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FROM THE DIRECTOR

The Penn State Statistical Consulting Center (SCC) has experienced a rewarding and exciting year. Contributing to Penn State's position as a leading research university through research and statistical education continually fulfills the SCC mission. It is a pleasure to share with you the highlights of the 1997-1998 academic year.

We see increasing interest and opportunities in our statistical consulting services, not only from the Penn State research community, but from the government and business community as well. We have added two new faculty consultants to our staff and created a new management position, Operations Manager. I would like to take this time to introduce Michelle Sturgis, the SCC's first Operations Manager. Michelle is a Penn State alumnus from the Department of Management Science and Information Systems. I am excited to have her on our team and look forward to her working with the staff and clients in coordinating our activities and seeking growth opportunities.

On the subject of growth, this year was an outstanding year for graduate student involvement and faculty outreach. Our consultants have been involved in a variety of research topics. Inside, you will find brief descriptions of some of our ongoing research.

Educating our students and graduate students from all disciplines is the SCC's main focus. We do this through free statistical advice for all Penn State graduate students. In the past, we offered this service only during the Fall and Spring Semester. The 1997-1998 academic year marks the first year we have offered full graduate student consulting during the Summer semesters. Demand was strong and kept our consultants busy all summer. We look forward to continuing this service in the future.

Finally, in this age of information transfer, I am happy to announce that the SCC has merged onto the information highway. We now have an online Request for Consulting form available at http://www.stat.psu.edu/~scc/. Statistical help is as close as your desktop.

This year saw managing director, Dr. Janice Derr, accept a one-year appointment as Fellow at the Food and Drug Administration beginning in March 1998. We wish her well as she begins this exciting venture at the FDA. The SCC would be thrilled to have the opportunity to work with her and the FDA on exciting research.
Her consulting responsibilities have been delegated to several faculty and staff members for the next year. Mosuk Chow has assumed responsibility for the GCRC studies and is now teaching STAT 580, our consulting practicum. Steve Arnold and Tanja Bekhuis are the lead consultants for the Center for Locomotion Studies. John O’Gorman, Karen(kb) Boomer and Haihong Li have consulted for the College of Agriculture. Finally, Michelle Sturgis is assuming the administrative responsibilities for the SCC.

I have continued to give oversight to the Center during this year, but am planning to take a Leave to assume the Program Director position at the National Science Foundation during the next year. Distinguished Professor Bruce Lindsay will be acting director and acting head during my absence.

I would like to thank everyone involved for their support of the SCC and encourage researchers to consider the statistical issues at the design stage of their research.

James L. Rosenberger, Ph.D.
Director (on leave at the NSF in 1998/1999)
Faculty and Staff Directory

Director
James L. Rosenberger, Ph.D.

Managing Director
Janice Derr, Ph.D.

Faculty Advisory Committee

<table>
<thead>
<tr>
<th>Name</th>
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<tr>
<td>Dennis Lin (chair)</td>
<td>MSIS$^1$ &amp; Statistics</td>
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<td>Steven Arnold</td>
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<tr>
<td>Vern Chinchilli</td>
<td>Health Evaluation Sciences</td>
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<td>Mark Handcock</td>
<td>Statistics &amp; Population Research Institute</td>
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<td>W.L. Harkness</td>
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<td>Martina Morris</td>
<td>Sociology &amp; Statistics</td>
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<td>Susan Murphy</td>
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Faculty Associates

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<td>J. Keith Ord</td>
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<td>Tanja Bekhuis</td>
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Operations Manager

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<td>Haihong Li</td>
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<tr>
<td>Mustafa Nadar</td>
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Undergraduate Students

| Name              | Major            |

$^1$ Management Science and Information Systems
STATISTICAL CONSULTING CENTER

Amy Schlegel               MSIS
Lisa Denton                MSIS
Scott Weiland              Computer Engineering
Sue Rohner                 Computer Engineering
Tauffau Wilkes             Computer Science

PC / UNIX Support

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<tr>
<td>Jun Recta</td>
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<tr>
<td>Gary Field</td>
<td>UNIX Administrator</td>
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Clerical Support

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<td>Undergraduate/Graduate Student</td>
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<td></td>
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The Statistical Consulting Center: Past and Present

Statistical consulting and collaboration has been an important component of the Department of Statistics' mission since its inception in 1968.

Through the years, many statistics faculty have provided statistical advice and collaboration with researchers within the Penn State University system. The Statistical Consulting Center (SCC) was organized formally in 1983 with funds from a Ben Franklin partnership grant. Since that time, the SCC has developed links with other units on campus, with other Penn State campuses, and with investigators from business, government and industry. The three-part mission that drives the SCC’s commitment to the research community is as follows:

**Research Participation**
*To provide high quality statistical input to high quality research projects.*

**Education**
*To train statisticians to interact effectively with investigators from other disciplines.*

**Collaboration**
*To encourage collaborative research between statisticians and investigators from other disciplines.*

When the Department of Statistics moved to the Thomas Building in 1992, the SCC moved into a specifically designed facility, with offices, a reception area, work space and meeting space.

At present, the financial support for the activities of the SCC comes from a combination of funds from the Statistics Department and specific research projects.

SCC Policy Changes

In the past, the SCC has offered two free consulting appointments to faculty, staff and graduate students. After careful consideration of client and consultant feedback, the SCC has found it more efficient to offer two free sessions to graduate students only. In order to sustain our relationship with all members of the research community, the SCC developed a project assessment service. Penn State faculty and staff, as well as external researchers can meet with a staff consultant free of charge to discuss the scope and budget of their project. We have found the assessment meeting to be a wonderful way for investigators to meet with the SCC at no charge and determine the value of our services.

Statistical Advice

The Statistical Consulting Center continues to see strong interest in our services from the Penn State research community. The figure below illustrates the SCC’s activity by College.

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<tr>
<td>O-PSU</td>
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A full listing of the clients who visited the SCC in 1997/1998 is available upon request.

**Statistical Topics**

Clients came to the SCC at various stages of their research studies and sought advice on a diverse set of topics. The figure below illustrates the diversity of topics at the design and the analysis stage.

**Topics at the Design Stage:**

- Sample Size: 23
- Experimental: 21
- Planning: 11
- Sampling: 9
- Other: 5
- Surveys: 4

**Topics at the Analysis Stage:**

- Variance & Covariance: 44
- Multivariate: 34
- Other: 23
- Descriptive Statistics: 22
- Linear Regression: 21
- Correlation: 19
- Nonparametric: 14
- Reliability: 12
- Categorical Data: 12
- 1 & 2 Sample tests: 8
- Estimates: 8
- Nonlinear Methods: 6
- Time Series: 5
- Survival: 1

**SCC Expansion**

1997/1998 marked the year in which the SCC began expansion of services. The SCC was able to retain two new Associate
Consultants. Our new additions are Dr. Tanja Bekhuis and Dr. Mosuk Chow. Dr. Bekhuis' background is in Quantitative Psychology and Social Sciences. Dr. Chow's experience is in sampling and biostatistics. Both Dr. Bekhuis and Dr. Chow are currently working on valuable research and making useful contributions to the projects.

We are happy to have them on our staff and look forward to a great 1998/1999 year.

**SCC and the Web**

During the Fall Semester at the SCC, Michelle Sturgis and Scott Weiland redesigned the SCC web page. The most notable and useful addition to the page was the interactive Consulting Request Form. Clients can now request statistical consulting services via the web.

To access the Request Form, go to http://www.stat.psu.edu/~scc/ and choose Services.

**STAT 470 Expands to Include Applied Consulting**

*STAT 470: Problem Solving and Communications in Statistics* is an undergraduate course which exposes students to a range of consulting topics. This course was taught by Janice Derr and Karen (kb) Boomer and included guest lecturers of current SCC clients: Rupert Amann, of BioPore; and Dr. Judy Wakhungu, Director of the WISE Institute, and Ms. Karen Wynn, Associate Director of the WISE Institute and former Director of WISER, an activity of the PA Space Grant Consortium (NASA); and former client Pat Irwin, of University Health Services. In addition, seven of the nine students had the opportunity to work with long term clients. Three of the clients were college seniors working on their undergraduate thesis. Brent Decker and Allison Shubert each worked with students to analyze survey data. Tim Freyer performed analysis of variance for his client. Two students, Samantha Cruz and Gang Bai, worked with Dr. Martina Morris, of the Statistics and Sociology Departments, to assess which factors may predict why some individuals dropped out of a longitudinal study. Finally, two students, under the supervision of John O’Gorman, worked with Paul Canavan and Dean Plafcan from the Center for Sports Medicine at Penn State. Brent Williams performed a reliability analysis on shoulder displacement measurements taken using a scapula measurement instrument. John Dinh used a repeated measures analysis of variance to investigate the leg strength of patients in rehabilitation recovering anterior cruciate ligament surgery.

We hope to expand this SCC service so that each STAT470 student has the opportunity to work with a client. There is no cost for the client and the analysis is performed during the spring semester. Preference is given to students in the University Scholars Program (that is, to students needing assistance with undergraduate thesis research). To participate, please contact the SCC by the end of December 1998.

**Research Project Teams**

The SCC has a strong commitment to student participation in research. There were numerous research teams active in 1997/1998 involving graduate and undergraduate students at all levels of
A number of funding mechanisms permitted us to involve graduate and undergraduate students in research at Penn State.

Here are brief descriptions of some of these very interesting projects:

**Surveillance of Falls in a Nursing Home**

The Center for Locomotion Studies (CELOS) conducted a multi-year study of falls in a nursing home. This study was part of a larger grant *Dually Stiff Floors for Injury Prevention for the Elderly* (Principal Investigators: Peter R. Cavanagh and Donald Streit). It was designed to evaluate where most falls occur in a nursing home so that shock absorbent flooring could be optimally placed to reduce injury. A total of 373 residents suffered 2205 falls. About 75% of the falls occurred in the residents’ rooms. Additionally, 9.6% of the residents who fell suffered fractures and 6.5% suffered hip fractures. The SCC has had a continuing relationship with CELOS and this year, Tanja Bekhuis worked with Mary Becker, RN, Project Coordinator on the study.

**Surveillance of Falls on Stairs**

CELOS is conducting a three-year project founded by the National Institute of Health. This project is lead by Principal Investigator Peter Cavanagh. The stairs project is a study of falling occurrences during stairs descent. The focus of the study is stair descent by the elderly. During this first year, the focus is on planning and recruiting subjects. Dr. Janice Derr and Haihong Li provided assistance with design efficiency and sample size calculations.

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**Bursar Billing Survey**

In the spring 1998 semester, the Bursar's Office at the University Park campus sent a questionnaire to every student who received a semester bill. The purpose of this questionnaire was to gain feedback from students in two areas: (1) clarity of the semester bill and (2) satisfaction with the interaction with Bursar Office representatives during phone contact. John O'Gorman, Tracy Spangler, and Lisa Denton worked with the Bursar Roseann Sieminski and lead analyst Scott Bittner to produce summary tables and pie charts. A sample pie chart is pictured below:

![Sample Pie Chart](http://www.bar.psu.edu/survey.htm)

**Figure 1. Summary of question 3: Is the Semester Bill easily understood?**

The complete summary of this project may be viewed at

http://www.bar.psu.edu/survey.htm

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**CELOS Posture**

Dr. Janice Derr and John O'Gorman continued work on this three-year, NIH-funded project with Dr. Peter Cavanagh and Dr. Robert van Deursen of CELOS. The goal of this project is to study the effect of diabetes on the control of posture. The primary focus of this year's work has been on
the development of a multiple regression model to predict various aspects of postural instability. Also repeated measures analysis of variance models were used to analyze latency and amplitudes of muscle responses from subjects standing on a platform. These responses were caused by changes in the position of the platform.

Scatterplot of two predictor variables: Monofilament and MVPT

Statistical analysis for Hatfield Quality Meats

Hatfield Quality Meats is a full line pork processor located in Eastern Pennsylvania. Hatfield Meats is very conscious of the needs and wants of its customers. Consumers today continue to demand products of consistent size and superior quality. To meet the customers’ demand for quality, the company wants to determine the distribution of many attributes of the fresh pork processed by Hatfield. The fresh pork-processing department of the company performed tests and collected data on loin quality. During Spring 1998, Drs. Mosuk Chow and William Harkness began actively consulting on Hatfield's pork sampling project. They proposed a stratified sampling scheme to take representative samples of pork loins from different suppliers so that one can accurately estimate the distributions of the important attributes of fresh pork quality, e.g., color and marbling. The sampling part was successfully implemented during the second quarter of 1998. Data analysis will be performed this summer. Haihong Li, Ph.D. student in statistic, will assist with the data analysis.

CELOS SAS Training

During the spring of 1998, Dr. Janice Derr and John O'Gorman presented a series of training seminars for the faculty, staff, and graduate students at CELOS. Many studies at CELOS involve an initial pilot study during which the reliability of the instruments is tested. Also repeated measures designs are a common methodology at CELOS. Thus the focus of these seminars was on reliability calculations using SAS PROC VARCOMP and repeated measures models using SAS PROC MIXED. Special thanks to Dr. Peter Cavanagh for suggesting these seminars and to all the investigators at CELOS who provided data sets.

Statistical Consulting with the General Clinical Research Center

The SCC joined with the Biostatistics Section of the Department of Health Evaluation Sciences at Hershey Medical Center to provide statistical support to the General Clinical Research Center (GCRC). The GCRC is located at Hershey Medical Center with a satellite unit at Noll Laboratory for Physiological Research at University Park. The predominant research emphasis of the Center includes basic, applied and clinical physiology. The Center is available for use by investigators within
Dr. Janice Derr served as the Biostatistician of the GCRC and reviewed the statistical component of the proposals to GCRC. Since Dr. Derr’s leave of absence in March 1998, Dr. Mosuk Chow was appointed the new Biostatistician for the GCRC. During the academic year 1997-1998, Haihong Li worked at the University Park GCRC to provide statistical assistance to researchers working on GCRC approved projects and held weekly office hours at the Noll Lab. We are grateful to Professor Vern Chinchilli, Chief of the Biostatistics Section, for providing this opportunity to our statistics graduate students.

Efficient sampling techniques help to estimate carbon dioxide degassing from Yellowstone.

Preparation for fieldwork is a critical component for the success of any study. A valuable aspect is the statistical planning, including the assessment of the number of samples to collect, and the design of sample placement. Karen (kb) Boomer has worked with Cindy Werner, a Ph.D. student, and her advisor, Dr. Sue Brantley, of the Geoscience Department, to develop a stratified adaptive cluster sampling plan for the assessment of the total carbon dioxide released from Yellowstone National Park. Most of the theory is based on the work of the Statistics Department’s Dr. Steven Thompson, whose ideas where adapted based on the observed spatial correlation at the study site. Using this plan, Werner was able to reduce the variability in her total estimator, and collect fewer samples than if she had used a less sophisticated sampling design. A two-part journal article, describing the development of the statistical plan and the geochemical results, has been submitted to the *Journal of Geophysical Research* for publication.

Variance estimation continues with Biochemistry Laboratory

Dr. Janice Derr, Dr. Jim Rosenberger, and Karen (kb) Boomer have continued to explore sources of variation in data sets, and how to automate data processing of artificial insemination data sets obtained by BioPore, Inc., of State College, PA.

Continuing with the work begun during the summer of 1997, the SCC team has worked with data from three animal species. One objective continues to be the assessment of how the variability would change as a function of the number of replicate samples or assay plates, technicians, analyses, and composite pools of material. In the analysis, we primarily use the SAS procedures GLM, MIXED, and VARCOMP. In addition, the team adapted a robust least squares iterative re-weighting...
technique to assist BioPore in the detection of data outliers.

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**SCC Collaboration helps Ph.D. Student.**

Collaboration between statisticians and other scientists is one of the SCC missions and was a primary part of the work Karen (kb) Boomer did with Frank Borsuk, Jr., a Ph.D. student in the School of Forest Resources. Working on a grant from the Pennsylvania Fish and Boat Commission, Frank needed guidance using SAS and also sought advice on appropriate analyses, including two factor analysis of variance and power analyses. With support from the SCC, Frank was able to perform his analyses and is looking forward to publishing his work in the near future.

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**Spatial Analysis in Plant Pathology**

The SCC research team has been assisting Dr. Dan Royse, of the Department of Plant Pathology, in the study of factors contributing to the spread of green mold in commercial production houses. The research benefited from the addition of Stat 597D student Yunling Du to our team. Yunling wrote a Splus program to assess whether the spread of green mold appeared to be spatially random or not. Thanks to Dr. Keith Ord for his assistance in helping us to design the analysis method. We have submitted preliminary results to the journal *Plant Disease*. A reviewer stated that “a primary merit of this work is that it is perhaps one of the first and only manuscripts to quantify spatial aspects of a disease in mushrooms.”

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**Retention of Wiser Interns as Compared to Their "Virtual Twins"**

The grant Women in Science and Engineering Research (WISER) Program to Retain First Year Women in Science and Engineering Majors was awarded by the National Science Foundation to co-P.I.’s Richard Devon and Karen Wynn. The WISER program is designed to improve retention of women students in science and engineering majors by providing first year undergraduate students access to cooperative research work in the laboratory and mentoring from male and female faculty and graduate students. This program started in 1994, and yearly evaluation by WISER interns showed that the program has effectively provided a good learning and coping environment for women students in the science and engineering courses, and that the interns were very satisfied with their experiences.

The NSF grant was awarded to study the impact of the WISER program and the SCC (with Janice Derr as co-investigator and Jean Recta as graduate researcher) implemented the quantitative portions of the assessment. This year, we completed a study that compared the retention of WISER interns with their male and female “virtual twins” – two control groups that were generated by computer search of the PSU Data Warehouse. The WISERs’ virtual twins were found by matching year and semester of entry, college, SAT scores, age, and ethnicity. A final criterion was self-reported “certainty of intended major” at the time of students’ entry into PSU, in order to match similarly motivated students among WISERs and the control groups.

We traced the academic majors of 96 WISERs and their male and female virtual twins over a period of 4 to 8 semesters and
found that an accumulated 35.6% of the WISERs changed majors, compared to 46.8% and 46.7% of the female and male control groups, respectively. Figure 1 shows the percentage of the subjects who changed majors in each semester. The non-WISERs changed majors earlier (during third and fourth semesters) than WISERs (fourth and fifth semesters).

Figure 1. Rate of change in major by WISERs and their virtual twins, by semester.

Some of these changes were just movements within science or engineering majors (SEM), and the rest were shifts out of SEM, or attrition. Figure 2 shows the cumulative rates of attrition from SEM, based on the subjects observed during each semester. Male and female non-WISERs appeared to shift out earlier (second year) and at higher rates than WISERs, and continued to do so even during their third year. In contrast, WISERs who dropped out of SEM did so mostly at the end of their third year and beginning of the fourth year. After this, no additional attrition was observed among the remaining WISERs.

Figure 2. Cumulative attrition rate of WISERs and their virtual twins.

Relative to non-WISERs, tests confirm that WISERs are more persistent in their academic program. They stay longer before making any changes in their major or before moving out of SEM. It may be inferred that the internship program gave WISERs the time and the environment to make better informed decisions about their majors, resulting in lower attrition rate among WISERs compared to the male and female control groups. It is estimated that a WISER is 1.6 times more likely to stay in the same major, and 2.5 times more likely to remain in SEM than her non-WISER twin.

All data collection and management in this study was conducted with strict security, confidentiality and anonymity maintained according to PSU policies.

These brief summaries show that the SCC is involved in some interesting and diverse statistical projects.
Have you ever looked at the colors in a bag of M&M’s through the eyes of a statistician? We invited girls in grades 5-12 to do just this in the SCC’s contribution to “Take Our Daughters to Work” Day on April 23. Karen (kb) Boomer, John O’Gorman, Jean Recta, Tracy Spangler, Maria Mouyi, Maren Olsen, Lisa Denton and Michelle Sturgis conducted a hands-on session with information, lots of bags of M&M’s, and computers. The students and their mentors appeared to enjoy their assignment as quality control statisticians, counting the number and colors of M&M’s in different sized samples. We hope they learned that statistics can be interesting, painless, and downright delicious!

**Sample distribution of M&M’s by color.**

Have you ever looked at the colors in a bag of M&M’s through the eyes of a statistician? We invited girls in grades 5-12 to do just this in the SCC’s contribution to “Take Our Daughters to Work” Day on April 23. Karen (kb) Boomer, John O’Gorman, Jean Recta, Tracy Spangler, Maria Mouyi, Maren Olsen, Lisa Denton and Michelle Sturgis conducted a hands-on session with information, lots of bags of M&M’s, and computers. The students and their mentors appeared to enjoy their assignment as quality control statisticians, counting the number and colors of M&M’s in different sized samples. We hope they learned that statistics can be interesting, painless, and downright delicious!

**Sample distribution of M&M’s by color.**

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<th>Percentage</th>
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<tr>
<td>Yellow</td>
<td>10%</td>
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<td>Red</td>
<td>21%</td>
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<td>Orange</td>
<td>15%</td>
</tr>
<tr>
<td>Green</td>
<td>23%</td>
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**Opportunities and Partings**

- **Dr. James Rosenberger, Director, SCC** accepted a one year appointment with the National Science Foundation effective September 1, 1998, as Program Director of the Statistics and Probability program. We couldn’t be happier for Dr. Rosenberger. Congratulations!

- **Dr. Janice Derr, Managing Director, SCC** accepted a one year appointment with the Federal Drug Administration effective March 1, 1998 as Research Fellow in the Department of Veterinary Medicine. We are extremely happy for Dr. Derr. Congratulations, Janice!

- **John O’Gorman, senior graduate consultant** has accepted a position with Lilly Pharmaceuticals in Indianapolis, IN. John will receive his Ph.D. at the end of the Summer semester. We will miss John’s many contributions and his ability to create successful relationships with investigators from varied disciplines. Good luck John!

- **Amy Schlegel** received her BS in May 1998 in Management Science and Information Systems, and began work as a software developer with Bell Atlantic in Maryland. We will miss Amy’s extraordinary organizational skills. We wish her the best in her new position.

- **Sue Rohner** received her BS in Computer Engineering in December 1997 and accepted a position as a systems analyst with Unisys Corporation in Philadelphia, PA. Sue was with the SCC during her entire college career and contributed immensely to its growth. We miss her greatly and wish her the very best of luck in her new career.

- **Scott Weiland** received his BS in Computer Engineering in May 1998 and is currently entertaining job offers from Raytheon and Digital in Massachusetts. Scott was instrumental in developing our Web based Request for Consulting Form. We will miss his sense of humor and his computer talent.

- **Tauffau Wilkes** obtained a Spring semester internship with SmithKline in Philadelphia, PA.
Lisa Denton, a senior in Management Science and Information Services is our new Operations Assistant. Lisa's background includes Navy service and accounting duties for various State College businesses. Lisa anticipates receiving her B.S. in May 1999. We are glad to have Lisa on our team and look forward to a great 1998/1999 academic year.