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Book of Interest

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Review

Traffic Flow Theory & Control, by D. R. Drew, McGraw-Hill Book Company, New York, 1968, 467 pages, $13.75

This book is largely a review of research done at Texas A & M over about the last five years, supplemented with material from lecture notes on traffic engineering practice and applied probability. Its purpose, quoting the author, is "to present traffic engineering as the science it is" and "to provide practicing traffic engineers with an insight into contemporary traffic research approaches." Problems (without solutions) are provided at the end of most chapters, probably in the hope that the book will be used as a textbook.

A short introductory chapter is followed by chapters on the vehicle, the driver, and the road. These chapters are a mixture of discussion and traffic engineering practice. The fifth chapter, entitled "The Circulation System," covers briefly the classification of roads, volume counting practices, the capacity of roads, and some useful material on lane distributions on freeways at various distances from exit ramps. In a chapter with this imposing title, I feel it would be reasonable to expect some discussion of criteria for a satisfactory circulation system, some comparison of rectangular grid, ring-and-radial and other road patterns, and some mention of mode of travel. These are all conspicuously absent.

Chapter six is a very brief and largely unintelligible discussion of traffic research that could well have been omitted. I challenge anyone to make sense of the flow charts on pages 115 and 116 of this chapter.

Chapters seven, eight, and ten are the applied probability chapters on discrete variables, continuous variables, and queuing, in that order. I feel that engineers will find these chapters extremely difficult to follow. Mathematics students can be taught probability with little or no reference to statistics, but this method is certainly not appropriate here. I can imagine readers wondering at the reason for being interested in variances when the only definition given is that a variance is the difference between the second moment and the square of the mean of a probability distribution. Moments are said to be useful because of their analogy with center of gravity and moment of inertia!

Both probability and moment generating functions are introduced but no mention is made of convolutions. Surely the principal reason for using generating functions is the ease with which convolutions can be handled?

As an application of the Poisson distribution, the probability of clearing the queue

at fixed-time traffic signals is considered. The probability of not clearing the queue is equated to the Poisson probability of $(x + 1)$ or more arrivals in one cycle where x is the number of vehicles that can get through in one phase. This assumes that the queue was empty at the start of the cycle—a point that the author appears to have overlooked. A numerical example is then worked through in detail arriving at a final cycle of 100 sec with the queue cleared in 57 per cent of cycles, yet a simple calculation shows that the average number of vehicles arriving per cycle exceeds the capacity in the example.

Chapter nine is on gap acceptance. Here it is unfortunate that the author plunges straight into the problem of drivers on a freeway ramp waiting for or choosing gaps for merging. It would have been much easier to have started with the less complicated problem of gap acceptance at a stop sign. Apart from this and the unnecessarily labored derivation of the formula for the average waiting time for a gap, this chapter is done well.

I found chapter eleven on simulation to be very poor. It starts with several pages on random walks, quadrature by Monte Carlo methods, and "number systems," that will not help many engineers. In comparing the periodic-scan and event-scan methods of incrementing time in a simulation, it is stated that "the event-scan method is much faster . . ."; it can also be much slower! Some of the mathematics on pages 273 and 275 is wrong, and a method described on page 274 for generating Poisson variables, generates binomial variables instead.

My main criticism of the simulation chapter though is not that it contains many errors, but that it will not help anyone who wants to simulate a traffic situation. Simulation, I feel, is best taught by example and there are no simple worked examples given. There is a description of an elaborate simulation of a short length of freeway but no results are given. In addition there are many practical problems that are not discussed, e.g., should I use a small number of long simulation runs or a large number of short runs, how long should be allowed for the process to settle down to a steady state, if there are many factors to be varied, what sort of fractional factorial design should be used, etc.?

Chapters twelve, thirteen, and fourteen deal with traffic flow theory or rather the mathematics of traffic flow theory. The familiar relations between space and time mean speeds are omitted. The mathematics of car-following theory is given without mention of the experimental work behind it. The last of these three chapters contains Drew's energy-momentum ideas that, even though they are carefully and fully developed, leave me unconvinced that they have practical value and the theory that kinetic energy plus acceleration noise equals a constant is not proven to my satisfaction.

The final two chapters are on freeway design and ramp control respectively. Here the text reverts to engineering practice. There is virtually no reference to the theoretical work of earlier chapters and many readers will be left wondering 'what was the point of all the theory?' The final chapter on "Surveillance and Control" is largely descriptive and was written too early to include the findings of Texas A & M's projects in this field.

The author fails in his intent to present traffic engineering as a science. Traffic flow theory is shown as highly mathematical and remote from traffic engineering.

This volume largely ignores the valuable experimental and empirical work that has been done and fails to appreciate the understanding of a problem that can be gained from a proper application of mathematical methods. The only point at which I feel that any practical value of research has been demonstrated in this book is in the relation between gap-acceptance parameters and geometrics for freeway merging. Probably the most valuable application of research to traffic engineering has been in the Wardrop/Webster work on traffic signal control that has produced simple and accurate methods for capacity and control calculations, yet the only mention that I can find of this work is in one sentence in chapter twelve.

I cannot recommend this book. It does not comprehensively cover the field, being largely restricted to what work has been done at Texas A & M, and it contains many errors. To use it as a textbook, the students would first need to have a knowledge of probability and statistics, though instructors will find that the problems (without solutions) are good.

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