mean difficulty levels for the different courses. It certainly is not the case that these differences are just random fluctuations, so there must exist explanations as to why some courses are more difficult than others.

If the research by Tanner (1986), suggesting an abstractness of concept as a contributing factor, and that by Horodezky (1983) and Solomon (1983), relating difficulty to vocabulary, are correct, then difficulty should be measurable as a function of the content of the course. That this is what is being measured by these perceptions of difficulty is suggested by the general trend of the mathematically-related courses to appear toward the upper end of the rankings and the consumer-related courses to group together at the opposite end. Since those courses which are at least generally related in content are perceived similarly in regard to difficulty level, this appears to be a reasonable claim.

Additional evidence in support of this concept was found in the results of the factor and cluster analyses. That courses appear to form identifiable groups based on both the factor analyses and the hierarchical clustering techniques suggests that the course content may indeed weigh heavily in these perceptions of difficulty. Many potential content areas exist which could contribute to the relative difficulty of courses. That areas such as "mathematically based," "family and consumer related," "earth and/or life sciences," and "foreign languages" are easily recognizeable and demonstrably repeatable suggests that different content areas may relate directly to varying difficulty levels.

There appears to be substantial evidence indicating that students' perceptions of course difficulty are verifiable attributes of the courses themselves. Furthermore, these perceptions are both replicable, and consistent, by students who differ on various demographic traits.

Grade distributions

The question of stability over time in regard to the average grades given in these courses was investigated by calculating correlation coefficients among the eight semesters of data and by the use of analysis of variance procedures. The correlations ranging from .318 to .695 (see Table 41) do not make a strong case for stability, but, at the same time, do not indicate a lack of stability either. Well over half of the pairwise values are larger than .5 (21 of 28), which indicates that, in general, the average grades in one semester were largely consistent with the others.

These results, when viewed in conjunction with the ANOVA results, make a somewhat stronger case in support of the claim that these grades do not substantially change from one semester to another. The test for overall differences among the eight semesters was clearly non-significant. There is no evidence to indicate that, as a group, the mean course grades varied across semesters. But, even if the entire group as a whole remained relatively unchanged, individual courses could vary considerably within this group when compared across semesters. The results from these analyses were somewhat less clear.

Approximately half of the courses (29 of 50) exhibited statistically significant p-values, indicating that at least one mean grade was considerably different from the others. However, several of these "significant" results are clearly affected by the extraordinarily large sample sizes, which results in extremely small MSE's and hence large and "significant" F-values. Eight of these twenty-nine courses had in excess of 1000 students enrolled in the eight semesters, and nine others had a total of between 500 and 1000 students. These seventeen (17) significant results can very likely be attributed to the large samples. Any claim that the differences found among the means represent actual differences, based on this evidence, would be "tenuous," to say the least. Of the twelve courses remaining, only six had a total of fewer than 200 students, and Spanish, with a sample size of $n = 80$ and a p-value = .0423, was the only significant result based on a sample of fewer than 100 individuals. Therefore, the evidence, although not absolutely conclusive, seems to be indicating that average course grades remain largely unchanged from one semester to another.

It should be emphasized that the average grade for each course in each semester, was calculated from only one section which was randomly selected from among those which were taught during that semester, if more than one was offered that term. This could also account for some of the differences across semesters. In courses such as English Composition and College Algebra, where upwards of twenty or thirty sections are taught each term, the average grades across all these sections are likely to be much closer from one semester to another than when only one section is selected for inspection and subsequent analysis.

The conclusion, again, is that the average grades do appear to remain largely unchanged over time. Some courses exhibited more across-semester disparity in their mean grades than did others, but the predominant trend seems to be that the average grades do not appreciably change from one semester to another.

<u>ACT composite score distributions</u>

The average values of the ACT composites for students enrolled in these courses were investigated using the same procedures and techniques as with the grade distributions in the previous section. The results of these analyses were similar to those done on the average grades; however, they indicate much greater stability than did the grades.

An examination of the pairwise correlation coefficients among the means revealed that fifteen (15) of the twenty-eight (28) values were .700 or higher, larger than any of the similar values for the average grades. This seems to indicate that ACT composites are less variable over time than were the grades.

The ANOVA results comparing the group of courses across the semesters were very comparable to the results on the average grades, and those for the individual courses resulted in only six with statistically significant results. Of these six, only Child Development had fewer than 200 students enrolled in the eight semesters. It can again be conjectured that the significance is a consequence of the large sample sizes, and that no real differences exist among the average ACT scores across the semesters.

Comparison of the different indices of course difficulty

The primary question of interest in this study was one of determining the degree to which possible measures of course difficulty were in agreement with each other. After showing that each of these measures was individually consistent across different groupings of students, and/or stable over time, they were compared to each other. The pairwise correlation coefficients revealed both similarities and differences.

The perceived difficulty and the perceived amount of work were so strongly related to each other, that the obvious conclusion was that they were in reality measuring the same construct. That is, students, in general, did not distinguish between difficulty and amount of work, but treated these two labels as different names for the same concept. A course that was perceived to be difficult was also perceived to involve a lot of work, while those courses which were perceived to require less work were also perceived to be easier. Concluding these measures to be essentially the same, it seemed to be reasonable to combine them into one index of perceived course difficulty.

The correlations between this new index of perceived difficulty and the measures based on average grades and average ACT composites, respectively, were decidedly weaker than between the two measures of perceptions (but definitely stronger than between the measures based on averages [$r = -.198$]). This correlation between perceived difficulty and average ACT composites was moderately strong (r = .625), but the coefficient between perceived difficulty and average grades was rather weak (r = -.366). The indication seemed to be that each of these measures was, at least to some extent, measuring unique aspects of course difficulty. Should this indeed be the case, then combining them into one measure of course difficulty would draw from each of these components and yield composite estimates of course difficulty that would be reflective of several differing aspects of this concept.

The final rankings (as shown in Table 52) appear to have done just that. Courses such as College Algebra and Economics, which were rated at the extreme end on one of the indices but not on the other two, were rated closer to the center on the final composite, partially eliminating the effect of those extreme rankings. Other courses, such as Calculus, Home Economics, Child Development, and Leisure and Recreation which were ranked on the extreme end of all three indices were ranked similarly here.

It is somewhat reassuring as well to find groups of similar courses ranked in a similar fashion. For example, many of the mathematically-based courses are ranked in close proximity to each other, as are most of the courses dealing with consumer and family relations. This is also true for Biology, Botany, and Biochemistry, which are at least somewhat similar in content, as well as Sociology and Anthropology (whose ratings of -0.9673 and -0.9674 are virtually identical).

Finally, the results of the regressions of average grades on ACT score, high school rank, and estimates of course difficulty, indicate that the prediction of academic performance can be improved by incorporating a measure of the difficulty level of the coursework completed (or to be completed) as additional predictors. It is interesting to note that significant increases in the percentage of variance explained were achieved using data that came entirely from university records. While the students' perceptions of difficulty were used as part of the composite estimates of course difficulty, a greater increase in R^2 was seen when the individual estimates were used in place of the composites. When this was done, the perceptions of difficulty did not contribute significantly. The implication is that all the information needed to incorporate measures of course difficulty into this prediction process is information that every college or university already has in its files. By utilizing information about average grades awarded and average ACT composites of enrolled students, better predictions of academic performance can be obtained than when such information is not utilized.

Recommendations for Further Study

While this study has contributed to answering the question of how courses differ in regard to their levels of difficulty and how these difficulty levels may be measured and used to aid in the prediction of academic performance, there remain aspects of this issue that bear further examination. For example, are these results replicable at other institutions, both public institutions similar to ISU and private schools which may vary considerably in many aspects from Iowa State? Would similar results be found when courses from all levels of the academic curricula are included in the analyses? What would be the effect of including all sections of each course taught during a semester, instead of sampling from just one section? How would perceptions of difficulty compare to perceptions of the amount of work involved if these data were collected from different samples of students using different survey instruments? What instructor effect is present on the average grades awarded in the courses? Within each college of enrollment, are there differences with respect to major department in either perceptions of difficulty or average grades awarded? All of these are questions whose answers could shed additional light on the issue of course difficulty.

In addition, some individual courses may bear further examination as well. What is it about Calculus that makes it far and away the most difficult course? Why did courses such as Economics and College Algebra have average grades which were so markedly different from how students' perceived these courses to be? Why do some courses with high average ACT composites (e.g., Calculus, General Physics, Geography, Architecture, and History) have relatively low average grades, while others with similarly high ACT scores (e.g., Engineering Graphics, Computer Programming, Economics, Philosophy, and Botany) have average grades which are also relatively high?

Implications

The concept of "course difficulty" appears to be real and verifiable in several ways. However, the utility of this concept must be weighed. Could the degree of student success in a course be more predictable by using course difficulty estimates? Research by Andrews (1987) suggests that this is indeed possible. If significant improvements in prediction were obtainable, this could lead to improved advising and counseling of students concerning their selection and numbers of courses in which to enroll. In view of Rasor's findings that students drop courses primarily because they are too difficult, such improvements in advising and counseling may have a direct effect on students' academic success and ultimately on their learning.

Brevin's article (1976) would indicate that such improvements could also lead to more equitable admission standards and improve the prediction of program success. It would also seem to be possible to use such course difficulty estimates to provide an alternative basis for recognition and reward of outstanding performance. Perhaps the number of credit hours awarded courses could be adjusted to reflect difficulty, so that the additional time required to learn in more difficult courses, as Gettinger and White (1979) have shown, could be more accurately reflected in grade point averages, or weighting methods reflecting variability in course difficulty could be produced which reduce social bias regarding gender and occupational interest.

Finally, by understanding this phenomenon of differences in course difficulty, perhaps we could gain insight into the attitudes, values, instructional methods, content characteristics, and evaluation processes which contribute to the gain in knowledge of any subject. Clearly the implications for application of course difficulty measures encompass a wide range of practical and philosophical issues. The central issue, however, as it should be with all educational research, is whether these insights can lead to improved student learning. It appears that such potential exists for using measures of course difficulty to do just that. The foundation has been laid. Now the work must proceed.

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APPENDIX A: ADDITIONAL TABLES

Table 53. Means and standard deviations of grade distributions for fall semester 1986

COURSE	MEAN	STD DEV
Calculus	1.571	0.921
Human Anatomy	1.755	1.046
Music Theory	1.801	1.680
Biology	1.844	1.224
Accounting	2.025	1.194
Journalism	2.027	0.620
Chemistry	2.040	1.466
Metal Fabrication	2.093	1.098
Art History	2.125	0.751
Geology	2.134	1.060
College Algebra	2.167	1.067
Forestry	2.254	0.889
History	2.261	1.032
Psychology	2.315	1.054
Electronics	2.318	1.157
Astronomy	2.334	1.280
Statistics	2.388	1.218
Textiles and Materials	2.418	0.864
Literature	2.420	0.860
General Physics	2.444	1.189
Mass Communications	2.452	0.761
English Composition	2.473	1.090
Geography	2.474	1.074
Materials Science	2.474	0.920
Food Science	2.482	0.990
Spanish	2.501	1.207
Human Nutrition	2.502	0.840
American Government	2.542	1.134
Philosophy	2.591	1.023
Crop Production	2.694	1.115
Educational Computing	2.704	0.870
Sociology	2.746	1.064
Biochemistry	2.772	0.876
Leisure and Recreation	2.788	1.145
Economics	2.833	0.907
Botany	2.843	1.055
Family Environment	2.908	0.932
Child Development	2.925	0.885
Anthropology	2.933	0.758

Table 53 (continued).

COURSE	MEAN	STD DEV
French	2.950	1.186
Drawing	2.982	0.849
Engineering Graphics	3.015	0.694
Speech	3.123	0.890
World Religions	3.133	0.633
Architecture	N/A	
Computer Programming	N/A	
Community and Regional Planning	N/A	
Entomology	N/A	
Home Economics	N/A	
Hotel, Restaurant, and Institution Management	N/A	

Table 54. Means and standard deviations of grade distributions for spring semester 1987

COURSE	MEAN	STD DEV
Calculus	1.556	1.312
College Algebra	1.758	1.134
Biology	1.902	1.126
Accounting	1.921	1.075
Chemistry	1.973	0.840
Human Nutrition	2.060	0.872
General Physics	2.096	1.018
Architecture	2.199	1.116
English Composition	2.227	0.896
History	2.289	1.180
Child Development	2.309	0.960
Metal Fabrication	2.350	1.167
Geography	2.360	1.027
Geology	2.362	1.056
Mass Communications	2.364	0.783
Botany	2.394	1.092
Family Environment	2.438	1.099
Textiles and Materials	2.458	1.034
Philosophy	2.486	0.986
Psychology	2.488	0.958
Electronics	2.514	0.974
Biochemistry	2.594	1.043
Leisure and Recreation	2.612	0.855
Literature	2.667	0.806
Crop Production	2.675	0.894
Sociology	2.679	1.119
Statistics	2.679	1.088
Human Anatomy	2.685	0.999
Drawing	2.734	1.193
Food Science	2.821	0.726
Engineering Graphics	2.826	0.703
Astronomy	2.867	1.263
World Religions	2.871	0.714
Anthropology	2.878	1.121
American Government	2.879	0.995
Speech	2.917	0.886
Art History	2.924	0.900
Educational Computing	2.970	0.868
Journalism	3.048	0.710
Hotel, Restaurant, and Institution Management	3.239	0.739
Economics	3.250	1.128

Table 54 (continued).

COURSE	MEAN	STD DEV
Computer Programming	N/A	
Community and Regional Planning	N/A	
Entomology	N/A	
Home Economics	N/A	
Forestry	N/A	
French	N/A	
Materials Science	N/A	
Music Theory	N/A	
Spanish	N/A	

Table 55. Means and standard deviations of grade distributions for fall semester 1987

COURSE	MEAN	STD DEV
Music Theory	1.689	1.020
General Physics	1.750	1.013
Accounting	2.024	1.139
Biology	2.029	1.093
Chemistry	2.111	1.166
Calculus	2.119	1.294
Geology	2.151	0.918
Art History	2.186	0.852
College Algebra	2.190	1.256
Textiles and Materials	2.197	0.717
Electronics	2.200	1.036
Astronomy	2.228	1.207
Psychology	2.297	1.085
Metal Fabrication	2.342	0.915
Human Anatomy	2.344	1.251
English Composition	2.360	0.614
Statistics	2.375	1.192
Forestry	2.382	0.993
Geography	2.440	1.022
Drawing	2.445	0.940
Mass Communications	2.468	0.974
Community and Regional Planning	2.485	0.756
French	2.493	1.128
Sociology	2.500	1.117
Family Environment	2.516	0.877
Botany	2.550	1.028
Literature	2.600	0.899
Materials Science	2.613	0.909
Philosophy	2.627	0.735
Crop Production	2.634	1.035
Human Nutrition	2.681	0.831
Biochemistry	2.713	0.832
Computer Programming	2.733	0.997
Anthropology	2.736	0.885
Engineering Graphics	2.754	0.945
American Government	2.852	0.935
History	2.855	1.145
Spanish	3.080	0.650
Food Science	3.094	0.648
Child Development	3.103	1.028
Educational Computing	3.127	0.512
Leisure and Recreation	3.139	0.606
Speech	3.192	0.892

Table 55 (continued).

COURSE	MEAN	STD DEV
Journalism	3.233	0.659
World Religions	3.329	0.535
Economics	3.367	0.675
Architecture	N/A	
Entomology	N/A	
Home Economics	N/A	
Hotel, Restaurant, and Institution Management	N/A	

Table 56. Means and standard deviations of grade distributions for spring semester 1988

COURSE	MEAN	STD DEV
College Algebra	1.445	1.450
Textiles and Materials	1.650	0.759
Accounting	1.762	1.141
Chemistry	1.809	1.583
Metal Fabrication	2.007	0.893
Architecture	2.086	1.082
English Composition	2.125	1.254
Geography	2.132	1.118
Biology	2.176	1.019
History	2.200	1.299
Electronics	2.259	0.939
Human Anatomy	2.261	1.187
Geology	2.303	1.092
Calculus	2.333	1.115
Drawing	2.333	1.134
General Physics	2.334	0.952
Home Economics	2.351	1.207
Biochemistry	2.433	1.110
Crop Production	2.460	0.866
Sociology	2.460	1.021
Human Nutrition	2.544	0.950
Computer Programming	2.571	1.152
Art History	2.630	1.153
Child Development	2.631	1.138
Philosophy	2.695	0.761
Journalism	2.720	0.985
World Religions	2.742	0.768
Literature	2.786	1.093
Educational Computing	2.795	0.989
Astronomy	2.803	1.190
Statistics	2.828	0.891
Mass Communications	2.846	0.936
Entomology	2.909	0.750
Food Science	2.920	0.906
Speech	2.957	0.812
Botany	2.969	0.756
Family Environment	2.973	0.845
Leisure and Recreation	2.976	0.861
Engineering Graphics	3.015	0.774
American Government	3.042	0.842
Hotel, Restaurant, and Institution Management	3.183	0.697

Table 56 (continued).

COURSE	MEAN	STD DEV
Psychology	3.238	0.758
Anthropology	3.386	0.621
Economics	3.586	0.654
Community and Regional Planning	N/A	
Forestry	N/A	
French	N/A	
Materials Science	N/A	
Music Theory	N/A	
Spanish	N/A	

Table 57. Means and standard deviations of grade distributions for fall semester 1988

COURSE	MEAN	STD DEV
Calculus	1.915	1.370
Chemistry	1.916	1.184
College Algebra	1.934	1.448
General Physics	1.950	1.115
Geography	2.098	1.118
English Composition	2.133	0.788
Journalism	2.160	0.765
Accounting	2.176	0.849
Geology	2.183	0.964
Biology	2.183	0.946
Textiles and Materials	2.236	0.954
Sociology	2.306	0.971
Psychology	2.353	1.065
Electronics	2.365	1.079
Human Anatomy	2.367	1.058
Home Economics	2.370	1.279
French	2.438	1.094
Materials Science	2.439	0.913
Speech	2.479	1.357
Metal Fabrication	2.489	0.914
American Government	2.500	1.622
Human Nutrition	2.510	0.969
Literature	2.525	1.124
Music Theory	2.530	0.812
Drawing	2.551	0.951
Food Science	2.557	0.836
Forestry	2.559	0.786
Crop Production	2.594	0.903
Statistics	2.605	1.216
Botany	2.621	0.911
Astronomy	2.634	1.037
Anthropology	2.667	1.029
Family Environment	2.682	0.984
History	2.709	1.004
Biochemistry	2.722	0.832
Computer Programming	2.746	0.981
Art History	2.802	0.982
Community and Regional Planning	2.805	0.894
World Religions	2.815	0.696
Mass Communications	2.859	0.920
Engineering Graphics	2.875	0.884
Economics	2.937	1.452

Table 57 (continued).

COURSE	MEAN	STD DEV
Child Development	2.977	0.912
Philosophy	3.051	0.801
Spanish	3.071	1.070
Educational Computing	3.083	0.602
Leisure and Recreation	3.308	0.423
Architecture	N/A	
Entomology	N/A	
Hotel, Restaurant, and Institution Management	N/A	

Table 58. Means and standard deviations of grade distributions for spring semester 1989

COURSE	MEAN	STD DEV
College Algebra	1.479	1.344
Chemistry	2.033	1.014
Geography	2.062	0.917
Botany	2.130	0.952
Astronomy	2.159	1.062
Biology	2.170	1.070
Calculus	2.173	1.308
Metal Fabrication	2.218	0.947
Statistics	2.280	1.018
Geology	2.297	1.129
Leisure and Recreation	2.413	1.067
American Government	2.430	0.998
Child Development	2.441	1.325
History	2.513	1.065
General Physics	2.521	0.914
Sociology	2.526	1.158
Psychology	2.529	1.183
Computer Programming	2.535	1.046
Literature	2.548	0.979
English Composition	2.560	1.070
Architecture	2.574	0.911
Journalism	2.579	0.463
Drawing	2.592	1.100
Textiles and Materials	2.640	0.787
Biochemistry	2.675	0.981
Accounting	2.682	0.923
Engineering Graphics	2.682	0.935
Philosophy	2.695	0.770
Electronics	2.719	0.763
Food Science	2.750	0.837
Educational Computing	2.773	1.123
Crop Production	2.787	1.135
Anthropology	2.792	0.920
Human Nutrition	2.829	0.817
Speech	2.841	0.810
Human Anatomy	2.862	1.067
Mass Communications	2.904	0.999
Art History	2.928	0.849
World Religions	2.929	0.480
Family Environment	2.957	0.842
Home Economics	2.988	1.067

Table 58 (continued).

COURSE	MEAN	STD DEV
Hotel, Restaurant, and Institution Management	2.993	1.010
Entomology	3.219	0.895
Economics	3.316	0.927
Community and Regional Planning	N/A	
Forestry	N/A	
French	N/A	
Materials Science	N/A	
Music Theory	N/A	
Spanish	N/A	

Table 59. Means and standard deviations of grade distributions for fall semester 1989

COURSE	MEAN	STD DEV
Art History	1.896	1.070
Human Anatomy	1.938	1.033
Chemistry	1.951	1.262
Botany	2.000	1.159
College Algebra	2.099	0.965
Calculus	2.133	1.166
Textiles and Materials	2.144	0.909
Biology	2.191	1.047
Accounting	2.279	1.051
Statistics	2.333	1.000
Astronomy	2.349	1.123
Engineering Graphics	2.403	0.822
Electronics	2.410	1.007
Forestry	2.416	0.946
Community and Regional Planning	2.423	0.795
Philosophy	2.435	0.915
Drawing	2.451	0.874
Music Theory	2.453	1.212
Computer Programming	2.473	1.233
Materials Science	2.473	1.030
Family Environment	2.492	0.870
Metal Fabrication	2.514	0.857
American Government	2.539	0.815
History	2.543	1.179
Biochemistry	2.599	0.905
Educational Computing	2.617	1.239
Mass Communications	2.622	0.726
Geology	2.633	1.019
General Physics	2.667	1.073
Geography	2.685	1.149
Human Nutrition	2.713	0.835
French	2.715	1.107
Literature	2.726	0.567
English Composition	2.760	0.597
Journalism	2.827	0.602
Anthropology	2.870	1.077
Food Science	2.870	0.880
Sociology	2.879	0.846
Child Development	2.885	1.176
Crop Production	2.885	0.895
World Religions	2.941	0.802
Speech	3.091	0.516

Table 59 (continued).

COURSE	MEAN	STD DEV
Economics	3.131	1.038
Leisure and Recreation	3.171	0.999
Home Economics	3.215	1.054
Spanish	3.266	0.500
Psychology	3.322	1.109
Architecture	N/A	
Entomology	N/A	
Hotel, Restaurant, and Institution Management	N/A	

Table 60. Means and standard deviations of grade distributions for spring semester 1990

COURSE	MEAN	STD DEV
College Algebra	1.131	1.265
Biology	1.808	1.048
Calculus	1.862	1.155
Accounting	1.979	1.204
American Government	2.055	1.033
Botany	2.073	0.926
History	2.076	1.071
Literature	2.142	0.860
Sociology	2.160	0.794
Computer Programming	2.244	1.302
General Physics	2.247	1.248
Human Anatomy	2.276	1.156
Engineering Graphics	2.318	1.198
Electronics	2.333	0.811
Architecture	2.374	1.078
Astronomy	2.378	0.707
English Composition	2.407	0.822
Art History	2.421	1.039
Chemistry	2.421	1.199
Mass Communications	2.424	0.932
Geology	2.493	0.973
Geography	2.505	0.863
Journalism	2.536	0.490
Family Environment	2.681	1.059
Drawing	2.684	0.940
Leisure and Recreation	2.705	1.020
Crop Production	2.720	0.934
Textiles and Materials	2.722	0.957
Biochemistry	2.723	0.900
Educational Computing	2.748	1.047
Entomology	2.791	1.021
Statistics	2.800	0.808
Human Nutrition	2.832	0.776
World Religions	2.847	0.705
Metal Fabrication	2.848	0.813
Food Science	2.849	0.807
Child Development	2.896	1.102
Hotel, Restaurant, and Institution Management	2.948	0.706
Psychology	3.000	1.259
Philosophy	3.081	0.682
Anthropology	3.136	0.888

Table 60 (continued).

COURSE	MEAN	STD DEV
Economics	3.175	0.831
Home Economics	3.231	0.880
Speech	3.349	0.639
Community and Regional Planning	N/A	
Forestry	N/A	
French	N/A	
Materials Science	N/A	
Music Theory	N/A	
Spanish	N/A	

Table 61. Means and standard deviations of ACT composite distributions for fall semester 1986

COURSE	MEAN	STD DEV
Calculus	26.061	2.839
Economics	24.867	4.307
Botany	24.727	4.221
General Physics	24.667	3.200
Engineering Graphics	24.158	3.640
Spanish	24.125	2.872
Statistics	24.026	4.541
Journalism	23.348	3.550
Sociology	23.333	5.445
Metal Fabrication	23.286	3.810
College Algebra	23.103	3.648
Anthropology	23.000	4.899
History	22.987	4.231
Speech	22.941	4.867
Forestry	22.886	3.998
Geography	22.873	4.665
Philosophy	22.854	4.217
Crop Production	22.625	5.174
Accounting	22.411	3.825
World Religions	22.342	4.512
Electronics	22.333	4.967
American Government	22.299	3.999
Biochemistry	22.203	4.649
Psychology	22.070	4.115
Music Theory	22.000	5.516
Literature	21.885	3.756
French	21.875	6.541
Drawing	21.824	4.004
Human Anatomy	21.814	4.521
Chemistry	21.692	5.692
Art History	21.625	4.041
Astronomy	21.615	4.770
Geology	21.472	4.402
English Composition	21.190	4.332
Mass Communications	21.128	4.748
Biology	21.074	4.601
Human Nutrition	20.667	4.177
Materials Science	20.630	3.845
Food Science	20.592	3.788
Educational Computing	19.833	4.988
Family Environment	19.243	5.335
Textiles and Materials	19.188	3.468

Table 61 (continued).

COURSE	MEAN	STD DEV
Child Development	17.867	4.462
Leisure and Recreation	16.923	5.564
Architecture	N/A	
Computer Programming	N/A	
Community and Regional Planning	N/A	
Entomology	N/A	
Home Economics	N/A	
Hotel, Restaurant, and Institution Management	N/A	

Table 62. Means and standard deviations of ACT composite distributions for spring semester 1987

COURSE	MEAN	STD DEV
Engineering Graphics	25.850	3.345
Philosophy	25.189	3.604
Calculus	24.900	4.097
Economics	24.393	4.314
Astronomy	24.000	4.375
Anthropology	23.480	4.984
Botany	23.455	4.490
General Physics	23.368	2.910
History	23.142	4.166
Geography	23.068	4.608
World Religions	22.955	4.656
Statistics	22.886	4.801
Architecture	22.851	4.438
Electronics	22.692	3.865
Chemistry	22.500	5.021
English Composition	22.455	3.262
Psychology	22.424	6.139
Speech	22.421	5.640
Metal Fabrication	22.406	3.635
Biochemistry	22.375	4.285
Food Science	22.313	4.785
Crop Production	22.276	4.391
Literature	22.273	4.177
Accounting	22.195	4.383
College Algebra	21.926	4.755
Geology	21.888	4.074
Human Anatomy	21.880	4.404
Biology	21.811	4.562
Mass Communications	21.518	4.817
Child Development	21.273	4.621
Textiles and Materials	21.143	4.127
Drawing	21.000	5.367
Journalism	21.000	3.021
Hotel, Restaurant, and Institution Management	20.932	4.202
Educational Computing	20.765	5.286
Sociology	20.429	5.560
Art History	20.426	5.490
Family Environment	20.191	4.586
American Government	20.105	5.772
Human Nutrition	19.841	4.175
Leisure and Recreation	19.729	4.574

Table 62 (continued).

COURSE	MEAN	STD DEV
Computer Programming	N/A	
Community and Regional Planning	N/A	
Entomology	N/A	
Home Economics	N/A	
Forestry	N/A	
French	N/A	
Materials Science	N/A	
Music Theory	N/A	
Spanish	N/A	

Table 63. Means and standard deviations of ACT composite distributions for fall semester 1987

COURSE	MEAN	STD DEV
Calculus	25.750	3.740
Engineering Graphics	25.500	4.775
Philosophy	24.500	4.585
History	24.421	5.124
Computer Programming	24.281	4.026
Chemistry	24.273	3.165
College Algebra	23.906	3.083
French	23.882	4.091
Botany	23.714	3.245
Accounting	23.400	4.031
Geography	23.356	4.263
Music Theory	23.346	4.108
Electronics	23.313	3.420
Literature	23.074	3.720
General Physics	23.053	3.822
Forestry	23.048	3.827
Journalism	22.941	3.913
Biochemistry	22.938	4.417
Astronomy	22.846	5.475
Psychology	22.820	4.380
Community and Regional Planning	22.714	4.175
World Religions	22.649	4.320
Spanish	22.643	4.971
Economics	22.636	4.510
Food Science	22.414	4.548
American Government	22.385	3.753
Anthropology	22.375	4.193
Crop Production	22.129	4.048
Statistics	22.069	4.582
Textiles and Materials	22.000	5.526
Mass Communications	21.849	3.829
Metal Fabrication	21.806	3.049
Art History	21.726	4.520
English Composition	21.696	2.653
Speech	21.389	4.539
Sociology	21.333	4.397
Biology	21.152	4.129
Human Nutrition	21.000	4.467
Geology	20.953	3.925
Educational Computing	20.813	4.102
Materials Science	20.788	4.679
Drawing	20.706	4.058

Table 63 (continued).

COURSE	MEAN	STD DEV
Human Anatomy	20.681	3.817
Family Environment	19.897	4.919
Leisure and Recreation	19.842	3.962
Child Development	18.182	4.737
Architecture	N/A	
Entomology	N/A	
Home Economics	N/A	
Hotel, Restaurant, and Institution Management	N/A	

Table 64. Means and standard deviations of ACT composite distributions for spring semester 1988

COURSE	MEAN	STD DEV
Engineering Graphics	26.214	3.286
World Religions	25.880	3.563
Computer Programming	25.320	3.399
Calculus	25.174	3.312
Botany	24.875	3.423
Psychology	24.682	5.131
American Government	24.421	2.912
Geography	24.156	4.066
Crop Production	23.875	3.649
Journalism	23.462	4.768
General Physics	23.455	3.826
Philosophy	23.364	4.241
Economics	23.269	4.025
Drawing	23.182	4.094
Mass Communications	22.919	4.386
College Algebra	22.885	4.330
Chemistry	22.875	4.161
History	22.829	4.631
Sociology	22.808	4.964
Architecture	22.644	4.450
Accounting	22.626	4.264
Literature	22.583	3.425
Biochemistry	22.564	4.321
Metal Fabrication	22.563	3.775
Speech	22.526	4.414
Entomology	22.500	4.224
Biology	22.221	4.161
Electronics	22.043	2.884
Anthropology	22.000	4.272
Geology	21.860	4.219
Statistics	21.853	4.384
Astronomy	21.737	3.557
Human Nutrition	21.474	4.364
Human Anatomy	21.368	4.297
Art History	20.908	4.197
English Composition	20.889	4.676
Hotel, Restaurant, and Institution Management	20.338	4.155
Leisure and Recreation	20.111	3.663
Food Science	20.000	4.820
Textiles and Materials	19.889	3.660
Child Development	19.714	4.839

Table 64 (continued).

COURSE	MEAN	STD DEV
Home Economics	19.458	4.653
Family Environment	19.322	4.984
Educational Computing	19.000	4.106
Community and Regional Planning	N/A	
Forestry	N/A	
French	N/A	
Materials Science	N/A	
Music Theory	N/A	
Spanish	N/A	

Table 65. Means and standard deviations of ACT composite distributions for fall semester 1988

COURSE	MEAN	STD DEV
Calculus	25.710	3.206
Computer Programming	24.927	3.563
Engineering Graphics	24.895	4.370
Electronics	24.600	3.439
General Physics	24.167	3.950
Botany	24.143	4.572
Metal Fabrication	23.909	4.267
College Algebra	23.862	3.399
History	23.556	4.382
Literature	23.500	3.632
Geography	23.265	4.585
World Religions	23.255	4.617
Drawing	23.235	4.590
Speech	23.167	4.328
Spanish	23.154	5.080
Music Theory	23.000	5.085
Astronomy	22.867	3.871
Accounting	22.798	3.775
Philosophy	22.773	3.995
Community and Regional Planning	22.714	3.952
American Government	22.667	5.145
Journalism	22.571	4.274
Biochemistry	22.484	4.152
Psychology	22.466	3.862
Statistics	22.393	4.202
Forestry	22.364	3.619
Crop Production	22.306	4.315
Economics	21.941	5.379
Educational Computing	21.929	5.342
Textiles and Materials	21.923	3.593
Human Anatomy	21.801	4.004
French	21.750	4.712
Anthropology	21.722	5.143
Mass Communications	21.579	4.270
Biology	21.552	3.993
Sociology	21.200	4.617
Chemistry	21.118	4.226
Food Science	21.103	4.358
Art History	21.077	3.635
Human Nutrition	20.716	4.365
Geology	20.636	4.399
English Composition	20.429	5.163

Table 65 (continued).

COURSE	MEAN	STD DEV
Leisure and Recreation	20.341	3.896
Home Economics	20.205	4.864
Child Development	20.000	3.381
Materials Science	19.894	3.767
Family Environment	19.883	5.063
Architecture	N/A	
Entomology	N/A	
Hotel, Restaurant, and Institution Management	N/A	

Table 66. Means and standard deviations of ACT composite distributions for spring semester 1989

COURSE	MEAN	STD DEV
Engineering Graphics	26.474	2.836
Food Science	25.455	3.328
Economics	25.308	3.197
Computer Programming	25.079	3.787
Botany	24.750	4.297
General Physics	24.625	3.573
Speech	23.850	3.746
Geography	23.711	4.500
Chemistry	23.688	2.983
Architecture	23.682	3.613
Calculus	23.667	3.922
Philosophy	23.652	4.270
Astronomy	23.571	4.052
Psychology	23.560	3.404
History	23.333	4.074
Metal Fabrication	23.108	3.204
Accounting	22.946	3.970
Entomology	22.842	2.949
English Composition	22.600	4.911
Biochemistry	22.571	3.636
Journalism	22.500	4.502
American Government	22.475	4.330
Crop Production	22.407	4.218
Electronics	22.250	2.745
Sociology	22.187	4.118
World Religions	22.154	4.586
Literature	21.870	4.037
College Algebra	21.667	3.658
Human Anatomy	21.663	4.670
Statistics	21.657	4.311
Mass Communications	21.636	4.155
Geology	21.396	3.935
Biology	21.376	4.140
Anthropology	21.368	5.209
Home Economics	21.078	4.508
Family Environment	20.969	5.276
Art History	20.648	4.622
Leisure and Recreation	20.357	4.048
Hotel, Restaurant, and Institution Management	20.303	4.232
Drawing	20.267	3.674
Educational Computing	20.133	4.033

Table 66 (continued).

COURSE	MEAN	STD DEV
Human Nutrition	19.811	4.305
Child Development	19.304	4.204
Textiles and Materials	18.824	3.127
Community and Regional Planning	N/A	
Forestry	N/A	
French	N/A	
Materials Science	N/A	
Music Theory	N/A	
Spanish	N/A	

Table 67. Means and standard deviations of ACT composite distributions for fall semester 1989

COURSE	MEAN	STD DEV
Calculus	25.188	4.468
Computer Programming	25.012	4.345
Economics	24.969	3.403
Accounting	24.628	3.559
Literature	24.333	3.620
General Physics	24.150	3.438
Philosophy	24.121	3.228
Engineering Graphics	23.850	2.925
College Algebra	23.706	4.019
World Religions	23.390	4.658
Electronics	23.304	3.661
Journalism	23.222	4.081
Geography	23.065	3.859
Anthropology	23.050	4.807
Community and Regional Planning	23.043	3.283
Botany	22.933	3.807
Forestry	22.825	3.895
Chemistry	22.692	3.301
Psychology	22.667	3.830
Speech	22.389	4.189
French	22.368	3.862
Astronomy	22.286	4.598
Spanish	22.250	3.683
History	22.140	4.305
Biochemistry	22.121	4.592
Crop Production	22.000	4.000
Metal Fabrication	22.000	4.690
American Government	21.960	3.972
Art History	21.923	3.830
English Composition	21.913	2.745
Mass Communications	21.861	4.385
Educational Computing	21.733	4.200
Sociology	21.704	4.614
Music Theory	21.692	4.126
Biology	21.520	4.240
Human Anatomy	21.447	4.051
Statistics	21.351	4.296
Geology	21.304	4.607
Child Development	21.273	4.485
Drawing	21.063	4.374
Food Science	20.900	4.940
Materials Science	20.734	4.423

Table 67 (continued).

COURSE	MEAN	STD DEV
Human Nutrition	20.272	4.395
Home Economics	20.240	4.140
Leisure and Recreation	19.684	4.987
Textiles and Materials	19.600	3.355
Family Environment	19.268	4.527
Architecture	N/A	
Entomology	N/A	
Hotel, Restaurant, and Institution Management	N/A	

Table 68. Means and standard deviations of ACT composite distributions for spring semester 1990

COURSE	MEAN	STD DEV
Computer Programming	25.578	2.992
Calculus	25.412	2.641
Engineering Graphics	25.238	3.923
Anthropology	24.700	4.092
History	24.339	3.556
Philosophy	24.208	5.225
Statistics	23.800	2.939
Literature	23.696	3.522
Economics	23.571	3.928
Botany	23.235	3.683
Biochemistry	23.147	2.732
Accounting	22.982	3.908
World Religions	22.982	4.677
Sociology	22.900	4.471
Metal Fabrication	22.854	3.603
Geography	22.779	4.368
Architecture	22.743	4.308
Drawing	22.588	4.836
General Physics	22.550	3.017
Journalism	22.333	4.589
American Government	22.322	3.721
Mass Communications	22.243	4.169
Speech	22.150	4.637
Crop Production	22.029	4.854
Entomology	22.000	4.509
Food Science	22.000	5.240
Art History	21.932	4.612
Astronomy	21.778	2.881
Human Anatomy	21.585	4.351
Geology	21.522	4.147
Biology	21.364	4.348
College Algebra	21.233	3.510
Electronics	20.833	4.515
Psychology	20.800	4.601
English Composition	20.765	4.323
Chemistry	20.714	4.880
Educational Computing	20.435	5.790
Human Nutrition	20.221	4.626
Leisure and Recreation	19.824	4.217
Home Economics	19.800	3.949
Family Environment	19.784	4.675

Table 68 (continued).

COURSE	MEAN	STD DEV
Hotel, Restaurant, and Institution Management	19.764	3.912
Textiles and Materials	18.667	4.139
Child Development	18.042	4.005
Community and Regional Planning	N/A	
Forestry	N/A	
French	N/A	
Materials Science	N/A	
Music Theory	N/A	
Spanish	N/A	

Table 69. Results of unadjusted multiple regression analyses for course difficulty regressed on student characteristics (model d.f. = 15)

COURSE	N	R^2	F	PROB>F
Accounting	546	.152	6.33	.0001
Crop Production	534	.117	4.57	.0001
Anthropology	541	.107	4.21	.0001
Architecture	541	.136	5.53	.0001
Drawing	546	.077	2.96	.0001
Art History	549	.145	6.01	.0001
Astronomy	549	.099	3.92	.0001
Biochemistry	543	.094	3.64	.0001
Biology	549	.074	2.85	.0003
Botany	545	.103	4.03	.0001
Child Development	549	.176	7.61	.0001
Chemistry	562	.088	3.53	.0001
Computer Programming	557	.032	1.20	.2701
Community and Regional Planning	538	.141	5.71	.0001
Economics	553	.103	4.09	.0001
English Composition	564	.066	2.58	.0010
Literature	546	.070	2.67	.0006
Entomology	538	.094	3.63	.0001
Home Economics	546	.161	6.76	.0001
Family Environment	546	.231	10.62	.0001
Human Nutrition	549	.179	7.74	.0001
Forestry	546	.177	7.63	.0001
Engineering Graphics	545	.189	8.22	.0001
French	544	.078	2.97	.0001
Food Science	542	.214	9.55	.0001
Geography	549	.117	4.69	.0001
Geology	545	.095	3.72	.0001
History	553	.085	3.32	.0001
Hotel, Restaurant, and Institution Management	540	.231	10.48	.0001
Metal Fabrication	544	.050	1.84	.0268
Electronics	548	.049	1.85	.0256
Mass Communications	543	.195	8.51	.0001
Journalism	541	.078	2.96	.0001
Leisure and Recreation	547	.107	4.24	.0001
College Algebra	560	.183	8.10	.0001
Calculus	551	.096	3.77	.0001
Materials Science	545	.038	1.38	.1515
Music Theory	547	.077	2.97	.0001
Philosophy	545	.089	3.46	.0001

Table 69 (continued).

COURSE	N	R^2	F	PROB>F
General Physics	551	.074	2.85	.0003
American Government	553	.112	4.50	.0001
Psychology	559	.138	5.80	.0001
World Religions	541	.162	6.76	.0001
Educational Computing	542	.129	5.19	.0001
Sociology	557	.128	5.32	.0001
Spanish	542	.086	3.32	.0001
Speech	553	.052	1.96	.0160
Statistics	552	.092	3.60	.0001
Textiles and Materials	543	.177	7.54	.0001
Human Anatomy	552	.034	1.27	.2180

APPENDIX B

PILOT STUDY SURVEY INSTRUMENT

A Survey of Course Perceptions
W. Miller
I.S.U.

Students may vary widely in their interests for various academic subjects. They may also vary in how they view the difficulty in learning various subjects. This instrument is designed to measure YOUR perceptions of various subjects regarding interest and difficulty. You may have already taken some of these courses or have considered them. Please consider each subject carefully. The names of the courses are "generic" and may not exactly match those in your institution.

Please provide the following information:

1. Gender: Male __________ Female ____________ (check one)
2. Undergraduate Major ____________________________ in the College of ________________________________.
3. Current classification: Freshman __________ Sophomore _________

   Junior ________ Senior ________ MA/MS _________ Ph.D. _________

   Other ________ (check one)
4. Estimated undergraduate grade point average __________ (on a 4.0 point scale).
5. Estimated size of high school graduating class _______________.

Directions: Below is a sample of undergraduate course titles. Please indicate in Section I how interested you are in the subject of the course. In Section II indicate how difficult you feel the course might be (or was if you took one like it). Mark whether or not you took such a course in Part III and whether or not it was required in Part IV.

Course Title	I. Level of Interest Very Low Very High 1 2 3 4 5 6 7 8 9	II. Level of Difficulty Very Easy Very Hard 1 2 3 4 5 6 7 8 9	III. Taken/Not Taken Yes	 No	IV. Required/Elective Yes	 No
1. Calculus						
2. Speech I						
3. Sociology I						
4. Psychology						
5. Geology						
6. Biology I						
7. Chemistry I						
8. Spanish I						
9. Pascal Programming I						
10. Electronics I						
11. Journalism I						
12. Music Theory I						
13. World History I						
14. Government I						
15. Economics						
16. Plant Science I						
17. English Composition I						
18. Principles of Teaching						
19. General Physics						
20. Computer Aided Design						

(OVER)

Course Title	I. Level of Interest Very Low Very High 1 2 3 4 5 6 7 8 9	II. Level of Difficulty Very Easy Very Hard 1 2 3 4 5 6 7 8 9	III. Taken/Not Taken Yes	 No	IV. Required/Elective Yes	 No
21. French I						
22. Biochemistry I						
23. Thermodynamics I						
24. Matrix Algebra I						
25. Psychopharmacology I						
26. Macroeconomics						
27. Structural Linguistics						
28. Computer Operating Systems I						
29. Architectural Drawing I						
30. Crop Production I						
31. Educational Media I						
32. Astronomy I						
33. Religions of the World						
34. Human Anatomy						
35. Hydraulics & Pneumatics						
36. Textiles & Materials I						
37. Child Development I						
38. Metal Fabrication						
39. Systems of Logic						
40. Mass Communications						

APPENDIX C

MAIN STUDY SURVEY INSTRUMENT

On the following page you will be asked to respond to four questions about each of 50 INTRODUCTORY LEVEL courses. The purposes of these questions are to determine:

1) how students differ in their interests for various subjects
2) how they vary in their perceptions of how difficult various subjects are, and
3) how much work they perceive to be required in different subjects.

You will also be asked to indicate which courses, if any, you have taken.

You have been randomly selected to participate in this study. Your participation is completely voluntary and should take about 20–25 minutes, but you are encouraged to respond so that accurate estimates of student interests and perceptions may be obtained. All responses are strictly confidential and no individual responses will be released at any time for any reason. Any questions you may have can be answered by contacting:

Dan Mundfrom
327 Snedecor
294-7805

Please circle the appropriate number for each of the following.

Sex:

0 – male
1 – female

Classification Level:

1 – freshman
2 – sophomore
3 – junior
4 – senior
5 – MA/MS
6 – PhD
7 – Other

College You Are Currently Enrolled In:

0 – Agriculture
1 – Business Administration
2 – Design
3 – Education
4 – Engineering
5 – Family and Consumer Sciences
6 – Sciences and Humanities
7 – Veterinary Medicine
8 – Graduate College
9 – Other

Estimated Undergraduate GPA:____________

This instrument is designed to measure YOUR perceptions of interest, difficulty and work required in various INTRODUCTORY LEVEL courses. Please respond to all four questions about each course, even the ones that you have not taken. The first three questions about each course ask you to make a rating on a scale from 1 to 9 (circle the appropriate number) indicating

(1) how interested you are in this subject,
(2) how difficult you perceive this course to be, and
(3) how much work you perceive to be required in this course.

For the fourth question, circle 1 if you have taken the course, or circle 2 if you have not taken it.

DIRECTIONS: Circle one number in each column for each course.

Course (Introductory Level Only)	Column 1 Level of Interest low high	Column 2 Level of Difficulty easy hard	Column 3 Amount of Work little much	Column 4 Taken yes	 no
Forestry	1 2 3 4 5 6 7 8 9	1 2 3 4 5 6 7 8 9	1 2 3 4 5 6 7 8 9	1	2
Leisure and Recreation	1 2 3 4 5 6 7 8 9	1 2 3 4 5 6 7 8 9	1 2 3 4 5 6 7 8 9	1	2
Hotel/Rest Management.	1 2 3 4 5 6 7 8 9	1 2 3 4 5 6 7 8 9	1 2 3 4 5 6 7 8 9	1	2
Crop Production	1 2 3 4 5 6 7 8 9	1 2 3 4 5 6 7 8 9	1 2 3 4 5 6 7 8 9	1	2
History	1 2 3 4 5 6 7 8 9	1 2 3 4 5 6 7 8 9	1 2 3 4 5 6 7 8 9	1	2
Spanish	1 2 3 4 5 6 7 8 9	1 2 3 4 5 6 7 8 9	1 2 3 4 5 6 7 8 9	1	2
Botany	1 2 3 4 5 6 7 8 9	1 2 3 4 5 6 7 8 9	1 2 3 4 5 6 7 8 9	1	2
English Composition	1 2 3 4 5 6 7 8 9	1 2 3 4 5 6 7 8 9	1 2 3 4 5 6 7 8 9	1	2
Anthropology	1 2 3 4 5 6 7 8 9	1 2 3 4 5 6 7 8 9	1 2 3 4 5 6 7 8 9	1	2
Journalism	1 2 3 4 5 6 7 8 9	1 2 3 4 5 6 7 8 9	1 2 3 4 5 6 7 8 9	1	2
Sociology	1 2 3 4 5 6 7 8 9	1 2 3 4 5 6 7 8 9	1 2 3 4 5 6 7 8 9	1	2
Biology	1 2 3 4 5 6 7 8 9	1 2 3 4 5 6 7 8 9	1 2 3 4 5 6 7 8 9	1	2
College Algebra	1 2 3 4 5 6 7 8 9	1 2 3 4 5 6 7 8 9	1 2 3 4 5 6 7 8 9	1	2
Astronomy	1 2 3 4 5 6 7 8 9	1 2 3 4 5 6 7 8 9	1 2 3 4 5 6 7 8 9	1	2
Art History	1 2 3 4 5 6 7 8 9	1 2 3 4 5 6 7 8 9	1 2 3 4 5 6 7 8 9	1	2
Electronics	1 2 3 4 5 6 7 8 9	1 2 3 4 5 6 7 8 9	1 2 3 4 5 6 7 8 9	1	2
Materials Science	1 2 3 4 5 6 7 8 9	1 2 3 4 5 6 7 8 9	1 2 3 4 5 6 7 8 9	1	2
American Government	1 2 3 4 5 6 7 8 9	1 2 3 4 5 6 7 8 9	1 2 3 4 5 6 7 8 9	1	2
Textiles and Materials	1 2 3 4 5 6 7 8 9	1 2 3 4 5 6 7 8 9	1 2 3 4 5 6 7 8 9	1	2
Geography	1 2 3 4 5 6 7 8 9	1 2 3 4 5 6 7 8 9	1 2 3 4 5 6 7 8 9	1	2
Music Theory	1 2 3 4 5 6 7 8 9	1 2 3 4 5 6 7 8 9	1 2 3 4 5 6 7 8 9	1	2
Human Anatomy	1 2 3 4 5 6 7 8 9	1 2 3 4 5 6 7 8 9	1 2 3 4 5 6 7 8 9	1	2
Geology	1 2 3 4 5 6 7 8 9	1 2 3 4 5 6 7 8 9	1 2 3 4 5 6 7 8 9	1	2
Literature	1 2 3 4 5 6 7 8 9	1 2 3 4 5 6 7 8 9	1 2 3 4 5 6 7 8 9	1	2
Drawing	1 2 3 4 5 6 7 8 9	1 2 3 4 5 6 7 8 9	1 2 3 4 5 6 7 8 9	1	2
Psychology	1 2 3 4 5 6 7 8 9	1 2 3 4 5 6 7 8 9	1 2 3 4 5 6 7 8 9	1	2
Educational Computing.	1 2 3 4 5 6 7 8 9	1 2 3 4 5 6 7 8 9	1 2 3 4 5 6 7 8 9	1	2
General Physics	1 2 3 4 5 6 7 8 9	1 2 3 4 5 6 7 8 9	1 2 3 4 5 6 7 8 9	1	2
Metal Fabrication	1 2 3 4 5 6 7 8 9	1 2 3 4 5 6 7 8 9	1 2 3 4 5 6 7 8 9	1	2
Comm/Regional Planning	1 2 3 4 5 6 7 8 9	1 2 3 4 5 6 7 8 9	1 2 3 4 5 6 7 8 9	1	2
Computer Programming	1 2 3 4 5 6 7 8 9	1 2 3 4 5 6 7 8 9	1 2 3 4 5 6 7 8 9	1	2
Chemistry	1 2 3 4 5 6 7 8 9	1 2 3 4 5 6 7 8 9	1 2 3 4 5 6 7 8 9	1	2
Human Nutrition	1 2 3 4 5 6 7 8 9	1 2 3 4 5 6 7 8 9	1 2 3 4 5 6 7 8 9	1	2
Accounting	1 2 3 4 5 6 7 8 9	1 2 3 4 5 6 7 8 9	1 2 3 4 5 6 7 8 9	1	2
Biochemistry	1 2 3 4 5 6 7 8 9	1 2 3 4 5 6 7 8 9	1 2 3 4 5 6 7 8 9	1	2
Architecture	1 2 3 4 5 6 7 8 9	1 2 3 4 5 6 7 8 9	1 2 3 4 5 6 7 8 9	1	2
Speech	1 2 3 4 5 6 7 8 9	1 2 3 4 5 6 7 8 9	1 2 3 4 5 6 7 8 9	1	2
World Religions	1 2 3 4 5 6 7 8 9	1 2 3 4 5 6 7 8 9	1 2 3 4 5 6 7 8 9	1	2
Child Development	1 2 3 4 5 6 7 8 9	1 2 3 4 5 6 7 8 9	1 2 3 4 5 6 7 8 9	1	2
Calculus	1 2 3 4 5 6 7 8 9	1 2 3 4 5 6 7 8 9	1 2 3 4 5 6 7 8 9	1	2
Food Science	1 2 3 4 5 6 7 8 9	1 2 3 4 5 6 7 8 9	1 2 3 4 5 6 7 8 9	1	2
Mass Communications	1 2 3 4 5 6 7 8 9	1 2 3 4 5 6 7 8 9	1 2 3 4 5 6 7 8 9	1	2
Home Economics	1 2 3 4 5 6 7 8 9	1 2 3 4 5 6 7 8 9	1 2 3 4 5 6 7 8 9	1	2
Engineering Graphics	1 2 3 4 5 6 7 8 9	1 2 3 4 5 6 7 8 9	1 2 3 4 5 6 7 8 9	1	2
Family Environment	1 2 3 4 5 6 7 8 9	1 2 3 4 5 6 7 8 9	1 2 3 4 5 6 7 8 9	1	2
French	1 2 3 4 5 6 7 8 9	1 2 3 4 5 6 7 8 9	1 2 3 4 5 6 7 8 9	1	2
Statistics	1 2 3 4 5 6 7 8 9	1 2 3 4 5 6 7 8 9	1 2 3 4 5 6 7 8 9	1	2
Economics	1 2 3 4 5 6 7 8 9	1 2 3 4 5 6 7 8 9	1 2 3 4 5 6 7 8 9	1	2
Philosophy	1 2 3 4 5 6 7 8 9	1 2 3 4 5 6 7 8 9	1 2 3 4 5 6 7 8 9	1	2
Entomology	1 2 3 4 5 6 7 8 9	1 2 3 4 5 6 7 8 9	1 2 3 4 5 6 7 8 9	1	2