Handbook
A guide to administering the collection of data for statistical indicators.

Statistical Indicators to Monitor the Quality of
The First Two Years of Undergraduate Mathematics

California State University San Marcos

I. Introduction
California State University San Marcos (CSUSM) is part of the (now) twenty-three
CSU campus system that enrolls over 300,000 students and seeks, in accordance with
the California Master Plan for Higher Education, to serve the top one-third of
California’s high school graduates. Founded in 1989 as the 20th campus in the CSU
system, CSUSM opened its doors to 448 (284 FTES) upper division students in Fall
1990. CSUSM enrolled its first freshman class in Fall 1995, thus adding about a 1,000
new students. Fall 1995 enrollment was 3,642 (2,683 FTES). By Fall 1997 CSUSM
had 4,684 students (3,480 FTES); currently (Fall 1999), CSUSM has over 5,000
students.

Over the course of the 1990’s the composition of the student population has changed.
In the early 1990’s more than 70% of CSUSM students identified themselves as
Caucasian, and only 18% identified themselves as American Indian, African-American,
Asian American or Hispanic. Almost 80% of CSUSM students were female. The
largest age group on campus was students aged 26-39 (43%) and over 60% of all
students was older than 25. By 1997, the percentage of students identifying themselves
by ethnic group as American Indian, African-American, Asian, or Hispanic had
increased to 33.3%. More than a third (34%) of all students were male and almost half
the students were under 25. Of the 170 full-time tenured or tenure-track faculty, 60.6%
were Caucasian; and 47.1% were female.

CSUSM has a strong commitment to writing across the curriculum, a global
perspective, and interdisciplinary instruction. As a new university, CSUSM is intent on
building a culture that promotes its goal of providing a high quality program for its
diverse student body. An essential part of this goal, therefore, is to develop a
comprehensive evaluation system to target the key components of our educational
program: curriculum and instruction; student outcomes (attitude and achievement);
student participation and institutional/departmental factors. The statistical indicators
project allowed us to begin to develop and implement a system for monitoring our
mathematics program.

I.1 Goals
The goal of the Mathematics Program is to provide the finest possible mathematics
instruction and learning environment for all students in the university. We strive to
achieve this broad goal in the spirit and intent of the CSUSM Mission Statement, College
of Arts and Sciences Mission Statement, Campus Strategic Plan, and the Mathematical
Sciences Program Mission Statement. The mathematics program has taken good advantage of not having opened the campus to lower division students in the first several years, to plan carefully the lower division. One important component of these planning efforts included assessment. The QIUME project has been a central and integral component of creating and implementing a plan for the ongoing evaluation of the lower division. This project focused on all lower division courses, including GEM 100 (general education math); Math 120 (College Algebra); Math 132 (Calculus for Business and Economics); Math 160 (Calculus I); Math 210 (Mathematics for Elementary School Teachers I); and Math 212 (Math for Elementary School Teachers II).

It should be noted that the original request to NSF called for a Fall 1996 start date for this project; and that CSUSM first offered lower division classes in Fall 1995. We have welcomed the infusion of NSF funding and the collaborative thinking with our colleagues on the advisory committees and at the other two participating institutions to help us design and put in place a formative procedure for assessing the impact and quality of our service to client disciplines, to general education, and our own major. We sought to create a system to monitor the background, attitude, and academic performance of students who have taken mathematics service courses at CSUSM. Additionally, we sought to gather and analyze data related to curriculum, faculty (discipline and client), department, and institution. The findings from this project will be discussed at regular faculty meetings so that improvements and revisions will be forthcoming. The Mathematics faculty plans for focused discussion of the impact of the results on our curriculum, faculty development activities, and classroom practices.

The instruments and procedures created in the QUIME project have been folded into an overall evaluation plan and practice for the entire mathematics program. Many of the data collection activities (dept survey, faculty survey, student survey, math lab evaluation, focus groups, client discipline interaction, yearly report from enrollment services, alumni data base) have been scaled-up, with appropriate modification, to help evaluate the entire mathematics program. We have sought to create instruments and procedures that could be adapted by state comprehensive universities or small liberal arts colleges interested in program evaluation and assessment.

I.2 Department overview
The mathematics program offers a rich mix of pure and applied coursework leading to a bachelor of science in mathematical sciences, a minor in mathematical sciences, subject matter preparation in mathematics (for prospective high school teachers), and a master of science degree. As reported in the Departmental profile, during 1998-99, there were 10.6 FTE mathematics faculty: 5 tenured males, 2 tenured females, 2 tenure-track males, 4 part-time faculty (2 females and 2 males), and 4 graduate teaching assistants. Ethnic backgrounds include African-American, Latino, South Asian, Asian, and Middle-Eastern. All tenure/tenure-track faculty hold Ph.D’s, with research areas that include numerical mathematics, algebra, analysis, and combinatorics/graph theory.
Tenure-track and tenured faculty regularly teach lower division courses; although in each semester, it is likely that at least one section is taught by a part-time faculty member. Lower division mathematics courses have a maximum enrollment limit of 35 or 40, and the departmental student faculty ratio is approximately 21:1. It should be noted that during 1998-99, two of the nine permanent faculty were on sabbatical; hence, more lower division courses were taught by part-time faculty than is normally the case. All faculty are actively involved in course, curriculum and program decision making. Since each lower division course has a single faculty member assigned to oversee it, effectively, there is a common syllabus in each lower division course; however, there is no departmental policy requiring such. Courses are regularly reviewed and updated. Each of the courses involved with this project had undergone review and revision between 1994 and 1999, except for Calculus I. The entire calculus sequence is slated for review during 1999 – 2000.

1.3 Description of data collection activity
This project sought to create indicators in the key areas of: curriculum and instruction; student outcomes (attitude and achievement); student participation; and institutional/departmental factors. Since it was not known which data would eventually emerge as indicators, we began the project by collecting data in many arenas. In this section, we describe the various data collection activities as they related to the key areas of: departments/institution, faculty, curriculum, classroom, and students.

1.3.a. Department/institution
The primary source of data related to assessing the department and the institution was the OIUME project-wide Departmental Profile. Here at CSUSM, the mathematics department chair assumed the responsibility for completing the Department Profile. This three section questionnaire asks for: a demographic profile; academic program information/instructional resources; curricular emphases of the department. The first two sections can be completed by the department secretary, although, on our campus, the department chair was heavily involved in interpreting the questions. The chair completed section three of the profile.

Additional information was gleaned from two primary sources: the Office of the Associate Vice-President for Academic Affairs – Institutional Resources; the Office of the Dean of the College of Arts and Sciences; Enrollment Services; the Performance, Evaluation, and Planning self-study document being created in conjunction with the fifth-year review of the mathematics program; the Office of Public Affairs; Facilities Services; Computing and Telecommunications; Library Services. These sources provided information about the demographic profile of the faculty and students; historical enrollment data and enrollment projections; student preparedness, including performance on the Entry-Level Mathematics Exam; classroom, technology, library and other facilities and resources; credentials/experience of the mathematics faculty.

1.3.b. Faculty
Each faculty member (full or part-time) teaching a section of a course involved in the QIUME study attempted to complete (hard copy or electronically) the Faculty survey. The Faculty survey contains two parts: the first part seeks to assess who the faculty are as
well as the faculty perspective on and participation in the life of the department; the second part seeks information about instructional practice related to the particular courses involved in the QIUME project.

I.3.c. Curriculum
Data were gathered from multiple perspectives, including the Department survey (Part three), Faculty surveys (Part two), client discipline feedback, student evaluations; and to some extent the mathematics lab evaluation, the focus groups, and the annual report from enrollment services.

We participate in year long discussions with faculty in client disciplines, including business and economics, computer science, liberal studies and education. In particular, for each of these disciplines, two or three faculty in mathematics are designated to meet with two or three client discipline representatives. The purpose of these discussions is the ongoing formative assessment of all aspects of mathematics service courses. Through these meetings, data was collected on the relevance, currency, quality, effectiveness, and applicability of the mathematics service courses.

Three focus groups were conducted, one with groups of students enrolled in the Mathematics for elementary school teachers course; with instructors of the Mathematics for Elementary School Teachers course; and with some students who frequent the Math tutorial lab. Logistical arrangements for the focus groups was coordinated by the Mathematics Department Chair’s Office. In most cases, experts to facilitate the focus groups were provided by the project.

Homework assignments from textbooks used in some of the courses involved in the study were collected for analysis using the taxonomy developed in conjunction with the project. These data were collected and submitted by individual faculty, and analyzed by a student hired and located at UIUC.

I.3.d. Classroom
The Departmental Survey, the Faculty Surveys, and the Student surveys seek information about the classroom practices of faculty and students; and about classroom facilities.

Other data gathered from faculty included the collection of syllabi, exams, and homework assignments. Syllabi are regularly collected for all courses taught at CSUSM; project personnel only needed to gain permission from faculty to use them in this project. Other artifacts mentioned were solicited and collected by the three faculty who oversaw the project. In the future, should we continue to collect exams and homework, the faculty member in charge of evaluation and assessment for the department will assume responsibility for collecting these items.

Also, several classroom observations were conducted using experts provided by the project.
I.3.e. Students

All three surveys (Department, Faculty, Student) sought information related to student outcomes, including: demographic composition of the student; student attitudinal surveys toward mathematics, course expectations, course participation and study practices.

Initiated in conjunction with this project, enrollment services has created an annual report to the mathematics program. The report contains information about students’ background before coming to CSUSM, student aspirations (major and career); and will track students academic progress after completing a lower division math course.

The project also sought input from faculty in client disciplines about general student needs and performance in courses that have lower division math course(s) as a prerequisite. This data collection took the form of monthly committee meetings among faculty in mathematics and faculty in each of the other disciplines. The relevant committees are: Business/Economics; Computer Science; Science; Education/Liberal Studies (teacher preparation); General Education. Mathematics faculty representatives/liaisons on this committee arranged meetings and led discussions with client discipline faculty, and led discussions among mathematics faculty at our regularly scheduled (weekly) mathematics faculty meetings.

Other data collected included information about usage of the mathematics tutorial lab (students using the lab must sign in each time they enter); as well as feedback from students via an annual alumni survey (mailed to all graduates of CSUSM) conducted by Alumni Services (not particular to mathematics), and an alumni data base overseen by the mathematics program.

We now describe the local process for administering the student attitudinal surveys.

Data collection:

Student attitudinal surveys.

Fall 1997: Four (4) courses.

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Sections</th>
<th>Instructors</th>
<th>Class Size</th>
<th>Course Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>GEM 100</td>
<td>3</td>
<td>3</td>
<td>35</td>
<td>Mathematical Ideas</td>
</tr>
<tr>
<td>Math 120</td>
<td>3</td>
<td>3</td>
<td>35</td>
<td>College Algebra</td>
</tr>
<tr>
<td>Math 132</td>
<td>3</td>
<td>3</td>
<td>40</td>
<td>Survey of Calculus</td>
</tr>
<tr>
<td>Math 210</td>
<td>3</td>
<td>3</td>
<td>40</td>
<td>Math for Elem Teaching, I</td>
</tr>
<tr>
<td>TOTAL</td>
<td>12</td>
<td>12</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

There were 334 students who participated the Pre-survey, 243 students in the Post-survey, and 218 students identified who participated both Pre- and Post-survey.


<table>
<thead>
<tr>
<th>Course No.</th>
<th>Sections</th>
<th>Class Size</th>
<th>Course Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>GEM 100</td>
<td>2</td>
<td>35</td>
<td>Mathematical Ideas</td>
</tr>
<tr>
<td>Math 120</td>
<td>3</td>
<td>35</td>
<td>College Algebra</td>
</tr>
<tr>
<td>Math 132</td>
<td>3</td>
<td>40</td>
<td>Survey of Calculus</td>
</tr>
<tr>
<td>Math 160</td>
<td>1</td>
<td></td>
<td>Calculus with Applications, I</td>
</tr>
<tr>
<td>TOTAL</td>
<td>11</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Math 210 2 2 40 Math for Elem Teaching, I
TOTAL 11 11
There were 361 students who participated the Pre-survey, 266 students in the Post-survey, and 241 students identified who participated both Pre- and Post-survey.

Fall 1998: Seven (7) courses.
GEM 100 2 2 40 Mathematical Ideas
Math 115 2 2 40 College Algebra
Math 125 1 1 40 Pre-Calculus
Math 132 3 3 40 Survey of Calculus
Math 160 2 2 45 Calculus with Applications, I
Math 210 3 3 40 Math for Elem. Teaching, I
Math 212 1 1 40 Math for Elem. Teaching, II
TOTAL 14 14
There were 446 students who participated the Pre-survey, 340 students in the Post-survey, and 276 students identified who participated both Pre- and Post-survey. Among the 446 students who participated the Pre-survey, 27 students didn't give their ID's (social security number), and 8 out of 340 students in the Post-survey didn't give their ID's.

Total number of students who participated the survey

<table>
<thead>
<tr>
<th></th>
<th>Pre-survey</th>
<th>Post-Survey</th>
<th>Both</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall 1997</td>
<td>334</td>
<td>243</td>
<td>218</td>
</tr>
<tr>
<td>Spring 1998</td>
<td>361</td>
<td>266</td>
<td>241</td>
</tr>
<tr>
<td>Fall 1998</td>
<td>446</td>
<td>340</td>
<td>276</td>
</tr>
</tbody>
</table>

We had student assistants distribute the survey. We spent about one hour with student assistants before survey administration to explain the project to them and to train them. We tried to ensure that students filling out the survey understood that the survey is not a teaching evaluation. We also promised students that any information gained from the survey is confidential.

We gave two surveys in each semester: Pre-survey and Post-survey. In order to compare answers in Pre and Post survey, we needed a method to identify students. We have used two systems of identification: Survey ID (which is not the Student ID) and Student ID.

In the first method, each copy of Pre-survey has its unique number which became the student's Survey ID. We kept the students' names and their Survey ID's in a sealed envelope. We opened the sealed envelope when we gave out the Post survey at the end of the semester. Students get their Survey ID back and put it on the Post survey. Then, we shredded the information of student's names and the Survey ID's. The advantage of using Survey ID is confidentiality. Students know that no individual can be identified. Also, this method doesn't require students to remember their Survey ID's. The disadvantage is that we can't compare answers from the surveys to anything beyond the surveys, for example, student's GPA or achievement after graduation.
We used Student ID once. The pros and cons of this method are flip-flop to those of the method of Survey ID. Student ID allows us to get more information about students which enable us to do further analysis. But, several students expressed concerns about confidentiality and some of them didn't give their Student ID.

A student assistant administered the survey to each class. Before the survey was passed, the student assistant gave a brief description about this project and asked students to sign a copy of consent form. It took about fifteen to twenty minutes to answer the survey and it took about thirty minutes to complete the whole process for each class.

After the survey, student assistant entered the data into EXCEL, and we exported the data file to MINITAB for most of our data analysis. On average, survey data for one class took one hour to enter.

**Data entry:**
A student assistant entered the data to EXCEL, and we exported the data file to MINITAB for most of our data analysis. On average, survey data for one class took one hour to enter. In EXCEL, each column represents answers for a question and each row represents answers of questions from a student.

**Data analysis:**
We compared students’ answers from pre and post surveys. In addition to being interested in what the responses were, and in analyzing what that means for how we teach, we are also interested in knowing if students change their attitude toward mathematics in one semester. Long term, we will be interested in attitudinal changes over a longer period of time. Some students only participated in the pre survey and some of them participated in the post. When analyzing for comparison purposes, we deleted those students who only participated in only one (pre or post) survey.

We perform the 1-sample t-test on paired data. We subtract the post survey answers from the pre survey answers (pre - post). Thus, students changed their answers more toward “Not at all helpful(5)/Strongly disagree” if the differences are negative.

The testing hypothesis we use is the following:
\[ H_0: \mu = 0 \text{ vs } H_1: \mu \neq 0 \]
where \( \mu \) is the mean of the difference. To be consistent with other tests we have done, \( H_0 \) is rejected if the p-value is less than or equal to 0.05.

The Pearson product moment correlation coefficients (\( r \)) are computed among various questions.
In order to decide if \( |r| > 0 \), hypothesis testing has been used with the significant level 0.05:
\[ H_0: \text{true correlation=0. } \text{Vs } H_1: \text{true correlation} \neq 0. \]
Let \( r \) be the sample correlation.

\[
t-\text{test: } t = \frac{r \sqrt{n-2}}{\sqrt{1-r^2}} \quad \text{reject } H_0 \text{ if } |t| > t(0.025, df=n-2)
\]
II. Getting started
A key factor in the successful implementation of this data collection activity is good communication. In this section we describe the various campus parties with whom we communicated in getting this effort off the ground.

II.1 Administration (campus and department)
While a benchmarking effort can be successful at any time, a data collection effort of this magnitude and scope coordinates well with a planned or required departmental review or other assessment efforts underway. For example, this QIUIME data collection was accomplished in conjunction with our departmental fifth year review.

At the same time, the entire CSU system was undergoing a strategic planning effort; so we were able to seize this opportunity to assess how well our program was appropriately aligned with Cornerstones.

• The first step in getting started is to plan at least one semester, ideally one year, in advance. One of the first decisions that should be made is to decide who will oversee this effort. Name the committee, and include on the committee someone who has both stature and respect on campus. In this first year, it is important to examine the existing departmental mission statement or goals statement, and create an initial plan, and discuss it with all faculty in the department, and especially with faculty who will be involved. The strategic plan need not be long (ours was only two pages); and should be flexible so that adjustments can be made based on changing environment and evolving needs.

• The next step, during the year before the data collection begins, is to meet with various administrators. This will vary from campus to campus. We met with the Dean of the College of Arts and Sciences, the Vice-President for Academic Affairs, the Director of Enrollment Services, the Director of Computing andTelecommunications, and a representative of the Office of Institutional Research. Consult with math tutorial lab coordinator. You will also want to clear this project with the office that oversees research on Human Subjects; on most campuses, administering surveys to students must be approved by this office, and it can take some months to submit and receive approval for this research on human subjects.

• We were fortunate enough to have an Advisory Committee of outside persons who offered sound advice throughout the project. In the beginning, they helped us focus the project according to the departmental mission and draft our initial plan.

• Since this effort targets lower division; communicate with feeder community colleges. In particular, if any course changes are envisaged, early communication and articulation helps ensure smooth transition and implementation. We met frequently with Ms. Annette Parker, who chaired the Mathematics Department at Palomar Community College to plan and coordinate activities related to course content and teaching strategies. Also, in our local area
there is an organization, the North County Higher Education Alliance, consisting of representatives from CSUSM and each of the three feeder community colleges, that meets monthly to discuss common issues of interest. If a similar organization exists, we recommend meeting with this body as well. This organization is, generally speaking, too broad in scope to accomplish the focused articulation to mathematics demanded by this project; however, the organization does serve as an effective communication vehicle, especially at an administrative level.

• Create a plan and mechanisms for ongoing feedback to the various constituencies on campus. Since the math faculty meet weekly, we simply requested time on the agenda. Similarly, create a plan for keeping administration informed. The particular vehicle or medium differs by institution. In our case, meetings worked best, accompanied or followed by written information. I sent administrators copies of progress reports that we gave at semi-annual project meetings.

II.2 Data support services
In the first semester of the project, we met with the Director of Enrollment Services and some of his staff to discuss and plan for our needs. We met with them again after the first year of the project after we revised our plans to include an annual report from them. In the first semester of the project, we also met with representatives from Institutional Research; however, most of our interaction with this office was simply requests for data.

II.3 Instructional staff
Important to keep all faculty informed; if possible and appropriate, keep them involved. In the first year, all faculty participated in the web survey. The second year only faculty teaching courses in the study participated in the web survey. The challenge for us was to keep part-time faculty informed. At the beginning of each semester we conduct part-time faculty orientation. At these meetings we explained the project in great detail; and followed up with intermittent email updates throughout the semester.

II.4 Students
Participating students learned of the project via announcements in classes. That is, early in the semester, either the faculty teaching the class or one of the faculty overseeing the grant explained the project to the class, and answered any questions students had. On the day of the pre-survey administration, the student assistant again explained the project and answered questions.

We found this grant presented a great opportunity to get students involved in research. We involved two students, one student who was a mathematics major and one student who was a preservice elementary school teacher (liberal studies major on our campus).

II.5 Departmental support staff.
The project definitely created extra workload for the department administrative assistant (secretary). Tasks included communicating with Foundation about the grant budget; maintaining the grant budget; coordinating travel arrangements for outside experts; helping with the departmental survey; facilitating communication with part-time instructors; completing paperwork, keeping timesheets, etc. for students workers; maintaining files, typing memos, arranging meetings, etc.

III. Keeping the ball rolling
In this section, we give a timetable for planning, administering, and analyzing this assessment.

III.1 Planning
At least one semester prior to the actual data collection:
1. Name the committee that will oversee this assessment, and include on the committee someone who has both stature and respect on campus.

2. Examine the existing departmental mission statement or goals statement, and create an initial plan, and discuss it with all faculty in the department, especially with faculty who will be involved.

3. Meet with appropriate administrators. Collaborate, as appropriate, with counterparts at other institutions. Clear project with Office for Research on Human Subjects. Learn about other assessments that might cooperate with this evaluation.

4. Create a plan and mechanisms for ongoing feedback to the various constituencies on campus, and communicate, as appropriate, the plan to the various parties, and to your Dean and other academic administrators where appropriate.

5. Select the courses for inclusion, and create or adapt data collection mechanisms. In our case this meant plan for: collecting data from institutional research; completion of departmental profile; facilitating the completion of the faculty survey; adapting, administering, and analyzing student survey; discussing with client disciplines; incorporating math lab survey into this assessment; creating, timing, and analyzing the enrollment services annual report; creating, using and maintaining an alumni data base.

III.2 Data Collection.
In this section, we describe data collection for the student survey. Other data collection activities were less complicated, and hence need no special description.

Student Survey: We give a sample schedule based on a 16-week semester for conducting the student survey.
Week 1: Prepare the Pre-survey questionnaires. Inform instructors whose classes will participate in the survey.
Week 2: Last day to add/drop class. Get information from instructors about what time the survey can be conducted and how many students they have in their classes (for printing enough copies of survey).

Week 3: Conduct the Pre-survey.


Week 14: Get information from instructors about what time the survey can be conducted and how many students they have in their classes.

Week 15: Conduct the Post-survey.

Week 16: Last week of class.

Break: Enter and analyze data.

**Semester III: 'Wrapping up'**

During the semester after the data collection:

1. Complete data analysis for the departmental survey, the faculty survey and the student survey, comparing and triangulating the data where appropriate.

2. Discuss findings from all project assessments with mathematics program, and with administrators.

3. Based on the discussions in the program, and on the data analysis, revise and streamline the assessment process. Create a short list of items to collect data on in the next five years. The short list should contain “indicators” that serve as surrogates or representatives for other data, items the department (or administration) deem important in continued assessment of progress toward department goals.

4. Create strategic plan for program changes based on findings.

3. Create an action/strategic plan for ongoing monitoring and for feedback into program. On our campus, this plan is an integral component of our Departmental Strategic Action Plan created as part of our Program Evaluation and Planning (5th year review) process. The plan calls for yearly data collection on a short list of indicators, and a large scale data collection approximately every five years, to “reset” the indicators.