

BOOK REVIEW: URBAN POLICE PATROL ANALYSIS  
BY RICHARD C. LARSON

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URBAN POLICE PATROL ANALYSIS

BY RICHARD C. LARSON

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REVIEW BY JAN M. CHAIKEN\*

During six years of research at MIT and The New York City-Rand Institute, Richard Larson has probably devoted more thought to the operations of police patrol cars than any police official in the country. The main reason is that policemen consider patrol operations a routine matter. These activities rarely attract the same kind of public attention as investigations of major crimes, crowd control at large demonstrations, and allegations of police misconduct. Moreover, patrol car duty ranks near the bottom in prestige of assignment for most policemen, usually just above uniformed foot patrol. As a result, top-ranking commanders may feel they have passed the point of concerning themselves with patrol cars.

Also, as Larson's book shows quite clearly, an analytical approach to improving the effectiveness of police patrol involves some rather close familiarity with queuing theory, geographically distributed stochastic processes, search theory, and other topics which are not in the bag of skills possessed by most policemen. The simple mathematical formulas which have long been trusted by police planners are no longer adequate for the complex task of allocating and dispatching patrol forces.

For this reason, a cooperative effort between police patrol commanders and analysts who have these skills, and who can design and operate simulations and various optimization programs, is the only realistic approach to studying patrol operations. Such a joint effort

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requires both funding and a strong commitment by policemen and analysts to work together over a period of time, conditions which have been met in few cities to date.

Despite these impediments to improving police patrol effectiveness through an analytical approach, the importance of doing so is indicated by the magnitude of public expenditures on this activity. In New York City alone, the taxpayers spend over \$10<sup>8</sup> per year on police patrol. In any city it is the police department's most costly single activity.

What do policemen in patrol cars do? Data from New York presented by Larson suggest that they spend about a third of their time responding to, and handling, calls for service from the public, another third on routine functions such as meals, processing forms, servicing their vehicles, and resolving traffic conditions or other problems they observe, and the final third patrolling their assigned areas.

The third of their time they spend on answering calls for service is mostly devoted to activities which are unrelated to crime. Typically, 80 percent of this service time is accounted for by incidents such as accidents, illnesses, family disputes, disorderly persons, and similar noncriminal events. Even when the police are called to the scene of crimes, it is seldom possible for them to do much more than make a report and console the victim. Investigation of the crime is usually the responsibility of detectives.

The third of their time that police cars spend on "preventive-patrol" in their assigned areas may in fact act as a deterrent to criminal activity on the streets, but the available evidence is not definitive on this. In any event, uniformed patrol is not nearly as effective a preventive tool as plainclothes patrol or appropriately located uniformed foot patrol. So an important reality is that police patrol duty, taken as a whole, is essentially an emergency service function, with small components of a crime-fighting function. But it has to be operated in such a way that important, crime-related incidents can be handled rapidly.

As a result, a practical, if somewhat oversimplified, view is that the objective of patrol allocation is to minimize response delays to high-priority incidents. Of the two components of response delay -- queuing time and travel time -- it is the queuing problem which is most

important in large cities. If all the cars in an area of the city are unavailable, either because they responded to previous emergencies or for other reasons, then subsequent calls will inevitably be queued, no matter how important they are compared to the earlier incidents. (Larson discusses preemption of service in progress so that units may respond to high-priority incidents, but this appears to work better in theory than in practice. The policemen do not like to be interrupted unexpectedly, except to assist other officers in trouble.) When queuing occurs, the associated delay ordinarily dominates the travel time.

Larson's book discusses both queuing and travel time in excruciating detail. Travel time is modeled as a function of sector design and travel speeds, as a function of the number of units on duty and their utilization, and as a function of the information available to the dispatcher about the locations of units. Larson even gives formulas for the increases in travel time which are caused by one-way streets. He treats queuing both analytically, using Cobham's multiserver priority queuing model in which all calls have the same exponentially-distributed total service time, and by a simulation model.

In addition, an entire chapter is devoted to models of preventive patrol. Here Larson develops formulas for the average time between passings of a patrol car, given varying patrol densities on different streets, and discusses optimal matching of patrol densities to outside crime rates.

These models are then used to address a variety of policy options open to patrol commanders for improving patrol service. One is to vary the number of units on duty by time and location, according to the arrival rates for calls for service. Larson presents a dynamic programming algorithm in which constraints are placed on the average travel time and patrol passing frequency, both of which depend on geographical variables, the number of units on duty, rates of calls for service, and service times; additional constraints can be used to meet other criteria of patrol commanders. The model supplies each command with enough units to meet the constraints, and then the remaining units are allocated in such a way as to minimize the city-wide average queuing delay.

Larson gives an example of an application, using New York data which are several years old, in which the estimated average queuing delay for the actual allocation on a Saturday night was 3.5 minutes, and the constraint levels entered into the program were not met in numerous precincts. The model-derived allocation, using the same number of patrol units, met all the constraints and had an estimated mean queuing time of only 0.67 minutes. On Sunday afternoon, by contrast, the number of patrol units actually on duty far exceeded the number needed to meet the constraints. Larson applied his model assuming a 20 percent reduction in the number of units and found that all constraints could be met, while the associated increase in the queue delay was so small as not to be of practical importance. Remarkably, the model-derived Sunday allocation with fewer units required an increase in the number of units in 8 of 77 precincts, compared to the number actually on duty.

These results strongly suggest that many police departments could substantially improve the overall level of patrol service and at the same time reduce the total number of patrol man-hours. In some cities, legal and contractual obligations may limit the flexibility of departments in trying to match the number of men on duty at different times to the number actually needed. But even where this is not the case, it may be a nontrivial problem to design equitable duty schedules for the men so as to achieve the desired manning levels. Methods for calculating such schedules have been developed by Nelson Heller, who works for the St. Louis Board of Police Commissioners.

Other policy options considered in Larson's book include changing the queue service discipline from first-in, first-out to closest-car, closest incident; establishing a formal priority structure for the queue; assigning certain units to respond only to high-priority calls; redesigning patrol areas; and installing an automatic vehicle locator system.

This book is a comprehensive statement of current knowledge related to operational analysis of police patrol and is one of the few suitable textbooks for public policy courses whose students have a solid technical background. Readers without such a background, including most policemen, will be able to read through to Chapter 2, and parts of

later chapters. The book is so arranged that they will have a good feel for the subject before they reach their limit.

The book's appearance is good, and the inevitable typographical errors are neither very numerous nor annoying. There is an annotated bibliography which should prove very useful, since much important work in this field is still unpublished, and you need to know the exact title and issuing agency to get a copy. One final clue to the reader: you can figure out the dedication of this book if I tell you that the Larsons have a pet cat, of whom they are very fond.







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