

Part 1: SABBATICAL PLAN

Board of Regents and CU System policies require the following information be provided by each faculty member applying for a sabbatical assignment. Thank you for completing this public document in a clear and substantive way. Each response should be a minimum of 300 words.

Applicant Name: [REDACTED]

Title of Sabbatical Project: _____ Exploring the Promise of Bayesian Methods in Educational Measurement and Research _____

(1) Describe your sabbatical's academic objectives including its contribution to your professional growth and expertise.

The primary aim of my sabbatical project is to expand my understanding and expertise with methods of Bayesian inference and data analysis. This includes both the philosophical underpinnings of Bayesian inference and practical methods of Bayesian data analysis, such as model building and estimation. Bayesian statistical methods are increasingly being used in the social sciences. Developing my expertise in these methods will enhance my methodological and substantive research as well as my teaching and mentoring capacities.

As a researcher and teacher my work applies and critically appraises the use of statistics and quantitative methods in education and social science research, with a primary focus on issues related to measurement. There are two broad paradigms for reasoning about uncertainty and probability in quantitative research and educational measurement: frequentist and Bayesian. While the two approaches have considerable overlap in practice, there are also essential philosophical and practical differences. My training and coursework in quantitative methods has been almost exclusively within a frequentist framework, as the frequentist framework continues to be the dominant paradigm in quantitative social science research (and academic research more broadly).

Although they are not new, application of Bayesian methods has increased substantially in recent decades. The increase is likely due to both philosophical and practical factors. First, as argued in a recent book by mathematician Aubrey Clayton (2021) tracing the history of these two paradigms, many problems surfacing with the use of statistics in social science research such as the "replication crisis" are [REDACTED] linked to the frequentist statistical paradigm and its reliance on the logic of null hypothesis significance testing. A Bayesian approach to inference and reasoning about uncertainty can overcome some of these challenges, and may even provide a formal method for reasoning about uncertainty that is more in line with the aims of science and with the intuitive ways people think. Second, computational intractability has long been an obstacle to implementing Bayesian approaches to data analysis. The development (and more widespread availability) of modern computing power has changed this and allowed for rapid development and increasing application of Bayesian methods in social science research.

To what extent can Bayesian methods actually improve educational research and educational measurement? What are the implications for how we train doctoral students in quantitative methods? These are some of the big picture questions I will have in mind as I study these developments and the underlying philosophical principles of Bayesian inference and data analysis, with an eye towards how exactly these principles and methods can improve my own work and my teaching, as well as the field of educational measurement more generally. While I have collaborated previously on the development of Bayesian methods for data analysis, I have

[REDACTED]

not had the dedicated time to develop a deeper expertise in this area. The time provided by a sabbatical will be critical in allowing me to develop expertise in this new area that I can continue to build upon in the future.

(2) Describe your work plan including all anticipated professional activities (i.e., where will you spend your sabbatical, what you will do, your work timeline, etc.).

My sabbatical work will take place here in Boulder Colorado, working at my home, my office at CU, and meeting with fellow colleagues at CU or in other locations as necessary. In addition to the activities I describe below, I will also continue my on-going research collaborations (including supervising graduate students) that include my role as a [REDACTED]
[REDACTED]

I have three broad goals for my sabbatical work. First, to better understand the foundations of Bayesian inference to determine where and how Bayesian approaches to inference and data analysis can overcome some of the limitations of the frequentist paradigm in quantitative educational (and social science) research and measurement that I have encountered. Second, to apply Bayesian data analysis techniques in my own research to solve practical challenges and improve the ways that I use data to evaluate claims or draw inferences. And finally, to develop curricular teaching materials that introduce students to Bayesian inference and data analysis for use in my courses and my advising.

To accomplish my sabbatical goals, I will begin by spending substantial time learning more about Bayesian inference and data analysis by reading canonical texts, connecting with colleagues in educational research with expertise in Bayesian methods at CU and elsewhere, and attending on-line or in-person training sessions (for example at the AERA and NCME national conferences). Canonical resources I have identified include a widely cited recent text on Bayesian inference for scientists (McElreath, 2020) with accompanying online materials; a foundational text on Bayesian methods in psychometrics (Levy & Mislevy, 2016); and the seminal Bayesian data analysis textbook by Gelman et al. (2013). I will identify additional foundational readings in the philosophy of Bayesian inference from these texts. I will work through these books during the spring of 2026. By the end of the spring semester, I anticipate having a better foundation in Bayesian inference and will write a short manuscript summarizing what I see as strengths and weaknesses that Bayesian methods can contribute to educational measurement aimed primarily at graduate students and new scholars in the field of educational research.

During the summer and fall of 2026 I will focus my efforts on the second and third aims, while continuing to immerse myself in relevant background literature. Here I will seek to identify ways that Bayesian methods could address practical data analysis challenges in my current research. For example, I believe there is potential to implement Bayesian methods in both on-going research collaborations I listed above. In developing the SEDA database, we continue to incorporate new data sources and create new metrics to study educational opportunities. We routinely encounter challenges posed by missing data, measurement error, and small sample sizes that Bayesian data analysis techniques may be able to address. In my collaboration with CDE, we have recently investigated best practices for reporting data for small student populations. Some of the newest approaches being tested out in other states include Bayesian modeling. These are but two examples – I anticipate many other instances in which Bayesian methods will be useful in improving my current and future research endeavors. I also anticipate my learning will set me up to produce methodological manuscripts related to these applications and seek out external methods grants to extend the applications in the future.

Finally, in terms of curricular materials, I aim to identify at least one core reading and data analytic example that could be incorporated into each of my quantitative methods courses to provide an introduction and connection to Bayesian inference and data analysis for students,

and to develop a draft syllabus for a potential course on Bayesian data analysis for the social sciences.

(3) Describe how meeting your sabbatical objectives will benefit the academic, clinical, and/or pedagogical goals of your primary unit.

The CU School of Education (SOE) mission “is grounded in a lived commitment to democracy, diversity, equity, and justice. We teach and engage in research with our colleagues in schools and communities to make a transformative difference. The work of our faculty, researchers, staff, and students contributes to evidence-based policy and practice. We aim for our graduates to be engaged and informed educators, researchers, policymakers, and community leaders.” Within the SOE I am rostered in the Research and Evaluation Methodology (REM) Program, which trains doctoral students to be experts in the use of quantitative methods to “better understand the effects of policies, programs, and practices that aim to facilitate learning and mitigate educational inequality.”

The methodological and applied focus of my sabbatical project will contribute to supporting multiple facets of the SOE mission and our REM Program area specifically. As a research methodologist in educational measurement, I seek ways to improve my own research and to disseminate both substantive and methodological insights more broadly. By developing my understanding of Bayesian statistics I will expand the range of methods I can draw upon when I conduct research. This will improve my research projects aimed at informing policy and practice and improving the development, use, and evaluation of standardized tests. Improving the quality of my research will directly benefit the SOE mission to contribute to evidence-based policy and practice aimed at improving educational equity.

My sabbatical objectives will also benefit the pedagogical goals of our REM program and the SOE. Our REM doctoral program trains students in the use of quantitative social science research methods. Currently, there are no faculty members in our program with expertise or substantial experience in the use of Bayesian methods, despite their increasing application in research. By developing my expertise in this area our program will be able to better prepare students to become leading scholars in the field. Our REM program is also responsible for designing and teaching our introductory quantitative methods courses for all doctoral students in the SOE. I plan to develop instructional materials that introduce students, at a big picture conceptual level, to Bayesian data analysis so that they can be better consumers of educational research (where they are increasingly likely to come across research using Bayesian methods), and be better prepared to take advanced courses that may include Bayesian methods.

(4) Describe how your sabbatical project will enhance the university's reputation.

The REM program is a nationally recognized leader in quantitative educational research and educational measurement. One of the unique aspects of our program, which we emphasize to prospective students, is the strong technical training students receive both in measurement and in applied statistics with an emphasis on causal inference. Another strength of our REM program, especially in educational measurement, is an emphasis on bridging technical issues in measurement and psychometrics with issues directly relevant to educational policy and practice. Bayesian methods are increasingly being used to address challenges that routinely arise in practice, such as issues related to missing data or measurement error. Thus, having the expertise to evaluate and apply Bayesian methods is critical to remaining leaders in the field able to bridge the technical and applied aspects of educational measurement, and quantitative educational research more broadly. Expanding my expertise in the use of Bayesian methods will eventually lead to new methodological and applied research products that enhance the quality and reputation of our program's academic research. Relatedly, as noted above, I anticipate the skills I develop during the sabbatical will allow me to formulate additional methodological research questions and seek external funding to carry out this work. Incorporating Bayesian methods into our curriculum, via course materials and active research projects, will allow us to provide the most up to date training for graduate students. This will serve to enhance the

university's reputation by enhancing the reputation of our REM doctoral training. Finally, there are very few graduate courses currently offered that focus specifically on Bayesian data analysis in the social sciences on the CU Boulder campus. Given the increasing use of Bayesian methods in applied research, this represents a significant gap in our campus-wide curriculum. Developing the expertise I need to design and teach a course in Bayesian data analysis for the social sciences would contribute to the campus-wide curriculum and enhance CU Boulder's reputation as a university where students can receive a cutting-edge education in social science research methods.

(5) Describe how your sabbatical will contribute to the educational experience of students.

My sabbatical aims will contribute to the educational experience of students in two broad ways: 1) increasing course offerings covering Bayesian methods in the social sciences and, 2) increasing opportunities to develop skills in Bayesian data analysis through graduate research assistantships and advising.

First, by developing my knowledge about Bayesian data analysis and developing curricular materials I will be able to incorporate materials related to Bayesian methods into my courses, thus expanding the comprehensiveness of our graduate courses. I teach a wide range of advanced graduate quantitative methods courses that enroll students across numerous departments at CU. The materials I incorporate into my courses will benefit students across campus. I believe there is currently no course offered at CU Boulder focusing specifically on the use of Bayesian data analysis in the social sciences (although one was previously offered in Fall 2023, the faculty member who taught the course is no longer at CU; I contacted this former professor and he enthusiastically supported my aim to develop and teach such a course in the future, noting that students taking the course in the past have been highly engaged and found it beneficial). As part of my sabbatical project, I will create a draft course syllabus for a course on Bayesian data analysis in the social sciences intended to fill this need. I anticipate teaching an initial version of the course as a special topics seminar sometime after my sabbatical and, eventually, creating a permanent course based on student interests and needs.

Second, incorporating the use of Bayesian methods into my own research will provide new educational opportunities for graduate students who work with me as research assistants and doctoral students whose research I supervise. As noted above, the increasing use of Bayesian methods makes this an important skillset for our doctoral students to develop. Developing skill and expertise through graduate research assistantships is a core element of our doctoral program. In addition, I regularly serve on dissertation committees and supervise independent student research projects. By developing my own understanding of Bayesian methods I will be better equipped to mentor and support students who may be applying these methods in their own research.

Part 2: REMUNERATION AND FUNDING PLAN

Regarding external funding, faculty members applying for sabbatical assignments are expected to apply for external funding (such as fellowships, grants, or clinical work) when appropriate. The total university salary to the faculty member, from sabbatical pay and any contract or grant administered through the university, shall not exceed university limits. There is no restriction on additional non-university income, subject to the faculty member satisfying the duties of the sabbatical plan and any contract/grant requirements. If a faculty member on sabbatical anticipates funding, sponsorship, employment, gifts, non-financial support, or other benefits from foreign institutions or sources, these should be detailed in the sabbatical remuneration plan, and all appropriate Export Control procedures should be followed. In addition, faculty members on sabbatical leave are not permitted to be paid for any administrative appointments or extra teaching during the sabbatical period.

- (6) Per CU System APS 1024, it is expected that faculty members applying for sabbatical will also apply for **external** funding to the extent it is available. Describe any anticipated external funding sources, amount of funding from sources external to CU, and attempts to obtain such funding.

I have submitted a proposal to the Spencer Foundation to fund part of my time during AY 2025-26 working on research investigating gender bias on mixed-format tests that use multiple-choice and open-ended items. I expect the use of Bayesian methods will help with some of my proposed analyses, thus making this complementary to my sabbatical aims. I regularly have contracts to conduct analyses and research related to school accountability and standardized testing with the Colorado Department of Education Accountability Unit. This collaboration will continue during my sabbatical year, and I anticipate that I can incorporate some of my planned sabbatical work into our partnership work as there have been previous instances where the potential to apply Bayesian methods have come up. I also plan to meet with the Research and Innovation Office (RIO) in early Spring 2025 to identify additional potential external funding opportunities to support my sabbatical work. I have not yet identified, but am actively seeking, funding opportunities that would support faculty development related to my sabbatical project (e.g., funding conference or other training sessions related to Bayesian methods, or support for developing instructional modules for use in my course and for dissemination).

- (7) Describe the source and amount of any additional funding to support your sabbatical, including departmental or gift funding.

I have not yet secured external funding.

- (8) Describe any anticipated support from foreign or international entities, including research collaborators, host universities, or other institutions, (e.g., equipment use, office/lab space, lodging or travel).

N/A.

- (9) Under the University's [APS 1024](#), faculty must identify business expenses to be reimbursed in connection with a Sabbatical Plan. Please describe anticipated business expenses and the funding source for those expenses.

No anticipated business expenses.

- (10) Will this plan require international travel? If so, please describe the travel including anticipated destination(s).

This plan does not require international travel.

Part 3:
DEPARTMENT CHAIR/UNIT HEAD
PLAN FOR COVERAGE AND REMUNERATION

Based on the corresponding CU System [APS 1024](#), the dean of the school/college shall ensure that the costs associated with the sabbatical are covered, including teaching replacement expenses. The dean may suspend a sabbatical if funding is not available in the school/college. Remuneration (from university resources such as state funding, university administered grants or contracts, or any other university managed sources) for the sabbatical assignment shall be as follows: for full-time faculty on nine-month appointments, either full salary for one semester or half salary for two semesters; for full-time faculty on 12-month appointments, six months full salary or 12 months half salary. Please note that remuneration from university-managed funds or university-administered grants or contracts should not exceed 100% of the faculty member's base salary in the case of full-pay sabbaticals, or 50% in the case of half-pay sabbaticals. For two-semester sabbaticals, remuneration sourced from General Funds (Fund 10) should not be used to supplement a half-salary. Stipends for administrative duties, such as chair or center director stipends, are not included in "base salary" and shall not be taken into account in calculating the individual's salary while on sabbatical.

- (11) Describe the plan for coverage of the faculty member's teaching responsibilities and replacement of teaching expenses. If it is known at the time this application is being made, include specific course names or numbers to be replaced each semester.

I support Prof. [REDACTED] application for [REDACTED] sabbatical. The proposed plan and research are fully supportive of the overall goals of the school to advanced educational practices. In terms of the impact on teaching that Prof. [REDACTED] sabbatical will have, we have worked internally to cover the courses and do not expect any significant impact to the operations of the school.

- (12) If the applicant is in an additional administrative position (e.g., chair or director), indicate how the administrative responsibilities will be covered.

Prof. [REDACTED] does not have any admin positions.