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Book Review

STATISTICAL METHODS FOR ESTIMATING PETROLEUM RESOURCES by P.J. Lee. (2008) Oxford University Press. Hardback, 256 pages. Price: $125.00. ISBN-10: 0195331907.

This book reviews one statistical approach to estimating the size of oil resources yet to be found in a particular region, given the statistics of the reserves found so far. This is an important subject, especially today as oil resources are dwindling, so estimation methods like this are very useful for specialists working in the oil industry. It is also relevant to those in other extractive industries because the techniques could equally be applied to mineral resources for example.

The layout of the book is fairly standard with some introductory chapters giving some basic geological definitions followed by some basic statistical definitions. This then leads to a discussion of the basic principles behind estimating oil in place in mature plays. The advantage of operating in mature regions is that (under various assumptions) the statistics of the various pool sizes may be determined from those so far found. One assumption made is that the pools have some underlying statistical distribution (for example log normal) whose moments can be estimated from the known samples. A further assumption is that the discovery process tends to be from the largest downwards. This would appear to be the key premise that distinguishes the approach used in this book from others commonly used. There are some more subtle assumptions that will be discussed later. This enables one to predict what future pools are present yet undiscovered. This process is exemplified in Chapter 3 of the book by following this process for several field examples. The book then discusses the problems of immature and explored plays, again giving the theory behind the methods and some applications using field data. Finally, the author gives a very brief discussion of alternative approaches to this problem.

There are many positive things about the book. It is well structured and gives a clear exposition of the theory, which is then backed up by some practical examples. The progression from the conceptually easier cases where data are plentiful to more immature plays is logical. References are clear and plentiful and give a good way into the subject matter for the student. The index is complete, which makes it easy to navigate and look up specific subjects for the reader who is just dropping in rather than reading from cover to cover (this is not true of many textbooks today). One thing that pleased me was the use of SI units in the most part. The oil industry, by and large, uses a system of units incomprehensible to other engineers. I would hope that any modern textbook in the subject would be in modern units, which this is.

So there is a clear, logical structure and features that make this monograph useful. Unfortunately there are some problems as well. The first and probably most important is that it is unclear who the intended audience is. The people interested in this subject area would be limited to petroleum economists to petroleum engineers or geoscientists. For students (at masters or above level) there is probably not enough background information, especially on statistical techniques. The book does not discuss some of the very practical points of estimating statistical parameters from small finite samples. There is no discussion of estimation of standard errors for example. This is particularly important when sample sizes can be very small. Many standard methods (such as one would find in an elementary statistics book) are only appropriate for Gaussian distributions, which these are manifestly not. I think that if this book were to be useful to the new student, they would benefit from a more thorough introduction to the statistics.

The other class of potential readers is the professional in the field who needs to do these sorts of calculations. Here the book may be more valuable, although it reads as though it were a very detailed guide on how to use the PETRIMES system so the workings of several of the examples are hard to follow without access to this system. Inclusion of some very simple examples followed through step by step may have helped here. However, this book could be useful as an adjunct to that tool.

A major problem with the statistical discussion is that there are some underlying assumptions that are not clearly stated. One is the independence of variables. While there is some discussion of correlation the problem then becomes quite deep. Estimation of correlation with small samples is tricky and it also impacts on the estimation of single point statistics from highly correlated samples. The discovery process is also affected, as there can be correlation between the exploration model of a play and the order in which fields are discovered. This is a subtle issue influenced by the psychology of the exploration process but past experience indicates that it can be a factor.

One other main problem I have is with the age of the book, which is effectively now 10 years old. There are no more recent references and a quick Google search indicates that there are newer systems now replacing PETRIMES (which undoubtedly would have been further developed had the author lived). This raises another issue that the modern statistical approach to

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modelling populations with limited sample sizes is Bayesian. This approach is discussed a little in Appendix A, which gives the theory behind maximum likelihood estimation of population statistics from finite samples. The appendix is very useful and hints at the mathematical rigor required. However, there are a whole host of Bayesian approaches that could be used that are not discussed.

Overall I think this short book is useful if you are using the PETRIMES system as it gives a detailed background to the rationale behind the approach. It is also useful in general because of the background to statistical approaches and the need for them. For these cases, it is a well-written little monograph. However, for the more general student or for a better discussion of a wider range of approaches, it is perhaps not the best place to start. Also, given the sad demise of the author, it could become dated quickly.

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