Book Reviews

Below are two book reviews of Monograph 13, third edition that have been written and published.

[I don't know these people personally, so they are independent I didn't just get my friends to write nice things ☺].

From CASLE Newsletter March 2007 and also in the Survey Review, 39, 304 p176 (April 2007):

C·A·S·L·E

Practical Least Squares and Statistics For Surveyors.

Bruce R Harvey

Third Edition March 2006
Monograph 13
School of Surveying and Spatial Information Systems
University of New South Wales
I.S.B.N 0 7334 2339 6.

Since your reviewer is not familiar with the previous two editions of this monograph nothing can be said about alterations to these texts, save that in the author's own words "After 20 years of teaching at UNSW and about ten years since the last edition, it is now time for a new edition".

This new edition is supported by a web site www.surveying.unsw.edu.au/ls which inter alia includes updates and corrections to the book. Concerning this aspect, the author makes the wise comment " It will be interesting to see if the web site lasts as long as the book". At the time of writing this review, the site was updated in October 2006.
The book is intended for students at the University of New South Wales, who have already passed foundation subjects including matrix algebra, statistics, computer programming and survey measurement techniques. Therefore derivations of theory or equations are rarely included, and practical aspects are emphasised rather than theoretical correctness.

It is not however a "cook book", because the author explains each process and expects the students to work the examples and think about the results at all stages. There is no question that this is a very useful text containing a wide range of examples, worked as fully as space allows, which explain theory and are useful for software testing.

Your reviewer faced with the same problem, of teaching about Least Squares estimation in another university, echoes fully the following sentiment "Students are not a homogeneous group and different people learn in different ways. Some have asked me to keep the notes as short as possible, to be concise. Others have asked for worked examples with full details. I have tried to please both groups". The dilemma is whether to teach the subject bottom up or top down. The analytical minds prefer the latter, ordinary mortals the former. Only the students can say if author has succeeded. But it must be said that the text is also useful for the professional surveyor in that most practical problems are dealt with, such as three dimensional coordinate transformation, combined terrestrial and GPS networks and sound advice given on the practical issues of inputting data and analysing output from software in general.

Although your reviewer would not agree totally with the order in which various topics are introduced, especially the subject of weights, he found himself agreeing time and again with the useful advice given especially when dealing with such practical issues as the need for calibration and reduction of systematic effects, and the merit of computing and displaying the C-O vector as a useful visual filtering procedure. Although Harley's traditional treatment of three dimensional intersection is probably adequate for normal surveying, it is not so in precise industrial work, where a proper three dimensional treatment is essential. Also the author might well have paid more attention to the failure cases which are useful in testing to see if the software is robust. A good example of this is in resection from three collinear control points, which wrongly fails if computed by the Barycentric fomula. Having read the whole book in some detail we wonder whether perhaps it is a little too detailed, and would benefit from some careful surgery. The final pages full of wisdom ought in our opinion to be repeated right at the start to set the scene for the student.

Your reviewer's only serious complaint about the text, which some might consider pedantic, concerns terminology not the subject matter, which is excellent. We were under the impression that surveyors have learned to bury such misleading terms as "adjustment" (which to a client sounds like fiddling the results) and use more constructive terminology such as "Quality estimation". We don't "correct "anything but use the observations to give best estimates of parameters: endlessly talking about errors conveys the impression to the client that we are no good at our job!

That said, let us repeat that we have here an excellent very valuable text for which the author is to be roundly congratulated.

A L Allan
Practical Least Squares and Statistics For Surveyors

PRACTICAL LEAST SQUARES AND STATISTICS FOR SURVEYORS

Practical Least Squares and Statistics for Surveyors. Harvey, B.R.. 3rd ed. Monograph 13, School of Surveying and Spatial Information Systems, University of New South Wales, Sydney

(2006). Paperback. ISBN 07334233396. 332+x pp. A$38.50 inc. GST.

Practical Least Squares and Statistics for Surveyors, written by Bruce Harvey, is one in a series of monographs from the University of New South Wales, Australia. This is the third revised and extended edition of the book; the first and second editions were published in 1991 and 1994, respectively. The author has been a lecturer at the School of Surveying and Spatial Information Systems (formerly the School of Geomatic Engineering) of the University of New South Wales for more than 20 years.

This book provides an introduction to all practical aspects of least-squares adjustments of survey networks. It is mainly written for undergraduate university students, but can be of use to anyone in the surveying industry with little knowledge of observation adjustments. Only little background in algebra and statistics is required for a good understanding of the book. The focus is on the practical interpretation of adjustment parameters and test statistics, rather than their mathematical derivation. Therefore, as the preface suggests, the book is not meant for experts in the field.

The book is divided into ten chapters, each of which is concluded with a number of questions and answers that the reader can use to test their understanding of the material. The style of writing is very informal, and the book is filled with cartoons that provide some light relief from the subject. The author has succeeded in explaining the concepts of least-squares analysis in a very clear manner without delving into mathematical derivations too much. This sets the book apart from many other textbooks on the subject of least-squares adjustment. The explanations are supported by many examples that each show realistic output data followed by a comprehensive discussion of the results. The examples mainly involve terrestrial survey methods. Only few contain GPS observations and no mention is made of the use of least-squares in photogrammetric surveys.

The first two chapters provide an introduction to the concepts of least-squares and statistics. A distinct difference with the previous two editions is the more extensive introduction to the least-squares approach and the rationale behind its use, while the derivations of the linearised observation equations and their least-squares solution are moved to later chapters.

The setup of the parametric functional model and the stochastic model, as well as the iterative least-squares solution, are discussed in chapters 3 and 4. The preparation of the input is explained in much detail, and many worked examples clarify the use of the observation model. On a critical note, the subject of datum definition, which is of crucial importance to the outcome of the adjustment, is treated only very briefly.

Chapter 5 deals with precision measures and global statistical tests of the output. The mathematical formulas here and in further chapters are presented without derivation and the text focuses on the interpretation of error ellipses and test statistics. This can be very helpful for anyone using least-squares adjustment software who is uncertain about the interpretation of results or the reasons for failure of statistical tests, such as the variance factor test or the goodness-of-fit test. Much the same can be said about chapter 6, which introduces the subjects of outlier detection and redundancy analysis.

In chapter 7, the arguably most important aspect of any survey campaign, network design, is treated. Since there is no straightforward method for optimal network design, this is mostly a trial-and-error procedure, which requires experience to be performed effectively. The author shares his experience by providing a general procedure for network design and by showing several survey design examples.

Chapter 8 gives alternatives to the parametric least-squares model in the form of the condition model and the combined model. Chapter 9 is a compilation of several non-related, more advanced network analysis subjects, for each of which a list of references for further reading is provided. Finally, chapter 10 is a summary of the key points from earlier chapters and contains a trouble shooting section to resolve problems with output of least-squares software.

In conclusion, as the title suggests, *Practical Least Squares and Statistics for Surveyors* treats least-squares survey analysis from a very practical point of view, other than most textbooks on the subject. The author regularly draws on his extensive experience to provide general rules-of-thumb to aid the interpretation of adjustment

parameters. Some readers may find there are too many examples in the book, but each of the examples is well worked out and very instructive. The book is very informative for those unfamiliar or only loosely familiar with least-squares analysis of survey networks.

Sten Claessens
Curtin University of Technology