

## Preface

Since more than 30 years, I taught several courses of basic mathematics for beginners at the university. This concerns students of engineering sciences, students of natural sciences and students of economical sciences. In particular, since almost 20 years I taught a course ‘Mathematics of Economics and Management’ at the Otto-von-Guericke University Magdeburg. The latter class included all relevant subjects from calculus and algebra. Roughly 10 years ago, I jointly with my co-author Yuri Sotskov from Minsk wrote a book ‘Mathematics of Economics and Business’ following exactly the structure of this lecture. This book appeared 2006 at Routledge, and I used it as the first item on my reading list for this class. However, this book explicitly includes only some refreshments from school in a short form in Chapter 4, namely how to work with real numbers. The foundations of calculus discussed in this book are, of course, also already a subject of school education in the upper classes so that there is a larger overlapping with mathematical subjects from secondary school education.

I noticed that at the beginning of their study, the majority of students has some partial knowledge about the basic mathematical subjects from school, but not at the required extent. It seems so that this tendency is even increasing currently. In any case, one can observe that beginners of a university study enormously range in their mathematical skills and aptitudes. I know that for many beginners at the university, mathematical subjects appear to be rather difficult. However, if these gaps are not filled at the beginning of the study, this will definitively cause subsequent difficulties in other courses. Without any doubt, nowadays a solid mathematical knowledge is the base for most (almost all) study courses.

So, I felt that there is a need to present some necessary foundations from the mathematical education at school in more detail and also some additional supplementary material, where I wish that university beginners are familiar with. When writing this booklet, I also used the experience collected in several classes of extra-occupational study courses, among them also a bridge course, which refreshes the main subjects from mathematics in school. Typically, the latter students have even more difficulties with mathematical subjects because their school education finished already some years ago. Summarizing, I found that there is a need to write such a booklet from my personal point of view, using the experience collected over the past decades. The goal was roughly not to exceed 250 pages.

Sure, the content of the mathematical education in secondary school varies from country to country a bit. So, I tried to cover a broad range of subjects which might be useful for a university study from an overall point of view. The booklet consists of 12 chapters. Chapters 1 - 2 discuss some basics: some mathematical foundations as well as real numbers and arithmetic operations. Chapters 3 - 5 deal with equations and inequalities. Chapter 6 surveys some basics from analytic geometry in the plane. This is nowadays not so intensively taught as at the time when I attended school, but nevertheless it addresses some useful subjects. Chapters 7 - 10 treat classical subjects from calculus. Chapter 11 presents some aspects of vectors. Chapter 12 discusses some foundations from combinatorics, probability theory and statistics.

I tried to write the chapters as independent as possible. So, it is not necessary to read all chapters beginning from the first one. Instead, the student can go immediately to a par-

ticular subject. Sure, the chapters are not completely independent since in mathematics, there are often specific relationships between different subjects. Nevertheless, there is no necessity to study the chapters systematically one by one in the given sequence for the understanding of the book. Moreover, since it is an repetition and summary of elementary material of mathematics, I avoided the formal use of theorems and definitions. Instead of, the major notions are shaded in grey and in addition, important formulas and properties are given in boxes.

Each chapter gives the learning objectives at the beginning. Moreover, every chapter finishes with a number of exercises. The solutions to the exercises (i.e., the concrete results) are given on my homepage so that the reader can verify whether to be able or not to solve typical problems from a particular topic. They can be downloaded as a pdf file under:

<http://www.math.uni-magdeburg.de/~werner/solutions-refresher-course.pdf>

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I hope that this small booklet will help the students to overcome their initial difficulties when studying the required mathematical foundations at the university. Typically, the first term at the university is the hardest one due to many changes compared with secondary school. I want to finish this preface with a hint: Long time ago, I was told that learning mathematics is somehow like learning swimming. Nobody learns it by looking how other people do it! One does not learn mathematics by exclusively listening to the lecturer or tutor and copying notes from the blackboard or slides. *Only own practice contributes to a significant progress.* The time necessary for getting a sufficient progress varies for the individual students significantly, so everybody has to find this out by solving a sufficient number of exercises. So, students in their first year at the university should not be afraid of mathematics but should take into account that some (or even a lot of) time is needed to get a sufficiently wide experience in applying mathematical tools.

The author is also grateful for all hints that improve further the content and the presentation of this edition. All suggestions should be addressed preferably to the email address given below. It is my pleasure to thank the publisher Bookboon for the delightful cooperation during the preparation of this booklet.

Frank Werner  
Otto-von-Guericke-University Magdeburg  
Faculty of Mathematics  
PSF 4120  
39016 Magdeburg / Germany  
Internet: <http://www.math.uni-magdeburg.de/~werner>  
email: [frank.werner@ovgu.de](mailto:frank.werner@ovgu.de)

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