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Report of the Primary Unit Evaluation Committee for Dr. Kyle Luh's Comprehensive Review, August 2024

This is the report of the Primary Unit Evaluation Committee (PUEC) for Dr. Kyle Luh's Comprehensive Review. The PUEC consisted of Associate Professor Agnès Beaudry, Associate Professor Sergei Kuznetsov, and Associate Professor Sean O'Rourke (chair).

Dr. Kyle Luh joined the Department of Mathematics as a tenure-track Assistant Professor in Fall 2020. He obtained his Ph.D. in Mathematics from Yale University in 2017. Prior to joining CU, he spent three years as a postdoc at Harvard University's Center of Mathematical Sciences and Applications. He was on paternity leave in Fall 2021. Due to this leave, he was granted a one-year extension to his tenure clock.

The PUEC met on August 23, 2024 to discuss Dr. Kyle Luh's record in research, teaching, and service. Our findings are summarized below.

Research:

Description of research. Dr. Luh's research is in probability theory, with a focus on random matrices and random graphs.

Random matrices were introduced in the 1950s by Nobel laureate Eugene Wigner to model the nuclei of atoms. Since then, the subject has grown greatly with publications in the field more than doubling every decade since. In the last few decades, random matrices have become a major topic in probability theory with connections to statistical physics, biology, number theory, and machine learning.

Random graphs are mathematical objects that lie at the intersection of graph theory and probability theory. Random graphs were introduced in 1959 by Paul Erdős and Alfréd Rényi and have been heavily studied—both inside and outside of mathematics—since then. For example, random graphs are often used to model social networks, road networks, and the internet.

Many of Dr. Luh's early works are motivated by questions arising in computer science. For example, many algorithms and methods for graphs are known to have terrible worst case performance. In applications, many practitioners often find that the typical behavior of these algorithms is significantly better than what the worst case bounds predict. Dr. Luh's work on random graphs describes some of the properties and behaviors of "typical" graphs, which can help explain this gap between the worst case bound and what is actually found in practice.

Another theme of Dr. Luh's work is in Littlewood–Offord theory. This is an area of probability theory, initially developed by J. E. Littlewood and A. C. Offord in the 1930s and 1940s, that investigates the behavior of sums of random variables and vectors. Littlewood–Offord problems (as well as inverse Littlewood–Offord problems) arise naturally in random matrix theory. Dr. Luh has studied and developed new bounds in several cases for the Littlewood–Offord problem.

Universality in random matrix theory is another theme developed in Dr. Luh's work. Universality is a widespread phenomenon in probability theory, which describes how many probabilistic results do not depend on the source of randomness. Dr. Luh's work in random matrix theory has established universality results for several matrix models.

Publication record. Dr. Luh has published 21 refereed journal articles and 4 refereed conference articles. Out of these, 9 have appeared since the beginning of 2021. This is a high rate of publication for theoretical mathematics, where one typically expects one high-quality peer reviewed publication per year. In addition, Dr. Luh has 3 submitted journal articles, including one with his former postdoc Vlad Margarint, and 3 works in progress, including one with his graduate student Nicholas Christoffersen.

Dr. Luh's work has appeared in leading journals of mathematics, mathematical physics, and probability theory, including *Advances in Mathematics*, *Transactions of the American Mathematical Society*, *Journal of Mathematical Physics*, and the *Electronic Journal of Probability*.

In regards to journal quality, the Australian Research Council (ARC) rated 20,712 journals. The ratings were released in 2010, and each of the 20,712 journals was given one of the following ratings¹:

- A* - for the top 7% of journals
- A - next 18%
- B - next 28%
- C - remaining 47%

While there is no consensus on the best measure of quality, these ratings are interpreted by the mathematical community as a decent measure of journal quality.

Almost all of Dr. Luh's publications are in high quality journals. The PUEC notes item [10] on his CV, published in *Advances in Mathematics*, and item [14], published in the *Transactions of the American Mathematical Society*. Both of these journals were given an A* rating by ARC. Dr. Luh also has publications in the *Journal of the London Mathematical Society*, *Journal of Mathematical Physics*, and *Electronic Journal of Probability*, which all have an A rating from ARC.

Dr. Luh's publication record is excellent, especially for a mathematician at such an early stage of his career.

Grants. Dr. Luh has acquired extramural funding through two grants: a Ralph E. Powe Junior Faculty Enhancement Award (2021–2022) and a Simons Foundation Travel Grant for Mathematicians (2023–2028). Dr. Luh has secured nearly continuous funding since he began at CU. As outlined in the Department's policies for reappointment, promotion, and tenure, while members of the Department of Mathematics are encouraged to apply for grants, research support is

¹The percentages below are for the mathematical sciences. The percentages for other disciplines may differ.

not required for reappointment or tenure. Dr. Luh’s record of obtaining extramural funding is excellent.

Talks. Dr. Luh has given a total of 18 talks, lecture series and colloquia, including 4 since starting at CU. The PUEC did note a lack of talks in calendar years 2021 and 2022, which is due, in part, to the COVID-19 pandemic and Dr. Luh’s paternity leave.

Dr. Luh is a perspicuous speaker, able to explain complex mathematical topics to students. For example, Dr. Luh was invited to give a lecture series at Ohio State’s Summer School on Random Matrix Theory and its Applications in May 2023. In addition, Dr. Luh also co-organizes a learning seminar for graduate students and postdocs during the academic year.

Overall, Dr. Luh has a strong research record. The PUEC voted **3-0** to rank Dr. Luh’s research record as **excellent**.

Teaching:

The PUEC analyzed the teaching of Dr. Luh by applying multiple methods of evaluation. This included analyzing materials provided by the candidate—his teaching statement, his teaching portfolio, sample teaching evaluations provided by Dr. Luh, both from courses taught at CU and from courses prior to CU, at Yale and Harvard Universities—and materials we solicited for this report, or that were gathered by the department through its regular evaluation of teaching.

Our review is mainly focused on Dr. Luh’s teaching at CU, Fall 2020 to Spring 2024. His teaching experience is very diverse—at CU, Dr. Luh taught ten sections of eight different classes—one lower division class (Math 2001 - Introduction to Discrete Mathematics, Fall 2020), six upper division classes (Math 3170 - Combinatorics, Fall 2022, Math 4510 - Introduction to Probability, Fall 2020 (two sections, remote) and Spring 2024, Math 4520 - Introduction to Mathematical Statistics, Spring 2021, Math 4530 - Theoretical Foundations of Data Analysis, Spring 2023) and three graduate level classes (Math 6310 - Introduction to Real Analysis 1, Fall 2023, Math 6350 - Introduction to Complex Analysis, Fall 2022 and Math 6550 - Introduction to Stochastic Processes, Spring 2022).

Modern FCQs do not provide overall instructor ratings. Still, applicable numerical FCQ scores for Dr. Luh are mostly in the 4-5 range. We focused on the Qualitative portion of the FCQ scores, from the complete set of FCQs for courses taught at CU. Students comments are generally positive. Some excerpts are:

- From Math 2001, Intro to Discrete Math, Fall 2023: “I loved this class because of Professor Luh, he was extremely helpful when answering questions and helped me a ton. < ... >”
- From Math 2001, Intro to Discrete Math, Fall 2023: “Kyle made his class exceptionally fun and engaging and actually encouraged me to pursue a minor in math.”
- From Math 3710, Combinatorics 1, Fall 2022: “One of the best professors I have had at CU, definitely the best in math department. Explains complex ideas in a simple way. < ... > Almost every class a real world example is brought up.”
- From Math 4510, Intro to Probability, Fall 2020 (remote, 2 sections): “I like the use of breakout rooms in class. It’s nice to practice the ideas we’re learning about and get

feedback in real time. < ... >”

- From Math 4510, Intro to Probability, Spring 2024: “Kyle is by far the best professor I have had at CU. < ... >”
- From Math 4520, Intro to Statistics, Spring 2021: “Kyle is great. Nothing but good things to say about Kyle < ... >”
- From Math 4530, Foundations of Data Science, Spring 2023: “This class is the best data science class there is. The way the prof teaches it is already perfect too.”
- From Math 6310, Intro to Real Analysis 1, Fall 2023: “I found this course to be very difficult, though I believe this was < ... > a problem with my mathematical maturity. < ... > Professor Luh is a fantastic instructor whose help and guidance I have greatly appreciated throughout this course.”
- From Math 6350, Complex Variables 1, Fall 2022: “Great instructor, any student would be lucky to have him.”
- From Math 6550, Intro to Stochastic Processes, Spring 2022: “I really enjoyed the class. I think making measure theory or even basic analysis a pre-req for the course would really help.”

Dr. Luh has been observed by his faculty peers. The reviews were highly positive. Some excerpts are:

- Dr. Wise, Spring 2023: “Dr. Luh’s presentation was very clear and engaging. < ... > The pace was excellent, and Dr. Luh frequently posed questions to the class to make sure students remembered why each feature of the neural network was there.”
- Dr. Ih, Fall 2022: “In sum, Dr. Luh successfully managed to keep the balance between the level of rigor and the speed of the class. It was good to see the interactions between the students and Dr. Luh.”
- Dr. Englander, Spring 2022: “My impression was that I observed a very professional teacher, who places emphasis on a clear and interactive style, which the students seem to appreciate.”

Two classroom interviews have been performed, in Fall 2020 and Fall 2023. Each time, the students had to come up with answers to certain questions about the class, and then, vote on them. For the first question, “What was the most effective aspect of Dr.Luh’s teaching”, student’s responses supported by the vast majority were:

- “Has excellent availability and enthusiasm”, (Fall 2020, Math 4510, remote)
- “Effective examples, lots of examples, and opportunities to try problems using breaking rooms”, (Fall 2020, Math 4510, remote),
- “Dynamic & Active teaching / in class exercises (very interactive)” (Fall 2023, Math 6310)

For the second question, “What could Dr. Luh do differently to improve learning in the class”, student’s responses supported by the vast majority were:

- “Post the proofs before the class so we can follow along without having to rush and write down the proofs during class, leading to distractions. Also slow down when going over

topics for the first time” (Fall 2020, Math 4510, remote)

- “Sometimes moves quickly through material. Might help to add in polls or other ways to check for understanding” (Fall 2020, Math 4510, remote)
- “Preparedness and Precision/Clarity of board work/More focus/Structured lectures” (Fall 2023, Math 6310).

Dr. Luh is currently advising two PhD students. He supervised three independent study courses for them. He also supervised a postdoctoral scholar, Vlad Margarint, for one year. In addition, Dr. Luh has been involved in two undergraduate summer research projects (2021 and 2024).

The PUEC solicited evaluation letters from students from three of Dr. Luh’s courses (Math 4510 - Spring 2024, Math 2001 - Fall 2023, and Math 6310 - Fall 2023) using the “Student or Trainee Solicitation Letter for Comprehensive Review, Tenure or Promotion” template. Four letters were received by the PUEC during Summer 2024, all of which are included in the dossier. The evaluations are highly positive; here are some quotes:

- “Kyle Luh is one of the greatest professors/teachers/instructors I have had in my life.” (from Math 2001 student)
- “Overall, I believe that I wouldn’t have enjoyed this class as much as I did if I didn’t have Dr. Luh as my professor.” (from Math 4510 student)
- “Overall, I believe that Professor Kyle Luh does an excellent job in presenting material to students in an insightful and clear manner, provides insightful one-on-one help to problem solving, and motivates students to learn even if the material does not particularly interest them. (from Math 6310 student)
- “He is very accommodating and kind, and, overall, a great professor!” (from Math 4510 student)

Dr. Luh’ Teaching portfolio contains a sample syllabus, sample course notes, both from CU and prior to CU, sample course worksheets and and MATLAB worksheets, sample final poster projects, all of which is very carefully designed. Also, there are sample student evaluations, from teaching at CU and from teaching prior to CU.

In Summary, Dr. Luh’s teaching is exemplary and has a broad scope.

The PUEC voted **3-0** to rank Dr. Luh’s teaching as **meritorious or better**.

Service:

The PUEC focused on Dr. Luh’s service since his arrival at CU Boulder. Dr. Luh’s service contributions, which are already noteworthy, are summarized here.

1. Service to the Department of Mathematics and University of Colorado Boulder.

- (a) *Diversity Committee:* Dr. Luh’s most significant service contribution has been his work as the chair of the Department of Mathematics’ Diversity Committee. He served in this role in a temporary fashion in Fall 2022, and then again starting in Fall 2023 to present. In this role, Dr. Luh has led initiatives that have had a positive impact

for undergraduates at CU Boulder and graduate students in the Department of Mathematics. The role of Diversity Committee chair is a significant time and emotional commitment and, as such, is one of the more challenging service assignments in the Department of Mathematics.

The Diversity Committee is tasked with creating and maintaining a welcoming, inclusive, and supportive community, and to open dialogues and address issues of equity, diversity, and department climate. The role of Dr. Luh as the chair of the committee has been to spearhead initiatives that support this mission, to help coordinate and support initiative of other committee members (approximately 10 including some faculty, postdocs and graduate students), and to advise the chair of the Department of Mathematics as well as other Mathematics departmental committees on DEI issues that arise in the department.

Two of the most noteworthy initiatives of Dr. Luh's in this role, both in terms of their positive impacts and the workload required to achieve them, are:

- i. The creation of a gender-neutral bathroom in the Mathematics Building. Dr. Luh had to coordinate tricky logistics with different units, secure funding for the changes to infrastructure, and overcome unexpected push-back by providing information and education to those involved on the importance of having such a space in the building for some members of CU's student body.
- ii. The creation of a summer-study program for graduate students in the Department of Mathematics who are preparing for their preliminary exams. Dr. Luh received a Dean's Innovation Grant to support the first iteration of this program, and has coordinated two of its iterations. The goal of the program is to increase retention, learning, and to improve the graduate student experience through this difficult examination process.

Dr. Luh's contributions as Diversity Committee chair far surpass those of any previous faculty who served in that role. His work has been truly exemplary and fully supports CU's mission of inclusive excellence.

- (b) *Graduate Committee:* Dr. Luh served one year on the Graduate Committee. This is one of the heavier service assignments as faculty on the committee participate in graduate admissions, an intensive and time-consuming process in view of the large number of applicants to the program (approximately 150 per year).
 - (c) *Kempner Colloquium:* For one semester, Dr. Luh organized the Kempner Colloquium. This involved coordinating with other faculty to create a list of speakers, chairing the colloquia, and organizing the delivery of food and refreshments.
 - (d) *Contributions to research group:* Dr. Luh co-organizes his research group's weekly seminar and a learning seminar for postdocs and graduate students in his research group.
 - (e) *Other service to the Department of Mathematics:* Dr. Luh has served on graduate examination committees, assisted in writing preliminary exams, and served as first-year faculty mentor.
2. **Outreach beyond CU:** Dr. Luh served 2 years as mentor for Científico Latino, a program aimed at increasing the participation of historically excluded communities in STEM.
 3. **Service to the profession:** Dr. Luh has organized special sessions at a regional and a national mathematics meetings. Dr. Luh has served as referee for papers in multiple

journals, both in mathematics and physics. He has served as reviewer for grant proposals for the Simons Foundation.

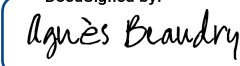
The PUEC has found Dr. Luh's engagement in service, in particular his contributions through the Diversity Committee, to be substantial and impactful. The PUEC voted **3-0** to rank Dr. Luh's service as **meritorious**.

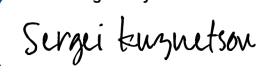
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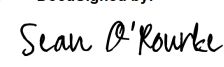
Overall, the PUEC is impressed with Dr. Luh's performance and finds that he is making good progress towards meeting or even exceeding the standards for tenure.

The PUEC voted **3-0** to recommend Dr. Luh's reappointment.

Sincerely,

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