

## Undergraduate Research Proposal: Spectral Shift Functions

Mentor: Dr. Anna Skripka

Student: Kirstin Harriger

Dear Undergraduate Committee,

I would like to apply for the Research Experience for Undergraduates program at the UNM Mathematics and Statistics Department. I was introduced to the REU program when I attended the Southwestern Undergraduate Mathematics Research Conference last spring. I was immediately interested in starting my own project after the conference, and I approached Dr. Anna Skripka to be my mentor because of my interest in mathematical physics. I started background reading and exercises in linear algebra a few weeks after the conference.

I have selected the research project "Spectral Shift Functions" mentored by Dr. Skripka. More specifically, I am interested in investigating properties of spectral shift functions of orders two and higher. Spectral shift functions emerged from physics in the late 40's and have become fundamental objects in perturbation theory. These functions contain information about the change of the spectrum of a matrix (more generally, an infinite dimensional operator) under influence of a perturbation. The first order spectral shift function is pretty well understood, but less is known about the second order spectral shift function, and almost nothing is known about the higher order spectral shift functions.

I have completed many classes useful to my project, such as: complex variables, real analysis in one variable, proofs and discrete structures, programming in MATLAB, linear algebra. Additionally, I continued my preparatory studies over the summer when I attended the Matrix Analysis mini-course of the Mentoring through Critical Transition Points math camp. When the current semester started, I set a regular meeting time with Dr. Skripka and I have begun creating and examining graphs of spectral shift functions.

I have completed a shorter REU at the Santa Fe Institute. I worked with Irene Lee in the SFI Learning Lab to edit an online computer science course through the New Mexico Computer Science for All program with the goal of analyzing the efficacy of the course. At the SFI Learning Lab I studied the mathematics required for quantitative social science, and I created curriculum for the course that would allow improvement with the material to be accurately reflected by the pretest and posttest results. The course is currently being offered at UNM for high school students earning dual credit. This experience helped me develop the discipline and patience necessary for research projects.

Participating in the Research Experience for Undergraduates program at the UNM Mathematics and Statistics Department would allow me to advance my studies in mathematics and make me a better candidate for admission to graduate school. I plan to present my work next year at the Southwestern Undergraduate Mathematics Research Conference. Being in the REU program would help me to continue my project and get the most out of it. I think I am a good candidate for this program because I have the mathematical and research experience necessary to work on the topic that I selected.

Thank you for your time and consideration,  
Kirstin Harriger