Integration Workshop 2005
Project descriptions

1. **Stone-Weierstrass**: Generalizes the fact that a continuous function on a a finite closed interval can be uniformly approximated by polynomials.
2. **Gelfand-Mazur**: Every element of a complex Banach algebra has a non-empty, compact spectrum.
3. **Topological groups and duality**: Basics plus the result that Pontryagin duality interchanges compact and discrete topological groups.
4. **Urysohn metrization theorem**: Characterizes those topological spaces which admit a metric inducing the given topology.
5. **Linear differential equations and the Jordan form**: Knowledge of the Jordan form of a linear transformation leads quickly to a characterization of the solutions of a linear, constant-coefficient differential equation.
6. **Combinatorial topology of dynamical systems**: How the topology of a surface affects the fixed points of the flow of a vector field.
7. **Geometric aspects of elliptic curves**: Some basics on the complex plane modulo a lattice as a space and as a group.
8. **Group representations**: Basics on groups acting on vector spaces.
9. **Topological vector spaces**: A finte dimensional real vector space has a unique reasonable topology.
10. **The Weierstrass $\wp$-function**: Basics on doubly periodic functions on the complex plane.
11. **Harmonic analysis and the distribution of numbers**: Ideas of Fourier analysis leading to Weyl's theorem that the multiples of an irrational angle are equidistributed in the circle.
12. **Constructing the p-adic numbers**: The p-adics are a completion of the rationals in the same sense that the reals are a completion of the rationals. The project gives two constructions and shows that they yield the same object (a topological field).
13. **Modules over PIDs**: A proof of the fundamental structure theorem for said modules.
14. **Winding numbers**: How many times does a closed curve in the plane wind around a point? Making this precise has amazing applications like the Brouwer fixed point theorem and the fundamental theorem of algebra.
15. **Primes in an arithmetic progression**: Uses analytic functions to show that if a is relatively prime to m, then the sequence $a, a+m, a+2m, \ldots$ contains infinitely many prime numbers.
16. **Compact Hausdorff spaces and C^* algebras**: A compact space determines and is determined by its algebra of functions.
17. **Calculating rational canonical forms**: How to find a nice standard form (different than the Jordan form) of a matrix.