Advice for Beginning Research Careers

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The information below is an excerpt from a document that resulted from an RAP (Research Among Peers), in 2001 supported by the NSF VIGRE grant DMS #9983160 at the University of Illinois. The objective of the RAP was to assist the participants in finding research questions and developing a successful research program. Below is advice that originated from discussions amongst the participants and comments offered by four faculty (3 assistant professors and 1 professor).

The participants (three graduate students, a post-doc and a visiting assistant professor) held weekly meetings at which they gave informal presentations of their past and current research problems. The presentations included explanations of basic concepts, to bridge the difference in the backgrounds of the participants (Algebraic Topology, Symplectic Topology and Symplectic Geometry), as well as history of the problems.

The participants also organized two well-attended panel discussions:

On the job market, concerning issues facing graduate students and post-docs on the job market (from how to get your application noticed to how to negotiate a contract for a tenure track job). Panelists were Matt Ando (Asst. Prof.), Mike Bennett (Asst. Prof.), Randy McCarthy (Assoc. Prof.) and Susan Tolman (Asst. Prof.)

Finding research problems, seeking advice from faculty members on how to manage a successful research program. Among the main points discussed in were: How to get started, where to find questions/problems and how to evaluate their merit, how to find collaborators and what-when-and-where to publish. Panelists were Matt Ando (Asst. Prof.), Bruce Reznick (Prof.), Andreas Stein (Asst. Prof.) and John Sullivan (Assoc. Prof.).

Questions, questions, questions

This section includes comments and advice from the RAP members and the "Finding research problems" panel discussion. We have attempted to attribute comments correctly and apologize for any misleading paraphrasing or misquoting.

This section might be of interest to any math graduate student or post-doc, regardless of specialization.

From Whence?

ASK!! Yourself, your friends, anyone you can think of. This is really crucial. Sometimes you get an answer; frequently you at least get an interesting comment; often you find out that the other person also doesn't know -- even when that person is a senior faculty member. All kinds of answers are instructive. The "I don't know's" are definitely important for dispelling the typical notion that everyone else knows what you don't.

Go to conferences! Talk to other mathematicians!!! All of our panelists emphasized this as CRUCIAL to finding good research problems. The panelists each attend between two and six conferences per year.

Attend talks, even if they are not in your field. Sullivan and Reznick emphasized the importance of this, and supported their stance with examples from their own experience of the direct impact a talk can (unexpectedly) have.

Follow your muse. All of our panelists had followed their own interests, often choosing a direction which might have been viewed as less than strategic. None recommended following their lead per se; but look at where they are....

Think "around" the big questions -- both open conjectures and proven theorems. [Ando] Just identifying these problems is worthwhile. Think about the implications of such conjectures or theorems and their relations to other questions.

Find connections with other branches of mathematics: Lots of good questions come "between fields" [Ando]. This is good source for collaborations [Sullivan].

Push your work to the limit: Think of the best possible theorem that could come from asking questions of a particular kind. When you have a result "push the conclusion and pull the hypotheses." [Reznick]

Examples, examples, examples, counterexamples. Well, this is how you really understand what is going on. Sometimes it is the key to noticing an underlying structure. Enough said.

Read research papers -- foundational, conference or workshop proceedings. Note that conference and workshop proceedings often contain a section listing open problems. The panelists all confessed that they read less than they think they should.

Consider analogies and dictionaries between subjects This can be a fruitful endeavor and apparently is the nature of a number of recent MIT theses.

General advice

Most panelists described having had a hard time starting out. They floundered for a while but now have more questions than can work on, even with giving problems to graduate students. So, DON'T GET DISCOURAGED!

- Think of writing papers as producing progress reports -- you need to let the mathematical community know where you are in your work at least twice a year. [Ando]
- Think on two levels -- one for research and one for writing. They spur each other on. [Ando]
- Research collaboration comes often when talking with another mathematician and you realize you are both "thinking along the same lines." [Sullivan]
- Have one or more big projects (that may take you several years to make significant headway on) AND little projects so that you are continually producing. [Sullivan]
- Think of research like sourdough -- publish what you know, but keep a little bit for yourself as a source for more. [Reznick]
- Have senior people in your field and your department read your papers for advice on where to publish.
- Talk to the BIG people: they'll be your references; they know of good research problems; they are not threatened by you; they view you as a source for furthering their ideas and the field as a whole. [Stein]
- Realize that the experts don't know everything. They may know a lot in a very broad sense, but on a particular aspect their knowledge is often very thin: like pie crust, it is not that hard to poke through! [Ando]
- Remember that mathematics really is one field; try to talk to mathematicians from other branches. They also are doing mathematics, so you really do share much in common intellectually! [Reznick]

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