EMS Press Criteria for Sustainable Open Access with Subscribe to Open (2024)

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1 Introduction

In 2021, EMS Press started publishing journals with *Subscribe to Open* (S2O) as its new business model for fair and sustainable Open Access. Under this model, libraries continue to subscribe to journals for the coming year as they always have and are guaranteed to have access to those journals, including the entire archive and online-first articles. The key difference to the traditional subscription model is that if a journal has enough subscribers to publish the title sustainably for a subscription year, then all articles in issues published in that subscription year become Open Access.

In this document, we explain the methodology used by EMS Press to decide which journals are published Open Access. The presented method is an advanced version of the one used in 2023[1] and has been used for the 2024 round which resulted in all 22 S2O journals becoming Open Access in 2024. Future S2O rounds may use a further updated method or adjusted parameters and we are committed to publishing amended criteria in the future if we make significant changes.

EMS Press chose S2O to make its new Open Access program sustainable and fair – and unsurprisingly those are the two key factors in the method:

- Sustainability: a publisher needs to cover its costs for the publication of a journal and leave some room for growth, e.g., for establishing new journals or handling increased submissions. The costs depend on a variety of factors, including the number of articles, number of pages, typesetting, copy-editing, print copies, shipping, editorial staff, internal processes, technology, archiving, overheads and many more.
- Fairness: the biggest benefit of S2O with respect to fairness is that there are no author fees. However, we also aim for fairness in the Open Access decision by basing the thresholds on the cost forecasts for the upcoming year and not just on revenues in previous years.

For a publisher that only offers subscriptions to individual journals the criterion can be kept simple: if a journal's revenue covers its forecast costs and

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[1] `https://ems.press/updates/2022-02-22-s2o-threshold-formulation`

a growth contribution for the subscription year, then that journal is published Open Access. A challenge we faced is that EMS Press also offers journal packages containing several journals. At EMS Press, almost no journal covers its costs only from individual subscriptions so the package revenues are crucial. However, there is no standard way to distribute the packages revenue to individual journals. A crude criterion would be to only look at the total costs and the total revenues for all journals and then publish either all or none Open Access. This has obvious drawbacks contradicting our fairness goal because some journals may actually generate enough revenue. It may also lead to unintended unfairness if the journal portfolio has traditional subscription journals alongside S2O journals. We are taking a more granular approach with a built-in and controllable "solidarity" optimisation among journals that yields per-journal results.

The original method we used in 2023 was able to handle a journals package that contains all journals. However, we are now offering packages with a smaller selection of journals (e.g., *EMS Essentials Package*) and we want this revenue to be distributed to the contained journals in a fair way. The method we present in this article supports such "flexible" packages.

2 Optimal Package Revenue Distribution

The basic idea of our model is to split the package revenue $r_i^{(p)}$ of package $i \in N_P := \{1, \ldots, n_P\}$ into contributions for each journal $j \in N_J := \{1, \ldots, n_J\}$ into three parts:

1. a regular contribution $a_{ij}^{(r)} \geq 0$ that is distributed across the journals in package i according to predefined weights ω_j (e.g., by individual package revenue, by publication output, or by subscribed pages),
2. an "internal solidarity" contribution $a_{ij}^{(s)} \geq 0$ that is used to fill a potential financial shortfall of a journal in package i and
3. an "external solidarity" contribution $a_{ij}^{(e)} \geq 0$ that is used to fill a potential financial shortfall of a journal that is not included in package i.

If we define the package structure via

$$q_{ij} = \begin{cases} 1 & \text{if journal } j \text{ is contained in package } i \text{ and} \\ 0 & \text{otherwise} \end{cases}$$

then the contributions from the i-th package fulfill

$$\sum_{j \in N_J} \left[q_{ij} \left(a_{ij}^{(r)} + a_{ij}^{(s)} \right) + (1 - q_{ij}) a_{ij}^{(e)} \right] = r_i^{(p)}$$

$$\text{and} \quad \sum_{j \in N_J} \left[(1 - q_{ij}) \left(a_{ij}^{(r)} + a_{ij}^{(s)} \right) + q_{ij} a_{ij}^{(e)} \right] = 0.$$

The former equation defines the basic splitting of the revenue where a journal j can either receive a regular contribution and an internal solidarity contribution if it is contained in package i or receive an external solidarity contribution if it is not contained in package i. The latter equation sets uninvolved contributions to zero (note that the contributions are non-negative). The combined revenue attributed to journal j is then given by

$$\overline{r}_j = r_j + \overline{a}_j^{(r)} + \overline{a}_j^{(s)} + \overline{a}_j^{(e)}$$

where r_j is the revenue from individual subscriptions of journal j and

$$\overline{a}_j^{(r)} = \sum_{i \in N_P} a_{ij}^{(r)}, \quad \overline{a}_j^{(s)} = \sum_{i \in N_P} a_{ij}^{(s)}, \quad \text{and} \quad \overline{a}_j^{(e)} = \sum_{i \in N_P} a_{ij}^{(e)}.$$

For the contributions $a_{ij}^{(r)}$, $a_{ij}^{(s)}$ and $a_{ij}^{(e)}$ we want to apply the following principles:

1. *Solidarity zero net profitability:* The solidarity contributions $a_{ij}^{(s)}$ and $a_{ij}^{(e)}$ should be used to fill a potential shortfall between journal j's costs c_j and revenues r_j to ideally achieve a zero net profitability, i.e., $\overline{r}_j = c_j$ for a journal with $r_j \leq c_j$.
2. *Solidarity fund minimality:* The solidarity contributions $a_{ij}^{(s)}$ and $a_{ij}^{(e)}$ should be minimal. As much revenue $r_i^{(p)}$ as possible should be applied through the regular contributions $a_{ij}^{(r)}$ and only the gaps are filled via $a_{ij}^{(s)}$ or $a_{ij}^{(e)}$ where necessary.
3. *Internal solidarity priority:* the revenue from package i should first be used to fill potential shortfalls for the journals in that package.
4. *Solidarity fund limits:* We want to be able to limit how big the entire solidarity fund can grow, i.e., $\sum_{j \in N_J} \left(\overline{a}_j^{(s)} + \overline{a}_j^{(e)} \right) \leq \alpha \sum_{i \in N_P} r_i^{(p)}$ with $0 \leq \alpha \leq 1$. Similarly, we want to limit the solidarity contributions for each journal $j \in N_J$, i.e., $\overline{a}_j^{(s)} + \overline{a}_j^{(e)} \leq \beta_j \sum_{i \in N_P} r_i^{(p)}$ with $0 \leq \beta_j \leq 1$.
5. *Respect journal weights:* the regular contributions should respect predefined weights $\omega_j \geq 0$ for $j \in N_J$, i.e., for each $i \in N_P$, $a_{ij}^{(r)} = \omega_j z_i q_{ij} r_i^{(p)}$ holds for all $j \in N_J$ and some $z_i \geq 0$.

With the notation

$$A^{(r)} = \left[a_{ij}^{(r)} \right]_{\substack{i \in N_P \\ j \in N_J}}, \qquad A^{(s)} = \left[a_{ij}^{(s)} \right]_{\substack{i \in N_P \\ j \in N_J}}, \qquad A^{(e)} = \left[a_{ij}^{(e)} \right]_{\substack{i \in N_P \\ j \in N_J}},$$

$$Q = \left[q_{ij} \right]_{\substack{i \in N_P \\ j \in N_J}}, \qquad r = \begin{bmatrix} r_1 \\ \vdots \\ r_{n_J} \end{bmatrix}, \qquad r^{(p)} = \begin{bmatrix} r_1^{(p)} \\ \vdots \\ r_{n_P}^{(p)} \end{bmatrix},$$

$$c = \begin{bmatrix} c_1 \\ \vdots \\ c_{n_J} \end{bmatrix}, \qquad \beta = \begin{bmatrix} \beta_1 \\ \vdots \\ \beta_{n_J} \end{bmatrix}, \quad \text{and} \qquad \omega = \begin{bmatrix} \omega_1 \\ \vdots \\ \omega_{n_J} \end{bmatrix},$$

we can define for $i \in N_P$

$$E_i := e_i^T Q \otimes e_i^T \in \mathbb{R}^{1 \times n_P n_J} \quad \text{and} \quad \overline{E}_i := (1_{n_J}^T - e_i^T Q) \otimes e_i^T \in \mathbb{R}^{1 \times n_P n_J}$$

where $e_i \in \mathbb{R}^{n_p}$ is the i-th unit vector, $1_{n_J} \in \mathbb{R}^{n_J}$ is a vector of ones and $\otimes$ is the Kronecker product. We furthermore define for $j \in N_J$:

$$F_j := e_j^T \otimes 1_{n_P}^T.$$

For improving the readability, we occasionally drop the dimension from the vector notation in the following if it is clear from the structure. To eventually arrive at a standard formulation, we introduce vectorised (stacked columns) variables $a^{(r)} = \operatorname{vec}\left(A^{(r)}\right), a^{(s)} = \operatorname{vec}\left(A^{(s)}\right), a^{(e)} = \operatorname{vec}\left(A^{(e)}\right) \in \mathbb{R}^{n_J n_P}$.

Then the above principles can be translated to the following optimisation problem:

$$\begin{aligned}
\text{minimize} \quad & \sum_{j \in N_J} \left(\overline{a}_j^{(s)} + 2\overline{a}_j^{(e)} + 4 \max \left\{ 0, c_j - \left(r_j + \overline{a}_j^{(r)} + \overline{a}_j^{(s)} + \overline{a}_j^{(e)} \right) \right\} \right) \\
\text{subject to} \quad & \begin{bmatrix} a^{(r)} \\ a^{(s)} \\ a^{(e)} \\ z \end{bmatrix} \geq 0, \\
& \begin{bmatrix} E_i & E_i & \overline{E}_i \end{bmatrix} \begin{bmatrix} a^{(r)} \\ a^{(s)} \\ a^{(e)} \end{bmatrix} = r_i^{(p)} \text{ for } i \in N_P, \\
& \begin{bmatrix} \overline{E}_i & \overline{E}_i & E_i \end{bmatrix} \begin{bmatrix} a^{(r)} \\ a^{(s)} \\ a^{(e)} \end{bmatrix} = 0 \text{ for } i \in N_P, \\
& \begin{bmatrix} 1 & 1 \end{bmatrix} \begin{bmatrix} a^{(s)} \\ a^{(e)} \end{bmatrix} \leq \alpha 1_{n_P}^T r^{(p)}, \\
& \begin{bmatrix} F_j & F_j \end{bmatrix} \begin{bmatrix} a^{(s)} \\ a^{(e)} \end{bmatrix} \leq \beta_j 1_{n_P}^T r^{(p)} \text{ for } j \in N_J, \\
& \begin{bmatrix} I_{n_J n_P} & -\operatorname{diag}(q) \left(\omega \otimes \operatorname{diag}\left(r^{(p)} \right) \right) \end{bmatrix} \begin{bmatrix} a^{(r)} \\ z \end{bmatrix} = 0 \text{ for } i \in N_P.
\end{aligned}$$

By introducing new optimisation variables $y = [y_1, \ldots, y_{n_J}]^\top \geq 0$ we can replace the maximum in the objective function with y and introduce new conditions that bounds the loss of each journal $j \in N_J$:

$$\begin{aligned}
& c_j - \left(r_j + \overline{a}_j^{(r)} + \overline{a}_j^{(s)} + \overline{a}_j^{(e)} \right) \leq y_j \\
\iff \quad & -\overline{a}_j^{(r)} - \overline{a}_j^{(s)} - \overline{a}_j^{(e)} - y_j \leq r_j - c_j.
\end{aligned}$$

Collecting all optimisation variables in

$$x = \begin{bmatrix} a^{(r)} \\ a^{(s)} \\ a^{(e)} \\ y \\ z \end{bmatrix}$$

results in the following standard linear optimisation program in block matrix notation:

$$
\begin{aligned}
\text{minimize} \quad & \begin{bmatrix} 0 & 1 & 2 & 4 & 0 \end{bmatrix} x \\
\text{subject to} \quad & x \geq 0, \\
& \begin{bmatrix} 0 & 1 & 1 & 0 & 0 \\ 0 & F & F & 0 & 0 \\ -F & -F & -F & -I_{n_J} & 0 \end{bmatrix} x \leq \begin{bmatrix} (1_{n_P}^T r^{(p)})\alpha \\ (1_{n_P}^T r^{(p)})\beta \\ r - c \end{bmatrix}, \\
& \begin{bmatrix} E & E & \overline{E} & 0 & 0 \\ \overline{E} & \overline{E} & E & 0 & 0 \\ I & 0 & 0 & 0 & G \end{bmatrix} x = \begin{bmatrix} r^{(p)} \\ 0 \\ 0 \end{bmatrix}
\end{aligned}
$$

where

$$
E := \begin{bmatrix} E_1 \\ \vdots \\ E_{n_P} \end{bmatrix}, \quad F := \begin{bmatrix} F_1 \\ \vdots \\ F_{n_J} \end{bmatrix}, \quad \text{and} \quad G := -\operatorname{diag}(q)\Big(\omega \otimes \operatorname{diag}\left(r^{(p)}\right)\Big).
$$

This problem can now be solved with any linear optimisation tool. We use the Python implementation in SciPy (`scipy.optimize.linprog`).

3 2024 Results

For the 2024 S2O round, we used the weights $\omega_j = \sqrt{p_j s_j}$ where p_j is the number of pages that will be published during the subscription year and s_j is the number of subscribers for journal j including all subscribers through packages. The weight ω_j is thus the square root of the subscribed pages and can be seen as a proxy measure for "interest" in the journal. Our solidarity fund limit was set at $\alpha = 0.5$, i.e., the fund can grow up to half of the total package revenue. The individual journal limits were set at $\beta_j = 0.2$, i.e., each journal can receive up to 20% of the total package revenue.

In 2024, EMS Press offered 22 journals with the S2O model, all of which reached the sustainability criterion. The criterion is that the overall attributed revenue $\overline{r}_j$ for a journal $j \in N_J$ covers its cots c_j, i.e., $\overline{r}_j \geq c_j$. Overall, 18 of the S2O journals received internal solidarity contributions, with 13 journals receiving a small contribution (less than 3% of the total package revenue) and the remaining 5 receiving a modest contribution (3–6% of the solidarity fund). In total, the solidarity fund for the S2O journals made up 44% of the total journal package revenue. The remaining package revenue was attributed to the journals according to the weights ω_j for $j \in N_J$. No external solidarity contributions were necessary.

The prescribed solidarity fund limits were not exhausted and we consider the 2024 S2O round a resounding success with healthy solidarity fund contributions. Ideally, the solidarity fund would not be necessary because each journal has enough revenue to cover its costs and leave some room for growth and new developments. However, this ideal condition often cannot be attained due to unforeseeable fluctuations of costs or revenues and the solidarity fund distributes our journal package revenues to where they are needed. We are aiming to reduce the dependency on the solidarity fund by increasing and stabilising revenues and the method described in this article allows us to

1. publish as many S2O journals Open Access as possible,
2. identify journals that need attention, and
3. control the distribution of revenues to operate sustainably.

In addition to the above, any remaining surplus revenues in the publishing house are used for future developments, e.g. supporting new and existing journals and ongoing technology development, and supporting the mission of the European Mathematical Society.

The method described in this article has served us well in the 2024 S2O round and it will be improved continuously in the next S2O rounds. We will publish further updates on how we make Open Access work sustainably and fair at EMS Press on our *Updates* blog[2].

[2] `https://ems.press/updates`