

DEPARTMENT OF MATHEMATICS

VIGRE Funding Report**(due 30 days after semester of support)****Semester/Summer and Year:**

SPRING 2009

Name: Jordan Schettler

List the graduate courses you have taken this semester (including independent studies), your grades, and the instructors:

Course	Title	Grade	Instructor
ECON 531	Games and Decisions	A	Martin Dufwenberg
MATH 536B	Algebraic Geometry (Part II)	A	Douglas Ulmer
MATH 599	Independent Study (Comprehensive Exam)	A	William McCallum

List the title, date and location of any talks you have given, either here or elsewhere:

"Riemann-Hurwitz Formulae for Number Fields" - 5/14/09 (MATH 101, Oral Exam Talk), see my other VIGRE reports (or my website) for a list of other talks I've given in past semesters.

If you are working on your dissertation, include a one paragraph description of your research progress. If you have not yet begun dissertation research, describe your progress toward finding a dissertation topic and advisor and beginning that research.

Completing the comprehensive exam this semester has helped me find a tentative advisor (William McCallum), get acquainted with a research area (algebraic number theory/Iwasawa theory), and has exposed me to some of the open questions in my area which might make good starting points for Ph.D. level research. I'm now ready (see below) to commence thesis work.

List publications, if any.

NA

Check all activities you completed during the funded period:

Academics:

- Independent Study
- Oral Comprehensive Exam
- Commence Thesis Research
- Conference attendance
- Conference participation
- Complete PhD

Professional development and outreach:

- AP Calculus Visit
- High School Workshops
- Undergraduate Research Project
- Undergraduate Research Seminar
- Super TA
- Mentoring junior graduate students for the qualifying exams
- RTG (help organize)
- Research Seminar (help organize)

Other (please specify)

I completed my outside of the department distribution requirements. This, together with passing the comprehensive exam and completing my communication skills and foreign language, has marked the final step in finishing all non-thesis requirements.

The conference mentioned above was the Arizona Winter School where I participated with a group of students working on projects for Manjul Bhargava.

Attach a brief statment about your academic progress and professional development during the period of support.

VIGRE REPORT PART II SPRING 2009

JORDAN SCHESSLER

1. ACADEMIC DEVELOPMENT

This past spring semester I completed all of my remaining non-thesis requirements including passing my comprehensives (the oral exam took place on 5/14/09) and knocking out the second half of my outside the department courses. I'm now an associate II (the highest position for graduate students), I found a tentative advisor, and I now have several ideas for research projects which could flower dissertation level work.

1.1. **Research.** I began doing background research on Iwasawa theory for an orals project with William McCallum over the summer of 2008. In the fall semester, we narrowed the focus towards investigating an analog of the classical Riemann-Hurwitz formula to number fields (as more deeply explained in my previous VIGRE applications). The formula for number fields was first derived by Kida in 1979, but the relationship between his theorem and the well-known statement for Riemann surfaces was not made entirely clear and there were a few hypotheses (e.g., requiring CM-fields and odd primes p) for Kida's result which were not fully satisfying. In an effort to rectify this, Iwasawa used Galois cohomology in 1980 to establish a more general statement (about representations actually) that did not exclude the prime $p = 2$ nor need the CM-field assumption. Moreover, the proof gives a very elegant proof of Kida's formula.

In the fall, I focused on Kida's paper, but this semester I tackled the more difficult (but more rewarding) paper of Iwasawa. My work culminated in finishing the comprehensive exam by writing a paper (available on my website) and passing my oral exam on the 14th of May. In the paper, I provided original examples of applying the formulas to compute Iwasawa invariants, included proofs of results which were present in Iwasawa's article, developed an original proposition to clarify the use a Pontryagin dual, and highlighted the connection between Iwasawa's cohomological methods and similar techniques used in proving the Hurwitz formula for curves. Romyar Sharifi (one of

my committee members) is interested in working with me to provide another proof of Kida's formula (with a weakened hypothesis) using some results he published in the Journal of Algebraic Geometry. I'm personally interested in using p -adic L -functions to give another proof of Iwasawa's formula (as Sinnott did for Kida's formula). In any case, there are fruitful directions of research topics in this area.

1.2. Outside the Department Courses. I obtained a letter grade of A in ECON 531: Games and Decisions and developed an original discrete Nash demand game which I developed solution concepts for, ran an experiment on, made a poster for, and presented the data upon. Thus all of my required outside courses have now been completed (General Relativity was the other course). I did not end up taking PHYS 577: Gravitation and Cosmology due to a schedule conflict.

1.3. Other Coursework. I also received an A in MATH 536B: Algebraic Geometry and gained invaluable insight into the Hurwitz formula for curves which motivated my own research into number field analogs. I now have completed a sequence I need in the geometry area and have hence completed the 2 non-core sequence requirements (I had already completed several other non-core sequences in algebra and number theory).

2. PROFESSIONAL DEVELOPMENT

I used VIGRE funding to take advantage of several professional development opportunities which included being the super TA for the core algebra sequence (MATH 511A-B), attending and participating in the Arizona Winter School, and meeting/corresponding with potential recruits for the program. As usual, I also regularly attended ANTS (algebra and number theory seminar) and the graduate colloquium.

2.1. Super TA. As a super TA for the algebra sequence, I held once-weekly meetings where the students and I discussed questions about homework problems or other questions about the course. I had occasion to lecture on a couple of topics related to but not significantly overlapping with course material. When there were no questions, I put up exercises which I had selected from quals and textbooks other than the required one and had students work on these; with 10 minutes or so remaining, I asked for volunteers to explain their solutions or ideas. I also held office hours two days a week, made special arrangements to meet students at additional times, and answered questions via email.

I'll also be running the algebra qual prep sessions this summer in addition to being the super TA for the algebra sequence next year as well.

2.2. Arizona Winter School. I attended and participated in this year's AWS on quadratic forms. I worked on a project in Manjul Bhargava's group which concerned classifying rings of finite rank. Bhargava (the youngest person to ever become a full professor in mathematics at Princeton) is well-known for this work as well his resolution of the 290 conjecture with John Hanke. I learned a fair amount and I met some future colleagues. At the end of the conference, my group and I presented on some of the results we recreated.

2.3. Recruiting. I played an active role in talking to recruits and advertising the many positive attributes of the department. In particular, I attended the recruitment workshop dinner at Doug Ulmer's house, went out to lunch with recruits (on two separate occasions) interested in number theory or algebra, and corresponded with several potential recruits answering questions about the department via email. At this point in my graduate career, I feel completely immersed in and dedicated to strengthening an already wonderful department, and the best way to improve a department is by getting the best students.