MATLAB for Behavioral Scientists: A novice's guide to MATLAB

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"MATLAB for Behavioral Scientists" (MBS) is certainly a useful addition to the field. Dr. Rosenbaum has done an admirable job of explaining the MATLAB language in terms that anyone should be able to understand. Indeed, "low-threshold" is a choice word to summarise this book. It is very general, and *very* basic.

Accessibility is key for MBS to achieve what is clearly its main goal: to allow students in the behavioral sciences to learn MATLAB. We believe this book makes that a realistic prospect: it explicitly and clearly requires no previous background in programming.

In the first of the fourteen chapters in MBS (*Introduction*), the author gently introduces the reader to the basics of programming—carefully beginning by explaining that it can be a humbling experience, and that an important place to start any programming job is wondering whether it will be worth the effort.

The second chapter, *Interacting with MATLAB*, teaches the user to use MATLAB's Command Window, to use the Editor to create, edit, save, and run simple scripts, and to interrupt programs running amock.

Chapter three begins to speak to the specifics of MATLAB. In *Matrices*, we learn to create, concatenate, transpose, and delete matrices. Some of MATLAB's useful shorthand methods are demonstrated.

In Chapter four, *Calculations*, mathematical operations both simple and advanced are introduced. Adding, raising to a power, and taking logarithms open the Chapter. Generating random numbers and magic squares closes it. In between, the author demonstrates the computation of medians, variances, and correlations. Though mentioned in the table of contents, least-squares fitting is left for a later Chapter.

Chapter five, titled *Contingencies*, is the chapter on flow control statements; the obligatory introduction to vectorisation of logical (here dubbed 'If-ing instantly') and other operations is included.

The sixth chapter, *Input–Output*, focuses on input and output. The author's claim that he writes from a practitioner's point of view rings true in the first paragraph, which is titled 'Copying and Pasting Data by Hand'. Detailed paragraphs on file I/O, recording user responses and response times (with the appropriate warnings and references to specialised toolboxes), and on printing formatted output to the screen make this one of the most useful and informative chapters in the book. The author did make the unfortunate decision to recommend using the `eval` function for generating numbered variables—something generally considered bad coding practice due to unreadability and inefficiency—in favour of intro-

ducing cells and structures with dynamic field names for this purpose.

Advanced data types are the topic of Chapter seven, *Data Types*. With the same gentle and somewhat informal style, the reader is introduced to MATLAB's cell and structure variables. In this Chapter, we found one of very few factual errors in the book: in paragraph 7.4 it is said that figures in MATLAB "are stored as structures, with records and fields". In fact, figures are stored as somewhat more complicated objects that behave differently from structures and are only superficially similar.

Chapter eight, *Modules and Functions*, focuses on the writing of functions, the prevention of labyrinthine programs, and the advantages of reusable code. One paragraph (§8.2) was somewhat puzzling, it seems to confound different scope rules in MATLAB (global variables vs. MATLAB's workspace), and that leads to a confusing story.

Chapters nine through twelve are clearly the author's bread and butter. Of course, MATLAB is famed for its graphical capabilities and exploiting them is an important skill. The entirety of Chapter nine (*Plots*) is devoted to plots of different types. Axis manipulations, subplots, and adding text are covered. Importantly, the use of the `set` and `get` functions to do graphical micromanagement is introduced. Somewhat out of place, we find a small paragraph on curve fitting here (§9.9).

The same functions play a large role in Chapter ten, *Lines, Shapes, and Images*, where the focus is on graphical objects. The Chapter then continues to cover reading and saving images.

Chapter eleven, *Three–Dimensional Graphics*, further describes MATLAB's graphical tools, now for 3D images like mesh plots, surface plots, and 3D histograms. This chapter also presents the MATLAB code to produce the rather spiffy cover image.

Chapter twelve, then, goes into animations. The author begins by explaining the somewhat unconventional animation technique of 'Whiting Out Successive Images', in which a moving object is plotted once in black, and then overplotted in white. Our intuition would be to either `delete` the dataseries object in question, or to use the `Visible` property's `'off'` setting. The Chapter concludes with information regarding the loading and saving of movie files.

The thirteenth chapter is called *Sound*, and teaches how to let MATLAB make sounds—ranging from a simple beep to 'Twinkle, Twinkle, Little Star' to six seconds of Händel's Hallelujah (which, admittedly, is built in).

The fourteenth and final chapter, *Going On*, concludes the book by giving some pointers to finding your own way in the

MATLAB world, by accessing supplied functions and toolboxes. It also mentions where to start if you want to write your own toolboxes, GUIs, or stand-alone applications.

After perusing the book, the adventuring novice will have learned to use most of MATLAB's basic capabilities. Speaking from the perspective of the behavioural scientist, it focuses on useful skills such as generating stimuli, interacting with users, and processing data. To point out a drawback, however, the low-threshold approach the author has taken means that there isn't really enough to the book for teaching a serious MATLAB-oriented course. MBS provides for an excellent introduction to MATLAB, and the style is sufficiently introductory to allow for independent study, but as a textbook in a technical course for students in the behavioral sciences, it fails to deliver somewhat—in the sense that there may not be enough material to fill an entire term. There could have been an introduction to the Statistics Toolbox, for example, to illustrate its functions for simple regression and analysis of variance. The Optimization Toolbox is certainly the one we use—and teach—more than anything, mainly of course for model fitting, which is largely unmentioned in the book. Some more chapters down these lines would have made MBS an extremely useful textbook, certainly if they were written as clearly as the present chapters are now. It remains true, however, that the book provides the reader with sufficient knowledge to access these toolboxes independently.

In summary, we like MBS, a lot, and we will certainly heartily recommend it to students who are interested in introducing themselves to MATLAB. We know well that MATLAB in particular has a very steep learning curve—just a basic introduction suffices to get the interested student started on their own. With that in mind, we believe MBS may come to play an important role in allowing people to use MATLAB.

MATLAB for Behavioral Scientists comes with an accessible website (www.matlab–behave.com) and is available via Amazon.com, at 20 euro for the paperback version.