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Here is How We Do It: Teaching SAS[®] at Community Colleges

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ABSTRACT

Data is everywhere today and SAS[®] skills are in high demand. Providing community college students with SAS[®] skills is extremely valuable in preparing them for real-world job positions. In this paper, we will describe our experiences and approaches to teaching SAS[®] at Ohlone College. With the paper presentation at the conference, we wish to share ideas and resources with other educators teaching SAS[®] so that we may all better train our students with strong SAS[®] skills to face the real world challenges.

INTRODUCTION

Community colleges serve close to half of the undergraduate students in the United States. They are diverse institutions that serve a wide variety of needs including many nontraditional students, from ages 13 to 80 years and education levels from elementary school to PhD, many of them are adults that are also working while enrolled in school. The comprehensive mission of community colleges makes them attractive to a broad range of people who seek particular programs or opportunities of special interest. Today's digital world produces data everywhere. Mastering a programming language that can be used to manage and analyze data efficiently is an important asset for community college students. SAS[®] is the perfect example such a language. SAS[®] programming skills are in high demand. Providing students with strong SAS[®] skills is extremely valuable for those who are looking for a job or preparing to make a career change that involves data management or statistical analysis. SAS[®] courses and certificate programs offered as cross-reference between Biotechnology and Computer Science department at Ohlone College equip students with solid SAS[®] programming and data analysis skills and provide them many job opportunities at an entry-level positions. In this paper, we shall outline our teaching and learning SAS[®] experiences and describe what we do to help our students to enrich their job skills therefore realize their career dreams.



About Ohlone College

A World of Cultures United in Learning

The Ohlone Community College District is a multi-campus single community college district located in the southern portion of the San Francisco Bay in California, USA. Ohlone College is an ethnically diverse institution that promotes innovation and continuous improvement in many departments and divisions. The College is named for the Native American population living in the area when Mission San Jose was founded. The main campus (Figure 2) is located in the City of Fremont that is just south of the historical Mission San Jose. Ohlone offers more than 180 degrees and academic programs and serves almost 17,000 students per year. Every year about 500 students transfer to four-year colleges and universities. Over 700 students graduate with degrees or earn vocational certificates every year. Ohlone College employs approximately 465 faculty and 220 support and management personnel.



Figure 1. Ohlone College Main Campus

SAS® COURSES

We have been offering SAS® courses to our Ohlone students starting the year of 2004. These SAS® courses have been available for students continuously since then due to the popularity and high demand. There are four cross-reference SAS® courses (Figure 2) developed by the effort of joined faculty teams from both the Biotechnology and Computer Science departments, which give our students solid SAS® skills and real world experience.

Course No	Title	Objective
BIOT/CS 133	Introduction to SAS® Programming	Basic SAS® programming skills
BIOT/CS 143	Advanced SAS® Programming	Advanced SAS® skills Preparation for the Base SAS® Certification Exam
BIOT/CS 133A	Data Analysis Using SAS®	Common statistical methods
BIOT/CS 141B	SAS® Graphing and ODS	Producing SAS® Graphs Delivering SAS® output in a variety of formats

Figure 2. SAS® Courses at Ohlone College

COURSE OUTLINES

BIOT/CS 133 teaches students the fundamentals of the SAS® system and provides an effective transition to other more advanced SAS® courses.

BIOT/CS 143 exposures students more advance SAS skills and prepares them for the Base SAS® certification exam offered by SAS® institute.

BIOT/CS 133A introduces students to data analysis using SAS®. Students learn common statistical methods and gain hands-on experience in data analysis with real-world applications. This course focuses on statistical inference,

analysis of variance, simple and multiple regression, categorical data analysis, and logistic regression. Students also learn how to write SAS[®] programs and interpret output. Emphasis is on fitting models, verifying the model assumptions, and using alternative analysis strategies when necessary.

BIOT/CS 141B introduces students SAS[®] GRAPH and ODS. Students learn how to design, construct, and display customized graphs quickly and efficiently. They also learn how to deliver SAS[®] output in a variety of formats.

TIPS FOR TEACHING SAS[®] AT COMMUNITY COLLEGES

Community college students have a wide spectrum of backgrounds, depending on their educational level, major, and work experience, especially with regard to computing experience. The large variation in students' computing background can be tricky, as we try to keep all of the students engaged in the material, including those who have programmed before. At Ohlone College, most students who are interested in taking the SAS[®] courses are from life science or computer science background. The ratio is usually half-half. For students with a life science education, this is usually their first exposure to computer programming. As instructors, we need to be mindful of these first-time SAS[®] learners so that they do not get lost in the class. In order to take care of this complex scenario, we start these students with our first SAS[®] course, BIOT/CS 133, which provides a gentle introduction to SAS programming, and the class is conducted at a relatively slower pace compared to other SAS[®] courses. We also provide these students with extra time outside classroom tutoring and office hours with those who need additional help. Gradually, these students catch up and become familiar with the computer-programming environment and feel comfortable with the rest of the class. For students with plenty of computer science experience, we usually challenge them by giving extra problems to solve and require them to do some outside classroom self-explorations. This kind of approach, we leave no one behind, which is our goal at community colleges.

For the other more advance SAS[®] courses. Our teaching methods may vary. Here is one of the strategies that we use for learning and teaching in these SAS[®] classes. Students with less SAS[®] experience are paired up with more experienced students with whom they can turn to with questions, and the more experienced students can hone their skills by teaching others. This peer-to-peer instruction approach is an effective way for students to understand the concepts presented in class. This is also a great way to build strong friendships between student partners. SAS[®] classes are usually conducted as half lecture and half hands-on programming lab.

To encourage student to learn materials beyond classrooms, a number of research papers are assigned to students periodically for classroom group discussions and activities. This group activity is a great approach when student come from a variety of educational backgrounds and working experiences, which is usually the case at community colleges. By providing a positive classroom environment and regrouping for each paper discussion, students can benefit and learn from each other and eventually build up a solid network among classmates at the end of a semester.

Throughout the semester, instructors sometimes provide students template SAS[®] code for complicated assignments and projects to perform various analyses and produce high standard reports. This way, students can modify the template code and complete homework assignments and projects in a timely manner.

Weekly programming assignments are typically due within one week. A final group project with real-life application is given at the end of each semester. The final project gives students an opportunity to further understanding the SAS[®] skills learned throughout the entire semester. This project can be a valuable piece at a job interview. Programming assignments and the final project are turned in as SAS[®] programs, which are graded by running the code and reviewing the log and the output, as well as evaluating the programming efficiency and style.

DATA SOURCES

Including real-life data in programming assignments and projects help students gain experience on reading and manipulating different types of data situations, which can help students make a smooth transition to work in a real world environment.

Here is just a short list of sources that are available publicly:

1. Provided by SAS[®] institute with the course notes
2. Government websites: *Census Bureau*, *Centers for Disease Control*, *National Highway Traffic Safety Association for automobile crash data*, *Agency for Healthcare Research and Quality for more national health survey data*
3. Google it on Internet

BASE SAS[®] CERTIFICATION

The SAS[®] Global Certification Program is available to anyone who would like to gain certification credentials from

SAS®. We have incorporated the Base certification into our programs at Ohlone College. At the end of BIOT/CS 143 Advanced SAS Programming course, students are prepared and guided to take the Base SAS® certification exam on site at Ohlone College main campus. This certification helps students build their resumes and gives them advantage during job interviews. The SAS® certification course uses the SAS® *Certification Prep Guide: Base Programming for SAS® 9, Second Edition* by SAS® Press as a reference in class.

CERTIFICATE OF COMPUTER APPLICATION IN BIOTECHNOLOGY



"Ohlone's biotech program is one of the best in the nation."

—DR. ELAINE JOHNSON, NATIONAL DIRECTOR, [BIOLINK](#)®.

Ohlone College Biotechnology department offers classes leading to various certificates and a degree in Biotechnology. These classes provide students with an excellent preparation in various protocols, hands-on laboratory techniques, and SAS® programming skills for data analysis and management. The Biotechnology program prepares students for entry-level positions in biotech companies in the Bay Area. The Computer Applications in Biotechnology Certificate is one of many popular certificates offered at Ohlone College. This is a cross-discipline certificate program developed by Biotechnology and Computer Science department faculty. The SAS® courses are important part of this certificate program (Figure 3).

Course No	Title	Units
BIOT 112	Introduction to Bioinformatics	2
BIOT 121	Biotechnology Careers	1
CS/BIOT 131	Computing in Biotechnology	4
CS/BIOT 133	Introduction to SAS® Programming	3
CS/BIOT 141B	SAS® Graphing and ODS OR	2
CS/BIOT 143	Advanced SAS Programming OR	(3)
CS/BIOT 133A	Data Analysis Using SAS®	(3)
		12-13

Figure 3. Computer Applications in Biotechnology Certificate Program



Ohlone College Biotechnology Program



Computer Science Department

SOFTWARE

Students have two ways to gain access to SAS[®]. First, Ohlone College has a site Licensed software for student's use. Second, students are encouraged to use SAS[®] OnDemand for Academics. This is a free software program for academic teaching and research since 2011.

RESOURCES FOR STUDENT AND FACULTY

- <http://support.sas.com/> for Knowledge, support, training, certification, software, community and event, papers, online documentation, bookstore, Certification, SAS[®] Global Academic Program, SAS[®] OnDemand, User Groups, Events, E-newsletters, Discussion Forums
- <http://lexjansen.com> for user group proceedings for local, regional, and global conferences including: SUGI and SGF, MWSUG, PhUSE, PharmaSUG, PNWSUG, SCSUG, NESUG, SESUG, and WUSS.
- Listservs and Groups
- sascommunity.org
- SAS[®] Tech support is a tremendous resource and they usually answer your question within 24 hours.
- The most recent edition of *The Little SAS[®] Book* by Delwiche and Slaughter.
- The SAS[®] certification course uses the *SAS[®] Certification Prep Guide: Base Programming for SAS[®] 9, Second Edition* by SAS[®] Press.
- Courses notes from the SAS[®] institute. SAS[®] content is constantly evolving and these lecture notes are updated accordingly.
- SAS[®] online documentation

CONCLUSION

SAS[®] is a powerful data management and statistical analysis software package. It is used extensively in health and medical research, academic, government and private sectors. SAS[®] skills are in high demand. Preparing community college students with solid SAS[®] programming and data analysis skills brings them many job opportunities. Since tuition rate is very low at community colleges, providing learning opportunities for this valuable skill at community colleges helps students get the best value. Changes are inevitable. It's not how you deal with the changes, but rather how you accept it. As technology evolves, it becomes increasingly important for community colleges to provide students opportunities to continue learning and updating their skills so our students and communities are prepared to face the evolving real world challenges. We hope this presentation has been invaluable and informative, and it can play a valuable role in encouraging the teaching and learning of SAS[®] skills at community colleges.

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