Publishing project: a series of math problem books with separate progressive solutions, compiled from collective contributions

THE GOAL AND DESCRIPTION OF THE PROJECT

INFAROM Publishing is initiating the publication of a series of math problem books for medium through advanced level, in a new format: each problem book specializes in a certain mathematical subdomain and contains four main sections: statements of the problems, solving hints, solving algorithms, and the complete solutions. This structure is more helpful for the solvers, who can work through several intermediary stages to reach the configuration of the complete solution. This approach has a positive effect on the development of intuition, analysis, and deduction skills.

The problems will be presented in increasing order of difficulty and will come from various sources, especially from mathematical publications of the 1970s and 1980s, as well as current prestigious journals. Original problems of the authors will be also included.

This editorial project is addressed to undergraduate and graduate students of mathematics institutions, as well as instructors, who can become authors/co-authors of problem books by collecting and editing the problems, according to publisher's guidelines. The purpose of co-opting these contributors is both professional and financial: professional, by assuring them an author's portfolio in their field of expertise, and financial, the authors having the opportunity to earn commissions from sales and to distribute their own books locally or on the internet, under their own terms.

The problem books will be published in English and distributed worldwide. INFAROM plans to publish such a problem book once at three months.

ELIGIBILITY

Who can apply for this project:
- undergraduate students of a mathematics college or university department of mathematics, minimum in the second year of study;
- graduates of a mathematics college or university department of mathematics.
We expect to apply:
- students aiming to build their own publishing portfolio for the future professional contests,
- secondary school, high school and college math teachers who want to create and distribute didactic material and generally any math lover who want to become an author of a problem book.

Applicants should have a good command of the editing program MS Word and of the integrated application Equation Editor or MathType, of written English; they should also be experienced in reading/editing math text in English.

Individuals may apply by completing and sending the online application form found at www.infarom.com/problem_books.html . After submitting the application form, applicants must e-mail us a scanned copy of an id, official statement, or diploma supporting the data provided with regard to the school institution.

THE STRUCTURE OF A PROBLEM BOOK

Each problem book will hold about 100 – 120 solved problems, collected by 1 – 4 authors and will have about 120 – 200 pages with physical dimensions of 6 x 9 inches. One author will collect and edit a minimum of 40 problems.

One title will be dedicated to a single mathematical sub-domain and the problems will have progressive difficulty levels, starting from medium level.

Each problem book will contain four sections: (1) the statements of all problems, (2) the solving hints for each problem (keywords, references and short observations which suggest to the solver indirectly the correct way to the final solution), (3) the solving algorithms (the chronological list of the steps for the solver to execute – procedures, theorems and formulas to be applied, and so on – without detailing them, in order to solve the problem completely), and (4) the complete solutions of all problems. Thus, the solver who faces difficulties in solving a problem can pass progressively through several rounds of indications and guidance, having at all times the opportunity to finalize the solution by himself or herself.

BENEFITS FOR AUTHORS

- Authors of the problem books may add the title to which they contribute to their own publishing portfolio. In that sense, the publisher provides them with an author certificate. The books following to be translated and publish in other foreign languages will mention the name of the authors of the original edition on their cover and also in their copyright page.
- Because INFAROM titles use the Ingram POD global distribution system, the exposure of the author's name on the internet is significant.
- Students authoring mathematical publications are eligible for a free membership in SIAM (Society for Industrial and Applied Mathematics), receiving the benefits of full members (see www.siam.org). INFAROM Publishing, through its active membership in SIAM, can propose two students per year for free membership, from the participants of the project of publishing problem books.
- Each author receives 1 – 3 free copies of the problem book to which he or she contributed.
- Authors have the opportunity at any time to order an unlimited number of copies at production cost (printing and shipping), with no additional cost, for distribution under their own management. The books can be distributed on the local market or on the web with no restrictions or obligations to the publisher.
- Authors who choose *plan A* of collaboration benefit by commissions of 4% of the list price coming from the distribution of the books; authors who choose *plan B* of collaboration (with 20% financial participation) benefit by commissions of 8% of the list price; the problem editors (those choosing *plan C* of collaboration) benefit by commissions of 2% of the list price (see the section below titled *Collaboration Terms and Conditions*).
- For plans A and B of collaboration, for the ebook version of each problem book, authors benefit by commissions of 8% of the list price.
- Authors also have the possibility of becoming, in time, a permanent consultant/editor of our publishing house in a certain sub-domain.

WORKING MODE AND DEADLINES

As the authors send problems, these problems are analyzed and distributed in domains and sub-domains. When an author has submitted 40 problems in the same sub-domain, the author has earned himself or herself a position of co-author of the respective problem book. When the problem book is completed with another 80 problems coming from other authors, the book is edited and published in about three weeks.

One author can also submit more than 40 problems for a problem book, up to its entire content, which assures himself or herself the title of unique author.

The acceptance of the problems implies submission to the criteria imposed by the editing rules. Such acceptance also avoids the double submission: a problem that has already been submitted by another author will be rejected.

To expedite publication, it is recommended that an author form his or her own team with one or two other colleagues, for working on the same problem book, using the same sources. In this way, the possibility of a double submission is minimized.

The recommended period for collecting, editing, and submission of the 40 problems by an author is 2 – 4 weeks from the acceptance in the project. Any additional delay increases the risk that collected problems may already have been submitted by other authors.

If one of the co-authors working on a team does not meet the agreed submission deadline, the problem book may be completed with the contribution of another author who is not part of the team, in order to expedite publication of the book.

COLLABORATION TERMS AND CONDITIONS

Applicants who have been accepted in the project can choose one of two collaboration plans described below:

Plan A assumes the content contribution from the authors of a problem book, without any financial participation, the publisher assuming all publication costs. The authors receive royalties of 4% of the list price coming from the distribution of the books and 8% of the list price coming from the distribution of the electronic edition (ebook). Each author receives a free copy of the printed book.

Plan B assumes the content contribution from the authors, as well as a financial contribution of 20% of the total publication costs (correction, editing, design, POD title setup, digital catalog, printing mould and initial promotional campaign). The authors receive royalties of 8% of the list price from the printed book distribution and 8% of the list price from the ebook distribution.
The total cost of publication depends on each title in part and on the technical elements of the book – about 900 euros for a 150-page book in 6 x 9 inch format. The authors' contribution of 20% of 900 euros comes to 180 euros; this amount may be split between co-authors who contributed to the respective problem book. The authors' royalties from book distribution is also split between co-authors. Each author receives three free copies of the printed book.

Plan C is for the authors who want just to edit the problems and their complete solutions (this activity consists of taking the problems from the source publications, checking them and editing them in MS Word), without extracting and editing the sections of hints and algorithms that are specific to the current project. The collecting sources can be on author's will or pointed by the publisher (by mentioning the respective publications or sending scanned images with their content). The editors receive royalties of 2% of the list price coming from the distribution of the printed books and a free copy of the printed book. The editors keep their co-author status, including the exposure of their name on the cover and in the copyright page.

All plans A, B and C assume the right of the authors to place direct orders at any time at the production cost of the books (printing and shipping) and to distribute them under their own management, at any retail price and on any market. The direct orders are unlimited (from a single copy to any number).

Authors can participate in the publication of a problem book either alone or in a team with other co-authors who have chosen the same plan of collaboration.

An author may submit the material for a problem book only in English.

Authors will sign a contract with the publisher similar to the one currently used by the regular INFAROM authors.

Briefly, the basic features of the three collaboration plans are the following:

Plan A	Plan B	Plan C
no financial participation	20% financial participation	no financial participation
author royalties of 4% for printed books	author royalties of 8% for printed books	author royalties of 2% for printed books
direct orders at production cost	direct orders at production cost	direct orders at production cost
author royalties of 8% for ebooks	author royalties of 8% for ebooks	no royalties for ebooks
one free copy for each author	three free copies for each author	one free copy for each author

COLLECTING GUIDELINES

The collecting sources include the following: mathematical books and journals, courses, and manuals published between 1960 and 2000, which contain solved problems with complete solutions.

Original problems are welcome, if they submit to the general publication guidelines presented in this material.

Problems can be in the same sub-domain or in different sub-domains, but the first variant is recommended, for hastening the publication. The problems should be of a medium or advanced level of difficulty, with as homogeneous as possible distribution within the submitted lot.

A maximum of 5 problems from one issue of a journal or magazine, and 10 problems from one book may be submitted for one problem book.

Each complete solution of a problem should cover between half a page and one full page of A4 format.

Exercises, trivial problems, direct applications of some statements, theorems, or known theoretical results are not accepted. The problems must imply an intuitive and deductive challenge for the solver.

Problems must be addressed to high school and college students and must be based on the theoretical knowledge achieved in high school and the first two years of study in a mathematics or technical college or university.

Olympiad problems should be submitted only for the corresponding domain (Olympiad problems - OLY).

EDITING GUIDELINES

Each submission will consist of a document edited in MS Word, with the integrated application Equation Editor or MathType. Insertions of scanned images are not accepted. All formulas, expressions, plots and other graphics should be created with MS Word tools. Figures imported from other applications of graphical editing are accepted.

For figures consisting of several graphical elements, grouping them into one object is recommended: *select objects – group*.

Do not use the option *Numbering* or *Bullets* for paragraphs, even in autoformat mode.
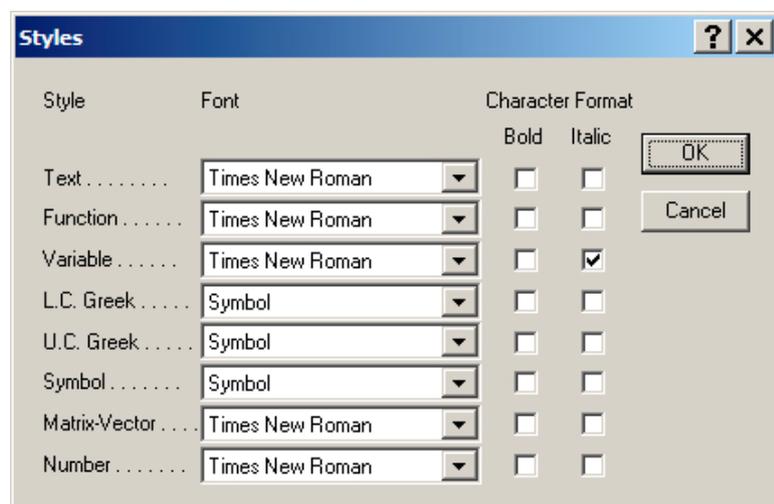
The basic settings of text editing in MS Word are the following:
- fonts: Times New Roman, normal, size 12, black;
- tab: 0.3 in
- page size: 6 x 9 in
- margins: 0.7 in at left, right, top and bottom
The settings for Equation Editor are the following:
- spacing and sizes: defaults
- *math* and *text* styles :

The format of the content of the document for an edited problem is as follows:

<u>Title</u> (in bold), containing the data: author code (to be assigned after acceptance of the application), mathematical domain code, problem number (referring to the chronology of the submissions).
Example:
1295, RAS, 025

Two blank lines.

<u>Statement</u> of the problem.

One blank line.

<u>Source</u>: identification data of the publication from where the problem comes – author(s), title of publication (in italics), number, volume (for journals and magazines), ISBN (ISSN) if available, publisher, year. An original and unpublished problem should be documented using only the author's name. Should be written with fonts of size 10. Example:
J. M. Stern. *Challenging problems in Discrete Mathematics*. Elmer Publishing, New York, USA, 1973

Two blank lines (of size 12).

<u>Hints</u>: enumerate a few keywords, a short framing of the problem in a specific pattern or ensemble of conditions that lead to a certain known theoretical result, important observations that might suggest the way of solving, and so on, without go deeper into the details. Length: 1–3 lines. Example:
$x = 1$ is a solution; sum of strictly increasing functions; injectivity.

Two blank lines.

<u>Solving algorithm</u>: underline the steps to be executed for solving, in chronological order – observations, procedures, theorems and formulas to be applied, calculations, calculus tricks, and so on. The steps are written one under another, without detailing them, but with direct reference to the elements of the respective problem.
Example:
Put the equation in a linear form.
Divide both sides to the power having the maximal base.
Write the left-hand side as a sum of similar exponential functions.
Check that $x = 1$ is a solution.
Show that the functions are strictly decreasing.
Show the injectivity using the fact that the sum of several strictly decreasing functions is still a strictly decreasing function.

Two blank lines.

<u>Complete solution</u>: Should be edited to occupy half a page to a maximum of one page. For special problems, solutions that exceed one page may be accepted. The solutions must be complete, without omissions that might interrupt the deductive flow, but must not be too detailed either, by containing trivial explanations – the problem books address solvers of medium and advanced level. The theorems, statements, and all theoretical results to which the text makes reference should be mentioned by their exact name or through description and not through references to other texts (authors must not use the type of phrasing: "according to a statement that was proven in the article/manual/solution of the problem…," and so on).

Two blank lines.

The next problem.

At the end of this material you will find a complete example of edited problem.

THE MATHEMATICAL DOMAINS AND SUB-DOMAINS

At this time, the collected problems should belong to the following sub-domains of mathematics:

Mathematical Analysis
    Real Analysis – sequences, series (internal code: RAS)
    Real Analysis – continuous functions (internal code: RAC)
    Real Analysis – derivable functions (internal code: RAD)
    Real Analysis – integrals (internal code: RAI)
    Inequalities (internal code: INE) – category of problem book, which may include problems from other sub-domains
    Theory of Measure and Integral (internal code: TMI)
    Complex Analysis (internal code: CVA)
    Multidimensional Analysis (internal code: MDA)
    Topology – Topologic, Metric, Vectorial Normed Spaces (internal code: TOP)
Number Theory (internal code: NUM)
Algebra
    Algebra II (sets, integer numbers, divisibility, equations, polynomials, etc. – based on matter of high-school and first two years of college) (internal code: AL1)
    Combinatorics (internal code: COM)
    Algebraic Structures – Groups, Vectorial Spaces, Rings and Fields (internal code: ALS)
    Linear Algebra – Equation Systems, Matrixes and Determinants (internal code: LIN)
Probabilities and Statistics
    Probabilities (internal code: PRO)
Discrete Mathematics (internal code: DIS)
Applied Mathematics (internal code: APL)
Challenging Problems (with high level of difficulty) (internal code: CHP)
Olympiad Problems (internal code: OLY)

    The domains shown in green have priority with respect to publishing.

Example:

1283, RAS, 015

Prove that if (a_n) is a sequence of positive numbers with $\sum\limits_{n=1}^{\infty} a_n < \infty$, then for all p in (0, 1)

$$\lim_{n\to\infty} n^{1-\frac{1}{p}}\left(a_1^p + ... + a_n^p\right)^{\frac{1}{p}} = 0$$

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Hints:
If $x_n \to 0$, then $x_n^a \to 0$ for all $a > 1$; the Hölder inequality

Solving algorithm:
Write the general term as $(x_n)^{\frac{1}{p}}$. Show that $x_n \to 0$:
For a given $\varepsilon > 0$, choose $N(\varepsilon)$ and prove the inequality $x_n < \varepsilon$ for any $n \geq N(\varepsilon)$:
Split x_n in two sums (one with indexes from 1 to N and the other from $N+1$ to n).
For the latter sum, apply the Hölder inequality.

Solution:

Define (x_n) by $x_n = \left(\dfrac{1}{n}\right)^{1-p}\left(a_1^p + ... + a_n^p\right)$. Since

$$n^{1-\frac{1}{p}}\left(a_1^p + ... + a_n^p\right)^{\frac{1}{p}} = \left[\left(\frac{1}{n}\right)^{1-p}\left(a_1^p + ... + a_n^p\right)\right]^{\frac{1}{p}} = (x_n)^{\frac{1}{p}},$$

it suffices to show that $x_n \to 0$. The Hölder inequality will be applied as follows:

$$\sum_k \left(\frac{1}{n}\right)^{1-p} a_k^p \leq \left(\sum_k \frac{1}{n}\right)^{1-p}\left(\sum_k a_k\right)^p.$$

Given any $\varepsilon > 0$, choose N such that $\sum\limits_{n=N}^{\infty} a_n < \left(\dfrac{\varepsilon}{2}\right)^{\frac{1}{p}}$.

For any n larger than both N and $\left[\left(a_1^p + ... + a_N^p\right)\cdot\dfrac{2}{\varepsilon}\right]^{\frac{1}{1-p}}$, we have

$$x_n = \left(\frac{1}{n}\right)^{1-p}\left(a_1^p + ... + a_N^p\right) + \left(\frac{1}{n}\right)^{1-p}\sum_{k=N+1}^{n} a_k^p < \frac{\varepsilon}{2} + \left(\sum_{k=N+1}^{n}\frac{1}{n}\right)^{1-p}\left(\sum_{k=N+1}^{n} a_k\right)^p =$$

$$= \frac{\varepsilon}{2} + \left(\frac{n-N}{n}\right)^{1-p}\left(\sum_{k=N+1}^{n} a_k\right)^p < \frac{\varepsilon}{2} + \frac{\varepsilon}{2} = \varepsilon.$$