UMBC Department of Mathematics & Statistics (Interim APR Report)

The APR for the department was completed in 2015 while the departmental action plan for the APR and the departmental response was approved by the graduate council and faculty senate in 2019. Due to this and the changes in the departmental administration (a change of the Department Chair occurred twice since the APR was completed), this interim report has been delayed. Therefore, it is reasonable to report on the progress and changes that happened until recently (except where noted).

Section 1: Notable Progress and Changes.

a) **Attrition:**

Three full time tenured faculty members, Professor Thomas Seidman (Applied Mathematics), Dr. Kofi Adragni (Statistics) and Professor Junyong Park (Statistics) either retired or resigned, in order to pursue other career options. These were all big losses for the department. Professor Seidman, who has been at UMBC for over forty-five years, was a leading internationally renowned scholar in the area of partial differential equations with more than two hundred publications in prestigious international journals. He has also been the recipient of several federal grants. Professor Junyong Park was recently promoted to the rank of full professor having served at UMBC for over twelve years. His research is in the area of machine learning and high-dimensional data analysis, topics that are currently at the forefront of research in data science. Professor Park retired from UMBC to pursue an academic career at the prestigious Seoul National University in South Korea. Dr. Kofi Adragni, also working in the popular area of statistical analysis of high-dimensional data, was recently promoted to the rank of associate professor with tenure. He left UMBC to pursue a career in industry.

The department expects an additional three or four retirements in the tenure-track faculty lines in the near future.

b) **New Hires:**

Dr. Justin Webster was hired in order to bolster the department's large academic footprint, due in no small measure to Professor Seidman's stature and contributions, to the field of applied analysis, partial differential equations and mathematical physics. Dr. Webster joined UMBC in Fall 2017 as a tenure-track Assistant Professor of Applied Mathematics . He received his doctoral degree in 2012 from University of Virginia. Subsequently he held postdoctoral positions at Oregon State University and North Carolina State University, and later became an Assistant Professor at the College of Charleston. Dr. Webster's research specialty is in the area of mathematical modeling and analysis of fluid-structure interactions such as the flutter of buildings, bridges, and the wings of an aircraft under strong winds, with applications to harvesting wind energy.In his short stint at UMBC, Dr. Webster already has made his mark as a scholar and educator. He has published twenty five peer-reviewed, several in topmost international journals in the field. His acumen for interdisciplinary research is evidenced by his recent multi-institutional collaborative NSF grant with Dr. J. Howell of Cornell University and the eminent scholar Dr. Earl Dowell of the department of mechanical engineering at Duke University, in which Dr. Webster is the lead PI and UMBC the lead institution. This award, which he received in Fall 2019, follows on the heels of his previous NSF grant during the period 2014–2017 on mathematical analysis of flutter; an enviable track record in procuring external funding. In addition to his extensive professional service, he has been an ambassador for our department (and UMBC at large) in terms of outreach to HBCUs and his involvement in the Pi Mu Epsilon (the national mathematics honors society).

Dr. **Seungchul Baek** was hired as a tenure-track Assistant Professor in August 2018 as a replacement for Dr. Adragni. He received his doctoral degree in May 2018 from University of South Carolina. Dr. Baek's research specialties lie in statistics, especially in the areas of machine learning, high-dimensional data analysis, dimension reduction, semi-parametrics, and multivariable analysis techniques. Immediate applications include biomedical research on gene expression and RNA-sequencing. Dr. Baek has developed a collaborative relation with the Medical School of South Carolina and he is expected to fill the gap in expertise due to Dr. Adragni's departure. His recent publications in top tier statistical journals provide a strong indication of his academic potential.

Dr. **Yehenew Kifle** was hired as tenure-track Assistant Professor of Statistics in August 2019, adding to the much needed diversity to the department profile. He received his doctoral degree in 2013 from University of Ghent, Belgium. Subsequently he held Assistant and Associate Professor positions at Jimma University (Ethiopia), University of Limpopo (South Africa) and Visiting Associate Professor position at UMBC before starting as a tenure-track Assistant Professor at UMBC in Fall 2019. Dr. Kifle's research is in the analysis and statistical modeling of time-to-event data, also known as survival analysis, which is a sub-discipline of biostatistics. Such data often arise in the study of various diseases such as HIV or cancer where one is interested in studying the time to occurrence of a certain event such as death or relapse, with the goal of ascertaining causes that influence such events. Dr. Kifle is an active researcher in the application of statistics to various scientific disciplines, most notably in medical research. Prior to joining UMBC, he had 29 peer reviewed articles published in various biomedical journals. He is the main organizer of the **African International Conference in Statistics**, providing a large impetus to UMBC's internationalization initiative currently underway.

Dr. **Thu Nguyen,** hired in Fall 2020 to fill Dr. Park's position, received her first PhD in statistical signal processing from University of Lille 1 - Sciences and Tech   nologies, Vileneuve d'Ascq, France, 2014 and PhD degree in applied mathematics from Wayne State University in May 2020. Her expertise lies in the area of stochastic approximation algorithms for stochastic networked systems and developing and applying efficient Monte Carlo samplers for complex statistical problems. Her research interests include applying these techniques to problems in statistical learning, artificial intelligence and machine learning. Her work is methodologically strong, and has significant practical applications, very much in line with the current trends in statistical research. In fact, several of her applications already appeared in top-tier journals such as the *IEEE Transactions on Signal Processing* and the *IEEE Transactions on Vehicular Research.* Her research interests and future research plan hold excellent potential for interdisciplinary collaborations and federal funding.

c) Undergraduate Course Restructuring.

Over the last several years, the department has been focused on pedagogical innovations to enhance student success. The Mathematics and Statistics Department has updated several areas in our programs in the last few years.

- A team including Senior Lecturer Dr. Elizabeth Stanwyck, Ms. Raji Baradwaj and Dr. Kofi Adragni worked to re-envision the pathways through our earliest mathematics course. The college algebra course was split into a STEM track (Math 106 Algebra and Elementary Functions) and a non-STEM track (Math 104 Quantitative Literacy). This has allowed non-STEM majors to get to Math GEP courses such as Math 120 and Stat 121 directly, while we were able to shift topics into Math 106 from the follow-on course Math 150 to alleviate pressure in that course and allow a deeper treatment of Trigonometry and better preparation for the Calculus sequence.

- One of our Math GEP courses (Math 120 Introduction to Contemporary Mathematics, renumbered from Math 100) was redesigned by our Distinguished Professor Manil Suri and has become a popular course.

- A team of individuals from the LRC, the CNMS Dean's office and the Mathematics and Statistics department updated placement testing to the adaptive learning system ALEKS. After initial results we then refined timing to place students better, leading to initial signs of greater student success.

- We have included an advanced complex analysis course (combined with Math 602 Complex Analysis) with a Math 301 Introduction to Mathematical Analysis I prerequisite in the course rotation opposite Math 410 Introduction to Complex Analysis (which has a more interdisciplinary focus).

- Email "nudges" piloted with Associate Provost for Data Analytics, Bob Carpenter, with modest improvements with minimal cost. Also, attendance tracking with Blackboard Qwickly showed large effects with even three absences triggering email nudges.

- Pi Mu Epsilon (Math honor society) has been revitalized with Dr. Justin Webster at the helm.

- We have been working with new Quantitative Reasoning Unit director and Associate Dean for CNMS, Dr. Beatrice Lauman on several initiatives: Ongoing placement testing refinement, Accelerated Math 106 Program (AMP) co-curricular enhancement, and Adjunct Affinity groups.

- We now have a broad implementation of course specific Quiz 0 prerequisite exams in lower level courses.

- We have been in development for the Introduction to Mathematical Reasoning course, which was recognized with a Hrabowski Innovation Fund award.   Initial data show improvement in Math 301 grade distribution.

- We worked with the Education department to support a new Middle Grades STEM Education Major.

- The Stat program revised   their prerequisite pathways and streamlined the program, which was passed through the UGC.

Future Focus:

(i) Subcommittees to look at updating Math 221 (Introduction to Linear Algebra) and Math 225 (Introduction to Ordinary Differential Equations).

(ii) Course and Program Mapping to identify program gaps and opportunities.

d) Graduate Coursework Reconsideration

There were some discussions in the APR report of the department's course requirements for PhD students, particularly the requirement that a student continues to take courses after their candidacy exam. The faculty strongly feel that in order to adequately meet the demands of the current job market, students need broad training in the discipline, rather than a training based on their narrow area of research. Our graduate program's consistent success in placing its alumni in highly select positions is a testimony to the effectiveness of the training the department provides. However, the graduate committee is currently engaged in a systematic and comprehensive review of all course requirements in the doctoral program order to align with current job market and graduate council recommendations..

e) Administrative Changes.

Soon after the APR, the department set up a committee to establish bylaws. This process has now been completed and the administration of the department closely follows the rules and procedures set forth in the bylaws. This has greatly improved communication and transparency in the department which has in turn fostered collegiality among various academic groups.

f) Grants and Scholarship

There has been a substantial uptick in the number of grants and IPAs, both funded and submitted compared to the period when the APR was performed (e.g. total departmental funding , external and internal, in the period 2011-2014 was 1.44 million dollars while in the period 2015-2018 it was 2.58 million dollars). Particularly noteworthy is the effort and success of all junior faculty (e.g. at the assistant and associate ranks) in this regard, several of whom were successful in obtaining federal funding for their research. This really bodes well for the department's future. Additionally, the department has been awarded four *Hrabowski Fund for Innovation* for

pedagogical innovation within the last four years, further evidencing the department's commitment to its educational mission.

g) Honors and Awards

The department's faculty, students and alumni continue to be honored by awards, distinctions, prestigious fellowships to professional societies, demonstrating the department's excellence in scholarship, teaching and mentoring. A few notable ones, after the APR, are as follows.

- Distinguished Professor Manil Suri received the Rockefeller Fellowship in 2016 and the Sloan Book Grant in 2019. He was also recently appointed as a contributing opinion writer for the New York Times.

- Professor Anindya Roy was elected fellow of the American Statistical Association in 2017. This is a prestigious honor bestowed by the largest and most preeminent professional statistical society in the world.

- Mr. Jeremy Rubin, who graduated with a major in statistics, was awarded the NSF Graduate Research Fellowship to pursue his doctoral studies at University of Pennsylvania.

- Dr. Sousedik has been the recipient of the *CNMS Early Career Faculty Excellence* award while Dr. Dasgupta received the *CNMS Adjunct Faculty Excellence* award, both in 2020, while Ms. Bonnie Kegan received the *CNMS Adjunct Faculty Excellence* award in 2019.
- Dr. Tamara Kolda (BS-Applied Mathematics, 1992) has been elected to the membership of the prestigious National Academy of Engineering. She has also been appointed chief editor of the SIAM (Society for Industrial and Applied Mathematics) Journal of Data Science, arguably the foremost data science journal in mathematics.

- Dr. Roman Sznajder (PhD, 1994-Applied Mathematics) received the *Presidential Achievement Award for Research and Grants* at his home institution, Bowie State University in 2020.

g) Sinha Ennovate Endowed Chair in Statistics

UMBC's application for matching funds to the Maryland E-Nnovation Initiative Fund (MEIF), to augment **Dr. Sinha and his family's** generous donation of $750,000 towards an Endowed Chair position in Statistics, has been approved. The matching amount of money from MEIF is $900,000. To present a brief history of this endeavor, UMBC so far has raised $900,000 from alumni and other sources, including Dr. Sinha *(the founding member of the department's statistics program)* and his family's initial gift of $750,000 towards the *Sinha Chair* (which incidentally will now be called The *Sinha Ennovate Chair).* This prestigious additional matching fund now brings the total amount to $1.8 million. The department will embark on the hiring process in due course.

Section 2: Outlook and Challenges

The undergraduate enrollment trend (by main plan) has been largely stable, with a slight uptick in the period 2015-17 while it has seen a slight dip in the period since then. However, in the same period, the graduate program, in particular the doctoral program, has seen a steady decrease (by 23% from 2014-2019). Since the students in the doctoral program are largely supported, this is indicative of declining resources for the doctoral program. If this trend is not reversed, it will impede the department's ability to attract high quality tenure-line faculty, adversely affecting research and funding. Moreover, as indicated in the enrollment projections conducted by Huron Consultants contracted by UMBC, due to population growth trends, the undergraduate program might also face a decrease in enrollment in the near future. It is therefore imperative that as a university, UMBC develops a plan to boost *Return on Investment* (ROI) of UMBC education, which is directly related to the quality of upper level courses and research experience accorded to the undergraduate students. This will also be hampered if the department is unable to hire top notch young faculty dedicated to research and scholarship,

who, as is well-known, are attracted to departments with quality graduate programs. An increase in investment in the department's doctoral program should be a priority.

Of additional note is the fact that the department faces a loss of at least three tenure-line senior faculty by 2021. This will seriously jeopardize the department's capability in terms offering upper level courses and research experiences for undergraduates for which the university is renowned, in addition to adversely affecting the research and graduate education. Therefore it is imperative for the university to restore these positions as soon as the budgetary situation permits.

Section 3: Future Plans

The current events and enrollment projections have brought to acute focus the need for developing innovative programs, with possibly interdisciplinary flavor, in both the undergraduate and graduate levels. To that effect, in the immediate future, the department plans the following.

- Establish a Actuarial and Financial Mathematics major in collaboration with the economics department. This is already in the works and some preliminary planning and discussion has taken place.

- Explore ways to establish a Masters program, possibly in collaboration with DPS, in Computational Science (incorporating data science, biostatistics, statistics and computational mathematics).

- Rejuvenate (and possibly re-purpose) the already existing Masters in Industrial Mathematics.

Section 4: Resources

In order to maintain the high scholastic and educational impact, it is imperative that the department is provided with adequate resources.

- The doctoral program is urgently in need of additional state and university funding. In order for the program to remain regionally competitive, one needs to boost the stipend of the graduate students to keep pace with inflation, at the least. The inadequate funding of the graduate program in the recent has resulted in a reduced number of available graduate student lines, and a crippling effect in an otherwise academically thriving program.

- It is absolutely essential that the tenure-track lines vacated by upcoming retirement be replaced, which is currently on hold due to budgetary considerations. The Department of Mathematics and Statistics provides by far *the largest credit-hour production* in the university due to the far-reaching demands of all entry-level STEM courses in science and engineering. With the current and impending loss of a half a dozen of full-time faculty, the offering of these foundational courses are placed in jeopardy unless an immediate action takes place.