Department of Mathematical Sciences

To: Christa Slaton, Dean, Arts and Sciences
From: Joseph Lakey, Academic Department Head
Date: 15 November 2014
Subject: Department Summary and Analysis for 2013–2014 and Goals for 2014–2015

Mission Statement

The Department of Mathematical Sciences provides core education in mathematics and statistics that prepares graduate and undergraduate students to be knowledgeable and responsible citizens of the world. It does this by conducting research, scholarship, and teaching, including teaching service courses for other programs, to fulfill the land grant mission of the university.

Personnel Changes

The Department of Mathematical Sciences tragically lost one its most esteemed colleagues, Maribeth Olberding, to cancer on May 28. Maribeth was universally respected and a perfect role model for her students aspiring to be future educators. Maribeth's commitment to the development of her students is a model that we will all try to live up to.

The department was fortunate to begin making up lost ground in its tenure-track ranks. Nick Michalowski and Shibin Dai joined the tenure-track faculty as new assistant professors in Fall 2013 and the department successfully hired Jianjun Paul Tian, who officially started on October 9, and Andres Contreras, who will join the faculty in Spring 2015. The department also successfully hired two new College Assistant Professors, Karen Villaverde and Ron Ausbrooks, who started in Fall 2014, and will have a visitor, Rama Mishra, on sabbatical from IISER-Pune in India, for the 2014-2015 academic year. As a result of these hires the department's dependence on contingency classes has diminished somewhat. It is trying to run a new Master's program in Financial Mathematics that amounts to one or two additional courses per semester added to its agenda. The number of ongoing faculty in 2013-2014 was 20 tenure-track (up from 18 in 2012-2013) and 8 College-track (7.25 FTE) including Maribeth, the same as in 2012-2013.

Accomplishments

Externally Funded Activities. Several faculty in the department were involved in seeking external funding through highly competitive programs. Some succeeded and others did not. The NMSU administration and academic departments are involved in a discourse on how to

incentivize such efforts. Seeking external funding can subtract from time spent on ongoing research projects, particularly when the proposed projects involve methods on or off the edge of current faculty expertise. The faculty of the Department of Mathematical Sciences met with the VPR recently to discuss its status, which is currently at a respectable rank of about 70th in the U.S. in new federal expenditures, good for a department of its size, but down from its inflated ranking in the upper twenties a few years ago when LIFT was in its heyday. One issue of concern to the department is the incompatibility between amounts of funds available for different types of projects versus prestige of the source, with NSF research programs and the Simons Foundation being near the top in prestige. Faculty involvement in external funding will be reported as follows. First new, ongoing and ending ARGIS funding, will be reported. Then faculty involvement in non-Argis funded programs will be identified with information on funding agency and home department or institution. Finally proposals under review and unsuccessful proposals will be reported to give a comprehensive view of faculty involvement in external funding and its pursuit.

New funded programs listed in ARGIS programs are as follows:
Dai, Shibin (PI), "Degenerate Diffusion in Complex Amphiphilic Structures," NSF, $114K (Aug. 2014 - July 2017);
Nick Michalowski (PI), "Collaborative Research: Branching Markov Chains and Stochastic Analysis Associated with Problems in Fluid Flow," NSF, $81K. (July 2014–June 2017);
Bulger-Tamez, Wanda (PI), Wiburg, Karin (Co-PI), **Morandi, Pat** (Co-PI), "2014 PED-MC2," NMPED, $1.17M. (Feb. 2014 – Sept. 2015).
Prof. **Tian** also is bringing NSF funding to the department which will be reported next year.

The following ARGIS projects have *ongoing* funding:
James, Avis (Co-PI), **Ballyk, Mary** (Co-PI), Boecklen, William (PI), "Collaborative Research: Integrating Mathematics into the Introductory Biology Curriculum: A First Step," NSF, $161K. (June 2012 – Aug. 2015);
Fouli, Louiza (PI) "Parameters, Blowup Algebras and Connections to Combinatorics," Simons Foundation, Other, $35K (Sept. 2012 – Aug. 2017);
 Giorgi, Tiziana (PI), "Investigations of Liquid Crystalline Mesophase Transitions via Landau-de Gennes Phenomenological Models," NSF $158K (Aug. 2011 – July 2015);
*Bulger-Tamez, Wanda (Co-PI), **Morandi, Patrick** (PI), "Mathematically Connected Communities - Leadership Institute for Teachers," NSF $4.9M (July 2009 – Dec. 2014);
Kurtz, Doug, Bulger-Tamez, Wanda (PI), **Morandi, Pat (Co-PI), "MC2-MSP Phase IV," Sponsored by NM Public Education Department, Local, $1.25M (March 2013 – Sept. 2014);
Stanford, Ted (Co-PI), Chamberlin, Barbara (Co-PI), Wiburg, Karin (PI), "Math Snacks: Addressing Gaps in Conceptual Mathematics Understanding with Innovative Media," Sponsored by National Science Foundation, Other, $3.5M (Sept. 2009 – Aug. 2015).
*-** Mary Ballyk, Bruce Olberding and Ted Stanford also participate on these grants but not PIs.

The following projects *closed* either during the review period or at the end of August 2013:

James, Avis (Co-PI), **Ballyk, Mary** (Co-PI), **Barany, Ernie** (Co-PI), Shuster, Michele (Co-PI), Boecklen, William (PI), "UBM-Group: Research Mentoring in Mathematical Biology at NMSU," NSF $240K (Sept. 2009 – Aug. 2013);

Salamanca-Riba, Susana (PI), "PD3: PCMI and the Districts Partner for Design Professional Development," IAS $341K (October 1, 2006 - August 31, 2013).

The faculty of Mathematical Sciences were involved in other *non-Argis funding* either as co-PIs on grants not administered through NSMU or as senior personnel (non-coPI) on ARGIS grants. Here is a partial list of programs that were reported by faculty on their annual reports.

Bezhanishvili, G. (co-PI), "Topological semantics of modal logic", Shota Rustaveli NSF (Georgia), Total Award: $120K

Bezhanishvili, G. (co-PI) "Co-supervision with Prof. Revaz Grigolia a Tbilisi State University PhD student Phridoni Alshibaia", Shota Rustaveli NSF (Georgia), Total Award: $20K

L. Fouli (Participant) "iCredits: interdisciplinary Center of Research Excellence in Design of Intelligent Technologies for Smartgrids," NSF, $4.9 M (NMSU-CS)

L. Fouli (co-PI) "Southwest Local Algebra Meeting 2014," NSA, $14K (Texas A&M)

L. Fouli (co-PI) "Southwest Local Algebra Meeting 2013," NSF, $15K (U. Arizona)

J. Harding (co-PI) "NSF 0931980 BLAST conference award," NSF, $33K, (U. Colorado)

N. Michalowski (co-PI) "NSF 1400429, New Mexico Analysis Seminars," $49K; (UNM)

N. Michalowski: Simons Collaboration Grant, $35K. (Award made but rescinded due to co-funding rules)

Other faculty were involved in important non-ARGIS projects funded at lesser amounts, or sought unsuccessfully funding through non-ARGIS sources.

The following ARGIS projects submitted during the review period are currently *under review*:

Trujillo, Karen (Co-PI), Chamberlin, Barbara (Co-PI), **Stanford, Ted** (Co-PI), Wiburg, Karin (PI), "Math Snacks Algebra - Using Games & Media to Help Students Understand Patterns, Variables & Equations," NSF, $2.99M (July 2014 – June 2018);

Palacios, Rebecca (Co-PI), **Wang, Tonghui** (Co-PI), Keeley, David (PI), "Obesity: How Morphometrics Behavior and Biomechanics Relate to Disease," Mountain West Research Consortium, $83K (July 2014 - June 2015);

The following *unsuccessful ARGIS projects* were submitted during the review period.

Fouli, Louiza (PI), "Parameters, Blowup Algebras and Symbolic Powers," NSF, $162K

Lakey, Joseph D. (PI), "Prolate Shift Frames in Time and Band Limiting," NSF, $84K

Bradley, Janice, Uribe-Florez, Lida J. , **Morandi, Patrick J**. , Cooper, Sonya L., Kinzer, Cathy J. J., "MC2 Algebra Maker Pathway (AMP)," NSF, $2.9M

Olberding, Bruce, "The Zariski-Riemann Space of Valuation Rings," NSA, $127K

Olberding, Bruce, "The Zariski-Riemann Space of Valuations," NSF, $238K

Gruszka, Thomas, **Stanford, Theodore B**., "Mathematical Habits of Mind of STEM Professionals," NSF, $729K

Dolgov, Igor, **Wang, Tonghui**, Ma, Ou, "A Bio-Inspired Approach for a Robot to Reach a Fast Moving/Rotating Object for Capture," NSF, $520K

The department recognizes that the administration pays attention not only to the department's successes in obtaining external funding but also its attempts, as one of several indicators of a healthy research climate, and sustained pursuit of external funding is also valued by the department administration.

Research and Creative Activity. As stated in the department criteria for promotion and tenure, quality of publications matters more than quality. Faculty are continually encouraged to document the quality of their efforts by including information about the prestige of the sources in which their works appear, reviews of their work, invitations and other recognitions. It is impossible to document the quality of faculty work here adequately. Here is summary data on publications. During the review period, 29 works were listed as published, the overwhelming majority in recognized scholarly journal; 21 additional papers were listed as accepted for publication, again mostly in strong journals. An additional 24 papers were listed as submitted for publication. This data is consistent with the prior year in which 56 papers were listed as published or accepted. On the other hand, as with prior years, publication was not necessarily balanced across the faculty. Nearly half the published papers were due to three faculty members. In fairness, of those who published "just" one or two papers, most of those works were lengthy and significant, in widely read journals, as encouraged by departmental criteria. Some tenure-track faculty did not list any works published, accepted or submitted, and a few others have not published in sources recognized by the American Mathematical Society. AMS data on graduate programs (http://www.ams.org/cgi-bin/agf/agf.cgi?listing_id=1728) currently lists 17 of our 20 tenure-track faculty as having published in the last three years. By comparison, U. Arizona lists 52 of 58 faculty with recent publications, Texas Tech lists 34 of 46 and UNM (which has 30 tenure-track faculty and 8 postdoctoral faculty) and UTEP (which does not have a PhD program) did not provide data. So currently our *ratio* is good, but very few PhD granting Math departments in the U.S. have fewer than 15 faculty visibly active in research, and falling to that level would be harmful to graduate recruiting.

Awards, Recognitions and Leading Scholarly Service.
The department had fewer awards and recognitions than in the past few years. Notable ones included Bruce Olberding's *Arts and Sciences Award for Outstanding Achievement in Scholarship*. Ted Stanford was part of the MathSnacks team whose game *Gate* won *Best in Show* at the 2014 *International Serious Play* Awards competition.

Several recent **alumni** of the department were recognized in a variety of ways that reflect well on the department. *Brandilyn Stigler* (MS 2001) was awarded tenure in the Department of Mathematics at Southern Methodist University in Dallas. She uses her background in Algebraic Topology in work to uncover the structure of gene regulatory networks. *Thomas Ngniatedema* (MS, 2004) received Kettering University's 2014 Outstanding New Researcher Award for his significant contributions in the area of Information Systems and Supply Chains Management. *Osama Ta'ani* (PhD 2011) was named the Ed and Marilyn Wixson Professor of Mathematics at Plymouth State University in June. *Zuhier Altawalbeh* (PhD 2012) was appointed Head of Mathematics at Tafila Technical University in Jordan and attributes the training that he received at NMSU to his rapid rise through the ranks.

Other evidence of the reputations of our faculty can be found in their professional obligations. Several faculty serve on Editorial Boards of scholarly publications, including Pat Baggett, *European Journal of Mathematics and Science Education*, Guram Bezhanishvili, *Journal of Language, Logic, and Computation, Tbilisi Mathematical Journal and Studia Logica,* John Harding, *Order*, Pat Morandi, *Journal of Algebra and Computational Applications*, Bruce Olberding, *Journal of Commutative Algebra* and *Communications in Algebra*, and Ross Staffeldt *Journal of Homotopy and Related Structures*.   Several faculty members served on Grant proposal panels: Fouli (AWM Mentoring grants, chair) Giorgi (NSF Applied Math), Lakey (NSF-CBMS), Morandi (NSF, Algebra and Number Theory). Nearly every tenure-track faculty member was involved in the service of peer-review, including article and manuscript reviews, book reviews, external promotion and tenure evaluations and scientific advisory boards. Several faculty were involved in organizing national and international conferences and workshops in their mathematical disciplines held during 2013-2014, including Bezhanivili (*Topological Methods in Logic* (TOLO), June 2014 in Tbilisi), Fouli (Special Session of *AMS Western Sectional* meeting Albuquerque and *Southwest Local Algebra Meeting* in College Station), Giorgi (Special Session of *AMS Western Sectional* meeting Albuquerque; *SIAM Mini-symposium*, Buena Vista FL), Lakey and Michalowski (*New Mexico Analysis Seminar* and *AMS Western Sectional* meeting Albuquerque), Olberding (Special Session of *AMS Western Sectional* meeting Albuquerque) and Wang (*14th Joint NMSU/UTEP Workshop*).

Eleven of 20 tenure-track faculty members reported giving talks on their work at external conferences, workshops, and colloquia, including *international presentations* by Pat Baggett (Psychonomic Society, Toronto), Shibin Dai (Tsinghua University and Chinese Academy of Sciences, Beijing), Tiziana Giorgi (AIMS Conference, Madrid and Instituto Nacional Matematica Pura e Aplicada, Rio de Janeiro), John Harding (Quantum Structures, Olomouc, Czech Rebuplic), Pat Morandi (TOLO, Tbilisi), Ross Staffeldt (IISER-Pune) and the grand winner, Tony Wang, who gave short-courses on separate topics in Mongolia, Thailand and China, as well as eight colloquium talks at different Chinese universities and two other conference or invited talks in China and Thailand.

University Service and Outreach.

Most faculty in Mathematical Sciences play their part in keeping the department's programs running smoothly. Several faculty members also served the College of Arts and Sciences on its standing committees, including Pat Baggett (Graduate Affairs and Travel Grants), Tiziana Giorgi (Curriculum and Educational Policies), Pat Morandi (Awards Committee, though May) Linda Zimmerman (College Track Promotion), Bruce Olberding (Planning and Budget) and Susana Salamanca-Riba (Research Affairs Chair and College Council). Others serve as external members on Departmental P&T Committees, including Pat Baggett (Communication Studies), Morandi (Psychology), and Smits (Computer Science). Other participation on university committees included Mary Ballyk (Center for Peer Learning Assistants Board), Fulte (NMATYC Articulation Task Force and Executive Board), Lakey (Faculty Senate, though May), Morandi (Faculty Senate, after May), Amal Mostafa (Committee for Assessment of Learning–General Education), Robert

Smits (University Research Council and Business Dean Search), Ross Staffeldt (delegate to IISER-Pune), Ted Stanford (Math Teaching Education Partnership), and Laura White-Hosford (Integrated Learning Communities and Preparing Future Faculty Advisor).

Pat Baggett, John Harding, Jerry Lodder, Bruce Olberding, Ted Stanford, Abby Train, and Laura White-Hosford all reported school outreach. Mary Ballyk, Pat Morandi, Bruce Olberding, and Susana Salamanca-Riba reported other outreach specifically related to educational initiatives. Others types of outreach was reported as well.

Student Credit Hour production. Math enrollments have declined but not as much as some other disciplines. Fall 2014 Census data has lower division math down 2.5% from 11,718 student credit hours (SCHs) in Fall 2013 to 11,428 SCH; upper division up 9.1% from 1,263 to 1,378 SCH; and graduate SCH down 10.2% from 442 to 397. The net Fall-to-Fall decline was 1.6% from 13,423 to 13,203, with the biggest percentage decline at the graduate level. The latter should be attributed to inability to attract strong students in 2012-2013, with only moderate improvement in 2013. Thus, while the net decrease has not been drastic, minimizing net decrease has come at the cost of shifting resources from those producing graduate degrees to ones supporting undergraduate degree programs. By comparison, the net Fall-to-Fall decline from 2012 to 2013 in MATH was 1.0% from 13,557 to 13,423. In both years the decline in MATH was smaller than the A&S total (4.2% 2012-2013 and 5.2% 2013-2014). As in priori years, a few faculty have generated over 1000 student credit hours in their regular teaching load. Members of the 1000+ club for 2013–2014 include Marcus Cohen, Alyne Fulte, and Linda Zimmeran. Chris Stuart and Laura White-Hosford just missed out at 935 and 927, respectively.

Majors and Degrees. The department produced two PhDs in 2013-2014 (both international, male, now employed in the U.S., one at NMSU Carlsbad and one at Brooklyn College), 6 M.S. degrees (3 male, 3 female, 2 international, two U.S. minority; employment includes Continuum Analytics and Sandia Labs among others) and 13 B.S. degrees (5 female, 1 international, 3 U.S. minority; employment includes Federal Reserve Chicago, White Sands, and Gainsco among others). By comparison, in 2012-2013 the department graduated a comparable 4 PhDs, 6 MS and 10 BS degrees, but is down from 17 BS, 5 MS and 6 PhDs in 2011-2012. The decline in PhDs is of greatest concern to the department. Based on Cognos data, the number of undergraduate MATH majors continues to hover in the low 60s, including 4 black or African American majors, 2 Asian, 26 white, 28 Hispanic, 2 two or more races, and two unknown ethnicity. Nearly half of our majors are female (29), well above the national average for Math. Most majors do not declare an *emphasis* early. Of the 40 who have declared an emphasis, 23 are focusing in Applied Math. The number of graduate students is currently 39, including 4 part-time. Most of them are international students from Africa and Asia including the Middle East, and Mexico. Ethnicities include 4 black/African, 6 white, 5 Hispanic, 11 Asian, 1 multi-racial, and 12 of unspecified ethnicity (mostly middle-eastern). Twelve of the 39 are female, slightly above the national average.

Progress on goals.

The Mathematical Sciences goal for **teaching** was to continue to track completion rates in our most populated General Education courses, seeking 75% as a long-term goal. Data will be forthcoming in early Spring, after the Fall grading period. Part of the reason for waiting is that substantial pedagogical changes have been made MATH 120 and MATH 190. These changes have actually raised the standards in those classes and probably will result in a short-term decrease in completion rates in those classes. However, neither of those classes are program completion requirements. The department hopes that students passing 120 and 190G are able to complete 121-142G and 191-192G (especially 192G) at higher rates. These changes are occurring in conjunction with the second teaching goal, which was to fill the position of Director of the Math Success Center, which the department has done with Dr. Train.

The primary goal for **research** was to have each graduate faculty member in the department actively involved in peer reviewed research. Ideally every such person would have had a paper published or submitted. A few did not, but in most cases those faculty provided evidence on their annual reports of substantial progress on significant projects. While a net increase of one tenure-track faculty member did not result in a substantial net increase in publications, it did significantly increase the number of NSF research grants in the department.

The department goals for **service** were to involve at least half of the graduate faculty in a college or university committees or policy bodies, and to involve at least two-thirds of the graduate faculty on professional committees, panels or conference organizing committees, or in reviewing scholarly work, and to involve half or more of the departmental College Faculty in committee or policy work that extends beyond the department. About half of the faculty were involved in university service beyond the department. The complete amount of such service reported seems realistic for a department of its size; however, many of those involved in such service were involved in multiple ways, while some faculty were not involved any in such activities. The department administration did find some meaningful and efficient ways to involve more faculty members in university service, and will continue to pay attention to other opportunities to do so. As mentioned above, just about all tenure-track faculty members were involved in peer review and about half were involved in leadership activities in their profession.

Mathematical Sciences Goals for 2014–2015:

The department views its core objectives as being long term ones. As such, those for 2015 are modest variations of the ones from 2014. The department's goals for 2013–2014 can be found on the next page.

Teaching Activities: Continue to track completion rates in our General Education courses MATH 120, 121G, MATH 190G–291G and STAT251G and to interpret them in the context of any modifications of those courses intended to enhance success in subsequent courses. Associated activities will include continue to revise placement guidelines and work on system-wide student learning outcomes for these courses.

Teaching Goals: (1) Identify successful and unsuccessful modifications in MATH 120 and MATH 190G, and document student success in the calculus sequence relative to student preparation as measured by readiness tests. Work with the administration and other campuses to identify desired learning outcomes that can be measured in a meaningful way.

Research Activities: Continue overall publication and other nationally and internationally recognized scholarship at levels consistent with recent years.

Research Goals: Involve each graduate faculty member in peer-reviewed work either submitted or accepted or performed in a suitable context in 2013–2014. Continue to emphasize the Boyer framework in the context of performance suitable for a research-intensive department of Mathematical Sciences.

Service Activities: Continue to serve the college, university, and profession in ways that reflect the central role of mathematics in promoting quantitative reasoning across curriculum, in promoting quantitative analysis in strategic planning, and in maintaining a strong national reputation.

Service Goals: Involve at least half the graduate faculty in a college or university committee or policy body, or in scholarship in the service of broader educational interests. Involve at least two-thirds of the graduate faculty on professional committees, panels or conference organizing committees, or in reviewing scholarly work. Involve half or more of the departmental College Faculty in committee or policy work that extends beyond the department.

Program Activities: In graduate recruiting, seek to establish a balance of about twelve to fourteen funded students in the Master's program and about 16 to 18 funded students in the PhD program. Articulate parameters for acceptable performance in fundamental Master's and PhD courses. Remind faculty to make a conscious effort to discuss the ways in which our programs are successful when they interact with researchers in their disciplines and (graduate level) and statewide and regional constituents (undergraduate). Continue to make undergraduate students aware of our major emphases and to reconsider whether we need to make any adjustments to the requirements of the different emphases..

Program Goals: Encourage all second-year Master's degree students to complete their work (or move on) in 2015. Have one-fourth of our current PhD students successfully complete their work (or move on) in 2014. Graduate a number of Bachelor's students consistent with numbers in the past two years.

Mathematical Sciences Goals for 2013-2014: The department views its primary goals as being long term ones. As such, those for 2014 are modest variations of the ones from 2013.

Teaching Activities: Continue to track completion rates in our General Education courses MATH 120, 121G, MATH 190G–291G and STAT251G. Continue to identify meaningful and concise ways to document student-learning outcomes.

Teaching Goals: (1) Hire a long term Director of the Math Success Center who can help to develop instruments measuring student preparation for "G" courses relative to national common core readiness standards and who can measure success rates relative to adequate preparation. Seek 75% or better success rates in "G" courses consistent with national benchmarks. Work with Arts and Sciences to identify desired learning outcomes that can be measured in a meaningful way.

Research Activities: Continue overall publication and other nationally and internationally recognized scholarship at levels consistent with recent years.

Research Goals: Involve each graduate faculty member in peer-reviewed work either submitted or accepted or performed in a suitable context in 2013–2014. Continue to emphasize the Boyer framework in the context of performance suitable for a research-intensive department of Mathematical Sciences.

Service Activities: Continue to serve the college, university, and profession in ways that reflect the central role of mathematics in promoting quantitative reasoning across curriculum, in promoting quantitative analysis in strategic planning, and in maintaining a strong national reputation.

Service Goals: Involve at least half the graduate faculty in a college or university committee or policy body, or in scholarship in the service of broader educational interests. Involve at least two-thirds of the graduate faculty on professional committees, panels or conference organizing committees, or in reviewing scholarly work. Involve half or more of the departmental College Faculty in committee or policy work that extends beyond the department.

Program Activities: In graduate recruiting, seek to establish a balance of about twelve to fourteen funded students in the Master's program and about 16 to 18 funded students in the PhD program. Articulate parameters for acceptable performance in fundamental Master's and PhD courses. Continue to make undergraduate students aware of our major emphases and clarify what is required for timely degree completion.

Program Goals: Encourage half of our current Master's degrees to complete their work (or move on) in 2014. Have one-fourth of our current PhD students successfully complete their work (or move on) in 2014. Produce about a dozen Bachelor degrees in MATH between December 2013 and August 2014.