Mathematics Journals: What Is Valued and What May Change

Report on the Workshop Held at MSRI, Berkeley, California, February 14–16, 2011

Mathematics relies on its journal literature as the main conduit for peer review and dissemination of research, and it does so more heavily and differently than other scientific fields. The conflict between universal access and the traditional subscription model that funds the journals has been debated for the past decade, while hard data on financial sustainability and usage under the different models has been slow to appear. However, the last ten years have seen the move from print to the electronic version of journals becoming the version of record. The workshop "Mathematics Journals: What Is Valued and What May Change" took an evidence-based approach to discussing dissemination, access, and usage of mathematics journals.

The workshop goal was to discuss what is important and unique to the publishing of mathematical research articles and how we can best ensure that publishing practices support peer reviewed research in the long term. Much of the current discussion is taking place between funders and publishers, including scholarly societies, but not directly with mathematicians. A second goal was to see if we can find a consensus of opinion on what is important about journal publishing to mathematicians, that is, where the balance lies between the need for profits from publishing and the desire for broader dissemination of research.

The presentations ranged widely; written reports of the talks can be found at http://www.msri.org/attachments/workshops/587/MSRIfinalreport.pdf. During the first morning, John Vaughn, Sam Rankin, and Jim Crowley described the way the world works in Washington, leading us to think about the future of mathematics journals should new legislation be passed to mandate open access[1] of federally sponsored research in the USA. Interleaved with those talks was a presentation on the work of the IMU from John Ball and a talk from Jean-Pierre Bourguignon that placed journals in the broader context of the research they publish and the nature of mathematical work.

We heard talks on how mathematics journals work in practice and saw evidence of the growth of journals and the changing behavior of readers and authors. Information was provided on the balance between not-for-profit and commercial publishers, the governance of learned societies, who reads mathematics journals, and the value of the older material to current mathematics research from the citation records. An unscheduled talk by Kristine Fowler, a librarian from the University of Minnesota, gave some interesting results from a recent survey of mathematicians' views on open access. David Gabai's talk on the recent history of the *Annals of Mathematics* provided a fascinating insight into the effect of free open access on the journal's subscriptions, along with a description of the low cost of publishing the journal. Talks were presented by a variety of major mathematics publishers, ranging from the AMS and Elsevier to Project Euclid. Finally, new publishing models for changing access were presented from a variety of speakers: mathematicians, publishers, and a new university office of scholarly communication.

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[1] *"Open access" refers to any research paper that is made freely available in published form at no cost to the reader; it does not distinguish between funded "gold" open access, where the author or research funder pays for publication, and unfunded "green" open access.*

Here is a summary of what we learned from the meeting.

Characteristics that Distinguish Mathematics Journals from Other Disciplines

- There are lots of journals in the mathematical sciences—774 listed "cover-to-cover" in the Mathematical Reviews database alone.
- They are fully international; one cannot distinguish how a journal operates according to which country it comes from. There are no boundaries to submission from overseas authors and no boundaries to the choice of country where an author may submit a paper.
- There are no speed pressures; refereeing is expected to be rigorous and detailed. The average time a paper spends between submission and acceptance is many months.
- Published articles form the building blocks of future mathematical research. A theorem, once proved, stands for all time and is cited for as long as the literature can be found. It is therefore important not to lose the building blocks.
- Evidence was shown for the longevity of mathematics papers in terms of both continued reading and citation of the oldest material.
- The community calls them referees rather than reviewers. Journals frequently rely on a single referee to provide a rigorous check of the work, plus opinions from others on the relative importance of the work.
- Data sets and other supplemental materials are rare in pure mathematics, and the paper stands on its own. This means there is no easy way to cheat in terms of the result presented, apart from direct plagiarism.
- Applied mathematics may include data and other supplemental material, but the data sets are commonly available, and it is not a part of the culture to refuse to give background data.
- Applied mathematics is distinct from applications of mathematics—both are valid, but the relevance of the work is judged on different criteria.

On the arXiv
Mathematicians recognize the value of having free access to prerefereed material, and the presence of a preprint on the arXiv (`http://arxiv.org/`) already fulfills most of the requirements laid out by the green open access lobby. In view of the long referee times, posting a paper on the arXiv first establishes primacy of the result in the few cases where this is important to mathematicians. Publishers have learned that they cannot put the genies back in the bottles and that much of "their" content is already freely available. Instead, they work to promote the final published version as the "version of record" and distinguish that from the arXiv version. Nowadays publishers encourage authors to post the early versions up to and including the final accepted version with an acknowledgement "to be published in the *Journal of X*". However, many authors fail to keep the record updated, and there are problems with referencing an arXiv preprint. This keeps the publishers happy that they still have something of value in hosting and selling the final published version in return for the costs of editing and dissemination.

For some sampled mathematics journals, as many as half the published papers have preprint versions posted on the arXiv, and the percentage is growing. This makes the arXiv by far the dominant preprint repository and the first place many mathematicians in certain areas of the discipline look for new research. It is supported by the many thousands who choose to post their preprints there; no university or publisher forces them to do so: As a result, there was no enthusiasm expressed during the workshop for alternative institutional repositories, which one speaker described as self-aggrandizing university projects. The prior assertion of copyright ownership made by some universities in order to deposit articles in their own repositories has the effect of removing the right of the author to decide where he wishes his work to be published. In contrast, the arXiv is widely and increasingly used; it is fully international, and the barriers to posting an initial preprint are very low.

A problem is that there is no long-term economic model for paying for the arXiv beyond the recent plea to major universities to support it through donations. We believe that there is an urgent need for the mathematics community to come up with a truly international solution during the next few years, and it is hoped that researchers from other subject areas, most notably theoretical physics, are also looking for a solution. The arXiv may need a fully capitalized perpetual fund to be set up; the IMU might consider what it can do to facilitate further discussion.

On the Archive
The switch to online versions as the primary source of mathematics journals has led to an interesting dilemma. Libraries would like to be the permanent repositories of the mathematical literature but have already begun to reduce their paper archives while not taking on the direct hosting of the journals they license. The publishers are now responsible for archiving and upgrading the online versions in line with demand for more functionality. The question is, what happens if the publisher folds? In the past the literature was scattered across many libraries. Nowadays publishers sign with archiving services like CLOCKSS, but this does not meet the desire for upgrades, and storing out-of-date formats has little value. This is particularly important in mathematics, where the rendering of mathematical symbols and formulas remains an issue. The recent development of MathJax is likely

to help but may herald another change in format that will require publishers to charge for future developments. Libraries may need to review their long-term archiving policies.

Open Access, Green and Gold
There was general consensus at the workshop that the "gold" open access model discriminates against unfunded authors, including retired authors and those from developing countries, although research councils around the world are considering whether to fund mandated open access. The question was raised whether mathematicians should become involved in the judgment of "who pays" for those papers where the author has no funding. It would be one more burden on mathematicians to identify the deserving needy, but if they are not involved, the publishers will make their own choices. If the National Science Foundation (NSF) decides to fund a government-mandated open access policy, the money will go to those publishers who have set up charges for optional open access. For "gold" open access, there is no embargo period, and once the NSF has paid the fee, the article is immediately freely available online.

Evidence from the *Annals* experiment in green open access was stark; libraries cancelled 34 percent of the subscriptions between 2003 and 2008, when the journal was freely available online. The *Annals* is one of the best journals in mathematics and one of the cheapest, and so it came as a surprise to many at the workshop to hear that some of the best-funded libraries in the U.S. had decided to save on the subscription rather than support the experiment in widening access.

On Embargo Periods
We did not hear anyone at the workshop support the principle of green open access after a short embargo like the National Institute of Health (NIH) model—a twelve-month embargo period (i.e., a manuscript must be deposited by an author in a public access repository within twelve months of publication). Many mathematicians voluntarily post their preprints to the arXiv, and this could answer the demand, if there is any, for public access. The window between a preprint being freely available on the arXiv, then again being freely available in published form just twelve months later is generally held to be too small given the long life of articles and the slow pace of publication in mathematics. The fear is that libraries will do as they did with the *Annals* and cancel the journal subscriptions and have their readers look at the preprint version for an extra twelve months. With no subscription income and no gold open access fees, many journals will not survive.

However, there was appreciable support for mandating green open access after a period that is more appropriate to mathematics, say after five years. This was mirrored by proposals from French

List of Invited Workshop Speakers

John Ball	Oxford and IMU
J. P. Bourguignon	IHES
David Clark	Elsevier
James Crowley	SIAM
David Gabai	Annals of Mathematics
Robert Guralnick	Transactions of the AMS
Susan Hezlet	LMS
Carol Hutchins	Courant Institute
Robion Kirby	MSP and Berkeley
Hans Koelsch	Springer
Matthias Kreck	MPI Bonn
Angus Macintyre	LMS
Paolo Mangiafico	Duke
Donald McClure	AMS
Samuel Rankin	AMS
Bernard Teissier	CNRS
John Vaughn	AAU
Mira Waller	Project Euclid
Tom Ward	University of East Anglia

and German mathematicians for making the archives of all journals freely available after five years. Should mathematicians be forced to choose a model for publicly funded future research, we think it likely that they would see five years as the best alternative even if it were at the expense of the closure of the very few "reverse" moving wall experiments, such as those operated by the London Mathematical Society.

Other Matters: Plagiarism, Impact Factors
There was strong criticism of the misuse of journal impact factors to evaluate individual papers, but concern was raised that it may not be possible for the IMU to provide any useful alternative index. Other concerns about the use of such metrics for quantifying journal quality have been well documented.

There was also a discussion on the apparent increase in plagiarism and in multiple submissions (where an author submits a paper to more than one journal simultaneously), along with the global rise in the number of mathematics papers being written. It was agreed that there is a need for societies/publishers to maintain standards. Tools such as CrossCheck have helped combat egregious cases, but these place an additional burden on staff and editorial boards. By comparison, the arXiv is used by some editors when checking complaints, and there was a discussion on whether its use could be extended to provide a more formal registration of papers.

Conclusions

The mathematics research community values its own standards of rigorous peer review, which it calls refereeing, and the longevity of its journals. Mathematicians want access to the old material and the certainty that it will be maintained and remain accessible regardless of the medium. They are wary of attempts to change scholarly publishing from the values of a nonscientific political world that does not understand the value and nature of the mathematical literature.

Some people would like to change the funding model for mathematics journals, arguing that they wish to provide public access to publicly funded knowledge. The arXiv already provides public access, but it suffers from having no long-term funding mechanism. We believe the most benefit to the community would come from addressing this problem and providing a permanent solution.

There is an argument for letting mathematicians decide what they want to support voluntarily rather than forcing new business models into the market. We should certainly encourage new experimental models, some of which have been very successful. Even those that are no longer free have helped apply pressure to keep the price of journals down. Through allowing mathematicians to decide which model they want to support voluntarily, one can discover sustainable long-term solutions. There may need to be some fail-safe mechanism to ensure that the past volumes of failed experimental journals are not lost to the literature.

The mathematics community has long argued against the high price of certain journals and would be happy to see a change in the funding model that reduces those profits that are not fed back into the research economy. As a result, the community is not closed to the idea of freeing up access, but it recognizes that any new model should not risk the long-term future of scholarly mathematics journals by imposing dangerously short mandated embargo periods. What the U.S. government decides to do will affect the worldwide mathematics community. It is hoped that the U.S. government does not force a model on its own researchers that may restrict the choice of where to submit a paper.

There should also be a clear division between funding research and being involved in evaluating the output of the research once funded. Paying for publication may influence the reader's judgment of the value of the research. In general, we see such schemes as unfair and a barrier to new research from unfunded mathematicians. If mandated open access were to be funded, there would be a case for no embargo period. Many publishers have already set up optional paid open access schemes to accommodate research funders who may impose a mandate. It is to be hoped that green open access that mandates open access twelve months after publication would not be imposed. Five years is considered a more appropriate period for mathematics.

Disclaimer

We have written the conclusions in the knowledge that there will never be a perfect list and certainly not all the workshop participants would support these views, which are our own. However, we believe that it is important to assert the unique value of peer review in mathematics journals and to describe what is necessary to support a healthy structure in which the very best of mathematical research can be distinguished while maintaining the breadth of mathematics journals. The many diverse journals in the mathematical sciences provide a platform for worthy research which has real value. We hope that this report may be used in future debates as fuel for the phrase "one size does not fit all".

—James Crowley, SIAM; Susan Hezlet, London Mathematical Society; Robion Kirby, University of California; Don McClure, American Mathematical Society