

# Ensuring widespread and equitable access to back issues of mathematics journals

IMU Committee on Permissions

August, 2024

The International Mathematical Union (IMU) Committee on Permissions was an ad hoc committee of the IMU that met from October, 2021 through June, 2024, with the task of preparing a report for the Executive Committee of the IMU regarding the following:

- A recommendation for IMU policy on the time frame for making papers freely available after publication, together with technical details such as licenses.
- A concrete proposal for how to implement this recommendation, for example by outreach to publishers, with the particular goal of negotiating access to existing back issues.
- Any additional considerations that may affect the availability of past papers, such as the demise of publishing companies or issues with archiving.

The membership of the committee was Thomas Brennan (chair), Henry Cohn, Samuel Hansen, Evelyne Miot, Valeria Simoncini, and Stephen Watt. We generally met every two weeks to gather information, discuss these issues, and formulate the present report. In addition to the public documents we cite, we also surveyed a sample of publishers and interviewed representatives of key publishers. To facilitate open communication, we agreed not to quote or attribute any opinions to any publishers without permission. We intend our report to reflect the current state of the mathematics publishing industry, but of course nothing we write indicates agreement by any particular publishers.

We include some background on the current state of mathematics publishing to explain our recommendations. Further background and definitions of terms can be found in various references, such as the [AMS Primer on Open Access](#).

## Summary of recommendations

Mathematical publications remain relevant to current research over a longer time-frame than in most other disciplines. Mathematicians therefore need enduring access to the literature and expect their papers to be readily available to readers over time. Our principal proposal is that

The IMU should recommend that every mathematics journal make all its articles freely available no more than five years after publication.

In Section I.2 we suggest text that we hope the IMU Executive Committee will choose to endorse, and in Section III.1 we discuss licenses. We also make a number of additional recommendations in Part III of the report, including that the IMU should:

- Provide guidance for publishers that the Author Accepted Manuscript (i.e., the manuscript version before the polish of typesetting and copy editing by publishers) should be allowed to be deposited, with proper linking to the publisher version of record, on their personal and/or professional website immediately and with an embargo of no more than 6 months in public repositories.
- Advocate to zbMATH, MathSciNet, and the International Mathematics Knowledge Trust for the creation of links to and indexes of author accepted manuscripts deposited in the arXiv and other open access repositories, continuing the work that zbMATH has already started by linking papers to arXiv versions, when they exist.
- Recommend that price transparency be a condition for any comprehensive “transformative agreements” for subscriptions undertaken.
- Work with the arXiv to identify actionable plans for the mathematical community to support its continued existence.
- Communicate to mathematicians that they should always update their preprint deposits with at least the accepted version, and, if possible under their copyright agreement, the version of record after their publisher’s embargo period.
- Promote librarian-led information literacy sessions for upper level undergraduate and starting graduate mathematics students, as well as stronger connections between mathematics departments and university libraries.
- Work with relevant stakeholders to preserve Green Open Access as a legitimate method for meeting open access mandates in the future.
- Discourage the use of article processing charges as a model for open access of articles.
- Promote the Diamond Open Access model and the Subscribe to Open model, and support initiatives in this direction.
- Convene a committee of mathematicians who are active within the editorial side of publishing and librarians to investigate potential future partnerships and collaborations which would further open access mathematical publishing.

We hope the IMU Committee on Electronic Information and Communication will take up some of these possibilities.

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# I Introduction and background

In 2006, the International Mathematical Union (IMU) General Assembly [endorsed the idea](#) of a Global Digital Mathematics Library (GDML), which would provide seamless access to the mathematical literature and make as much of it as possible freely available. This project is clearly important for mathematics and for society more broadly, but it is an ambitious undertaking, and there has been little progress in creating such a library.

The biggest steps so far have been

- the creation of the [International Mathematical Knowledge Trust](#) (IMKT) in 2015, which subsumed the IMU’s GDML working group. Currently, the IMKT has important projects in several areas, such as special functions, formalization of mathematics, and document analysis, which would support and extend a future GDML, and
- the EU funded project EuDML, which has been the first and only transnational concrete implementation of a DML (Digital Mathematics Library) project so far, indexing more than 270 000 items in open access from 14 reliable collections, running through years 2009–2013. EuDML is still maintained but no more developed due to insufficient resources dedicated to IT development and curation of content. However it is a successful concrete example of how a DML could be further built.

In 2014, a committee of the Board on Mathematical Sciences and their Applications issued a report on the GDML, called [Developing a 21st Century Global Library for Mathematics Research](#). This 143-page book does an excellent job of laying out the justification for a GDML and its potential benefits, as well as the issues and challenges that must be confronted, and it concludes with a strategic plan. Unfortunately, nobody has been found to take a leadership role in funding and implementing the plan, and there seems to be little momentum in that direction.

Fortunately, a viable alternative has emerged, as described by Klaus Hulek and Olaf Teschke in [The transition of zbMATH towards an open information platform for mathematics](#). This alternative is [zbMATH Open](#), formerly known as Zentralblatt MATH. It is a database of publications in mathematics, including bibliographic information, reviews in many cases, and links to papers. While not the only such database ([MathSciNet](#) is another prominent example), it has the unique property of being open access. As stated on [their website](#):

After a concerted effort by zbMATH stakeholders, the Joint Science Conference (Gemeinsame Wissenschaftskonferenz) agreed in the first week of December 2019 that the Federal and State Governments of Germany would support FIZ Karlsruhe to transform zbMATH into an open platform. As a result zbMATH Open has become a freely accessible research tool for the mathematical community worldwide since January 2021.

This step was inspired by the International Mathematical Union’s 2014 vision of a Global Digital Mathematics Library: “to provide a coherent and sustainable open platform in which all mathematics-relevant information and data can be brought together, comprehensively accessed and used free of charge under a uniform interface”.

While zbMATH Open in its current form falls short of the full vision for a GDML, Patrick Ion and Mila Runnwerth have proposed to view it as an initial step, which they call GDML<sub>0</sub>. From this perspective, bringing a full GDML into existence amounts to three tasks:

- Building an initial interface and index GDML<sub>0</sub>.  
GDML<sub>0</sub> now exists in the form of zbMATH Open, although it may be improved, supplemented, or even replaced as necessary over time.
- Making as many mathematics papers as possible freely available.  
How to do so is the primary topic of this report.
- Building tools and interfaces on top of the index GDML<sub>0</sub>, such as search engines that can handle formulas and changes of notation or terminology.  
These sorts of questions are far more subtle and complex, but solutions can evolve over time once the foundation is in place. Recent advances in AI may play a valuable role here, but they cannot replace access to the literature.

Many mathematicians use other portals to navigate the literature, including subscription services such as [MathSciNet](#) and freely available tools such as [Google Scholar](#). Whatever their merits, subscription services cannot form the basis for a universally accessible GDML, and while other freely available websites are useful, they suffer from several disadvantages: they produce automated results of mixed quality, and they are under the control of for-profit companies, whose interests may not always align with the mathematical community's interests in the future.

One method some people use to access scholarly article for free is [Sci-Hub](#), which makes research papers available without regard for (and often in violation of) copyright law. Sci-Hub plays a significant role in enabling mathematicians to access the literature even if their institutions cannot pay for access. However, its disregard for copyright is generally illegal, and of course it strictly rules out most forms of governmental or institutional support. For these reasons, Sci-Hub cannot play any official role in a GDML.

Among legal and freely available options, zbMATH Open has by far the best and most accurate coverage of mathematics, and its ownership is dedicated to the public interest. We therefore expect it to play a key role in indexing mathematics, alongside other databases and portals.

## I.1 Ensuring access to mathematics papers

With the first step of GDML<sub>0</sub> in place via zbMATH Open, the pressing question is how to ensure that as much of the mathematical literature as possible can be accessed by as many people as possible. Today, paywalls and similar barriers to access are an inconvenience even for researchers at well-funded universities, and they can be a severe obstacle for those who are less privileged. This remains the case despite attempts to ameliorate these issues, such as discounted access for researchers based on local purchasing power.

The mathematical community is exploring a number of different approaches to open access, and it is too early to arrive at definitive conclusions on how best to ensure sustainable and high-quality journals. More exploration and experience are needed, and it would be

premature for the IMU to try to arrive at a policy consensus. However, there is a key issue on which we believe consensus should be possible, namely access to back issues.

Here, the question is whether mathematics papers should remain locked behind a paywall for a lengthy period of time. Copyright typically does not expire until 70 years after the author's death, which is often a century or more after publication. When publishers have exclusive rights to distribute mathematics papers, they have what amounts to a monopoly over access to humanity's knowledge.<sup>1</sup> This situation does not serve the interests of authors, readers, or society at large, and even commercial publishers do not want to limit access for its own sake.

What's the alternative? When publishers control access to back issues, the only way to broaden access is to convince the publishers that doing so is in their own best interests. Fortunately, the mathematical community is in a position to make a compelling case for this.

We propose that publishers should adopt a form of open access via a moving wall, in which all papers published in mathematics journals are eventually made freely and publicly available under a suitable license. This license should enable not just access from the publisher's website, but ideally also third-party hosting and distribution, for example as part of the GDML. In Section I.2, we offer a specific proposal for such a policy, which we encourage the IMU Executive Committee to put into place as an official IMU policy.

Part of our motivation is that the American Mathematical Society (AMS) and Elsevier both make papers from their mathematics journals available for free after at most five years,<sup>2</sup> although neither one currently uses a license as permissive as we'd like. The fact that free access to back issues is compatible with the business models of both the AMS and Elsevier is a very encouraging sign: anything these two very different publishers can agree on should be broadly acceptable within the mathematics publishing industry, and indeed they are not the only publishers with such a policy (for example, EDP Sciences and the Société Mathématique de France do the same for some of their journals). A five-year window seems like an uncontroversial choice, which would not overly constrain publishing or funding models, and we propose that the IMU endorse such a window.

We don't see this proposal as an ideal long-term solution. We hope the research community eventually ends up with immediate open access to all research papers, and we believe the world is generally headed in that direction. However, open access is a difficult issue. For example, immediate open access is not compatible with a subscription model for journal funding, and it is not clear how to replace subscriptions with a funding model that would be well suited for mathematics. For example, research funding for individual mathematicians is in many cases not sufficient to cover open access fees. We do not seek to fully resolve this issue, but we do offer some recommendations related to open access later in the report.

From this perspective, we recommend a five-year window because it is short enough to be meaningful and valuable for the mathematical community, while long enough that it should not interfere with the business models used by publishers, including subscriptions. The goal of our recommendations is not to disrupt the publishing industry, but rather to highlight an

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<sup>1</sup>Of course copyright holders cannot stop anyone from writing another exposition of the contents of a paper, and much of the most important material eventually becomes more widely available through expository papers, textbooks, and lecture notes. However, expository writing is too labor-intensive to cover more than a fraction of the research literature.

<sup>2</sup>Four years in the case of Elsevier.

opportunity for gains without disruption. Whether disruption is necessary or desirable is a different topic for debate.

Our recommendations address only journals, and not books, for two reasons: the way books are sold can be less compatible with open access than journals are (publishers are more reliant on a long tail for sales of popular books), and authors generally receive royalties. This does not amount to much money for the vast majority of authors of mathematics books, but it does for a few, and even those not making much in royalties might be legitimately unhappy to lose this income. In the long run, the GDML will have to deal somehow with the issue of books, but our proposal does not address that topic.

Another complication is where to draw the lines between mathematics journals and those in computer science, physics, statistics, data science, or other fields. There is no principled answer to this question, and the best we can do right now is to work with publishers to draw the lines somewhere. Ultimately, all of academia needs to address this problem, but mathematicians are ideally situated to take the first steps.

Mathematics is an ideal case for opening up back issues, because mathematics papers remain relevant to current research for an exceptionally long time, far longer than in most other fields. On the one hand, this longevity means access to back issues is particularly important to mathematicians. On the other hand, it means publishers won't be giving up anything of great value in the overall scheme of things, since there is not a lucrative market for fifty-year-old papers in medicine or engineering. We believe that's why Elsevier has been willing to open its archives: mathematicians consider this access valuable, but it's not worth a lot of money in other fields, so there's no risk of financial disaster if the idea spreads beyond mathematics.

The IMU is well suited to address this topic. Unlike some other learned societies, it has no publishing house of its own, and it is therefore not in competition with other publishers. Furthermore, the IMU can address the interests of the mathematical community as a whole, across geographic or intellectual boundaries.

## I.2 Proposed policy

We recommend that the IMU Executive Committee adopt the following recommendation as official IMU policy and communicate it publicly to mathematicians, member organizations, and publishers:

While the International Mathematical Union (IMU) has no legal authority to regulate or control publishers, it is part of the IMU's mission to make recommendations for which policies would best serve the mathematical community. As such, the IMU firmly believes that no published mathematical research paper should be withheld from public access for many years, by paywalls or other barriers to access. Instead, all articles published sufficiently long ago should be freely available for download. Specifically,

The IMU recommends that every mathematics journal make all its articles freely available no more than five years after publication, including all past articles for which digital files or scans are available.

Ideally, all articles should be made permanently available five years after publication under a non-restrictive license, such as [Creative Commons BY](#) with copyright held by the authors, and for papers published in the future, publishers should commit to this condition in the publishing agreement with the authors. For minimal compliance with this recommendation, articles should be freely available as the version of record for download by the public, without payment of fees, user registration or similar access control, digital rights management, or other use of special software to restrict or control access.

Changing access policies is a business decision that can take time, but the IMU believes that January 1, 2026 is a reasonable time frame for this change. Any publishers not providing access to back issues after that date will not be in compliance with this IMU recommendation.

This five-year window in the policy was chosen based on the last decade of experience with subscription journals published by Elsevier (using a four-year window) and the American Mathematical Society (using a five-year window). In both cases this window has not proved disruptive to the publisher's business model, and we expect that such a window should be similarly harmless across mathematics publishing. We also mention that several publishers (Elsevier, Springer, EDP Sciences, Société Mathématique de France) have freely provided the back issues of several of their well-established journals to the digital mathematical library [Numdam](#) for hosting and free access after a five-year window. In this respect, the question of access to back issues is independent of the question of open access upon publication, which is itself an important goal but where the community is still exploring how best to achieve it sustainably.

Our proposal is a more detailed and formal version of a recommendation made by the IMU Committee on Electronic Information and Communication in their 2002 [Recommendations on Information and Communication](#) (Recommendation 12).



## II Process

### II.1 An overview of mathematics publishing

We began the work of this committee by taking a look at the landscape of mathematical publishing. To understand this landscape, it's useful to compile some statistics. Unfortunately, it's impossible to produce precise counts, for several reasons:

- The boundaries of mathematics are porous, especially in applied mathematics but even in theoretical mathematics. There's no principled way to decide which papers count as mathematics and which are primarily in an adjacent field.
- It's not always clear what counts as a publication. In most cases, everyone is in agreement, but there's a wide spectrum of journals with varying levels of academic or institutional credibility. Wherever one draws the line, some arbitrary choices will have to be made.
- There is no database with complete coverage of mathematics papers, and even in the most comprehensive databases, there are papers added years after their publication date and journals which are not indexed.

Table 1 gives an overview of the twenty-five largest publishers in mathematics, as best we could determine via zbMATH queries. Springer and Elsevier combined publish more than 40% of all mathematics papers indexed by zbMATH, including Taylor & Francis, Wiley, and World Scientific brings the total above 50%, and the next twenty push it over 71%.

There are far too many different journals and publishers to attempt a comprehensive survey, and so we drew up a list of 65 different publishers for further examination, with multiple representatives from every continent other than Antarctica. This list included 43 learned societies, 13 for-profit publishers, 5 non-profit publishers, and 4 university presses. Only 7 of the publishers did not offer any path to open access for articles, and at least 31 of the publishers require a fee to publish open access in at least one of their journals. These fees can be as low as \$500 USD, but many of them are more than \$2000 USD. Almost all of the publishers we looked into had explicit preprint rules, which generally allowed for the depositing of preprints up to the submitted copy, but they varied widely on post-peer review versions with some allowing it, other having an embargo until sometime after publication, and yet others not allowing any deposit at all.

While this scan provided an overview of the landscape of mathematical publishers, it could not provide us with the deeper reasons behind why decisions were made or what the future could hold. In order to dig deeper into those questions, we used our scan to identify some key publishers whom we interviewed, and then we sent out questionnaires to the other publishers on our list.

### II.2 Publishers interviewed

We were able to conduct interviews with representatives from the American Mathematical Society, Elsevier, Oxford University Press, the Society for Industrial and Applied Mathematics, Springer, Taylor & Francis, and World Scientific Publishing, as well as receiving detailed

Table 1: Number of 2020 papers listed in zbMATH by publisher.

Rank	Publisher	#	%
1.	Springer	24,972	21.22%
2.	Elsevier	22,522	19.13%
3.	Taylor & Francis	5,075	4.31%
4.	Wiley	3,590	3.05%
5.	World Scientific	3,123	2.65%
6.	Institute of Electrical and Electronics Engineers	2,650	2.25%
7.	Cambridge University Press	2,630	2.23%
8.	American Institute of Mathematical Sciences	2,500	2.12%
9.	IOP Publishing	2,325	1.98%
10.	De Gruyter	2,016	1.71%
11.	Hindawi	1,793	1.52%
12.	Society for Industrial and Applied Mathematics	1,763	1.50%
13.	American Mathematical Society	1,282	1.09%
14.	Oxford University Press	1,234	1.05%
15.	American Institute of Physics	780	0.66%
16.	Science Press	738	0.63%
17.	EMS Press	725	0.62%
18.	International Press of Boston	702	0.60%
19.	Russian Academy of Sciences	702	0.60%
20.	Institute of Mathematical Statistics	685	0.58%
21.	Mathematical Sciences Publishers	646	0.55%
22.	University of Niš	519	0.44%
23.	Polish Academy of Sciences	452	0.38%
24.	EDP Sciences	448	0.38%
25.	Royal Society Publishing	437	0.37%

Data collected on November 5, 2023. There were 117,702 journal papers from 2020, of which these 25 publishers account for 71.63%. Some journals list multiple publishers, in which case we listed them under the larger publisher.

written responses from the Australian Mathematical Society, Brazilian Mathematical Society, Chinese Academy of Mathematics and System Sciences, Institute of Mathematical Statistics, Mathematical Society of the Philippines, Mathematical Science Publishers, Nigerian Mathematical Society, and Sociedad Colombiana de Matemática. While this sample of publishers emphasizes Asia, Europe, and the Americas, it represents a broad spectrum of locations and types of publishers. As mentioned above, we agreed not to quote or attribute any opinions to any publishers without permission, and nothing we write should be interpreted as the opinion of any particular publisher.

Our biggest takeaway from these interviews and written responses was the enormous diversity of perspectives and opinions. There is no consensus on what the future of publishing might hold or how best to get there, which criteria are crucial, or how key publishing decisions should be made. Instead, each publisher has its own approach. This diversity of opinion is a valuable resource for the field of mathematics, because it leads the publishing industry to experiment with many different options. In a time of change, this sort of experimentation is the only way to find out which approaches work best, and it offers the IMU a chance to provide guidance on what matters to mathematicians.

The same diversity holds at the level of countries, with different countries moving at different paces and even along somewhat different trajectories in areas such as open access. Of course it is important for the IMU to be sensitive to this variation across countries, and we have done our best to focus on issues with cross-national applicability.

In terms of access to back issues, there was widespread agreement that this issue is important, and there was a good deal of openness to trying making them publicly available. However, this openness was not shared by every publisher, and we also ran into some reluctance, ranging from hesitation to outright lack of interest. As best we understood, the hesitation was because any serious change requires thought (and of course the representatives we spoke with usually were not empowered to determine this sort of policy), and the lack of interest was based on a lack of any business incentive to open up back issues (which might change if it became clear that such a policy matters to mathematicians).

If the IMU adopts the policy from Section I.2 recommending at most a five-year window, we expect that some publishers will implement it immediately, and more can be convinced to do so, but it is not likely that every publisher will agree in the foreseeable future. Despite this lack of unanimity among publishers, we consider it important for the IMU to communicate its perspective on what would best serve the mathematical community.

## III Further recommendations and rationale

### III.1 Licensing

A minimal standard for free access to back issues would be that they could be freely downloaded from the publisher's site to an individual reader's computer, but not distributed directly by third parties such as the GDML and with no guarantee of future access. In many cases that would be better than the status quo, and it may be the best that some publishers will allow in the near future. However, we hope for a more robust and permissive framework, with a license guaranteeing certain rights.

One critical issue is the choice of license. Recall that a license grants permission to distribute a copyrighted work, under conditions specified by the license. (Certain forms of distribution are automatically allowed, such as fair use in the U.S., but other distribution constitutes a copyright violation if not allowed by a license, and the rules regarding distribution vary between countries.)

The goal is to move to a future in which nobody controls access to old mathematical papers, rather than a future in which the GDML works with publishers to control access. In particular, the license should grant the same rights to all people and organizations, rather than carving out a special role for the GDML,<sup>3</sup> and it should be irrevocable. At the same time, the license should not grant such broad rights that reasonable mathematicians might be uncomfortable with it. The goal is to arrive at a consensus solution that solves our most pressing problems, rather than to spend years trying to agree on a perfect solution.

We expect that the issue that most worries publishers may be the use of an irrevocable license. Giving up control is always worrisome, even when it seems clear that it should be harmless. It would be reasonable for publishers to start with a trial period before deciding whether to use an irrevocable license. However, we hope that publishers will eventually choose to use such a license.

We consider the following four criteria essential:

1. The license should be a clear and predictable standard across all of mathematics, rather than being negotiated on an individual basis with publishers. The only question should be whether the license applies, rather than which variant is relevant.
2. The license should be well known and used more broadly than just mathematics. It should be one that people interested in such things already understand well, rather than requiring ad hoc examination and study.<sup>4</sup>
3. The license should be easy to understand, so that any mathematician can quickly and reliably determine what is allowed. There should be no gray areas, where reasonable people might disagree about how to interpret it.

In practice, the condition that the license be well known means it should be a [Creative Commons \(CC\)](#) license. The gold standard for open access is the [Creative Commons Attribution License \(CC BY\)](#), which allows arbitrary distribution or adaptation of the work,

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<sup>3</sup>For one thing, the GDML may later be superseded by other projects, and our planning should account for that.

<sup>4</sup>[Proliferation of standards](#) is a problem.

provided that it appropriately credits the original authors.<sup>5</sup> The CC BY license would thus be ideal.

There are also Creative Commons licenses that allow only noncommercial use, but we recommend against using them. The difficulty is that defining what “noncommercial” means is [ambiguous and contentious](#), with many gray areas.<sup>6</sup> The principle that the license should be simple and not subject to these sorts of disagreements rules out a noncommercial license. Similarly, there are drawbacks to the use of the No Derivatives Creative Commons license for scholarly publications, including licensing issues when quoting even small sections in future works.<sup>7</sup>

The copyright holder cannot revoke a Creative Commons license once it has been granted. Once a paper has been obtained under such a license, it can be freely distributed forever.<sup>8</sup> However, there’s nothing stopping a publisher from deciding not to license any further papers. To protect against this, the publishing agreement with the author should guarantee that the paper will be available under a CC BY license five years after publication. That would protect the rights of authors who chose to publish in a journal with the expectation that their paper would become freely available, while allowing the publisher to change their policies starting with newly accepted papers.

It is also worth noting that Creative Commons licenses are non-exclusive. Thus, a plan along these lines would in no way prevent authors or publishers from granting greater permissions to use or adapt papers. Instead, it would simply set a baseline for what mathematicians can reasonably expect.

## III.2 Open Access

We wish to stipulate that the members of the committee believe that as a general principle open access to scholarly works is a positive thing. We believe that removing barriers that prevent everyone from being able to access mathematical information would be a great benefit to the mathematical community, especially as it would help open the door to people and communities that have historically been excluded from participating.

This belief though is a very general one and does not extend to believing that all current, and possible, methods for achieving open access are positive things. From both our research and personal experience as scholars we know that there are problems in the world of open access that range from where the funding comes from to a multitude of perverse incentives.

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<sup>5</sup>The license can specify what counts as appropriate credit, for example an academic citation, and it also does not allow anyone to suggest incorrectly that the original authors endorse an adaptation or the people adapting it.

<sup>6</sup>For example, nonprofit is not the same as noncommercial, and charging students tuition can be a commercial activity. There can also be overlap between different activities: if a noncommercial organization has a website on a service supported by advertisements, is that a problem? What about activities like [Google Scholar](#), which do not generate revenue but do serve as advertising for a commercial brand? It’s easy to create examples that some people consider obviously commercial and others consider obviously noncommercial.

<sup>7</sup>Brigitte Vézina discusses this, along with other drawbacks, in [this post](#).

<sup>8</sup>Technically, the copyright holder can stop offering new copies under the license. This means if you obtain a new copy from the copyright holder, that does not authorize you to redistribute it. However, the license cannot be revoked from the previous copies, so [any copy that can be traced back to a CC licensed copy can still be redistributed](#).

We do expect to continue to see governmental and funder mandates, such as the [Nelson Memorandum](#) (US) and the [National Plan for Open Science](#) (FR), which will require researchers to provide some form of open access for their work. It is important that mathematicians advocate for open access methods that balance the reasonable request that publicly funded research be openly available to the public with the realities of funding and culture within mathematics.

### III.2.1 Green Open Access

Green Open Access (Green OA) refers to the depositing of articles for free access, primarily preprints but also sometimes the published version as well (often after an embargo period established by the publisher). In many ways Green OA repositories are a direct evolution of what were, and often still are, known as preprint servers. In mathematics the main repository for Green (OA) is the [arXiv](#). Green OA is the most common open access method used by mathematicians, with over 38,000 deposits in the arXiv mathematics category each of the past 3 years [1] and Web of Science showing between 43,000 and 49,500 mathematics articles [across all open access methods](#) during those same years.

The large positive for Green OA as an open access method is that it is free for both the authors and the publishers. This is of course because the cost is being absorbed by the owner of the repository, though their costs are lower than they would be for a publisher as they are not doing any editing or typesetting and often any reviewing and moderation is undertaken by volunteers, as is the case at the arXiv [2]. From the mathematical perspective arXiv has been a huge boon for access to mathematical information, as it has provided not only a way to easily allow for people to get articles for free but it has also dramatically increased the speed of distribution for mathematical information which has long suffered from publication lags of over a year. Most Green OA repositories, such as the arXiv, are non-commercial enterprises that are funded through institutional partnerships, grants, and donations from a range of sources including commercial publishers, foundations, universities, and individuals. This method of funding carries with it inherent risks, and one of our recommendations is that the IMU work with the arXiv to identify actionable plans for the mathematical community to support its continued existence.

The main problems with Green OA, especially when implemented through the use of preprints, are quality and publishers not allowing immediate post-peer review deposit. Honestly to call these problems may be a bit too strong of language. Preprints are just that, pre-publication version of articles and therefore it is well within expectations that there could be errors in even the best articles that are deposited. The open deposit nature of the repositories was also always going to attract the people who used to have to send their fanciful mathematics directly to faculty post boxes. The problem more stems from articles that are not obviously wrong, but do contain a major issue, as these can often be hard to detect and as it becomes more and more common for mathematicians to rely on the arXiv for material as it is open and free these incorrect articles are more likely to be used by other mathematicians. Thankfully this can in large be ameliorated through better information literacy education and therefore another recommendation for the IMU is to promote librarian led information literacy sessions for upper level undergraduate and starting graduate mathematics students, as well as stronger connections between mathematics departments and university libraries.

The arXiv also provides for updating deposits with newer versions of papers, including the accepted versions and published versions, which can be helpful for determining article quality. This does raise the second problem though, that of publishers not allowing immediate post-peer review deposit. We understand publishers want to protect their income, and could see immediate deposit in a repository as popular as the arXiv as potentially cutting into that income, but we also believe it is important for the mathematics community that the best quality work is being accessed. Therefore we also recommend that IMU provide guidance for publishers that the Author Accepted Manuscript (AAM), the version before the polish of typesetting and copy editing by publishers, be allowed to be deposited, with proper linking to the publisher version of record, on personal and/or professional websites immediately and with an embargo of no more than 6 months in public repositories. Note that this right given to authors to deposit their AAM after no more than 6 months already exists in some cases, such as research supported by public funds in France since 2016, thanks to the “Loi pour une République Numérique.” The IMU should also communicate to the wide mathematical community the importance of updating their preprint deposits with at least the accepted version, and, if possible under their copyright agreement, the version of record after their publishers embargo period. Finally we recommend the IMU advocate to zbMATH, MathSciNet, and the International Mathematics Knowledge Trust for the creation of an index of author accepted manuscripts deposited in the arXiv and other open access repositories. (Note that zbMATH has already taken an important step in that direction by linking entries in their database to the version appearing on the arXiv, if any.)

### III.2.2 Gold Open Access

Gold Open Access (Gold OA) refers to cases where the publisher makes a scholarly work free to read after being paid a fee, typically called an Article Processing Charge (APC). Gold OA and APCs have become the dominant method for opening access to scholarly works for large scale publishers. All of the large scale mathematical publishers we looked into had at least one Gold OA journal, and most had multiple including hybrid journals that offer the choice between published closed access or paying an APC to open up an article. The APCs for these mathematics publications ranged from \$550 to \$4140 USD. Most researchers, across all the sciences, who publish via Gold OA publication are paying for the APCs with grant money and there is very limited institutional support to cover APCs [4]. As grant funding in mathematics is less common than it is in the physical and lab sciences this can make it quite challenging for mathematicians to pay for APCs. We do not expect this to be a concern for most commercial publishers as the subjects that receive more grant funds also publish much more and therefore are going to be the ones that drive most decisions about APC amounts and Gold OA efficacy.

Voluntary Gold OA is a reasonable, if somewhat close to pay-to-play, publication method. A problem does come in once publishing open becomes involuntary, through something like a funder mandate. If the open mandate requires fully open publication, instead of just the deposit of the accepted manuscript or the version of record with a 6 month embargo, this would then force researchers to scramble to publish in one of the very few Diamond (free to read and free to publish) journals or to pay the APC to make an article open. Thankfully most mandates currently allow for Green OA deposits, but academic publishing is a very

profitable sector and it would not be unexpected for publishers to lobby for Gold OA to be preferred to Green OA in future mandates. For this reason we recommend the IMU work with relevant stakeholders to preserve Green OA as a legitimate method for meeting open access mandates in the future.

Furthermore, the system of APCs may lead to a dramatic blow-up of public expenditures for scientific publication. For instance in France the cost of APCs has been multiplied by 3 between 2013 and 2020; see [5]. In 2022 the Centre National de la Recherche Scientifique in France has officially recommended to its researchers [not to pay APCs for their publications](#).

Shifting from a primarily subscription to a primarily APC funding model also introduces a problematic incentive for commercial publishers: the more articles they publish the more money they make. This introduces the possibility that in order to make more money publishers could lower standards so that they accept more articles or push for shorter and shorter articles with ever more deli-sliced results so that an author may end up paying multiple APCs to publish instead of one. This is the same thought process that has already brought us predatory journals and we are starting to see some evidence of this in the legitimate publisher space with the explosion in the number of special issues, and other guest editor based journal issues. These guest edited issues allow publishers to vastly increase the total number of articles they publish in a given year. This vast increase in number of articles does not equate with increase in quality though, as the reputation of some of the publishers that heavily rely on guest edited issue is not always stellar [7]. In view of these considerations we therefore believe that Gold Open Access via APCs is not a good fit for the mathematical community.

### III.2.3 Transformative Agreements

One of the ways institutions and consortia have attempted to make it easier for their researchers to publish in Gold OA journals through what are known as Transformative Agreements (TAs). These agreements come in many different forms but usually boil down to an institution and its library coming to an agreement with a publisher to shift from paying the traditional subscription fees toward one which pays for the OA publication of the institutions scholarship. TAs have been signed at all levels from a single university to national consortia. Typically the more an institution has historically published, the higher the cost of the TA for them, with some variance due to economies of scale. It is also the case that nearly half of all TAs do not include the fully Gold OA journals, instead only allowing for publishing in Hybrid journals [8].

As the number of total publications for any institution impacts the amount of money a publisher is likely to obtain in the next TA contract cycle all of the same perverse incentives around increasing the total number of publications exist with TAs. This also means that smaller institutions and institutions from lower and middle-income countries are at a great disadvantage even getting publishers to the table with regard to TAs as it will not be as profitable for commercial publishers to shift away from their subscription revenue [6]. They also introduce a perverse incentive for authors to publish in a non-ideal journal, especially authors who do not have funding for paying APCs. Namely, if your institution has a TA with Publisher A but not with Publisher B, an author may be tempted to go with a journal from Publisher A even if the best fit journal was from Publisher B.



Recently, cOAlition S, a group of national research funding organisations, with the support of the European Commission and the European Research Council to promote immediate access to OA publications, has confirmed the [end of its financial support for Open Access publishing under transformative arrangements after 2024](#). Indeed, when Plan S was created in 2018, cOAlition S considered transformative arrangements as useful means to repurpose funds for journal subscriptions to publication fees, with the principle that the transformation should be completed by the end of 2024, in order to avoid that this arrangements would become “permanent and perpetuate hybrid open access”. This is not an isolated incident either, as at least two French institutions (INRIA and Université of Lorraine) [have expressed reservations](#) about the national transformative-like agreement between Elsevier and the French national consortium Couperin for the period 2024–2027.

In reality it is very hard to judge if TAs have been a net positive for the scholarly publishing landscape as they have not come with openness with regard to cost [6]. Without this information being publicly available it is very hard to determine if TAs are providing a positive impact for researchers, libraries, and institutions or just providing extra profit for publishers. We do not believe we have enough data to suggest the IMU take a specific stance on whether or not TAs are a reasonable method for pushing OA publishing forward, but we do recommend that IMU advocate for price transparency be a condition for any transformative agreement undertaken.

#### III.2.4 Subscribe to Open

There is a growing move toward the Subscribe to Open (S2O) model among some non-profit mathematical publishers, with Mathematical Sciences Publishers, EDP Sciences, Société Mathématique de France, and EMS Press employing the model. In S2O a publisher sets a goal number of subscribers, and if they meet the goal, then the journal becomes fully open access without any APCs for authors. We feel that this model has great potential as it offers the potential for spreading out the costs for OA publishing more equitably among institutions. There are however potential pitfalls, such as administrative language that libraries work under not allowing them to pay any money for something that is “free”. The largest potential pitfall though is that of the free-rider problem, wherein some institutions will decide not to pay because enough others will for the journal will become open. This is not a guaranteed result though, and through some coordination between libraries and mathematics departments at different institutions it would be possible to avoid this issue.

#### III.2.5 Diamond Open Access

Diamond Open Access (Diamond OA) is the pinnacle of OA, publishing where it is free to publish and free to read. While we would love to see a world where Diamond OA was the go to model for publishing, we also recognize that it is the hardest model to pull off effectively as Diamond OA journals often have to be mission funded through a grant or run on a shoestring by volunteers. There are interesting cases where a publisher makes a Diamond OA journal themselves though, such as American Mathematics Society’s Communications of the American Mathematical Society, which was funded by a donation for this purpose. There are also opportunities for existing closed journals to flip to Diamond OA, such as the Arcadia and NSF funded MIT project [shift+OPEN](#) and the [MathOA](#) initiative.

Two of the most interesting recent Diamond OA projects in mathematics are the work of Centre Mersenne and Advances in Combinatorics. [Centre Mersenne](#) was launched in France in 2018, a complete public infrastructure for scientific publications published in Diamond Open Access, with a strong kernel in mathematics. Centre Mersenne is developed by Mathdoc, a French research unit supported by CNRS and the University of Grenoble. Centre Mersenne now hosts and produces more than 14 mathematics journals, two of them being flipped from Elsevier or Springer publishers. Centre Mersenne’s sustainability is possible thanks to strong support from the institutions and a modest contribution from the journals to cover the costs of recurrent production. Advances in Combinatorics is a Diamond OA journal started by Tim Gowers and Dan Král in partnership with the Queen’s University library [3]. The big innovation with this journal is the partnership with a library who provides the funds that are needed to host and manage the journal’s peer review system, for less than the cost of a normal journal subscription. In light of this exciting partnership we recommend the IMU convene a committee of mathematicians who are active within the editorial side of publishing and librarians to investigate potential future partnerships and collaborations which would further open access mathematical publishing.

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## A Appendix: Interview Questions

This appendix contains template questions for our written and in-person interviews of publishers. We used these as a general guide and made adjustments to tailor our interviews based on the nature of particular publishers and also based on how interview topics naturally evolved.

## A.1 Template for Written Interview Questions

Dear -----,

My name is ----- and I am writing on behalf of the International Mathematical Union Committee on Permissions. This committee has a mandate to survey how mathematical publishers are approaching access to publications and their range of potential future plans. It would be extremely valuable to understand the views of ----- on these issues because the outlook of your organization is highly relevant to the overall picture. This survey will help form the basis of recommendations to mathematical authors and institutions.

We were hoping you would be willing to take some time to answer the 6 questions listed below. We also will not name or quote you directly in any resulting reports without first asking for explicit permission to do so.

Also, if you are not the right person to get in contact with about this we are sorry and would be very grateful if you could point us in the right direction.

Question 1: From where do you draw your authors?

Question 2: What percentage of your publications are in the domain of mathematics, statistics, theoretical computer science?

Question 3: What are your rules for authors regarding the depositing of pre- and post-prints?

Question 4: What open access model(s), if any, are you currently using and are there any which are currently under consideration? (e.g., CreativeCommons, free to read, etc.)

Question 5: Have you considered opening up access to your publications after a certain amount of time has passed? If so, after how long? Why that length of time?

Question 6: What role do you believe scholars, mathematics departments, institutions, and libraries should play in open access?

With best regards,

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Member of the International Mathematical Union Committee on Permissions

## A.2 Template for In-Person Interview Questions



### Committee on Permissions Interview Topics

In a typical one-hour discussion, only some of these topics will be addressed, with the choice and depth of the topics depending on the particular interviewee.

#### I. **Mission**

What is the mission of your organization?

From where do you draw your authors? Your clients?

What is the relative volume of periodicals versus book series and monographs?

How long do you target to keep series volumes and monographs in print (or print-on-demand)?

What fraction of your publication is in the domain of mathematics, statistics, theoretical computer science?

#### II. **Rights Management**

What is your copyright model? (e.g., assignment, perpetual license, etc)

What are your pre- and post-print rules?

What rights can authors normally retain?

What additional rights can authors retain upon request?

### **III. Open Access**

#### **A. General Features**

What models have you considered for open access?

What open access model(s), if any, do you use? (e.g., Creative Commons, free to read, etc.)

Is there an additional cost to authors who publish as open access and, if so, how is this determined?

What kind of licenses are you ready to put on your open access content? (For instance, would you consider something like the Elsevier Open Archive Content, or allowing downloading of the full collection and dissemination of it elsewhere?)

Do your licenses allow for free reading or free reuse?

#### **B. Back Catalogs and Books**

Have you considered opening up your back catalogs? And if so, after how long? Why that length of time?

[Question for book publishers only] Do you have, or plan to have, a model for book open access?

#### **C. Special Situations**

Do you have any institutional open access agreements? (e.g., S20, Read and Publish, Transformative Agreements, etc.)

Given the inequity in funding and access across the world, what considerations have you built into your fees?

Do you have special (open access) publishing agreements with developing countries?

#### **D. Future Plans**

Do you have plans for expanding your open access offerings?

What kind of open access do you intend to emphasize? (e.g., diamond, gold with APC)

**IV. Access Mechanisms**

**A. Software**

What protocols (application programming interfaces) does your organization support for programmed access?

**B. Additional Services**

Do you provide/sell services based on your content? (e.g., text mining, institutional ranking, etc)

Do you provide catalog data for open access materials you publish?

**C. Long-term Access**

What approach does your organization take to long-term access?

- Physical safeguards? (e.g., replication, disaster recovery, war, etc, printing)
- Legal safeguards? (e.g., escrow, negative easements, trigger events, etc)

**V. Business Model and Institutional Roles**

What role do you believe scholars, mathematics departments, institutions, and libraries should play in open access?

How are the revenues of your publications used? Do different fields subsidize each other? Are publication profits retained or distributed?