Data Compilation and Statistical Analysis of Bachelor of Science in Engineering Graduates at the University of Central Florida

June A. Hagerty

University of Central Florida

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DATA COMPILATION AND STATISTICAL ANALYSIS
OF BACHELOR OF SCIENCE IN ENGINEERING GRADUATES
AT THE UNIVERSITY OF CENTRAL FLORIDA

BY

JUNE A. HAGERTY
B.A., Westfield State College, 1972

RESEARCH PAPER

Submitted in partial fulfillment of the requirements
for the degree of Master of Science
in the Graduate Studies Program
of the College of Engineering
University of Central Florida
Orlando, Florida

Summer Term
1985
ABSTRACT

The College of Engineering at the University of Central Florida (UCF) required a data set containing the Bachelor of Science in Engineering (BSE) graduates from 1970 on, to be updated each semester. The data set was created in 1984, through the use of the Statistical Analysis System/Full-Screen Product (SAS/FSP), a computer system which allows for easy access to and editing of data values, and the use of SAS programming for statistical analysis of the data set.

The data set presently (1985) contains 1483 observations each with 70 variables, such as personal information (age, social security number, ethnic origin), degree information (junior college attended, grade point average, honors), post-graduate information (master and doctorate degrees, first job after graduation), and test results (CLAST, SAT, GRE). The current data was obtained through the Department of Institutional Research and transcripts.

Because this data set will be in use a long time, a manual has been written that contains a detailed description of (a) the data set and all its variables, (b) the use of the full-screen product with a tutorial, (c) the use of the questionnaires, and (d) the method used to collect data.
Five tests were performed on four semesters of graduates, equaling 301 observations. The math and overall grade point averages (GPAs) for transfer and time-shortened-degree (TSD) students were tested against the math and overall GPAs of the general UCF BSE population. It was discovered that the math and overall GPAs of the graduates who received Associate of Arts degrees from Florida community colleges before entering UCF lowered significantly at UCF. The tests also suggested a possible difference in academic approaches between the community college and UCF, and there should be more than just a recognition of the drop in math and overall GPA. The TSD graduates did not perform as well in the math and overall curriculum as might be expected.

Recommendations for manual testing, updating of the data set, and further testing with SAS are included.
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This research paper summarizes the development of a data set to file information concerning all past, present, and future Bachelor of Science in Engineering (BSE) graduates of the College of Engineering at the University of Central Florida. Approximately 1500 observations were established, and some statistical analyses were performed on the data.

The computer system had to meet certain requirements to be successful, including:

1. easy memory expansion,
2. an easy-to-read data set,
3. ability to update the data easily without risk of gross mistakes or mass deletions of data,
4. easy access to data for statistical analysis, and
5. simplified acquisition and updating of data through computerized questionnaires.

The Statistical Analysis System/Full-Screen Product (SAS/FSP) met all of these criteria. This product "provides interactive, menu-driven facilities for data entry, editing, and retrieval" (Council, Ray, Saffer & Sigmon 1982). The beauty of a full-screen procedure is that it allows the user to work with a screen of data rather than
with one line at a time. This package uses SAS (Statistical Analysis System), which is a very powerful statistical computer tool. It can handle large amounts of data values because it inverts large matrices; it also requires a relatively small amount of time and money to run.

Once the file produced by the package was operational and the data was input, the next question was to decide what kind of statistical analysis should be performed. The UCF College of Engineering is very interested in the correlation between the backgrounds of the students and their performance in mathematics and the overall curriculum. This relates directly to the admissions policy which follows the policy of all Florida state universities, which do not have a limited access program in engineering.

The following chapters describe how the file is set up, its use, and the suggested method of data acquisition. The results of some specific example studies are also described.

A few definitions are important to help the reader better understand the topics in this paper:

1. Computer system: a group of computer programs that work together.

2. Data value: a single measurement, such as one person's height, the number of calories in one brand of bread, the annual rainfall in one city.

3. Observation: a set of data values for the same individual, such as physical measurements for one
person, nutritional values in one brand of bread, weather measurements for one city in California.

4. **Variable**: a set of data values for the same measurements, such as the heights of all the persons in a class, the numbers of calories in different brands of bread, the annual rainfalls for California cities.

5. **Data set**: a collection of observations, such as the physical measurements of all the students in a class, nutritional values for different brands of breads, weather measurements of cities in California.

(Helwig 1983)
SETTING UP THE DATA SET

Initiation of a Data Set

The job of creating a BSE graduate information data set began in late 1982. The UCF Department of Institutional Research had a database which included graduate information from the first graduating class in 1970. However, their database did not have all of the information that was needed for a BSE data set. Their database was reviewed to determine what information could be used from its records. A computer program had to be written which copied onto tape such data as names, social security numbers, ethnic origins, sex, birth data, citizenship, and test scores, i.e., all routine UCF data. The program was written and the data copied to tape in June, 1983. Since then this important and expensive program has been thrown out, and is further commented on under "recommendations."

When the project began, the university was using a Harris system as a mainframe with plans to change to an IBM. Therefore until this was accomplished, the project had to be put on hold. During this period, data was collected from available BSE transcripts that were still on
file in each engineering department. These transcripts generated such information as math and overall grade point averages, unreported test scores, military service, associate degrees, time-shortened credits, etc.

Choosing a Computer System

In 1984, the IBM was in full use and Instruction & Research Support (I & R Support) could assist in implementing the required data. At this time, the SAS/FSP (Statistical Analysis System/Full-Screen Product) package was available, and the program was written to set it up as originally planned. As it turned out, the delay was beneficial, because the act of reviewing transcripts showed that some of the information that was originally going to be saved would probably be useless, and some new information became important, such as a new emphasis on the College Level Academic Skills Tests (CLAST).

The SAS/FSP computer system is a powerful tool, and is simplicity in action. Each student record is set up as an observation containing 70 variables presented on four monitor screens. All the observations together constitute a data set, which as of early 1985 contained 1483 observations.

The data set is named GRADSTAT, and when this is requested through the computer, the first information to appear on the monitor is the SAS/FSP-generated menu,
as shown in Figure 1. Option number one is the most important option for data-value input and editing. The next two options explain function key uses and certain basic capabilities used in the editing option, such as searching for an observation by variable names or parts of variable names.

Commands are issued by using Program Function Keys, thus allowing for one-key procedures in exchange for multiple-key procedures. For example, PF13 issues various help screens, PF19 changes the monitor view to the previous screen of an observation, and PF22 changes the monitor view to the same screen of the next observation. With only a limited number of keys to remember, learning to use the computer system becomes simple and straightforward.

Developing a Manual

Because this data set is intended to be updated constantly in years to come, preferably once a term, it is important that when someone who does understand the procedures leaves, another can finish the tasks easily with little or no reliance on the last assistant. Therefore, a manual has been written to answer any questions. Figure 2 illustrates the manual's table of contents.

The manual contains four major sections, and the introduction urges that the entire manual be read to avoid costly mistakes and unnecessary frustration. The first
FSED IT Primary Option Menu

Select option ====> _  Press END to return to SAS

1 Edit SAS data set: GRAD.BS
2 Review or change PF key definitions
3 Review edit commands
4 Review the PROC FSEDIT statement and options
5 Review or change screen modification PF keys
6 Modify the edit screen

Fig. 1. Initial menu of the SAS/FSP computer system.
part illustrates exactly what an observation looks like and gives an alphabetical listing of all the variable names for quick reference. The second part presents all the variables in depth, listed as they appear on the screens. A copy of one of these pages can be found in Appendix A.

The third section is a tutorial which leads the user step-by-step from turning the computer terminal on, logging onto the account, and editing the data values, to searching for observations, acquiring data values, and logging off the computer. The reader will notice that whenever something very important is presented, or caution must be taken to avoid a mistake, it is printed in red to emphasize that importance.

The fourth section contains all extra materials that the assistant may need. These are the appendices, and they hold such things as sheets that aid in looking for the correct data. Another appendix consists of a packet which can be sent to the graduates and allows them to verify the information already on file such as name, citizenship, high school graduation date, and associates degree; and information that can only be acquired from the graduate such as the first job after graduation, other degrees (Master, Doctorate), and status as an Engineer Intern or a Professional Engineer.
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Fig. 2. The table of contents for the user's manual for the BSE graduates' data set.
USE OF SAS/FSP FOR BSE GRADUATE DATA SET

Contents of Data Set

Each observation in this data set is one student who graduated from the College of Engineering at the University of Central Florida (BSE graduate) beginning in 1970. As of early 1985, the data set covered all graduating students through the summer semester of 1983, for 1483 observations. Because of the large amount of data values, 70 variables per observation, it was necessary that the variables be presented in such a way that anyone could interpret the information easily, and read it quickly.

An observation is seen on four separate screens, each screen containing only what can be seen on a monitor at one time. Figure 3 illustrates the first screen of an observation exactly as one would see it on the monitor. Appendix B contains the copies of all four screens.

All typing appears on the screen at the position of the cursor, which, in this figure, can be found following "COMMAND => ", and looks like this: "_. This cursor can be moved in all directions, either from space to space, line to line, or from input area to input area. (An input area is the spaces following any prompt for information.
EDIT SAS DATA SET: GRAD.BS

COMMAND => _

SCREEN 1
OBS 1

BSE GRADUATE STATISTICS
GENERAL INFORMATION

LASTNAME: _________________ FIRSTNAME: ____________________________
SOCIAL SECURITY NUMBER: _________ BIRTH YEAR: _________ SEX: _
BIRTH NATION: __ ETHNIC GROUP: _ CITIZENSHIP: __
DISABILITY CODE: _ VETERANS ADMINISTRATION CODE: _
YEAR GRADUATED FROM HIGH SCHOOL: _________ AGE AT COLLEGE GRADUATION: ___
YEARS BETWEEN HIGH SCHOOL GRADUATION AND COLLEGE GRADUATION: _________

DATE FILE ENTERED: _______ DATE FILE UPDATED: _______

Fig. 3 SAS/FSP-generated screen number 1 of an observation as it appears on the computer monitor.
When there is no information in the input area, it is designated by a row of dotted lines.) Each one of these input areas is designated by a variable name. For instance, the prompt "LASTNAME:" places a data value with variable named "LASTNAME," and the prompt "DATA FILE ENTERED:" associates its data value with the variable named "DTENT."

Information is input by simply typing it in the correct spaces. If a correction is necessary, all one has to do is type over it. If the input needs to be erased, simply space bar over it until it is gone from the screen. When the ENTER key is hit, the computer is notified of the total erasure, and the program reinstates the dotted lines.

This computer system has many features that are very user-friendly. For instance, if the user is unsure if the variable name requires input that is numerical or alphabetical, the cursor can be positioned on the input area of that variable, and PF13 is used. This is a help key, and just below the command line there will appear the name of the variable and its input requirement.

The user can easily move from screen to screen, and observation to observation; however, often a piece of data must be put into a particular observation. The SAS/FSP gives the user many different ways to search for a particular observation. It can search by any criterion in any variable name, and if more than one observation
meets this criterion, it will show them all. For example, suppose one wishes to find John Miller. First the search will be done by his last name. The user types in at the command line:  

```
NAME LASTNAME (ENTER)
L 'MILLER' (ENTER)
```

This tells the program that an observation must be found whose variable named LASTNAME has the data value Miller. Always beginning a search from the first observation, the monitor will show the first screen of the first Miller it comes to, provided there is one. If this is not the correct Miller, the user hits the PF17 key (repeat key) until the correct Miller is shown. The program will also search by using parts of a data value, such as the first four numbers of a social security number.

Source of Data Values

Information for this data set has been collected in many different ways, some which have not been implemented yet:

1. From the main university database found at the Department of Institutional Research. This provides names, social security numbers, date of graduation and engineering discipline, ethnic origin, and past test scores.

2. From the graduates' personal transcripts. These provide math and overall grade point averages, associate degree information, the college from which it was earned, unrecorded test scores, and transfer credits.
3. From mailed computerized questionnaires. Not only does this computer system use the language SAS (Statistical Analysis System) for statistical analysis, but it also has the ability to create reports. A program has been written to generate a questionnaire for each observation, supplying the data values that are already in the data set. A copy of the questionnaire can be found in Appendix C, and the program that generated it is in Appendix D. When a graduate receives a questionnaire in the mail, he or she can verify the computer's information, and fill in the information for the blank spaces. The packet for this questionnaire also includes a cover letter, an explanation of each data value, and an addendum which is discussed in the "Recommendations."

The SAS/FSP computer system has turned out to be very successful for the purposes of this data set. As long as the manual is used by the user, the user will know how to practice on the data set safely without destroying any data. Also, extra characters have been provided for each observation, so that a new variable can be added if needed, such as a new test score. The variable can be written into the program, and the screens can be edited to handle another prompt for the new variable.
**Capabilities of the SAS Language**

Thus far only the mechanical manipulation of the data set afforded by the computer system has been discussed. SAS is a very powerful computer language. In fact, many statisticians feel it is more powerful than SPSS, another language used for computer-aided statistical analysis, because of its ability to invert large matrices. In actuality computer systems such as SAS, Minitab, and BMDP are all quite reliable, but the full-screen product that uses SAS is definitely superior.

Not only this, but Sas is well-documented with a complete manual, along with quite a few smaller manuals that expound on particular uses. Two of these manuals are included in the Bibliography.

The programs are fairly simple. The program in Appendix D is a good example. The first two lines are:

```
PROC SORT DATA=GRAD.BS OUT=SAMPLE1;
   BY LASTNAME FRSTNAME;
```

This short program sorts the data set named GRAD.BS, and stores the new order of data values under the name SAMPLE1. It sorts the data set by the variable LASTNAME, then sorts by FRSTNAME with each LASTNAME. "PROC FREQ;" runs frequencies on any variables specified, and "PROC REG;" does regression. These are only a few examples of SAS capabilities.
STATISTICAL ANALYSIS OF DATA SET

Introduction

Because this data set will most likely be kept up-to-date for quite a few years, the possibilities of different types of analyses are numerous and far-reaching.

For this particular point in time, some of the testing, such as averages and frequencies, are simply for the purpose of acquiring a feel for the performance of the engineering students during their undergraduate years and beyond. Other tests that have been done are to review the results of UCF's admission policy, and to see if the backgrounds of these graduates may have affected their performance in school.

A Task Force on Higher Education and the Schools was created during the annual meeting of the Southern Regional Education Board (SREB). Their first report, presented in 1981, was entitled "Meeting the Need for Quality: Action in the South." At this time, they "endorsed 25 recommendations to move the South beyond minimum levels toward quality education" (SREB 1983). Mentioned was ". . . strengthening high school graduation requirements, raising college admissions standards, mandating minimum requirements for teachers" (SREB 1983).
The task force was extended for two years, and a progress report was delivered in 1983. The report advised many things, such as the south being below the national average in many areas, and the high school dropout index being much higher. They advocated higher college admissions standards, "thereby sending a message to college-bound students to pursue a rigorous high school program" (SREB 1983).

Overview of Testing on Admission Policy at Other Institutions

"An admission policy is a forecasting model that is intended to predict the potential student's degree of success relative to at least the first 25% of college work at the particular institution" (Costello 1977). Nationally, there seems to be a loss of reliability in the SAT and a de-emphasis of the grade-getting potential of students. Research shows evidence that the classroom grades and test scores do not correlate with adult success. It is also felt that entrance requirements based on SAT scores primarily are not realistic. This "may eliminate students from the engineering profession who would, if given the opportunity, successfully complete the requirements for an engineering degree" (Costello 1977). There seems to be a fine line between predicting academic success and a person's real ability.
The list of recommendations presented here have been the results of testing at different schools:


2. There is significant correlation between the grade point average (GPA), high school rank, and the number of math courses taken in high school (1980 ASEE Southeastern Section Meeting Proceedings 1980).

3. Let there be a minimum SAT total of 650 with a math score of 350. Let more students enter, and then Calculus I can tell the real story. Counsel the student at that time (Costello 1977).

4. Consider extracurricular activities during high school. Stice feels that this is the only variable that appears to correlate with success ten years after graduation (Stice 1979).

5. Consider unique criteria for engineering as a professional school. No screening in engineering results in "high attrition rates, switched majors, and student frustration at the sophomore and even junior level (Dillard 1976).

6. Define a "marginal bracket" somewhere between those who are clearly admissible and those clearly not admissible. Send them a letter saying they are not admissible, but if
they are really interested, they may request an interview (1980 Frontiers in Education Conference Proceedings 1980).

7. The scheduling of classes is an important variable in student performance, considering the ramifications of advising and the optimization of course selection (1980 Frontiers in Education Conference Proceedings 1980).

As the list lengthens, the diversity rises. What then, should UCF do to admission criteria?

**UCF Admission Criteria**

There are three major ways to gain admittance to the College of Engineering:

1. The high school student applies during senior year with a high school transcript and Scholastic Aptitude Test (SAT) scores. They are called first-time-in-college students. They are also referred to as native students.

2. The high school student with very high grades and high SAT scores (Range: 1100 and higher, minimum: verbal-500, math-550) is exceptional. This student is accepted early, and is allowed to earn college credits before he or she finally begins study at UCF as a native student. This is called a Time-shortened Degree program (TSD), because the objective is to allow the student to earn his or her degree in as little as three years.

3. Transfer students make up the largest and most diverse group of students. These students attend a
Florida community or junior college, and earn their Associate of Arts degree. They then transfer into UCF as a junior (third year) student. Their GPAs should be at least 2.5, but in the past no tests such as the SAT have been required. From 1984 on, all sophomores are required to take and pass the College Level Academic Skills Test (CLAST) before they can move onto upper-division coursework.

**Tests Decided on the for Data Set Group**

1. Compare (a) math GPA of UCF students at graduation to (b) overall GPA as of UCF graduation.
2. Compare (a) math GPA for courses taken before UCF to (b) math GPA as of UCF graduation.
3. Compare (a) associates degree overall GPA to (b) overall GPA for these same students at UCF graduation.
4. Compare (a) math GPA for TSD students to (b) math GPA of non-TSD students.
5. Compare (a) overall GPA for TSD students to (b) overall GPA of non-TSD students.

**Reasons for Choice of Tests**

A group of 301 graduates formed from the summer and fall semesters of 1982, and the spring and summer semesters of 1983 was tested. Of these graduates, 168 (55.8%) students entered UCF as juniors with no or very little formal testing, i.e., no Scholastic Aptitude Tests (SAT),
American College Tests (ACT), or Florida Twelfth-Grade Tests (FTG) scores. Also, because the average age of these students at graduation was 24 years, testing had been performed at a different time in their lives, thus adding another factor to an already less-than-accurate indicator of performance. That left math and overall grade point averages.

During the review of transcripts, a poor performance in the required mathematics courses seemed to take a toll on the engineering student, therefore the math GPA was compared to the overall GPA. The math courses reviewed consisted of calculus, differential equations, and probability and statistics (usually five courses). Also studied was the Associate of Arts graduate's GPA once enrolled at UCF.

The testing of the time-shortened degree students was done because of curiosity, and because the program is somewhat controversial. Their math and overall GPAs seemed to be lower than might be expected when compared to all other students. Of the 301 graduates, 31 (10%) TSD students were compared to their peers. Table 1 describes the entire test group in detail.
<table>
<thead>
<tr>
<th>Number of graduates:</th>
<th>301</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time Frame:</td>
<td></td>
</tr>
<tr>
<td>Summer, 1982</td>
<td></td>
</tr>
<tr>
<td>Fall, 1982</td>
<td></td>
</tr>
<tr>
<td>Spring, 1983</td>
<td></td>
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<td></td>
<td></td>
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</table>

<table>
<thead>
<tr>
<th>SEX</th>
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<tbody>
<tr>
<td>Females</td>
</tr>
<tr>
<td>Males</td>
</tr>
<tr>
<td></td>
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</table>

<table>
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<tr>
<th>AGE AT GRADUATION</th>
</tr>
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<tbody>
<tr>
<td>Range: 20 - 44 years</td>
</tr>
<tr>
<td>Mean: 24.8 years</td>
</tr>
<tr>
<td>Density: 22 - 27 years (71.43%)</td>
</tr>
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<tbody>
<tr>
<td>United States</td>
</tr>
<tr>
<td>Foreign</td>
</tr>
<tr>
<td>Largest group (Iranians)</td>
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<tr>
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<th>TAU BETA PI MEMBERS</th>
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<th>UCF TIME-SHORTENED DEGREE</th>
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<table>
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<th>ASSOCIATE DEGREE</th>
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<tbody>
<tr>
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</tr>
<tr>
<td>No</td>
</tr>
<tr>
<td>Florida C.C. or J.C. or UCF</td>
</tr>
<tr>
<td>Out-of-state C.C. or J.C.</td>
</tr>
<tr>
<td>University of Central Fl.</td>
</tr>
<tr>
<td>Valencia Comm. College</td>
</tr>
<tr>
<td>Brevard Comm. College</td>
</tr>
<tr>
<td>(24 other colleges listed)</td>
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<th>ENGINEER DISCIPLINES*</th>
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<td>Mechanical (910)</td>
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*Discipline codes for UCF
RESULTS

For all tests:

a. Null hypothesis \((H_0)\): \(\mu_1 - \mu_2 = \emptyset\)
b. Alternate hypothesis \((H_a)\): \(\mu_1 - \mu_2 \neq \emptyset\)
c. Sample size: 301 observations
d. Test: comparison-t, two-tailed test
e. Level of significance: \(\alpha = 0.01\)
f. Observed significance level: p value = the probability that \(t\) is greater than the absolute value of the computed \(t\) statistic.
g. If the p value of the test is less than the maximum value of \(2\alpha (0.0001)\), then the null hypothesis is rejected.

Test Number 1:

a. math GPA for courses taken before UCF
   \(\mu_1\): 2.689 Minimum: 0.882 Maximum: 4.0
b. overall GPA as of UCF graduation
   \(\mu_2\): 2.821 Minimum: 2.006 Maximum: 3.871
t-score = -5.29 \(p < .0001\)

\(H_0\) is rejected, therefore, the math GPA could be significantly lower than the overall GPA.
Test Number 2:

a. math GPA for courses taken before UCF

\( \mu_1: 2.95 \quad \text{Minimum: } .5 \quad \text{Maximum: } 4.0 \)

b. math GPA as of UCF graduation

\( \mu_2: 2.79 \quad \text{Minimum: } 1.156 \quad \text{Maximum: } 4.0 \)

t-score = 4.51  \quad p < .0001

\( H_0 \) is rejected, therefore, the math GPA could be significantly higher than the UCF math GPA.

Test Number 3:

a. associate's degree overall GPA

\( \mu_1: 3.027 \quad \text{Minimum: } 2.0 \quad \text{Maximum: } 3.951 \)

b. overall GPA for these same students at UCF graduation

\( \mu_2: 2.86 \quad \text{Minimum: } 2.107 \quad \text{Maximum: } 3.868 \)

t-score = 6.29  \quad p < .0001

\( H_0 \) is rejected, therefore, (a) could be significantly higher than (b).

Test Number 4:

a. math GPA for TSD students

\( \mu_1: 2.80 \quad \text{Minimum: } 1.552 \quad \text{Maximum: } 4.0 \)

b. math GPA of non-TSD UCF students

\( \mu_2: 2.689 \quad \text{Minimum: } .882 \quad \text{Maximum: } 4.0 \)

t-score = -1.4195  \quad p < .1568

\( H_0 \) may not be rejected, therefore, if there is a difference between (a) and (b), it is not significant.
Test Number 5:

a. overall GPA for TSD students
   \[ \mu_1: 3.093 \text{ Minimum: 2.159 Maximum: 3.871} \]

b. overall GPA of non-TSD UCF students
   \[ \mu_2: 2.821 \text{ Minimum: 2.006 Maximum: 3.871} \]

\[ t\text{-score} = 3.6584 \quad p < .0003 \]

H_0 may not be rejected, therefore, if there is a difference between (a) and (b), it is not significant.
RECOMMENDATIONS

**Future Development of the Data Set**

1. Add the names, dates of graduation, and disciplines to update the data set through spring of 1985.

2. Once this is completed, mail out the questionnaires as soon as possible. The addresses may be obtained through the Alumni Office.

3. Have a student learn the system as soon as possible to test the credibility of the user manual.

4. Less data is needed from the database at Institutional Research than originally requested, therefore re-evaluate the original data request. To avoid confusion, rather than require information about the last degree earned, require all degrees of a graduate. In the present data set, some of the engineering degrees are master's degrees, which assume an incorrect BSE date.

5. Stay in contact with knowledgeable person in I & R Support in Computer Center I (currently Mary Garner). She/he can help with any problems.

6. If a program is written again to pull data off the Institutional Research database, do not let the program be discarded without the permission of the
Assistant Dean of Engineering. It has happened once already. In terms of time, the saving of that program could be crucial.

Statistical Analysis

1. Math GPAs and overall GPAs lower significantly for students who received associate degrees at community colleges and transfer to UCF to complete their studies. Different conclusions could be drawn from this: either the community colleges are not teaching well enough, or UCF is purposely making its math courses more difficult than is necessary. Math GPAs for UCF students are lower on the whole than overall GPAs as well. It is recommended that this trend be looked at more closely.

2. The small difference between TSD graduates and other UCF students is of interest. Students of that calibre should have had better math grades. Their overall GPA was higher, but the means differed only by .3 from each other, not an overwhelming showing. Perhaps these students have not been given the opportunity to mature enough, to learn how to study, or to learn how to cope psychologically with an occasional low grade. Many of these students still complete their degrees in four years, because they must retake courses due to withdrawals or unacceptable marks.
3. In the future, some serious testing should be performed regarding the CLAST scores. Relate the math GPA to the math section of the CLAST. Because every student is now required to take this test, it should be a valuable variable.

4. Stice's supposition concerning extracurricular activities is interesting. An addendum has been attached to the questionnaire packet requesting a list of high school and college activities in the hopes that some type of study may be done. It may reflect a maturity on the part of the student that is missing in the student that only concentrates on his studies. This maturity and ability to relate to other people could make a person a better employee. That should be the goal of any university: to prepare a student for the rest of his/her life in the work field.

5. It has been decided that some new variables should be added to the data set:
   a. UCF GPA to be compared to the overall GPA, and
to do some studies on native students,
   b. UCF credits at graduation, and
   c. number of overall credits at graduation.
These will be added to the data set in the very near future, in order to update that data as soon as possible.
APPENDIX A

EXPLANATION OF DATA INPUT
EXPLANATION OF DATA INPUT

TOPIC TITLE: DGYR4

TITLE ON SCREEN: YEAR 4:

SCREEN NUMBER: 1 2 * 3 4 5

NUMBER OF AVAILABLE CHARACTERS: 4

POSITION IN RECORD: 107 - 110

TYPE OF CHARACTERS:
- Numeric (999)
- Alphabetic (NNN)
- Alphanumeric (9N9)

REPRESENTATION OF CHARACTERS:
The year Major 4 was awarded
YY - year
MM - month
Example: September, 1976 -- 7609

COMMENTS:
Quarter System:
- 7301 - Winter, 1973
- 7303 - Spring, 1973
- 7306 - Summer, 1973
- 7309 - Fall, 1973

Semester System:
- 8301 - Spring, 1983
- 8305 - Summer, 1983
- 8308 - Fall, 1983

PAGE NUMBER: 24
APPENDIX B

REPLICATION OF COMPUTER-MONITOR SCREENS
EDIT SAS DATA SET: GRAD.BS

COMMAND ===>

---

SCREEN 1

OBS 1

BSE GRADUATE STATISTICS
GENERAL INFORMATION

LASTNAME: ___________________ FIRSTNAME: ___________________

SOCIAL SECURITY NUMBER: ___________ BIRTH YEAR: ________ SEX: __

BIRTH NATION: __ ETHNIC GROUP: __ CITIZENSHIP: __

DISABILITY CODE: __ VETERANS ADMINISTRATION CODE: __

YEAR GRADUATED FROM HIGH SCHOOL: ________ AGE AT COLLEGE GRADUATION: ___

YEARS BETWEEN HIGH SCHOOL GRADUATION AND COLLEGE GRADUATION: ________

DATE FILE ENTERED: _______ DATE FILE UPDATED: _______

SAS/FSP-generated screen number 1 of an observation as it appears on the computer monitor.
EDIT SAS DATA SET: GRAD.BS

COMMAND ==> _

---

BSE GRADUATE STATISTICS
ENTRY INFORMATION

DEGREES AWARDED:

MAJOR 1: ______
MAJOR 2: ______
MAJOR 3: ______
MAJOR 4: ______

YEAR 1: ______
YEAR 2: ______
YEAR 3: ______
YEAR 4: ______

DO YOU HAVE YOUR AA DEGREE: _
WHICH COLLEGE?
TRANSFER GPA: ______
TRANSFERRED HOURS EARNED: ___

INITIAL ENTRY DATE TO U.C.F.: ______
STATUS ENTERING UCF: _

NUMBER OF CLEP HOURS: ______
TIME SHORTENED DEGREE HOURS: ______

NUMBER OF MATH CREDITS: ______
TRANSFER MATH GPA: _____

---

SAS/FSP-generated screen number 2 of an observation as it appears on the computer monitor.
EDIT SAS DATA SET: GRAD.BS

COMMAND ===> _

===>

BSE GRADUATE STATISTICS
DEGREE INFORMATION

DEGREE HONORS AWARDED: _
TAU BETA PI: _
OVERALL MATH GPA: _____
OVERALL GPA: _____

ARE YOU PRESENTLY A GRADUATE STUDENT?
HAVE YOU BEEN ACCEPTED TO A GRADUATE PROGRAM?
HAVE YOU COMPLETED A MASTERS PROGRAM?
STATE WHERE RECEIVED: __
FIELD OF STUDY: ___

ARE YOU PRESENTLY A DOCTORAL CANDIDATE?
HAS YOUR DOCTORATE BEEN AWARDED?
YEAR AWARDED: __

DESCRIPTION OF JOB AFTER GRADUATION: ________
FIELD PERTINENCE: _

REGISTRATION AS ENGINEERING INTERN OR PROFESSIONAL ENGINEER: __
RESIDENT STATE REGISTERED: __

SAS/FSP-generated screen number 3 of an observation as it appears on the computer monitor.
EDIT SAS DATA SET: GRAD.BS

COMMAND ===>

SCREEN 4

OBS 1

TEST SCORES

COLLEGE LEVEL ACADEMIC SKILLS TEST
MATHEMATICS: ________  READING: ________  WRITING: ________  ESSAY: ________

AMERICAN COLLEGE TEST
ENGLISH: ________  MATH: ________  SOCIAL SCIENCES: ________
NATURAL SCIENCES: ________  COMP: ________

SCHOLASTIC APTITUDE TEST
VERBAL: ________  MATH: ________  TOTAL: ________

FLORIDA TWELFTH GRADE
PHYSICAL: ________  MATH: ________  ENGLISH: ________  TOTAL: ________

GRADUATE RECORD EXAM
VERBAL: ________  QUANTITATIVE: ________  TOTAL: ________
ADVANCED: ________

TEST OF ENGLISH AS A FOREIGN LANGUAGE: ________

SAS/FSP-generated screen number 4 of an observation as it appears on the computer monitor.
APPENDIX C
GRADUATE QUESTIONNAIRE
1. **LAST NAME:**
2. **FIRSTNAME:**
3. **SOCIAL SECURITY NUMBER:**
4. **BIRTH YEAR:**
5. **BIRTH NATION:**
6. **ETHNIC GROUP:**
7. **CITIZENSHIP:**
8. **MILITARY BET (Y/N):**
9. **YEAR GRADUATED FROM HIGH SCHOOL:**
10. **DEGREES AWARDED:**
    - **MAJOR:**
    - **YEAR:**
    - **MAJOR:**
    - **YEAR:**
    - **MAJOR:**
    - **YEAR:**
11. **DO YOU HAVE AN ASSOCIATE DEGREE (Y/N):**
12. **WHICH COLLEGE:**
13. **DEGREE HONORS AWARDED (B.S.E.):**
14. **MEMBER OF TAU BETA PI (Y/N):**
15. **ARE YOU PRESENTLY A GRADUATE STUDENT (Y/N):**
16. **HAVE YOU BEEN ACCEPTED TO A GRADUATE PROGRAM (Y/N):**
17. **FIELD OF STUDY:**
18. **STATE WHERE RECEIVED:**
19. **ARE YOU PRESENTLY A DOCTORAL CANDIDATE (Y/N):**
20. **HAS YOUR DOCTORATE BEEN AWARDED (Y/N):**
21. **YEAR AWARDED:**
22. **DESCRIPTION OF JOB IMMEDIATELY AFTER GRADUATION:**
23. **DOES THE JOB PERTAIN TO YOUR FIELD OF STUDY (Y/N):**
24. **REGISTRATION AS ENGINEERING INTERN OR PROFESSIONAL ENGINEER (E.I./P.E.):**
25. **RESIDENT STATE REGISTERED:**
26. **GRADUATE RECORD EXAM (IF TAKEN):**
    - **VERBAL:**
    - **QUANTITATIVE:**
    - **TOTAL:**
27. **PRESENT JOB TITLE AND/OR DESCRIPTION OF JOB:**

---

*The text continues on the page, but it is not fully visible in the image.*
APPENDIX D

SAS PROGRAM FOR GRADUATE QUESTIONNAIRE
PROC SORT DATA=GRAD.BS OUT=SAMPLE1;
   BY LASTNAME FRSTNAME;
OPTIONS OBS=5;
DATA _NULL_;
   SET SAMPLE1;
   FILE PRI;
   PUT _PAGE_ '1.' LASTNAME: '/;
   PUT '2.' FRSTNAME: '/;
   PUT '3.' SSN @ 40 '4.' BYR: '/;
   PUT '5.' BNATN @ 40 '6.' ETHNIC: '/;
   PUT '7.' CITZEN @ 40 '8.' MILITARY VET (Y/N): ' '/;
   PUT '9.' SHYR: '/;
   PUT '10.' MAJOR: 'YEAR: '/;
   PUT '10.' MAJOR: 'YEAR: '/;
   PUT '11.' AADGYN: '/;
   PUT '12.' COLLEGE: '/;
   PUT '13.' DGHNRS: '/;
   PUT '14.' TAUBII: '/;
   PUT '15.' GRSTUD: '/;
   PUT '16.' CAND: '/;
   PUT '17.' FIELD: '/;
   PUT '18.' STATE: '/;
   PUT '19.' DOCAND: '/;
   PUT '20.' GRADYN: '/;
   PUT '21.' DOCYN: '/;
   PUT '22.' PERTIN: '/;
   PUT '23.' PERTIN: '/;
   PUT '24.' EIORPE: '/;
   PUT '25.' RESST: '/;
   PUT '26.' GREQUN: '/;
   PUT '27.' GRETOT: '/;
RETURN;
The importance of matrix inversion goes back to the least squares solution to the general linear model, defined as:

\[ y = B_0 + B_1x_1 + B_2x_2 + \ldots + B_kx_k + \varepsilon \]

Basically, regression is fitting a line to a group of data points with the least amount of error. When this model is written in the form of matrices, it translates to:

\[ \bar{Y} = \bar{X}\bar{B} + \bar{E} \quad \text{(all matrices).} \]

When \( \bar{B}' = (\bar{X}^T\bar{X})^{-1}\bar{X}^T\bar{Y} \), where \( \bar{X}^T \) is the transpose of \( \bar{X} \) provided the matrix \( (\bar{X}^T\bar{X}) \) has an inverse. This solution comes very close, if not exactly to the algebraic answer (Ott 1977).


Costello, Francis J. "A Study on the Validity of Admissions Policy as Applied to the School of Engineering at an Urban University." Research Report, Nova University, University of New Haven, 1977.


