Statistics - Ph.D
2017 - 2018 Assessment Plan

I. ANNUAL REPORT FOR 2016 - 2017

Mission Statement

The Ph.D. program seeks to serve its students and society by offering a high-quality graduate experience that prepares future statistics faculty members and research statisticians for business, industry, and government. It strives to produce graduates who will substantially advance the state of knowledge in the field.

Goal 1.

The Doctor of Philosophy in Statistics is designed to prepare the student to teach statistics at the collegiate level, to do independent research, and/or work as a lead statistician in business or industry.

Curriculum

Beyond the coursework required for the master of science, tested in the Ph.D. qualifying exam, candidates for the Ph.D. are required to take additional advanced coursework in statistical theory, including: STAT 810 – Probability Theory I, STAT 811 – Probability Theory II, 721 – Stochastic Processes, STAT 822 – Advanced Statistical Inference, STAT 823 – Large Sample Theory, STAT 824 - Nonparametric Inference, and STAT 740 – Statistical Computing. They must successfully complete a doctoral dissertation that adds to the body of knowledge in the field, orally present that dissertation, and successfully pass an oral exam on the topics of the dissertation administered by at least four faculty members. Students who express the desire to pursue careers in academia are afforded the opportunity to teach, including weekly support meetings with the course coordinator.

Learning Outcome 1.

The Ph.D. recipient should have solid knowledge of the advanced theory of statistics and probability.

Measures and Criteria

Ph.D. students should successfully demonstrate mastery of the advanced theory of statistics and probability in the seven advanced courses expressly designed to cover the major topics in the area at the level appropriate for the Ph.D. Professors of Ph.D. required courses should rank at least 80% of students completing their courses as "adequate" in terms of mastery of the material. Students completing the Ph.D. theory courses should have confidence in their knowledge,and particularly in their ability to modify concepts and arguments presented in these courses to solve new methodological bottlenecks. Therefore, the median score on the exit survey question "How do you assess your ability to derive and interpret results in mathematical statistics?" should be at least "very good."

Methods

Success in meeting this learning outcome is evaluated every third year (the next round is academic year 2017-2018). Information for this evaluation include the students' demonstration of this knowledge through exams and coursework, a summary of each student's command over PhD core material as evidenced by their

Comprehensive Examination, supplemented by the students' impressions of their knowledge as evaluated by the graduate student exit survey.

The professor(s) of STAT 810, 811, 721, 822, 823, 824, and 740 will evaluate student performance in the form of a written summary of the strengths and weaknesses of that cohort of students in terms of the course's subject matter. Specifically, each professor will delineate the most important areas in which students met or exceeded the expectations of the course's learning outcomes as listed in the course syllabus. As a summary measure, each professor will provide a proportion of students completing their course that are at least "adequate" in terms of mastery of the material.

Each student's Comprehensive Examination Committee will provide a brief written summary of the student's strengths and weaknesses in terms of PhD core sequence material in relation to the student's research topic(s) on the Statistics Department Comprehensive Examination (i.e. Dissertation Proposal) form.

The assessment coordinator will prepare a summary of student responses to the exit survey question: "How do you assess your ability to derive and interpret results in mathematical statistics?"

These results will be presented to the department's graduate committee who will prepare a report on the findings, along with initial suggestions for further refinement or improvement of the program if necessary. The committee report will be presented to the entire department as an agenda item at the annual department retreat.

Results

No assessment needed this year.

Use of Results

No assessment needed this year.

Learning Outcome 2.

The Ph.D. recipient should have the ability to substantially add to the body of knowledge in the field in statistics.

Measures and Criteria

The Ph.D. students' research should be presented to the field at large through publication in statistical journals and presentations at national research meetings of statisticians, including the publication of the dissertation. At least 80% of graduated Ph.D. students should have one or more major publications stemming from their dissertation in a mainstream statistics journal within three years of their defense. In addition, the median score on the exit survey question "How do you assess your ability to develop statistical work that is publishable in a reputable journal of the field?" should be at least "very good".

Methods

Success in meeting this learning outcome is evaluated every third year (next round will be academic year 2016-2017). The major source of information for evaluating this criterion is the actual research productivity of the current Ph.D. students in the department and those who have graduated within the past three years. The expectation is that each successful PhD student will eventually publish at least one substantial paper from their dissertation, and ideally two or more. Therefore, upon defense of the PhD, it is expected that each graduate student will have at least one

paper submitted for publication. This information on raw productivity (submitted papers) and quality (accepted papers) is supplemented by the students' impressions of their capabilities as evaluated by the graduate student exit survey, and the evaluation of the dissertation research at the time of the defense by the final examination committee.

The assessment coordinator will collect the titles of publications (and names of journals) made by the current Ph.D. students in the department and those graduated within the past three years.

The assessment coordinator will prepare a summary of student responses to the exit survey question: "How do you assess your ability to develop statistical work that is publishable in a reputable journal of the field."

Each Ph.D. final examination committee shall produce summaries of the quality of research in the student dissertation. These reports are collected by the assessment coordinator.

These results will be presented to the department's graduate committee who will prepare a report on the findings, along with initial suggestions for further refinement or improvement of the program if necessary. The committee report will be presented to the entire department as an agenda item at the annual department retreat.

Results

Graduate student publications for 19 current students and 21 students graduating 2014-2017 are listed below. Current students include third-year students, who have just begun their research. Among students who graduate in 2014-2017, 15 (72%) had at least one submission or publication, and 10 (48%) had multiple submissions/publications, some of which post-date their dissertation work. Among current 5th year (or greater) students, 5 of 6 (83%) have a single publication or submission. Three of 7 4th year students (42%) have a publication or submission, and 1 of 7 3rd year students (14%) have a single publication or submission. Only one current student has multiple submissions/publications.

Our eight 2014-2017 graduates who accepted tenure-track positions upon graduation have all had submissions or publications, with seven of those eight having multiple publications or submissions. This outcome clearly meets the criteria for former doctoral students. Eight of our 13 (62%) current students who may defend their thesis in a year have submissions or publications; this percentage is lower than it should be.

Exit survey

A total of 10 PhD students completed the exit survey from December 2013 to May 2017. Their response distribution to Q21 (How do you assess your ability to develop statistical work that is publishable in your field?) was: Fair-1, Good-4, Very Good-4, Excellent-1, so the median score falls between Good and the target of Very Good. Compared to historical data, the response to this question has proven stable.

Seungchul Baek (4th year)

1. Jiang, F., **Baek, S.,** Cao, J. and **Ma, Y.** (2015+) A Functional Single Index Model, *Annals of Statistics*, submitted.
2. **S. Baek**, O. Komori, and **Y. Ma** (2017+). An optimal semiparametric method for two-group classification, *Scandinavian Journal of Statistics*, submitted.

Junshu Bao (2016)

1. **Bao, J.** and **Hanson, T.** (2016). A mean-constrained finite mixture of normals. *Statistics & Probability Letters*, **117,** 93-99.
2. **Bao, J**. & **Hanson, T.** (2015). Bayesian nonparametric multivariate ordinal regression. *Canadian Journal of Statistics*, 43, 337-357.
3. **Bao, J., Hanson, T.,** McMillan, G., and Knight, K. Assessment of DPOAE test-retest difference curves via hierarchical Gaussian processes. *Biometrics*, accepted.

Wen Cheng (2014)

1. **Cheng, W**., **Dryden, I.** and **Huang, X.** (2016). Bayesian registration of functions and curves. *Bayesian Analysis* **11**, 447-475.
2. **Cheng, W**., **Dryden, I. L**., **Hitchcock, D. B.**, Le, H. (2014), "Analysis of spike train data: Classification and Bayesian alignment," *Electronic Journal of Statistics*, 8, No. 2, 1786-1792.
3. **Cheng, W**., **Dryden, I. L**., **Hitchcock, D. B.**, Le, H. (2014), "Analysis of proteomics data: Bayesian alignment of functions," *Electronic Journal of Statistics*, 8, No. 2, 1734-1741.
4. **Cheng, W**., **Dryden, I. L**., **Hitchcock, D. B.**, Le, H. (2014), "Analysis of AneuRisk65 data: internal carotid artery shape analysis," *Electronic Journal of Statistics*, 8, No. 2, 1905-1913.

William Cipoli (2016)

1. **Cipolli, W**., **Hanson, T**., and McLain, A. (2016). Bayesian nonparametric multiple testing. *Computational Statistics & Data Analysis,* **101**, 64-79.
2. Fowler, J., **Cipolli, W**., & **Hanson, T.** (2015). A comparison of three diagnostic tests for diagnosis of carpal tunnel syndrome using latent class analysis. *Journal of Bone & Joint Surgery*, 97, 1958-1961.
3. **Cipolli, W.** and **Hanson, T.** Computationally tractable approximate and smoothed Polya trees. *Statistics and Computing*, accepted.

Yin Fu (2015)

JeanMarie Hendrickson (2014)

Peijie Hou (2017)

1. **Hou, P., Tebbs, J.,** Bilder, C., and McMahan, C. (2017). Hierarchical group testing for multiple infections. *Biometrics*, in press.

Bereket Kindo (2016)

1. **Bereket Kindo**, **Hao Wang**, **Edsel Peña** (2016). Multinomial probit Bayesian additive regression trees. *Stat*, 5, 119–131
2. **Peña, E.,** Wu, W., **Kindo, B.,** Hill, B., **Rahman, F.,** and Wanda, L. (2014). Multi-Group and Multi-Agent Binary Decision-Making. Under revision for *Naval Logistics Quarterly*.

Taeho Kim (4th year)

Han Lee (2016)

Li Li (2014)

1. **Li, L**., **Hanson, T**., & Zhang, J. (2015). Spatial extended hazard model with application to prostate cancer survival. *Biometrics*, 71, 313-322.
2. **Li, L., Hanson, T.**, Damien, P., and Popova, E. (2014). A Bayesian nonparametric test for minimal repair. *Technometrics*, 56, 393-406.
3. **Li, L.** and **Hanson, T.** (2014). A Bayesian semiparametric regression model for reliability data using effective age. *Computational Statistics and Data Analysis*, 73, 177-188.

Xiang Li (3rd year)

Yawei Liang (3rd year)

Juexin Lin (3rd year)

1. **Lin, J.** and **Wang, D.** (2016+) Single-index regression analysis of pooled biomarker assessments. *Journal of Multivariate Analysis*, under review.

Haigang Liu (3rd year)

Jianxuan Liu (2017)

1. Liu, J. , Ma, Y., Zhu, L. and Carroll, R.J. (2017+). Estimation and inference of error-prone covariate effect in the presence of confounding variables, *Electronic Journal of Statistics* (in press).
2. Liu, J., Ma, Y. and Wang, L. (2016+). A new robust estimator of average treatment effect in causal inference. Under revision in *Biometrics*.

Piaomu Liu (2016)

1. **Piaomu Liu** & **Edsel A. Peña** (2016): Sojourning with the Homogeneous Poisson Process, *The American Statistician*, **70**, pp. 413–423.
2. Watson, S., **Liu, P., Peña, E.,** Sutton, M., Eberth, J., and Lessner, S. (2016). Comparison of Aortic Collagen Fiber Angle Distribution in Mouse Models of Atherosclerosis Using Second-Harmonic Generation (SHG) Microscopy. *Microsc. and Microanal.,* 1-8.
3. **Liu, P.** and **Peña, E. A.** (2015). Dynamic Modeling & Analysis of Recurrent Competing Risks and a Terminal Event. *Statistical, Stochastic and Data Analysis Methods and Applications*, Editors: Alex Karagrigoriou, Teresa

Oliviera and Christos Skiadis. ISAST: International Society for the Advancement of Science and Technology.

4. D. Oliver, H. Ji, **P. Liu,** A. Gasparian, E. Gardiner, S. Lee, A. Zenteno, L. Perynskaya, M. Chen, P. Buckhaults, E. Broude, M.D. Wyatt, H. Valafar, **E. Peña**, M. Shtutman (2016+). Identification of novel cancer therapeutic targets using a designed and pooled shRNA library screen. To appear in *Scientific Reports.*

Chong Ma (4th year)

1. **Chakraborty, P., Ma, C., Grego, J.** and **Lynch, J.** (2017+). A modified mixed model approach to the large scale multiple testing problem. Submitted.

Kaiwen Mai (2016 ABD)

1. **Grego, J.M.**, Yates, P.A. & **Mai, K.** (2015). "Standard error estimation for mixed flood distributions with historic maxima", Environmetrics, 26(3), 229-242

Xichen Mou (3rd year)

Beidi Qiang (5th year)

1. **B. Qiang** and **E. A. Peña** (2016+). Improved Estimation of System Reliability with Application in Software Development. To appear in Analytic Methods in Systems and Software Testing. Ron S. Kenett, Fabrizio Ruggeri and Frederick W. Faltin (eds). John Wiley & Sons.

Yanlei Peng (8th year)

A.K.M. Rahman (2014)

1. **AKM Fazlur Rahman**, **James Lynch**, and **Edsel Peña** (2014). Nonparametric estimation of gap-time distribution with recurrent event data. *Journal of Nonparametric Statistics*, 26, 575-598.
2. **Peña, E.,** Wu, W., **Kindo, B.,** Hill, B., **Rahman, F.,** and Wanda, L. (2014). Multi-Group and Multi-Agent Binary Decision-Making. Under revision for *Naval Logistics Quarterly*.

Yong Shan (2016 ABD)

Shiwen Shen (4th year)

Chuan-fa Tang (6th year)

1. **Tang, C., Wang, D.,** and **Tebbs, J. M.** (2016+). Nonparametric goodness-of-fit tests for uniform stochastic ordering. *Annals of Statistics*, accepted.

Jeff Thompson (4th year)

Jianhong Wang (6th year)

1. **J. Wang** and **X. Lin** (2016+). A Bayesian Approach for Semiparametric Regression Analysis of Panel Count Data, submitted to *Lifetime Data Analysis*.

Lu Wang (3rd year)

Qianqian Wang (4th year)

1. **Wang, Q., Ma, Y.,** Wang, Y. (2017+) "Predicting disease risk by transformation models in the presence of missing subgroup identifiers, *Statistica Sinica* (in press).

Naichen Wang (2015)

1. **Wang, N., Wang, L.**, & McMahan, C. (2015). Regression analysis of bivariate current status data under the Gamma-frailty proportional hazards model using the EM algorithm. *Computational Statistics and Data Analysis*, 83, 140-150.
2. **N. Wang, L. Wang**, and C. McMahan (2015). "Regression analysis of bivariate current status data under the Gamma-frailty proportional hazards model using the EM algorithm". *Computational Statistics and Data Analysis*, 83, 140-150.

Shamim Md Warasi (2016)

1. **Warasi, M., Tebbs, J**., McMahan, C., and Bilder, C. (2016). Estimating the prevalence of multiple diseases from two-stage hierarchical pooling. *Statistics in Medicine* **35**, 3851-3864
2. **Huang, X**. and **Warasi, M.** (2016+). Maximum likelihood estimators in regression models for error-prone group testing data.

Yizheng Wei (4th year)

Haifeng Wu (2016)

Zizhen Wu (2016)

1. **Wu, Z**. and **Hitchcock, D. B.** (2016), "A Bayesian Method for Simultaneous Registration and Clustering of Functional Data," Computational Statistics and Data Analysis, 101, 121-136.

Bin Yao (2016)

1. **B. Yao, L. Wang**, and X. He. (2016). "Semiparametric regression analysis of panel count data allowing for within-subject correlation". *Computational Statistics and Data Analysis*, **97**, 47-59.

2. **B. Yao** and **L. Wang.** (2016+). Regression analysis of current status data with generalized odds-rate hazards models. Under revision at *Lifetime Data Analysis.*

Shun Yu (2015)

1. **Yu, S.** and **Huang, X.** (2016+) Tests for link misspecification in generalized linear mixed models for binary responses. Submitted.
2. **Yu.** S. and **Huang, X.** (2016+) Effects and detection of random intercept misspecification in generalized linear mixed models.

Tianming Zhang (5th year)

X. M. Androulakis, K. Krebs, B. L. Peterlin, T. Zhang, N. Maleki, S. Sen, C. Rorden, P. Herath (2016+). Modulation of intrinsic resting state fMRI networks in women with chronic migraine. Accepted by *Neurology.*

Yifan Zhang (3rd year)

Ge Zhao (5th year transfer to Penn State)

1. **Zhao, G.** and **Ma, Y.** (2016+) Robust Nonparametric Kernel Regression Estimator, *Statistics and Probability Letters* (in press)

Xinchu Zhao (4th year)

1. **Zhao, X.** & **Habing, B.** (2016+) A rotatable asymmetric variable compensation MIRT Model. Under revision at *Applied Psychological Measurement.*

Qiang Zheng (3rd year)

Haiming Zhou (2015)

1. **Zhou, H.** and **Huang, X.** (2016). Nonparametric modal regression in the presence of measurement error. *Electornioc Journal of Statistics*, **10**, 3579-3620.
2. Liu, J., Liu, S., **Zhou, H., Hanson, T.**, Yang, L., Chen, Z., and Zhou, M. (2016). Association of green tea consumption with mortality from all-cause, cardiovascular disease and cancer in a Chinese cohort of men. *Journal of European Epidemiology*, **31**, 853-865
3. **Zhou, H.** & **Hanson, T.** (2015). Bayesian spatial survival models. In R. Mitra & P. Müller (Eds.) *Nonparametric Bayesian Methods in Biostatistics and Bioinformatics (Frontiers in Probability and the Statistical Sciences).* (pp. 215-246). Switzerland: Springer International Publishing.
4. **Zhou, H., Hanson, T.**, Jara, A., & Zhang, J. (2015). Modelling county level breast cancer survival data using covariate-adjusted frailty proportional hazards model. *Annals of Applied Statistics*, 9, 43-68.

5. **Zhou, H., Hanson, T.**, & Knapp, R. (2015). Marginal Bayesian nonparametric model for time to disease arrival of threatened amphibian populations. *Biometrics*, 71, 1101-1110.
6. **Zhou, H.**, and **Huang, X.** (2016+) Bandwidth selection for nonparametric modal regression. Submitted
7. **Huang, X.** and **Zhou, H.** (2016+) An alternative local polynomial estimator for the errors-in-variables problem. Submitted
8. **Zhou, H., Hanson, T.,** and Zhang, J. Generalized accelerated failure time spatial frailty model for arbitrarily censored data. *Lifetime Data Analysis*, accepted.

Use of Results

Overall, our PhD students are motivated to produce publishable works from their dissertation research that contribute new statistical methodology and theories to existing statistical literature, and we have had students graduated in recent years who accomplished this. We will use these past successes to create more incentives for current and future PhD candidates in our department to continue producing high-quality research products as they work through dissertations. These incentives include, for example, inviting alumni back for seminars, encouraging students to apply for research grants such as SPARC, supporting students to attend and present research at conferences, organizing student research talks during the department seminar slots. Based on these assessment results, we will gather input from dissertation advisors on effective means of motivating and guiding students on their research to address up-to-date challenging problems, and other approaches to cultivate a vivid research atmosphere in the department.

Learning Outcome 3.

The Ph.D. recipient who desires a career in academia should have the ability to teach at the collegiate level.

Measures and Criteria

Ph.D. students who express the desire to pursue a career in academia should be given the opportunity and support to build their vita by successfully teaching a course as its instructor of record. At least 90% of students should be rated as "Good" in faculty evaluations and get an overall rating of 3.5 out of 5 in student evaluations.

Methods

Success in meeting this learning outcome is evaluated every third year (the next will be academic year 2015-2016). The two major sources of information for evaluating this criterion are the faculty evaluations and student evaluations of the graduate teaching assistants in the program. This information is supplemented by the students' impressions of their capabilities as evaluated by the graduate student exit survey.

The assessment coordinator will prepare a summary of all faculty evaluations and student evaluations of the graduate teaching assistants over the previous year.

The assessment coordinator will prepare a summary of student responses to the exit survey question: "If you are interested in pursuing a career in academia, how do you assess your ability to teach statistics at the collegiate level."

The assessment coordinator will summarize job placements for PhD students graduating during the last three years.

These results will be presented to the department's graduate committee who will prepare a report on the findings, along with initial suggestions for further refinement or improvement of the program if necessary. The committee report will be presented to the entire department as an agenda item at the annual department retreat.

Results

No assessment needed this year.

Use of Results

No assessment needed this year.

Learning Outcome 4.

Doctoral students should complete all required coursework, pass the qualifying exam at the Ph.D. level, then propose, write, and defend their dissertation in a timely manner.

Measures and Criteria

Information on the time from admittance into the program to defense of the dissertation will be compiled for each student, including those that ultimately do not finish (i.e. are all-but-disseration, or ABD). At least 80% of students admitted with at most a bachelors degree should finish within 5 years; at least 80% of students admitted with a masters degree in statistics should finish within 4 years.

Methods

Every year the Graduate Director will compile time-to-degree information for each student, as well as information on ABD students, and present this information at the annual departmental retreat in May. If trends in increasing time to degree or increasing numbers of ABD students are apparent, measures will be discussed and enacted to help students more expeditiously finish and defend their dissertations.

Results

For academic year 2016-2017, we have an 8th year student continuing in the program. Two 7th year students withdrew from the program without defending a proposal, while one 7th year student returned to campus to defend his thesis. Five 6th year students will complete their thesis by Summer 2017, while one continues in the program while working full-time. One fifth-year student will graduate this academic year, while another needs to identify a new advisor. One 4th year student will graduate this year.

Use of Results

In general, we do not come close to our goal of a median time to graduation of 5 years for incoming bachelor's students and 4 years for incoming MS students. Attrition is low, and even students who leave USC for work meet with some success so long as they defend their proposal before they depart. At our retreat, we asked the graduate committee to review policies for the proposal defense and our dissertation preparation courses to ensure forward progress on students' theses.

II. FUTURE ASSESSMENT PLAN FOR 2017 - 2018

Mission Statement

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