Workshop on Mathematical Structures and Uncertainty

Workshop Summary

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The focus of this workshop was various mathematical choice models representing travel behavior, based primarily on individual-choice theory. In conjunction with other methods, these tools produce information on travel flows on proposed transportation systems and other related alternatives. These techniques possess many advantages over existing procedures (covered extensively in the Workshop on Long-Range and Strategic Planning Methods) but are sometimes cumbersome to use and contain unknown errors. The state of the art was assessed, relating methods to practical and institutional problems. In background papers, Steven R. Lerman and Joel L. Horowitz summarized the state of the art and the state of the practice.

The workshop participants found that methods currently available can generally support decision-making for a wide range of planning problems. However, many planners and decisionmakers view these methods as unnecessarily cumbersome and irrelevant to their concerns in their current form. In addition, current models are deficient in ability to represent or predict travel behavior accurately for many options. Thus, two different areas were addressed:

1. Overcoming barriers to current use of the best available techniques for specific purposes and
2. Improving the behavioral content and accuracy of existing techniques.

A number of reasons were identified for failure to move techniques into practice. These are

1. Heavily technical descriptions of methods,
2. Excessive claims about unrealized advantages,
3. Lack of clarity of ways in which techniques respond to planner-identified problems,
4. Inadequate priority or time given to learning new techniques,
5. Failure to acknowledge the source of improved capabilities, and
6. Inadequate definition of current and future issues.

To deal with these concerns, it was suggested that gap-closing materials, such as methodological manuals, software support, instructional programs, and documentation of successful applications, be developed. Issues and planning areas most appropriate for analysis should also be identified. Numerous short-range projects, operating procedures, and pricing decisions are sample cases where simple applications of advanced models can be described. Selected regional-scale problems should also be studied through upgrading of current large-scale model systems. Emphasis should be on issues that cannot be addressed by current (traditional) methods and issues that can be addressed more efficiently by new methods. Planners' criteria for selecting and using models and procedures can be satisfied by new methods, which should be described. This includes simplified applications (such as pivot-point methods), improved (or new) issue sensitivity, higher levels of precision than traditional models (reduced uncertainty), and ability to apply model systems at different levels of complexity.

Options for adopting new models should be developed, varying according to level of sophistication, range of problems, and development of a new model or adoption of one from another environment.

Mathematical Models of Travel Demand: A State-of-the-Art Review

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The state of the art in modeling transportation systems has evolved at an extraordinarily rapid pace since the early highway studies of the 1950s. This rapid evolution has been the result of the confluence of several major factors, including

1. The growth of the government's involvement in the transportation sector and the government's willingness to fund both research and planning activities;
2. The extensive fertilization of transportation systems analysis from other fields, notably economics, statistics, and operations research;
3. The technological advances made in digital computers; and
4. The perceived demand for a rational decision process in making capital investment and operating decisions in the transportation sector.

These and other forces have all acted to produce major innovations in the field of travel demand analysis, which forms a large part of what has constituted transportation systems analysis. I intend to examine the various components of travel-demand modeling and describe what I believe to be the major changes in the state of the art. I will particularly emphasize innovations in the last few years in order to focus the attention of workshop participants on the progress we in the research community have collectively made since the last major international conference on travel demand, held in Elsbee, West Germany, in 1979. I will also present my personal evaluation as to whether the state of the art in different areas has advanced as rapidly in recent years as it has in the past and why any observed rate of change has shifted.

This review is restricted to what I term mathematical behavioral models, i.e., abstract, mathematical representations that purport to approximate in some way the processes underlying travel demand.