Overview of the Undergraduate and Master's Student Actuarial Research at UC Santa Barbara

Actuarial research course sequence PSTAT 296A-B, *Research Projects in Actuarial Science*, was introduced in 2010 and is offered annually in Fall and Winter quarters. The main purpose of the course is to expose students to real-world research problems related to insurance industry. Students also get training in scientific writing, presentation skills, realistic data analysis, Excel and R programming, and group teamwork. In return, sponsoring companies benefit from resulting research and access to UCSB's 300+ actuarial majors and faculty.

PSTAT 296A-B is taught over 20 weeks and enrolls about 8-18 students who complete a group actuarial project in partnership with actuarial/insurance/risk-related companies. Depending on the number of projects, typically each project team includes 3-4 students. This is a required sequence for masters' students pursuing the combined five-year B.S./M.S. degree in Actuarial Science. We also invite our top undergraduates to participate. Some students pursuing MA in Applied Statistics participate as well.

Typically, students in the *Actuarial Research Project* class have taken applied statistics courses in regression, time series, possibly data mining, as well as actuarial courses in compound interest, life insurance, finance, etc. They have working knowledge of SAS, R and at least one programming language, typically C++ and Python. Students also complete an upper-division Business Writing class at UCSB.

All projects are presented as posters at the annual Undergraduate Research Colloquium at UCSB. In addition, best projects are submitted for presentation at the annual Actuarial Research Conferences. Frequently, the students also make an on-site visit and presentation to the industrial partner. For example, several times students visited CSAA in Walnut Creek, CA (paid for by CSAA) and made PowerPoint presentations to the entire CSAA actuarial department.

Company Sponsor Expectations

An insurance company, or other company with an insurance risk problem, sponsors the project which means the following:

- The research project comes from the sponsoring company. We have been focusing on health-related projects and property/casualty projects because our faculty have special expertise in these areas.
- A representative from the company is available to have a kick-off call with students within the first couple weeks of the project (October). A new Fellow is suitable for this role as our primary contact.
- A representative from the company is available to have a few interim calls and emails over the 6 month project to answer questions or provide guidance as needed.
- The students will make a final presentation to the company with their findings, and also issue a report or article. The company can visit UCSB in-person for this or we can set up some type of web call.
- Most of the week-to-week project needs are under the direction of qualified faculty to save time/involvement for the sponsoring company.

Although we do not charge companies for completed projects, we very much appreciate donations to our Actuarial Program Fund supporting Actuarial Exam Fee Reimbursement program and other actuarial events at UCSB. More information is available at http://www.pstat.ucsb.edu/giving.htm . We also have a Corporate Affiliates program for our industry partners.

Partial List of Past Projects:

- *Territorial Analysis for Ratemaking, 2010-11.*
  Industry Sponsor: AAA NCNU.
  Faculty Supervisor: Profs. M. Ludkovski, PhD and R. Feldman, PhD
  Statistical Methodology: data mining, specifically, clustering

- *Pricing Options for Life Insurance*, 2010-11
  Faculty Supervisor: Prof. M. Ludkovski, PhD
  Statistical Methodology: Monte Carlo simulations
  This project won the first prize at the UCSB Undergraduate Research Colloquium.

- *Predictive Modeling for Healthcare Using Regression Techniques, 2011-12*
  Industry Sponsor: Solucia Consulting
  Faculty Supervisors: Profs. M. Ludkovski, PhD, I. Duncan, FSA, and R. Feldman, PhD
  Statistical Methodology: model selection algorithms (LARS and LASSO)
  A presentation based on this project was a prizewinner for student presentations at ARC 2012.

- *Predictive Modeling for Healthcare Using Regression, 2012-13*
  Industry Sponsor: Solucia Consulting
  Faculty Supervisor: Prof. M. Ludkovski, PhD
  Statistical Methodology: Classification and Regression Trees (CART) and Multivariate Adaptive Regression Splines (MARS) procedures
  A presentation based on this project was a prizewinner for student presentations at ARC 2013.
  A paper based on this project was published in the *North American Actuarial Journal* in May 2016

- *Trend Analysis for Quarterly Insurance Time Series, 2013-14*
  Industry Sponsor: CSAA Insurance Group.
  Faculty Supervisor: Prof. M. Ludkovski, PhD
  Statistical Methodology: time series
  A poster, based on this project shared the first prize in the ARC 2014 poster competition.

- *Impact of Diabetes on Length of Hospital Stay for Elective Orthopedic Procedures in California, 2014-15*
  Industry Sponsor: William Sansum Diabetes Center
  Faculty Supervisor: Prof. I. Duncan, FSA
  Statistical Methodology: Poisson GLM model
  A paper based on this study was accepted for publication.

- *Claim Severity Distribution of Homeowners & Auto Insurance, 2014-15*
  Industry Sponsor: CSAA Insurance Group.
  Faculty Supervisor: Prof. J. Duncan, FCAS
  Statistical Methodology: fitting distributions for auto/homeowners claim severity

- *Predictive Modeling for Hospital Readmissions, 2015-2016*
  Industry Sponsor: Santa Barbara Cottage Hospital
  Faculty Supervisor: Profs. I. Duncan, FSA, W. Herndon, PhD
  Statistical Methodology: logistic regression
  *A presentation based on this project shared the first prize for student presentations at ARC 201*6

- *Relationship Between Exercise, Obesity and Diabetes*
  Industry Sponsor: Vitality Group
  Faculty Supervisor: Profs. I. Duncan, FSA, W. Herndon, PhD
  Statistical Methodology: general linear models
  A poster based on a portion of this study presented at the 2016 American Diabetes Association conference

- *Health Benefits Associated with an Employer-Sponsored Health Promotion Program & Device-Reported Activity, 2015-21016*
  Industry Sponsor: Vitality Group
  Faculty Supervisor: Profs. I. Duncan, FSA, W. Herndon, PhD
  Statistical Methodology: multivariate regression
  A paper based on this study delivered at the institute of Actuaries, London, in June 2016.

- *Auto Frequency Trend & Hand-Held Devices, 2015-2016*
  Industry Sponsor: Allstate Insurance
  Faculty Supervisor: Prof. J. Duncan, FCAS
  Statistical Methodology: frequency-severity model
  A presentation based on this study delivered at the SOA Annual Meeting in October 2016.

- *Simulation of systemic events based on random banking networks, 2016-17*
  Industry Sponsor: Center for Financial Mathematics and Actuarial Research (CFMAR), UCSB
  Faculty Sponsor: Prof. M. Wildman, PhD
  Statistical Methodology: Monte Carlo Simulations
  A presentation based on this project was delivered at ARC 2017

- *Workers Compensation Survival Models to Predict Life Expectancy, 2016-17*
  Industry Sponsor: CSAC-EIA
  Faculty Sponsor: Profs. I. Duncan, FSA, R. Molinari, PhD
  Statistical Methodology: survival analysis
  A presentation based on this project was delivered at ARC 2017

- *Analysis of the California Office of Self-Insured Plans Medical Reserving Methodology, 2016-17*
  Industry Sponsor: CSAC-EIA
  Faculty Sponsor: Prof. J. Duncan, FCAS
  Statistical Methodology: loss development method

- *Auto Mileage Forecasting, 2016-2017*
  Industry Sponsor: CSAA Insurance Group
  Faculty Supervisors: Profs. J. Duncan, FCAS and R. Molinari, PhD
  Statistical Methodology: regression models

- *Text Mining Auto Subrogation Recoveries, 2016-2017*
  Industry Sponsor: CSAA Insurance Group
  Faculty Supervisors: Profs. J. Duncan, FCAS and R. Molinari, PhD
  Statistical Methodology: text mining

- *Predictive Modeling in Healthcare Costs using Regression Techniques, 2016-17*
  Industry Sponsor: Santa Barbara Actuaries
  Faculty Sponsor: Profs. I. Duncan, FSA and R. Molinari, PhD
  Statistical Methodology: regression models

- *Risk adjustment for Medicare Accountable Care Organizations, 2016-17*
  Industry Sponsor: Santa Barbara Actuaries
  Faculty Sponsor: Prof. I. Duncan, FSA
  Statistical Methodology: actuarial risk assessment, general liner models, simulation

A sample of journal publications resulting from PSTAT 296A-B projects:

1. Duncan I. & Guerrier S., Member Plan Choice and Migration in Response to Changes in Member Premiums after Massachusetts Health Insurance Reform, *North American Actuarial Journal*, 2016 (to appear).
2. Kerr D., Yadollahi M., Mendoza H., Chen X., Dong S., Guerrier S., Laan R. & Duncan I., Use of a Publically Available Database to Determine the Impact of Diabetes on Length of Hospital Stay for Elective Orthopedic Procedures in California, *Population Health Management*, 2016 (to appear).
3. Duncan I, Loginov M, & Ludkovski M., Testing Alternative Regression Frameworks for Predictive Modeling of Health Care Costs, *North American Actuarial Journal*, 20(1), 1-23, 2016.
4. Duncan I., Fallah, H., Huynh N., Robbins-Kelly D., *Predicting Re-Admissions among Medicare Patients in a California Hospital* (in preparation).