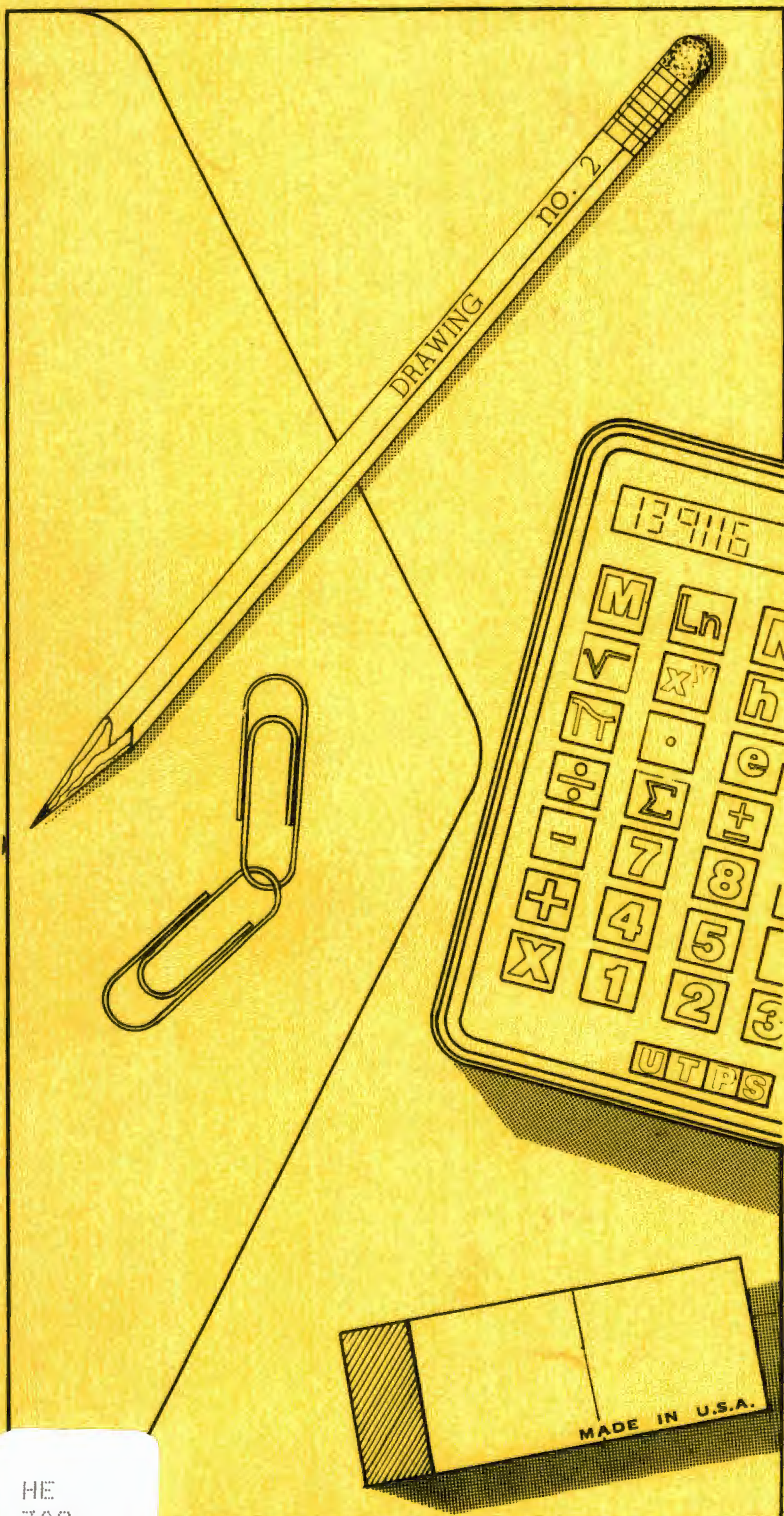
simplified aids for transportation analysis



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16. Abstract

In January 1976, the U.S. Department of Transportation (DOT) issued a Technical Notice (DOT-1-76) requesting transportation planners, engineers, and transit operators to submit useful but not widely known manual techniques that could be developed and distributed as simplified aids for transportation analysis. Over 70 analytical aids were submitted in response to this request.

This report contains the annotated summary of each of the analytical aids submitted for review and consideration. In each case, it identifies the person or agency that submitted the aid, provides a brief description of the aid, and, in many cases, provides a reference document which describes the technique and/or an application of the technique. These descriptions are intended to assist the transportation analyst in determining which of these analytical aids might be useful in a particular local application. They also provide a source or reference for obtaining additional information concerning the technique.

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SIMPLIFIED AIDS FOR TRANSPORTATION ANALYSIS

Annotated Bibliography of Analytical Aids

Prepared by

Peat, Marwick, Mitchell & Co.

1025 Conn. Ave., N.W. Washington D.C. 20036

JANUARY 1979

Prepared for

U.S. Department of Transportation
Urban Mass Transportation Administration
Office of Planning Methods and Support

FOREWORD

Today's transportation planner confronts ever-changing issues within a variety of work environments. To assist him, UMTA's Planning Methods and Support Program researches, develops and distributes planning aids, including novel planning studies, and new design and forecasting techniques.

This is one of a series of six reports describing simplified aids to improve transportation decisions without resorting to computers or extensive data collection. The series, titled Simplified Aids for Transportation Analysis, presently includes the following titles:

1. Annotated Bibliography (UMTA-IT-06-9020-79-1)

2. Forecasting Auto Availability and Travel (UMTA-IT-06-9020-79-2)

3. Estimating Ridership and Cost (UMTA-IT-06-9020-79-3)

4. Transit Route Evaluation (UMTA-IT-06-9020-79-4)

5. Estimating Parking Accumulation (UMTA-IT-06-9020-79-5)

6. Fringe Parking Site Requirements (UMTA-IT-06-9020-79-6)

All are the work of recognized experts. They clearly present usable planning concepts, and add to the growing set of manual and computerized techniques comprising the UMTA/FHWA Urban Transportation Planning System (UTPS).

More important than the production and dissemination of new tools is the experience and opinion of their user. Local issues change. Better methods evolve. Or, realistically errors may appear in the final product. We depend on you, the transportation planner, to alert us to any of the above. We need your comments and your ideas. Please let us hear them, so we can continually improve our products.

You may obtain copies of any of the above reports from the National Technical Information Service (NTIS), Springfield, VA, 22161. On your request, please include the reference number in parenthesis.

Robert B. Dial, Director
Office of Planning Methods
and Support (UPM-20)
Department of Transportation
Washington, DC 20590

ABSTRACT

In January 1976, the U.S. Department of Transportation (DOT) issued a Technical Notice (DOT-1-76) requesting transportation planners, engineers, and transit operators to submit useful but not widely known manual techniques that could be developed and distributed as simplified aids for transportation analysis. Over 70 analytical aids were submitted in response to this request.

Based on an evaluation process conducted to determine the most useful, easily applied, and generally applicable techniques, several of these analytical aids have been selected and documented in sufficient detail to permit their immediate use. In addition, three analytical aids were developed separately as part of the Short Range Transportation Planning project, and an annotated bibliography of each analytical aid reviewed was prepared. These individual analytical aids and the bibliography have been prepared as separate reports and have been brought together in this manual of simplified aids for transportation analysis.

This report contains the annotated summary of each of the analytical aids submitted for review and consideration. In each case, it identifies the person or agency that submitted the aid, provides a brief description of the aid, and, in many cases, provides a reference document which describes the technique and/or an application of the technique. These descriptions are intended to assist the transportation analyst in determining which of these analytical aids might be useful in a particular local application. They also provide a source or reference for obtaining additional information concerning the technique.

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I. INTRODUCTION

In January 1976, the U.S. Department of Transportation (DOT) issued a Technical Notice (DOT-1-76) requesting transportation planners, engineers, and transit operators to submit useful but not widely known manual techniques that could be developed and distributed as simplified aids for transportation analysis. Over 70 analytical aids were submitted in response to this request.

This report contains a summary of each of the analytical aids submitted. In each case, it provides a brief description of the aid, identifies the person or agency that submitted the aid, and, in many cases, suggests a reference document which describes the technique and/or an application of the technique.

These descriptions are intended to assist the transportation analyst in determining which of these aids might be useful in a particular local application. The source and reference entries will enable the analyst to obtain additional information and subsequently to facilitate the use of those techniques. For the convenience of the user, the aids are described in the following functional categories:

- planning, evaluation, and design for conventional bus transit and paratransit;
- planning, evaluation, and design for express bus and rail transit;
- transit route monitoring and evaluation;
- sketch planning analysis;
- trip generation analysis;
- land use planning and activity allocation analysis;
- economic analysis;
- parking analysis;
- environmental analysis; and
- miscellaneous functions such as traffic safety, traffic operations, intercity travel, and air travel.

Within these categories, aids are presented alphabetically by source, using either an individual's last name or the first word in an agency's title.

The fact that a technique appears in this bibliography does not imply an endorsement by DOT or by Peat, Marwick, Mitchell & Co. Every aid submitted in response to the Department's Technical Notice has been included here as a service to the transportation analyst. It is assumed that the user will independently consider the soundness of any information provided by these sources.

II. PLANNING, EVALUATION, AND DESIGN FOR CONVENTIONAL TRANSIT AND PARATRANSIT

This section comprises 25 analytical aids, each representing a simplified approach to the planning, evaluation, and design of conventional transit and paratransit services.

SOURCE

J. Barry Barker and Dan Krechmer
Northern Middlesex Area Commission
144 Merrimack Street
Lowell, Massachusetts 01852
(617) 454-8021

DESCRIPTION

In this analytical aid, on-board survey and census data are used to determine a relationship between income and transit trips per household. This relationship is then used in conjunction with various elasticities to estimate potential ridership for new or modified bus routes.

SOURCE

Edward G. Bates, Jr.
Urban Transportation Systems Associates, Inc.
1643 Beacon Street
Newton, Massachusetts 02168
(617) 332-0552

DESCRIPTION

Urban Transportation Systems Associates (UTSA) has been involved in a number of transit development programs and has developed a simple technique for estimating ridership in areas that are not at present being served. This analytical aid involves the development of trip generation relationships from similar areas that presently do have transit service. After the population within a potential service area has been determined (usually about three blocks each side of the bus route), the trip generation relationship is applied to the population to yield transit trips. Auto availability and distance from the central business district are two variables that have also been used successfully in predicting ridership. Further, the technique considers the route productivity (passengers/route mile) and relates this value to productivities of similar bus systems in similar areas around the country.

If the population base has already been developed and is available, very little time is needed to apply the technique. The analysis of a bus route can probably be made in a day or so.

SOURCE

Walter Cherwony, P.E.
Simpson & Curtin, Transportation Engineers
1346 Chestnut Street
Philadelphia, Pennsylvania 19107
(215) 545-8000

REFERENCE

"A Method for Assessing Short-Range Transit Proposals." Walter Cherwony, Senior Engineer, Simpson & Curtin; Lewis Polin, Transit Analyst, Simpson & Curtin.

DESCRIPTION

With renewed interest in public transportation service spurred by the dual concerns of energy conservation and improvement in the quality of the environment, transit systems have been beset by numerous requests for additional mass transportation services. While expected costs and revenues associated with new services are not the only parameters employed to assess the merits of individual route proposals, transit agencies are nevertheless expected to utilize scarce public resources judiciously.

This paper describes a methodology which will enable transit systems to determine the probable patronage of a new route after only a few weeks of service, thus reducing the need for a time-consuming and costly experimentation period. Using data obtained from recently implemented transit services in Albany, Minneapolis, and Philadelphia, the paper traces through a number of steps devoted to the development of a mathematical model employed to evaluate ridership results and to project ultimate patronage demand for service.

SOURCE

John Collura, formerly with
North Carolina Department of Transportation
P. O. Box 25201
Raleigh, North Carolina 27611
(919) 829-4713
(Contact David C. Robinson)

DESCRIPTION

This analytical aid is used to estimate the potential ridership and public financial operating assistance required for fixed-route bus system alternatives in urban areas with populations less than 300,000. These estimates are considered useful for determining various levels of funding for state public transportation assistance programs and for re-evaluating urban transportation plans.

The method uses multiple regression equations generated from 1974 operating data for 55 bus systems across the country. The data were collected by the Department of Mass Transportation of the North Carolina Department of Transportation, in detailed telephone interviews with local bus operators. The equations can be solved using a hand calculator and readily available data inputs.

SOURCE

Joseph C. Corradino, B. Douglas Coomer, and Wayne S. Upshaw
Schimpeler-Corradino Associates
1429 South Third Street
Louisville, Kentucky 40208
(502) 636-3555

REFERENCES

"Successive Overlays--A Small City Transit Surveying Process." Traffic Engineering (December 1974): 9-11.

Paducah Transit Study. Louisville: Schimpeler-Corradino Associates, (1974).

DESCRIPTION

The "successive overlays" technique used in this analytical aid identifies areas of a small city that represent potential transit markets. The process is not intended to define the size of the market or its desires, but rather to indicate where the market for transit exists.

The initial task in this technique is to determine socioeconomic factors indicative of potential transit ridership. The indices chosen by the authors were evaluated on the basis of (1) the data's availability, vintage, and geographic compatibility and (2) the data's ability to describe the transit user. The indices included:

- passenger cars per dwelling unit;
- average income;
- females age 16 to 24;
- persons age 62 or over; and
- dwelling units per acre.

After the indices were selected and stratified to reflect high, medium, and low propensities to use transit, shadings of gray were developed for each level. Each index was then graphically recorded on a transparency that could overlay a map of the study area. The five transparencies were then successively superimposed, resulting in various shadings of gray on the composite overlay. The darkest areas indicated a high transit potential.

SOURCE

Peter G. Drake
South Coast Area Transit
336 Sanjon Road
Ventura, California 93003
(805) 643-1319

DESCRIPTION

In this analytical aid, a preliminary schedule is prepared for a proposed route or service extension to obtain vehicle hours, operator pay-hours, and vehicle miles. The operating costs associated with the proposed service are then calculated using unit cost estimates. The route is then operated on a short-term basis to determine actual ridership response. Direct mailers and newspaper and radio coverage are used to encourage use of the new routes during the test period. At the conclusion of this period, the operating costs and patronage revenues are compared to determine whether the new route should be continued or eliminated.

SOURCE

Charles P. Elms
N. D. Lea & Associates, Inc.
123 Green Street
Huntsville, Alabama 35801
(205) 539-2781

REFERENCE

Lea Transit Compendium, Volume II. Huntsville, Alabama: N.D. Lea Transportation Research Corp., (1975).

DESCRIPTION

This analytical aid enables the analyst to determine the relation of transit fleet density to demand density (i.e., person trips/square mile/hour) and vehicle productivity. The relations are established by a set of simple equations which are then portrayed graphically. The user can gain insight into the problem of sizing the transit fleet by using the method as a sketch planning tool.

SOURCE

Roy R. Friedman
Seattle Metro
Planning Division
1333 Airport Way South
Seattle, Washington 98134
(206) 447-6390

REFERENCE

"Statistical Models of the Mean and Standard Deviation of Passenger Wait Time in Urban Bus Transit." Master's thesis, Northwestern University, 1976.

DESCRIPTION

This analytical aid provides a method for calculating passenger wait time based on transit service characteristics. The mean and standard deviation of passenger wait time are calculated from (1) the mean scheduled headway, (2) the ratio of the standard deviation to the mean bus travel time between adjacent bus stops, and (3) the number of minutes downstream from the dispatch terminal that a particular passenger is located.

SOURCE

Alice D. Garland
Division of Mass Transportation
North Carolina Department of Transportation
P.O. Box 25201
Raleigh, North Carolina 27611
(919) 829-4713

DESCRIPTION

Data generated from a car pool computer program can be used to produce a "density matrix" which specifies, by time intervals, how many commuters leave each home grid and travel to a specific work grid. The matrix was used as an analytical aid in Raleigh, North Carolina, to identify how many people live in outlying towns and work in downtown Raleigh. Using this information, the areas best suited for a van pool or bus pool program are easily determined. The matrix can also be used to identify areas best suited for express bus service or to plan new bus routes.

SOURCE

Gordon Halls
Alberta Transportation Department
Transportation Building
9630 106th Street
Room 340
Edmonton, Alberta, Canada T5K 2B8
427-6717

REFERENCE

N. D. Lea & Associates, Inc. Transit Demand, Fleet Size, and Cost Estimator. Edmonton, Alberta, Canada: Planning Branch, Alberta Highways and Transport, (1975, rev. 1976).

DESCRIPTION

This analytical aid provides a method for quickly estimating the potential demand for and cost of providing typical local bus transportation systems in small cities or suburban communities of 5,000 to 50,000 people. It is not intended to be a substitute for a careful analysis and feasibility study for a particular city; rather, it is intended to provide a guide to assist policy makers in determining whether or not such studies should be undertaken at all.

The analytical aid is calibrated for 1976 travel demands and costs in the environment for transit systems in Alberta, Canada. The methodology accommodates variations in city size, shape, and population density, and in vehicle sizes, operating policies, and fares. The approach can be used for a conventional fixed-route local bus system or a demand responsive system, though it should not be used for costing integrated fixed-route/demand responsive services.

SOURCE

Kenneth W. Heathington and James D. Brogan
The University of Tennessee Transportation Center
Knoxville, Tennessee 37916
(615) 974-5255

REFERENCE

"Sketch Planning for Public Transportation Services--An Application."

DESCRIPTION

This analytical aid provides a simplified approach to evaluate quickly at a very gross level various plans for providing public transportation services. Various alternatives, ranging from very simplified bus-oriented systems to high-speed rail facilities operating on dedicated right-of-ways are reviewed in terms of meeting the needs for public transportation travel. The proposed method quickly reviews and evaluates alternatives without substantial outlays in time and/or resources.

This gross level of analysis, or sketch planning, does not, however, provide for as detailed an analysis as would normally be needed before implementation. The sketch planning process, nevertheless, does enable the planner to differentiate between those alternatives which have merit and those which should not be given additional consideration.

Data requirements for the sketch planning process are from two sources: the socioeconomic and demographic variables enumerated in Census Bureau reports and origin and destination data available from metropolitan area transportation studies. This sketch planning process makes no attempts to forecast future needs; it gives an indication only of what is now needed in public transportation services.

SOURCE

Michael Holoszyc
Systan, Inc.
P.O. Box U
Los Altos, California 94022
(415) 941-3311

REFERENCE

With Dale Miller. "The Planning and Design of a Demand Responsive Transportation System for Morristown and Morris Township." Report prepared for the Transportation Program, Princeton University (1975).

DESCRIPTION

This analytical aid is used to estimate auto availability in areas smaller than census tracts. Auto ownership for selected census tracts in an areawide study was found by the researchers to be closely related to a variable that equaled the average home market value times the percent of homeowners. Since these latter two variables are contained in census block data, auto availability in any small area could be fairly accurately determined.

SOURCE

Antti Kalliomäki
Helko (Coordination Office,
Helsinki Metropolitan Area Transportation Plan)
Sähköttäjänkatu 1
SF-00520 Helsinki 52, Finland
90-140411

REFERENCE

Liikennetekniikka Oy. Liikenne-ennusteiden käsittelyrutiineja. Helko, (1971). (In Finnish; abstract available in English.)

DESCRIPTION

This analytical aid, known as an "F-model," changes traffic matrices according to new land use forecasts. The model will provide accurate results if: the trip forecast is made with gravitation models; the original matrix is correct according to old land use forecasts; the formulas used for trip generation and attraction give at least the correct proportional change of trip production; and networks and modal splits essentially do not change.

SOURCE

Antti Kalliomäki
Helko (Coordination Office,
Helsinki Metropolitan Area Transportation Plan)
Sähköttäjankatu 1
SF-00520 Helsinki 52, Finland
90-140411

REFERENCE

Tom Granberg. LINJA, Joukkoliikenneyhteyden kuormituksen laskentaohjelma. Espoo, Finland: Espoo City Planning Office, (1975). (Source address is Kutojantie 1, SF-02610 Espoo 61, Finland.)

DESCRIPTION

This analytical aid, used to estimate ridership on a proposed bus line, requires a matrix of transit passengers and a detailed description of the proposed routes and competing lines. Each proposed bus line is then examined using the program LINJA to produce an estimate of the number of passengers, a profitable number of buses per day, and the number of passengers transferring from the existing bus lines.

SOURCE

Edwin Leung, Tahir Qizilbashagha, and Blaine Royce
West Virginia University
Morgantown, West Virginia 26506

REFERENCE

"Feasibility of Developing Low-Cost Measures of Demand for Rural Public Transportation: Technical Memorandum No. 1."
December 1975.

DESCRIPTION

This report presents a statistical and graphical analysis of patronage on rural public transit routes in Monongalia, Marion, and Harrison counties in northern West Virginia. The analytical aid deals strictly with data such as daily ridership, route length, frequency of service, and similar patronage and service information. Socioeconomic data, such as automobile ownership and average income, were not used in the analysis because they were not currently available. The summary evaluation draws a comparison between these West Virginia rural transit operations and other rural programs across the country in terms of two statistics: passengers/day/vehicle and daily ridership/vehicle/population.

SOURCE

Douglas Gordon Milliman
Hensley-Schmidt, Inc.
1212 American National Bank Building
Chattanooga, Tennessee 37402
(615) 267-4364

DESCRIPTION

A procedure was developed for evaluating the effectiveness of programs designed to encourage car pooling. The analytical aid requires that a multiple vehicle-occupancy count be conducted during the AM peak hours on principal roadways serving major employment centers before the car pooling program is implemented. The researchers suggest that the counts encompass five arterials over five successive days in medium-size cities representing approximately 50,000 to 70,000 vehicles. The same multiple-occupancy count should also be undertaken after program implementation. A two-way chi-square contingency test should then be performed on the data comparing the number of one-person autos to the number of multiple-occupant autos before and after the initiation of the car pooling program.

SOURCE

Edward K. Morlok and John A. Warner
Department of Civil and Urban Engineering (D-3)
University of Pennsylvania
Philadelphia, Pennsylvania 19174

REFERENCES

U.S. Department of Transportation. Development and Testing of a Transportation Model for High Accessibility Urban Corridors, Contract DOT-05-40092 (in press).

Bus Cost and Performance Model. Philadelphia: University of Pennsylvania, (1975).

DESCRIPTION

In research supported by the Program of University Research of the U.S. Department of Transportation, a method was designed to evaluate the effects on the quality of service, capital costs, and operating expenses of various extensions of a public transportation facility from a downtown location into a corridor. This analytical aid, designed for manual computation, can also be used to evaluate options such as express, skip-stop, and zone-express operation of any public transportation mode.

The costs of providing public transport service with different level-of-service characteristics are predicted as a function of the length of the rapid transit facility's extension into the corridor, the transit route structure, passenger traffic, and the operator's service policies. Cost components--fixed facility and vehicle capital costs, vehicle operator labor expense, and other vehicle operating expenses--are internally determined by the model using route, transit ridership, and unit cost input information which can be varied to describe local conditions. Passenger travel time, waiting time, and fraction seated are predicted as a function of the same facility length, route, and ridership information. This permits the user to determine a direct relationship between changes in system cost and the travel time gains which might result from various levels of expenditure on given capital or policy improvements; or, alternatively, to explore the costs of several such alternatives designed to achieve a desired level of service. Use of the technique is illustrated by an analysis of an exclusive bus transit right-of-way in an actual urban corridor.

SOURCE

William B. O'Brien
Transportation Planning Branch
Engineering and Transportation Department
10th Floor, Century Place
9803 - 102A Avenue
Edmonton, Alberta, Canada T5J 3A3
(403) 425-2479

REFERENCE

Transit Service Planning Model (Schedules and Costs): Documentation Report. Edmonton, Alberta, Canada: Transportation Planning Branch, Alberta Highways and Transport, (1975).

DESCRIPTION

The Transit Service Planning Model (Schedules and Costs) (TPMSC) described in this report can be used as an analytical aid to provide rough estimates of vehicle requirements, service frequencies, and annual operating costs for a system of transit routes. The required input to the model includes data on each route, data on transit vehicles, travel demands on each route, and service policy variables.

TPMSC calculations are carried out on a route-by-route basis. For each route, the model estimates the minimum cost headways and the number of vehicles required for a specific time period to satisfy the given passenger volume. The second step in the model is to estimate the annual operating costs for the service based on the annual hours and miles of operation on the route. Unit hourly and mileage costs for specific vehicle types are then applied to these quantities to give annual operating costs by time period. The number of peak hour vehicles for the route is multiplied by the annual cost per vehicle to estimate annual vehicle related costs. These costs are then added to the hourly and mileage costs to estimate total annual operating costs of the route.

SOURCE

Lowell O'Grady
Augusta-Richmond County Planning Commission
525 Telfair Street
Augusta, Georgia 30901
(404) 724-4391

DESCRIPTION

In this analytical aid, priority service areas for transit operations are identified on the basis of below average zonal median income and vehicle ownership, and above average population density and percent captive population. Data from a similar sized city are used to relate level of service and modal split. Internal and external zonal transit trips are then determined as a function of total zonal trips, percent transit coverage, a "zone factor," and modal split. Operating cost and deficiencies are calculated on the basis of patronage forecasts against an average fare.

SOURCE

Richard W. Perry
New York State Department of Transportation
1220 Washington Avenue
Albany, New York 12232
(518) 457-6408

DESCRIPTION

The computer grid matching techniques currently used in developing car pooling programs can be used, as described in this analytical aid, to improve local transit services. By running a series of time segment matrix displays for those persons who prefer "riding," but not "alternative driving" or "driving," differences in present bus scheduling and routing as compared to present trip desires become evident. These data can be used to adjust scheduling and/or routing to improve the area's public transportation service. The adjusted time schedule and routing can then be mailed to the potential ridership.

SOURCE

David G. Putz
New York State Department of Transportation
1220 Washington Avenue
Albany, New York 12232
(518) 457-7245

DESCRIPTION

Recent small urban area transit studies conducted by the New York State Department of Transportation have involved extensive home interview surveys for use in estimating transit patronage. A comparison of the survey results indicates that transit ridership forecasts for different small urban areas in the state can be made using common trip generation rates in areas not having their own home interview survey data base. Trip generation rates for different types of service have been calculated for various fare levels using this analytical aid. These rates are multiplied against census population data using age-sex matrices. This procedure has effectively eliminated the need to conduct new home interview surveys in small urban areas of 10,000 to 30,000 population.

SOURCE

Dr. W. G. Roeseler, Head
Department of Urban and Regional Planning
Texas A & M University
College Station, Texas 77843
(713) 845-1046

REFERENCES

"Mode Preference Model." Traffic Quarterly, July 1974, pp. 401-418.

Kansas City Transit Associates. "Analysis of Transit Attitude Survey, Long Range Transit Plan, Kansas City Region," Technical Memo, Vol. II, No. 18. Available from Mid-America Regional Council, Kansas City, Missouri.

DESCRIPTION

The Mode Preference Model described in this article is used to estimate transit demand on the basis of a controlled sample interview survey. Using this analytical aid, ridership projections are made for various types of trips, including work trips, shop trips, trips by the elderly, etc. To use this technique a series of attitude surveys are conducted at major trip attraction areas in a metropolitan region; these surveys provide not only those data typically found on an origin-destination survey, but data relating to public opinion toward transit as well. The mode preference indicated by the respondents is the basis for the sample expansion, and calibration of the mode preference model is completed by comparing these responses with existing loads and other applicable quantitative indicators.

The Mode Preference Model has been applied in conjunction with transit development programs in Bryan, Texas; Beaumont, Texas; and Joplin and Springfield, Missouri.

SOURCE

David A. Rynerson
Lane Transit District
P. O. Box 2710
Eugene, Oregon 97402
(503) 687-5581

DESCRIPTION

In this analytical aid, two approaches are used to address the issues of patronage estimation, service frequency, and the effect of service frequency on patronage:

- Transit Service Factor - relationship between annual revenue miles, ridership on existing similar systems, and population of area served; and

- Modal Split Estimation - rough percentage estimates of modal split based on assumed tripmaking rates, census-based population and employment data, and state employment division based employment data (when traditional large sample origin and destination data are not available).

SOURCE

James I. Scheiner
Simpson & Curtin
1346 Chestnut Street
Philadelphia, Pennsylvania 19107
(215) 545-8000

DESCRIPTION

For a relatively homogeneous area without current transit service, the "bus service module" concept developed by the authors is a quick way to predict the fiscal implications of a new fixed-route run out of an existing transit operating base. In this analytical aid, basic route planning parameters are abstracted from the proposed service including round-trip miles, speed, span, and headway. This information is applied to specific unit cost and revenue estimates based on the labor contract and passenger-per-mile ranges. The result is a quantum "packet" of bus service for placement in a community willing to participate in deficit funding.

III. PLANNING, EVALUATION, AND DESIGN FOR EXPRESS BUS AND RAIL TRANSIT SERVICE

This section provides summaries for 15 analytical aids, each representing a simplified approach to the planning, evaluation, and design of express bus and rail transit services.

SOURCE

David E. Boyce, Gene Desfor, et al.
Regional Science Department
University of Pennsylvania
3718 Locust Street
Philadelphia, Pennsylvania 19174
(215) 243-8206

REFERENCES

U.S. Department of Transportation. Impact of Suburban Rapid Transit Station Location, Fare and Parking Availability on Users' Station Choice Behavior, TP1-30 (1974). Available from Mr. Ray Weil.

(Desfor, G.) "Binary Station Choice Models for a Rail Rapid Transit Line." Transportation Research 9(1), 1975, pp. 31-41.

DESCRIPTION

This analytical aid employs graphical procedures for determining park-and-ride rapid transit station market areas and service corridors. The procedures apply to rail and bus rapid transit systems. These procedures are useful for quick studies of the effects of alternative station and line locations on market size and on the capability of arterial systems to serve station access requirements. The station choice model developed from the study describes the alternatives available to a user at each location and identifies the minimum cost of using the facility. Collectively, the results form market areas for each station of a rapid transit line.

SOURCE

Hurvie E. Davis
Department of Transportation
City Hall
Tucson, Arizona 85703
(602) 791-4371

REFERENCE

"Public Transportation System Improvements--Express Bus Service." Memorandum to the Mayor and Council of the City of Tucson from the Tucson Department of Transportation. February 23, 1976.

DESCRIPTION

The purpose of this analytical aid is to determine the feasibility of providing peak-hour express bus service to a CBD. The primary sources of information needed include the 1970 Census work-trip information, data from an on-board survey, and information on peak loadings. The steps followed in the analysis process include:

- identification of areas having high work-trip generation rates to major trip attractors.

- identification of those areas which currently generate sufficient transit ridership to warrant service improvements. This includes determining the approximate total number of peak-hour transit trips from each subarea, calculation of the percent of travel to the CBD area versus other areas, and field studies of potential time savings afforded passengers by express service on various routes.

- selection of area(s) for immediate improvement.

- determination of the cost effectiveness of providing improved service through a comparison of the operating cost of the increased service to the revenues generated by the service and the user benefits derived from reduced travel time.

SOURCE

C. D. Dougherty, R. K. Mufti, and L. S. Golfin
Delaware Valley Regional Planning Commission
1819 John F. Kennedy Boulevard
Philadelphia, Pennsylvania 19103
(214) 567-3000

REFERENCE

Projection of Future Demand for Fringe Parking Facilities in the Pennsylvania Portion of the Delaware Valley Region. Philadelphia: Delaware Valley Regional Planning Commission (1974).

DESCRIPTION

A methodology is presented for determining the location and quantity of additional parking space required to serve projected change-of-mode parking demand. Potential fringe parking sites are identified using this analytical aid, by evaluating site selected criteria including available land, accessibility by the highway system, current rail ridership, and current change-of-mode parking demand. To determine the quantity of additional fringe parking needed at these selected commuter rail sites, the future demand for change-of-mode parking is calculated. This involves a four-step process:

- Trip Interchange Estimation - The origin-shed areas and the destination-shed areas (CBD) for the commuter rail system are delineated and trip distribution tables are then applied to determine future trip interchange volumes.

- Modal Split Estimation - Disutility rates for the auto and rail modes are computed for each origin-shed area and the percentage of commuter rail trips derived from diversion curves.

- Park-and-Ride Estimation - The proportion of projected commuter rail patrons needing a parking space is established by using a relationship between the distance patrons travel to the station and their access mode to the station.

- Parking Needs Estimation - The additional parking spaces over and above the number of spaces already existing or planned are calculated for each site.

SOURCE

C. D. Dougherty, R. K. Mufti, and L. S. Golfin
Delaware Valley Regional Planning Commission
1819 John F. Kennedy Boulevard
Philadelphia, Pennsylvania 19103
(215) 567-3000

REFERENCE

Modal Choice Analysis of an Exclusive Bus/Carpool Lane. Delaware Valley Regional Planning Commission (1975). Prepared for New Jersey Department of Transportation and U.S. Environmental Protection Agency.

DESCRIPTION

This analytical aid determines the effects of an exclusive bus/car pool lane on modal choice within the travel corridor. The analysis includes two principal tasks: modal choice analysis and operational analysis.

The modal choice analysis involves a mathematical model which sets the probability of choosing one means of transportation over another as a function of travel and socioeconomic characteristics. Since the model portrays only a binary choice situation, a procedure is used to model these situations for each travel alternative (i.e., mode) and then in turn to solve each choice situation as a set of simultaneous equations.

The operational analysis includes highway capacity analysis with and without the exclusive bus/car pool lanes, and the relative effects of implementing exclusive lanes on the peak-flow and the contra-flow configuration. It also includes an analysis of the resultant traffic weaving problems and preferential treatment for buses and car pool vehicles.

SOURCE

Lee W. Eason
Washington Department of Highways
Highways Administration Building
Olympia, Washington 98504
(206) 753-5636

DESCRIPTION

Density plots and other listings from the FHWA Carpool Matching System are used for bus line planning in this analytical aid. Since the plots are for a particular time of day, they provide data for analysis of short-range transit solutions, such as express bus operations.

SOURCE

Charles P. Elms
N. D. Lea & Associates, Inc.
123 Green Street
Huntsville, Alabama 35801
(205) 539-2781

REFERENCE

Lea Transit Compendium, Volume II. Huntsville, Alabama: N. D. Lea Transportation Research Corp., (1975).

DESCRIPTION

This analytical aid provides a method for determining the relation between average system speed and station (or stop) spacing. A universal curve which does not change in shape is derived and can be used for any mode of transit. The user simply calculates a K factor which, together with the cruise velocity, locates the curve for each mode with respect to the ordinate and the abscissa (system speed and station (or stop) spacing).

SOURCE

H. L. Jordan
Vought Ground Transportation Marketing Administration
Vought Corporation Systems Division
P.O. Box 5907
Dallas, Texas 75222

REFERENCE

Planner's Handbook for Automated Guideway Transit Systems. Dallas: Vought Corporation Systems Division.

DESCRIPTION

Vought Corporation has submitted as an analytical aid its planning handbook for use in the consideration of Automated Guideway Transit (AGT) Systems. The handbook is designed to assist in providing the technical information required for planning the installation of Vought's urban AGT systems. Planning information is provided for analysis of overall system design, control and communications, vehicles, guideways, passenger stations, maintenance centers, and wayside electrification systems. Periodic updating of the material presented in this handbook is planned by Vought Corporation.

SOURCE

Ian R. Kingham
Transportation Research Board
2101 Constitution Avenue, N.W.
Washington, D.C. 20418
(202) 389-6741

REFERENCE

"An Application of Mode Choice Methodologies to Infrequent Commuter-Rail Service." Transportation Research Record 610.

DESCRIPTION

This analytical aid is the result of research into available commuter rail patronage estimation methodologies which can be applied to the corridor level, can be run manually, and provide a quick response. Two methodologies were adapted to consider infrequent rail service and applied to Baltimore's southwestern corridor:

- the graphical approach, involving the application of a simple graphical technique relating modal split to station distance from the CBD; and

- the computational approach, involving the application of a marginal utility model to corridor census tracts.

Modal-split relationships for the graphical approach were based on a correlation between commuter-rail ridership, expressed as the percentage of the total number of trips to the CBD, and the distance of the station to the CBD. These relationships were developed by Alan M. Voorhees based on Philadelphia's, Chicago's, and San Francisco's experience and are included in the report. From the modal-split curves, the appropriate commuter-rail percentage is multiplied by the number of CBD employees for each census tract in the demand area. These patronage estimates are then adjusted to reflect different service frequencies utilizing factors which reflect experience.

The computational methodology delineates commuter-rail demand within the proposed service corridor using census tract journey-to-work data. "Marginal utility" is then calculated considering auto and rail modes for each census tract using the Washington Council of Governments (WASH-COG) free choice model for work trips. The calculations are based on a function of income, cost, and running time. The commuter-rail portion of the total journey-to-work trips to the CBD is then determined from an application of the WASH-COG free choice model and an adjustment for auto captivity. The study hypothesized that infrequent service could result in a large number of auto captives. For this reason, a relationship between auto captivity and number of trains for peak period operation was developed.

In addition to material contained in the published paper, a comparison report provides an appendix comparing the sensitivities of mode split models to "excess time" and parking costs.

SOURCE

A. D. May, Group Planner
Roads and General Division, Room 593
Transportation Branch
Planning and Transportation Department
County Hall
London SE1 7PB, England
(01) 633-7436

DESCRIPTION

The Planning and Transportation Department has developed an analytical aid to prepare a priority assessment of fixed guideway park and ride facilities and to estimate traffic generation associated with new land use developments.

SOURCE

Craig Miller
Beiswenger Hoch and Associates, Inc.
P.O. Box 600028
1190 N.E. 163rd Street
North Miami Beach, Florida 33160
(305) 949-4318

REFERENCE

Technical Report No. 1: I-95/N.W. 7th Avenue Bus/Carpool Systems: Final Proposal to UMTA and FHWA by the Florida Department of Transportation. North Miami Beach: Florida Department of Transportation. Supply depleted.

DESCRIPTION

For this analytical aid, two modal split analysis methodologies estimate express bus service patronage for peak hour operations. They require the use of an urban area transportation study trip table, FHWA's CMAT program, census data, and employment data from a transportation survey or census tape. The modal split factor is based on a travel time ratio versus percentage split curve for work trips adjusted upwards slightly to account for "other" trips not recorded in the model.

SOURCE

Robert Redmond
Transit and Traffic Engineering Branch HHP-26
Urban Planning Division
Federal Highway Administration
Washington, D.C.
(202) 426-0210

DESCRIPTION

One of the outputs of the FHWA Carpool Matching Program is a density matrix of the number of commuters residing in each home grid square who commute to a certain work grid at a specific time. The matrix can be a useful tool for use in planning new express bus routes and also for adjusting existing routes and schedules.

SOURCE

Louis D. Rollo
Asbury Park-New York Transit Corporation
401 Lake Avenue
Asbury Park, New Jersey 07712
(201) 774-2727

DESCRIPTION

Four "rules of thumb" concerning the provision or expansion of suburban commuter-oriented express bus service are described in this analytical aid. These rules relate ridership volumes and service frequency to the desirability of providing express bus service along major commuter corridors. This approach assumes that frequency of service and express operations are mutually antagonistic; that is, express service increases demand but cuts frequency, which then decreases demand. These rules of thumb are valid only for commuter transit operations of between 35 and 70 miles in length.

SOURCE

J. Arnold Torma
Gannett, Fleming, Corddry and Carpenter of Michigan, Inc.
232 W. Grand River, Suite 1702
Detroit, Michigan 48226
(313) 961-3340

DESCRIPTION

This analytical aid provides a method for the identification of the number of lanes and their configuration for exclusive bus facilities with local pickup in downtown areas. Projects such as transit malls can be designed by relating the expected flow of buses to the anticipated delay or the probability of delay. Graphs have been developed from simulations and probability theory for relating flow to delay.

SOURCE

J. Arnold Torma
Gannett, Fleming, Corddry and Carpenter of Michigan, Inc.
232 W. Grand River, Suite 1702
Detroit, Michigan 48226
(313) 961-3340

DESCRIPTION

This analytical aid describes a method for plotting the intensity of trip productions and attractions for a given day (present or forecast) by small areas to identify relative trip intensities of different locations. A trip productions and attractions table is input to a plotting routine with coordinates of each aerial unit. The result is a contour map of intensity of total trip productions, total trip attractions, trip productions plus trip attractions, total trip attractions, trip productions plus trip attractions, density of trip productions and attractions, or any measure desired. It is used to evaluate routings, alignments, and station sites.

SOURCE

Dr. V. Webster
Transport and Road Research Laboratory
Department of the Environment, Crowthorne Berks
United Kingdom
Telex 848272

DESCRIPTION

This analytical aid provides a method for calculating the maximum likely speed of a bus in a bus lane. The method is applicable in two situations: a CBD with maximum potential running speed of 30 mph and a CBD with maximum potential running speed of 40 mph. The method accounts for traffic signal, bus boarding and alighting, and acceleration/deceleration delays.

IV. TRANSIT ROUTE MONITORING AND EVALUATION

This section provides summaries for five analytical aids, each representing a simplified approach to transit route monitoring and evaluation.

SOURCE

Jim Deatherage
Metropolitan Tulsa Transit Authority
510 South Rockford
Tulsa, Oklahoma 74120
(918) 585-1195

REFERENCE

"MTTA Route Evaluation Procedures." Staff memorandum. July 16, 1975.

DESCRIPTION

This route evaluation procedure uses a manual network to depict and summarize transit performance on individual links of the system. Traffic checker reports on passenger behavior and schedule adherence are compiled into a format similar to the UNET portion of UTPS. This permits a comparison between revenue and cost patterns for every section of a route as well as a constant review of schedule reliability. Timing point observations from the supervisor's daily report are also added to the system to permit a measure of route efficiency.

SOURCE

J. Heilig
200 Arrowhead Place
211 W. 2nd Street
Duluth, Minnesota 55802
(218) 722-5545

DESCRIPTION

This analytical aid provides a method for monitoring transit route ridership utilizing radio equipped buses. The route-by-route ridership survey is performed to identify capacity problems (both excessively over and excessively under vehicle capacity).

SOURCE

Richard A. Murphy, John Whittington, Paul Price
San Diego Transit
P.O. Box 2511
San Diego, California 92112
(714) 238-0100

DESCRIPTION

To analyze existing transit routes, the San Diego Transit Company uses eight traffic checkers to conduct passenger counts. The checkers survey each run or trip a minimum of three times with the entire system checked about every six months. This information is then keypunched and processed in the following four programs:

- The first program is a passenger counting program for each bus stop. A profile of the activity at each bus stop over an average day is produced.
- The second program is the trip load program. Each trip is listed by terminal or starting time providing information on: (1) passengers per trip, (2) the largest boarding stop, (3) the largest "off" stop, and (4) where the maximum load point occurs.
- The third program is the route summary. Each route is divided into one-mile sections and the program then counts the total passengers boarding and alighting in each section.
- The fourth program is a run-time summary. This program develops information concerning the on-time capability of each route. When a route is rewritten, this program and associated data are used as a guide to figure running time.

Each route is evaluated on the basis of nine performance factors:

- monthly ridership (average);
- monthly growth in revenue passengers (average);
- percentage growth in passengers (monthly average);

- load factor;
- passengers per trip (monthly average);
- revenue per mile (monthly average);
- revenue per hour (monthly average);
- percent transfers (monthly average); and
- net cost per passenger.

SOURCE

Wayne E. Weidemann
Bi-State Development Agency
3869 Park Avenue
St. Louis, Missouri 63110
(314) 771-1414

REFERENCE

"Proposed Standards and Criteria for Service Expansion and Elimination." St. Louis: Bi-State Development Agency (February 3, 1976).

DESCRIPTION

This analytical aid provides a method for developing standards to evaluate existing transit service as well as proposed transit plans. The standards, established with regard to financial resource availability, political acceptance, and practical application, can be used to evaluate transit service expansion or elimination. The technique consists of two steps: (1) classifying transit routes by function and geographic area, and (2) establishing an average productivity index by classification (measured in passengers per revenue mile). Existing routes or proposed new routes which do not fall within one standard deviation below the average productivity index are defined as nonproductive. New routes have a 6-month period to meet this standard. Routes identified as nonproductive are analyzed and methods are developed to improve their productivity. If, after modifications, the routes still do not meet the minimum standard, they are recommended for elimination.

This approach is simple and systematic, and has built-in flexibility. It is practical because it takes into consideration (1) the multiple jurisdictions within an area, (2) the varying socioeconomic characteristics of the operating area, (3) the types of services being offered, and (4) the need to increase the systems operating efficiency and passenger productivity on a continuing basis.

SOURCE

Robert S. Winterhalter
Mid-Ohio Regional Planning Commission
514 South High Street
Columbus, Ohio 43215
(614) 228-2663

DESCRIPTION

In this analytical aid, service criteria are established for making route modifications or adding new service to selected areas. Transit route planning must be built upon a foundation of goals, objectives, policies, and service criteria. There are many standard sets of goals, objectives, and criteria that are used across the country. These can be tailor-made to the desires of the policy board of a transit authority or a regional authority can develop its own unique list. In either case, once criteria are adopted, the metropolitan transit authority and the regional authority can begin to review and revise the existing routes.

Service criteria must first be prioritized so that a logical implementation plan can be developed. A map with transit routes overlayed with densities, types of land use, and data showing the cost effectiveness of each route should be analyzed to determine which lines should be modified and where new lines should be added. A priority list, for transit service opportunities, might then be developed as follows:

- Provide new service to unserved areas.
- Provide service to major employment, commercial, institutional, and cultural centers using route deviation when appropriate.
- Increase the frequency of service on routes when load factors reach 130.
- Add new express service on local routes when load factors exceed 130.
- Upgrade urban service to produce transit time that is no more than double automobile traveling time during peak periods.
- Add new service to unserved suburban areas.

- Add direct service to major employment centers or communities which provide a guaranteed load of 40 passengers per bus at regular fares.

- Add additional night service and/or weekend service on main routes in urban areas.

- Add greater frequency of service to suburban areas.

- Add service to rural areas with stops at a community center or a park-and-ride lot.

- Add service to smaller employment, commercial, institutional, and cultural centers (those having less than 1,500 population), again using route deviation where appropriate.

- Add additional night and/or weekend service to suburban areas.

- Add greater frequency of service to rural areas.

V. SKETCH PLANNING ANALYSIS

This section provides summaries for 11 analytical aids representing simplified approaches to sketch planning analysis.

SOURCE

Thomas deWolf and David Williamson
Richmond Regional Planning District Commission
6 North Sixth Street, Suite 500
Richmond, Virginia 23219
(804) 644-8586

REFERENCES

Plan Report 1: Results of the Preliminary Analysis of Proposed Transit Routes and Improvements. Richmond: Richmond Regional Planning District (1975).

Technical Memorandum #3: Preliminary Assessment of Transit Alternatives Using Sketch Planning Techniques. Richmond: Richmond Regional Planning District (1975).

DESCRIPTION

This analytical aid can be used to perform a modal split on trip productions to a specific location using the logit model sketch planning technique described in the Macromanual. Trip productions are derived from gravity model output data for trip interchanges; in this manner, only the origin and destination districts that would be served by a proposed transit improvement are considered in the analysis.

SOURCE

Frederick C. Dunbar
Charles River Associates
1050 Massachusetts Avenue
Cambridge, Massachusetts 02138
(617) 354-0200

REFERENCE

"Estimating the Effect of Urban Travel Policies: Linear Model of Nonwork Travel." Available through National Technical Information Service.

DESCRIPTION

Nonwork travel behavior, including transit trips, VMT's, number of auto trips, and average auto trip distance, at any level of aggregation, is forecast with a linear simultaneous equation system or with the elasticities implied by the model described in this analytical aid. Most policy scenarios can be simulated with a calculator in 15 minutes if suitable data are available. Data requirements comprise about 25 variables; for aggregate data, the means of the observations can be used without incurring aggregation bias.

SOURCE

Frederick C. Dunbar
Charles River Associates
1050 Massachusetts Avenue
Cambridge, Massachusetts 02138
(617) 354-0200

REFERENCE

"Calculating the Effects of Urban Travel Policy: Applications to Market Segment Data for Work Trip." Available through National Technical Information Service.

DESCRIPTION

In this analytical aid, existing disaggregate mode choice models are applied to cross-tabulations of travel data to predict the effects of changes in level of service on mode split (including auto passenger) and VMT's. The simulation of a typical policy scenario takes about two hours on a calculator; it takes less time on a computer with a simulation package. Data requirements comprise about 12 observations (existing tabulations of market segments) and about seven variables for each observation.

SOURCE

Frederick C. Dunbar
Charles River Associates
1050 Massachusetts Avenue
Cambridge, Massachusetts 02138
(617) 354-0200

REFERENCE

"Calculating the Effect of Urban Travel Policy: Application to Sketch Plan Zonal Data for the Work Trip." Available through National Technical Information Service.

DESCRIPTION

In this analytical aid, a sample of sketch plan zonal interchanges from any given planning region is used for quick policy evaluation. Disaggregate mode choice models are adjusted using several approaches to account for the aggregation problem. The resulting adjusted models are applied to the data base to simulate the regional, or subregional, effects of policy options. For most urban areas, the use of a computer for the simulation is advised. Typical data base requirements comprise eight variables from a 5-percent sample of a sketch planning zone trip table (approximately 100 observations). Outputs include predicted mode splits (including auto passenger) and VMT's. Using interactive hardware and software, the user can simulate the effects of a policy option in approximately one hour.

SOURCE

Juergen A. Fehr
Alan M. Voorhees & Associates, Inc.
2150 Shattuck Avenue
Berkeley, California 94704
(415) 843-9746

REFERENCE

Technical memoranda from the Boston Transportation Planning Review Study, Reference Number 920.

DESCRIPTION

These memoranda present the results and conclusions of prototypical studies of potential line-haul transit alternatives for the Boston Transportation Planning Review Study. The two primary purposes of the analysis were:

- to determine the relative inherent advantages of various transit system extension alternatives under consideration; and

- to develop factual data and background information to better understand the performance and sensitivity of each alternative in terms of its capital cost, operating cost, and level of service.

The approach described in this analytical aid is based on the assumption that each transit mode has certain inherent characteristics including speed, operating patterns, capacities, operating costs, service provided, etc., which make it more favorable (or unfavorable) than other modes considered in similar circumstances. By comparing selected alternatives on a hypothetical basis, the relative differences in cost and service can be measured.

SOURCE

Albert E. Klais
Wisconsin Department of Transportation
Division of Planning
4802 Sheboygan Avenue
Room 901
Madison, Wisconsin 53705
(608) 266-1403

REFERENCE

<u>North Fitchburg Transportation Study.</u> Madison: Wisconsin Department of Transportation (1975).

DESCRIPTION

This analytical aid consists of the analysis approach used by the Wisconsin Department of Transportation to conduct the North Fitchburg Transportation Study. The methodology employs a traffic assignment network approach, with modifications made to traffic volumes, to account for modal split and auto occupancy. The procedure is not a manual procedure, although it is less time-consuming than a full-scale, areawide, modal-split analysis.

The traffic assignment network used for the study was refined by splitting traffic analysis zones to more closely represent anticipated zonal loadings. Highway capacities were closely examined and checked in an attempt to reflect more accurately the capacity of the existing plus the committed system. "Corridor reduction factors" were then developed to reflect the travel demand along certain links resulting from shifts in modal split and auto occupancy rates assumed under different study alternatives.

SOURCE

Bernard C. Koontz
Washington State Department of Highways
Planning Research and State Aid
Highway Administration Building
Olympia, Washington 98504
(206) 753-7425

DESCRIPTION

A simple post-distribution modal-split procedure for use in small urbanized areas is described in the analytical aid submitted by this author. The independent variables used in this procedure include vehicles per dwelling unit for home-based work trips and home-based nonwork trips, and accessibility or distance to a transit line for non-home-based trips.

SOURCE

Eric C. Phillips
Planning and Research Division
Arkansas Highway Department
P.O. Box 2261
Little Rock, Arkansas 72203
(501) 569-2207

REFERENCE

"Experimental Application of a Method for Small Urban Areas Through Synthesization," Georgia State Highway Department.

DESCRIPTION

This analytical aid describes an approach for synthesizing a trip distribution table for small urban areas based on a procedure for synthesizing friction factors.

SOURCE

Marshall F. Reed, Jr., and Carmen Difiglio
Highway Users Federation
1776 Massachusetts Avenue, N.W.
Washington, D.C. 20036
(202) 833-5878

REFERENCE

Technical Study Memorandum No. 10: Testing Urban Transit's Future." Paper presented to the American Society of Civil Engineers in Montreal, Canada, August 1974. Available from Highway Users Federation.

DESCRIPTION

This report describes a "sketch planning" process for the quick analysis of proposed improvements to an urban transit system. This process can be used to test and evaluate alternative levels of transit service and compare estimated riderships, costs, and social benefits. The primary objective of the methodology is to simulate the potential changes in transit ridership resulting from alternative transit improvement policies.

The sketch planning process requires the development and calibration of a modal split model or diversion curves appropriate for estimating person trip interchanges between super-zones of a metropolitan region--typically stratified as CBD, CBD-fringe, and suburban. The procedure is capable of testing several combinations of transit services ranging from commuter-rail to demand-responsive services. Average unit costs are also provided for use in calculating the capital and operating costs associated with the proposed transit improvements.

SOURCE

M. Schlappi and John W. Dickey
Center for Urban and Regional Studies
Division of Environmental and Urban Systems
Virginia Polytechnic Institute and State University
Blacksburg, Virginia 24061
(703) 951-5177

REFERENCE

"QUANDATT: Quick and Dirty Analysis Techniques for Transportation." Springfield, Virginia: National Technical Information Service (1973). Publication No. PB 225-441/5AS.

DESCRIPTION

This report contains regional population, employment, land use, travel, and related models for testing different aggregate urban transportation alternatives. These models include:

- Minimum Travel Time Paths (TRANSET);
- Regional Population Growth (Cohort-Survival);
- Regional Employment Growth (Input-Output);
- Zonal Land Use Development (Empiric);
- Number and Segregation Families by Income (%);
- Trip Production and Attraction (Voorhees);
- Try Distribution (Gravity); and
- Modal Split (Twin Cities).

The eight models have been simplified and integrated so that a large number of sketch plans can be quickly evaluated.

SOURCE

Jeffrey M. Zupan
Regional Plan Association
235 East 45th Street
New York, New York 10017
(212) 682-7750

REFERENCE

(With Boris S. Pushkarev) Public Transportation and Land Use Policy. Bloomington: Indiana University Press (1977).

DESCRIPTION

This report, submitted as an analytical aid, detailed the land use and density arrangements required to support a variety of public transportation modes and levels of service. Major chapter subjects include:

- demand for transit: the role of service improvements;
- demand for transit: the role of the density of development;
- transit supply: operating and capital costs;
- transit supply: operating conditions;
- matching supply and demand at different densities; and
- procedures for estimating transit demand.

VI. TRIP GENERATION ANALYSIS

This section provides summaries for two analytical aids, each of which represents a simplified approach to trip generation analysis.

SOURCE

William A. Elgie, Jr.
Delaware Department of Transportation
P.O. Box 778
Dover, Delaware 19901
(302) 678-4346

REFERENCE

Special Traffic Generator Study: Report Number 1, Residential Generators. Dover: Delaware Department of Transportation (1974).

DESCRIPTION

This analytical aid provides an approach for gathering, reporting, and developing travel generation rates for residential areas based upon traffic counts and field interviews in 60 residential sites in Delaware. A number of stepwise multiple regression equations for residential trip generation were developed from the data gathered during this study. The equations depict the number of one-way trips generated per dwelling unit per subdivision as a function of average number of autos owned per dwelling unit, average income per household, and percentage of single-family detached and duplex dwelling units.

SOURCE

Charles Erdrich
c/o Professor Richard J. Scranton
Department of Civil Engineering
Northeastern University
360 Huntington Avenue
Boston, Massachusetts 02115
(617) 437-2444

REFERENCE

"A Disaggregate Stochastic Model for Predicting the Trip Generation Impact of Proposed Housing Developments" (Master's thesis, Northeastern University, 1975). Available from Dodge Library, Thesis Department, 360 Huntington Avenue, Boston, Massachusetts 02115.

DESCRIPTION

This analytical aid provides a technique for predicting the trip generation impact of proposed housing developments. The technique, which is designed for use by a local planning agency, is a short-cut method for analyzing a special context planning problem.

The author has formulated a theoretical model of residential trip generation and applied the model to a particular specialized situation. In the theoretical model, the probability that an individual will choose whether or not to travel for a specific purpose or activity is determined by: his socioeconomic level, his overall impedance to alternate destinations engaged in the given activity, and the overall attractiveness of these destinations as perceived by the prospective tripmaker. A logistic function was chosen as the mathematical form for relating the above factors to the probability of travel.

Two important factors were considered in the specification of variables for the operational models:

- availability of data for both formulating the model and making predictions with it; and
- sensitivity to relevant policy decisions to be made.

In the model, the number of trips generated by a proposed housing development is dependent on: the number of housing units, the number of rooms per unit, and the gross rent per unit. These data are readily available from the housing site plan, and, using census data and consumer price information, may be used to determine values for family size (number of persons per unit) and income level. Trip generation is then estimated as a function of these variables. Four trip generation models are calibrated using the method of maximum likelihood estimation: urban work, urban shopping, suburban work, and suburban shopping. An expression for accessibility, combining features of the theoretical impedance and attractiveness terms, is shown to be statistically significant only in the suburban shopping model. A comparison of actual versus predicted trip generation is presented for several levels of disaggregation, and a method is provided for evaluating the level of confidence in the estimates.

VII. LAND USE PLANNING AND ACTIVITY ALLOCATION ANALYSIS

This section provides summaries for four analytical aids, each of which represents a simplified approach to land use planning and activity allocation analysis.

SOURCE

John M. Courtney
Architecture Planning Research/Associates
3034 M Street, N.W.
Washington, D.C. 20007
(202) 337-1755

REFERENCE

"Developing Alternative Futures--Changes in the Land Use Planning Process." Paper presented to the American Society of Civil Engineers National Capital Sector Conference, June 1975.

DESCRIPTION

This paper argues that one of the major planning problems to date has been the tendency to plan for a static society at a given future date, with specified population, income, employment, and residential projections. Little attention is given to the process of getting from here to there and none to what may happen after that planning date.

Most plans and forecasts that are made are based explicitly or implicitly on assumptions about the future--assumptions which are often incorrect. In an effort to remedy this trend, the author advocates the use of planning scenarios which define possible futures rather than the most probable future. In this instance a scenario is defined as "... a plausible story about how present conditions could lead to hypothetical future states, with the aims of identifying points at which important choices will have to be made and the options that will be available at those points and thereby assessing probable outcomes."

SOURCE

John W. Dickey, John F. Brotchie, and Ron Sharpe
Center for Urban and Regional Studies
Division of Environmental and Urban Systems
Virginia Polytechnic Institute and State University
Blacksburg, Virginia 24061
(703) 951-5177

REFERENCES

"TOPAZ (Technique for the Optimum Placement of Activities in Zones)" (unpublished).

National Technical Information Service. Proceedings of the First Binational (U.S./Australia) Urban Systems Symposium, April 1975. Edited by J. W. Dickey and R. W. R. Muncy. (NTIS Pub. No. PB 241 120/AS)

DESCRIPTION

This report documents the development and application of the mathematical programming model TOPAZ which provides an analytical aid designed to allocate land use in an urban area in such a fashion as to minimize public service and travel costs. The primary objectives of this program are to:

- minimize total urban service and transportation costs;
- minimize travel (both in urban areas and in buildings);
- minimize air pollution emissions and gasoline consumption; and
- maximize accessibility.

In addition to projecting the optimum distribution of land use in an urban area, TOPAZ has been used to determine the arrangement of campus buildings, the layout of hospital wards, and the distribution of activities around a reservoir.

SOURCE

Robert E. Heightchew, Jr.
Highway Users Federation
1776 Massachusetts Avenue, N.W.
Washington, D.C. 20036
(202) 833-5293

REFERENCE

"Countywide Land Use Forecasts." Journal of the Urban Planning and Development Division 101 (November 1975): 135-145.

DESCRIPTION

This analytical aid provides a manual procedure for developing land use forecasts for small urban area transportation studies using limited time and monetary resources. The procedure assumes that: (1) the population and employment for the entire area in the target year are established; and (2) the general nature of a typical activity in the target year can be described. Given these assumptions, the task is one of distributing population and employment among the available locations.

The distribution or allocation of activities requires a three-step process. First, the available undeveloped or underdeveloped land is subdivided into small areal units called cells. Each cell is then ranked according to its relative attractiveness to future development. Second, the total activity to be allocated (consisting of industrial, commercial, high-density residential, and low-density residential land uses) is disaggregated into hypothetical "individual activities." The individual activities are used to array the four land use forecast groupings into different population and employment density categories. Finally, the list of individual activities is matched to the list of ranked cells. The distribution of population and employment resulting from this process is then used to project future travel demand patterns for the study area.

SOURCE

Arthur W. Lewis
Economics Section
U.S. Army Engineer District, Kansas City
700 Federal Building
Kansas City, Missouri 64106
(816) 374-3173

REFERENCE

"Location Advantage--Transportation Costs for Small Areas Within a Metropolitan Area." Economics Section, U.S. Army Engineer District, Kansas City (1975).

DESCRIPTION

The purpose of the Location Advantage methodology is to determine the transportation costs and, subsequently, any advantage or disadvantage to locating future development in various areas of a metropolitan region. The analytical aid described in this report uses gravity flow techniques to determine distances and times traveled to various areas within a metropolitan area. Cost data are then used to determine transportation costs for small areas within a metropolitan area. The procedure uses data that can be obtained from urban transportation studies, i.e., attraction relationships, generation relationships, and friction factors. Currently the methodology is performed by calculator but it could be readily computerized.

VIII. ECONOMIC ANALYSIS

This section provides summaries for four analytical aids, each representing a simplified economic-based transportation analysis method.

SOURCE

Mr. R. H. Heacock
Acting Assistant Director
Transport Engineering Branch
Bureau of Transport Economics
P.O. Box 367
Canberra City A.C.T. 2601, Australia

DESCRIPTION

This analytical aid, the Corridor Model, consists of a set of programs which enables the user to avoid the repetitious calculating tasks involved in performing benefit-cost studies of urban public transport projects. The programs take data from studies of passenger behavior and the relevant output of transportation planning packages and compute the discounted costs and benefits associated with the project. The model cannot be used to analyze a complete urban area, but focuses its attention on particular corridors within an urban area. It uses the concept of "generalized cost" as defined by the Mathematical Advisory Unit in the United Kingdom and can analyze rail, bus, and train projects.

The programs are coded in IBM CALL/360 FORTRAN, and are interactive (with the user providing answers to program-generated questions at a typewriter terminal). The emphasis is on ease of operation and rapidity of turnaround.

The model has been used extensively by the Bureau of Transport Economics in Australia and it is at present undergoing modification in order to improve its efficiency and cost effectiveness.

SOURCE

Mr. R. H. Heacock
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Transport Engineering Branch
Bureau of Transport Economics
P.O. Box 367
Canberra City A.C.T. 2601, Australia

REFERENCE

"Program User Manual, General-Purpose Investment Analysis Model (GPINVEST)." Canberra, Australia: Bureau of Transport Economics, (February 1976).

DESCRIPTION

This analytical aid, General Purpose Investment Analysis Model, consists of a set of programs which enables the user to avoid many of the repetitious calculating tasks involved in benefit-cost studies. Basically, the model enables the user to specify complex time-streams of costs and benefits in a simple manner. The programs obtain actual costs and benefits in a particular year in several reporting categories. The user may specify discount rates and may obtain tables of discounted costs and benefits on demand. Totals for each year and category are generated automatically, together with grand totals for costs and benefits. Benefit-cost ratio and net present values are provided, and internal rates of return may be computed if desired. The model can also accommodate cost-only studies.

The programs are coded in IBM CALL/360 FORTRAN, and are interactive (with the user providing answers to program-generated questions at a typewriter terminal). The emphasis is on ease of operation, and the model is manipulated largely by "yes" and "no" responses.

Specifications of cost and benefit time-streams are supplemented by titling information, with the result that a study "profile" is generated. This profile may be edited, listed, and stored for future use. A file of model usage and status information is preserved. Error warnings are provided at most steps in the operation of the model, and a system of error codes is used to indicate the nature of particular errors. In general, the user is given opportunities to correct errors directly.

The specifications of cost and benefit components may be selected from a wide range of standard mathematical functions. These include lines, sine waves, sawtooth waves, and discrete values. The means and amplitudes of sine, square, and sawtooth waves may be modulated by a variety of functions, and positive or negative half-cycles may be suppressed, if desired. Final report generation features automatic selection of decimal places and a plot of total annual costs and benefits.

SOURCE

Douglass B. Lee
Institute of Urban and Regional Research
245N OH Oakdale Campus 23F
Oakdale, Iowa 52319
(319) 353-3862

REFERENCE

"A Cost-Oriented Methodology for Short-Range Transportation Planning." Paper presented at the 55th annual meeting of the Transportation Research Board, Washington, D.C., January 1976.

DESCRIPTION

This analytical aid consists of an "impact evaluation" strategy for short-range transportation planning which breaks a policy problem down into small, manageable problems and the applies a depth of analysis that is appropriate to the level of debate on the issue. Flexibility is of paramount importance, with six steps--input parameters, service environment, demand, capacity, quality and pricing, and unit costs--being ordered in accordance with the specific problem. Ordering depends upon which variables are selected as "facts," which as "targets," and which are derived as "requirements." Evaluation is accomplished by comparing incremental unit costs (e.g., cost per passenger mile or per trip) with service level changes and other incremental benefits.

Operationally, the analyst begins by listing salient facts (vehicle capacity of the existing road network, price of gasoline), then adds a list of targets (minimum levels of service, desired mode split, maximum cost per trip, given vehicle capacity), until enough information has been assembled to calculate requirements (additional capital investment, occupancy factors, feeder systems, levels of operation). Any of these may be reordered, either between different problems or within different cycles on the same problem. Mode split, for example, can be regarded as fact, target, or requirement; the price of gasoline may be a fact today but a policy variable tomorrow.

SOURCE

D. A. Quarmby
London Transport
55 Broadway
London, SW1H OBD
United Kingdom

REFERENCES

M. H. Fairhurst and P. J. Moms. "Variations in the Demand for Bus and Rail Travel in London up to 1974." Economic Research Report R210. London: Business Planning Department, London Transport, (1975).

M. H. Fairhurst. "London Transport's Fares Revision (March 1975): An Analysis." Economic Research Report R218. London: Business Planning Department, London Transport, (1975).

DESCRIPTION

For this analytical aid, an analysis of weekly bus and rapid rail ridership was used to develop reliable estimates of price, service level, and income elasticities by mode and peak/off-peak operations. The results from this analysis are being used for detailed service planning and for strategic policy evaluation using simple "business" models.

IX. TRAFFIC OPERATIONS ANALYSIS

This section provides summaries for seven analytical aids, each of which represents a simplified approach to traffic operations analysis.

SOURCE

Robert W. Crommelin
Crommelin-Pringle & Associates
4525 Sherman Oaks Avenue
Sherman Oaks, California 91403
(213) 788-8570

REFERENCE

"Employing Intersection Capacity Utilization Values to Estimate Overall Level of Service." Traffic Engineering (July 1974): 11-14.

DESCRIPTION

This analytical aid provides a technique for estimating the overall level of service for an intersection, based on volume levels and intersection geometrics. The output of the method is an estimate of intersection capacity utilization (ICU) which is defined as ". . . the proportion of the total hour required to handle intersection traffic volumes if all approaches operate at the level of service E." The following steps are involved in applying the technique:

- determine design peak-hour turning movement volumes for the morning and evening peak-hours at the intersection;
- make an inventory of existing and planned intersection geometrics;
- calculate capacity in terms of vehicles per hour of green traffic signal for each approach or phase using Highway Capacity Manual level of service E;
- identify critical movements for each phase;
- calculate the volume/capacity (V/C) ratio for each critical movement by dividing volume by capacity;
- add an allowance for yellow signal clearance intervals;
- relate the sum of the V/C ratios plus yellow signal allowance (the ICU) to level of service; and

- revise phasing, geometrics, or other factors if necessary, to bring the total ICU to the desired level of service. When the ICU approaches one, it equals operation at level of service E (capacity); if less, it represents operation at a higher level of service.

SOURCE

Jerome W. Hall
Associate Professor
Department of Civil Engineering
University of Maryland
College Park, Maryland 20742
(301) 454-2438

REFERENCE

Research on Route Diversion Parameters. Brookland, Maryland: Maryland State Highway Administration, (February 1975).

DESCRIPTION

Selected portions of this report relate the experiences of one researcher in setting up and operating a roadside survey along Interstate 95 within the Baltimore-Washington corridor. These experiences are related to:

- development of a field survey form for distribution to motorists;
- the selection of an appropriate survey site along the roadway;
- the development of a signing scheme alerting motorists to the presence of the survey crew positioned ahead on the roadway; and
- the management of the survey in the field, including the number of personnel needed, the sorts of traffic control assistance required from local and state law enforcement agencies, and ways to ensure an even flow of traffic through the survey site.

SOURCE

Howard R. Kirby
(for the late Professor R. J. Smeed)
Traffic Studies Group
University College London
Gower Street
London WC1E 6BT, England
01/387 7050

REFERENCES

R. J. Smeed. "Traffic Studies and Urban Congestion." Journal of Transportation Economics and Policy 2(1), 1968, pp. 33-70.

J. G. Wardrop. "Journey Speed and Flow in Central Urban Areas." Traffic Engineering and Control 9(11), 1968, pp. 528-32, 539.

R. J. Smeed and E. M. Holroyd. "Some Factors Affecting Congestion in Towns." Paper presented to Conference on Engineering for Traffic, July 9-12, 1963 (London: Printerhall Ltd.), pp. 83-91.

DESCRIPTION

Research has produced several interrelations between the supply characteristics of streets and parking facilities in the central areas of cities and traffic volumes on central area streets. Supply variables include average speed of traffic, roadway widths, area of the central city, average distance traveled in the central city, and proportion of the central city area devoted to streets and parking. Travel characteristics which are investigated as functions of the supply characteristics and traffic volumes in central cities include:

- average length of a journey during the peak period;
- number of vehicles that arrive at central city destinations in a peak hour;
- average distance traveled in the central area;
- travel times;
- daily variation due to congestion;

- time losses due to congestion;

- proportion of roadways which are occupied by vehicles; and

- occupancies of buses and cars.

The effect of the following traffic capital and operational improvements are investigated in terms of these relationships:

- intersection improvements;

- circumferential roads around the central area; and

- parking improvements.

SOURCE

Ira S. Kuperstein
New Jersey Institute of Technology
Newark College of Engineering
Civil and Environmental Engineering Department
323 High Street
Newark, New Jersey 07102
(201) 645-5431

DESCRIPTION

This analytical aid is used to determine the best type of control (scheduled or demand-responsive) and optimum cycle length for draw-bridges which conflict significantly with vehicular movement when opened. The methodology draws an analogy between this problem and the operation of (and the design of the timing for) a traffic signal at an isolated intersection.

SOURCE

Robert H. Patneaude
Bureau of Transportation Planning and Development
Massachusetts Department of Public Works
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DESCRIPTION

This analytical aid provides a manual procedure for calculating turning movements at "T" intersections using a simple set of two simultaneous equations which relate nondirectional turning movements at the intersection to nondirectional counts on each leg. Suppose the three legs of a "T" intersection are designated A, B, and C, with AC being the nonturn, through movement. Count volumes recorded on each leg are V_A, V_B, and V_C, respectively.

Let the turning movement volumes (total for both directions) be V_{AB} and V_{BC}, and through movement volume be V_{AC}. Using V_A, V_B, and V_C, the right and left turning movement volumes (V_{AB}, V_{BC}) can be determined. The first equation describes the two traffic components of the middle leg of the intersection (B):

$$V_B = V_{AB} + V_{BC}$$

For the second equation, the through movement volume (V_{AC}) can be expressed as a function of each through movement leg traffic count and the turning movement volume:

$$V_{AC} = V_A - V_{AB} = V_C - V_{BC}$$

Solving both equations simultaneously yields the turning movement volumes:

$$V_{BC} = \frac{-V_A + V_B + V_C}{2}$$

$$V_{AB} = \frac{V_A + V_B - V_C}{2}$$

SOURCE

Samuel R. Seward and Robert N. Taube
Program Research and Development Section
Department of City Development
734 North Ninth Street
Milwaukee, Wisconsin 53233
(414) 278-2690

REFERENCE

"Development of Warrants and Planning Guidelines for Bus Actuated Signal Preemption Systems." Milwaukee: Department of City Development (Feb. 1976, Revised July 1976).

DESCRIPTION

Although bus preemption systems have been tested and proven feasible, no generalizations have been drawn from these experiments. Planners have therefore been prevented from applying this innovation to their particular geographic locations with any assurance that it would be economically desirable. This report presents a disaggregated view of an unconditional green signal extension preemption strategy. The impact upon both bus and other traffic at characteristically defined intersections is measured by a monetary equivalent of traveler's time saved or lost due to a preemption action. The frequency of this occurrence is determined by the proportion of randomly arriving buses which arrive within a predetermined time interval where the need for, the eligibility to receive, and the ability to grant a preemption is recognized. The accumulation of the net savings and losses from the preemption system can be compared to the costs of supplying, installing, and maintaining the necessary equipment to yield a revenue-cost comparison. Cycle length, bus loading, auto volumes, and maximum green extension lengths provide warrants by which quick reference tables are supplied to look up average daily return and the revenue-cost ratio. This revenue-cost comparison is used to evaluate the economic desirability of installing a bus-actuated signal preemption system at any identified intersection.

X. PARKING ANALYSIS

This section provides summaries of three analytical aids, each representing a simplified approach to parking analysis.

SOURCE

Warren T. Anderson and Tom Knoche
Baltimore City Department of Planning
222 East Saratoga Street
Baltimore, Maryland 21202
(301) 396-4358

REFERENCE

"Waverly Parking Study." Baltimore City Department of Planning (1976).

DESCRIPTION

This analytical aid employs a turnover survey, a peak-hour questionnaire, and a software package to analyze the parking conditions in subareas of a city and is designed for areas encompassing 10 to 50 blocks in non-CBD locations. The surveys are conducted at both on-street and off-street parking facilities within the study area. Data from the surveys can be used to analyze turnover, space utilization, and supply/demand for geographic subareas and duration categories based on peak-hour accumulations. This analysis enables the planner to identify short- and long-term parking supply deficiencies, determine locations requiring metering and/or better enforcement, and develop policies to better use existing parking facilities.

SOURCE

C. Edwin Brewer
Department of Traffic and Parking
200 Orange Street
New Haven, Connecticut 06510
(203) 562-0151

DESCRIPTION

This analytical aid determines the percent of drivers in moving vehicles looking for an on-street parking space in a particular block. This information allows the planner to estimate the reduction in traffic volume which could be expected if off-street parking facilities were provided.

For a given block, the field observer must wait until all the on-street parking spaces are occupied. Once a single space is vacated, the observer must count the number of vehicles which pass this empty space until it is occupied again. The percent of parkers looking for a parking space is therefore equal to one divided by the number of vehicles which passed the space before it was occupied.

SOURCE

C. Jackson Faustman
(formerly with Eno Foundation, Westport, Connecticut)
2415 L Street
Sacramento, California 95816

REFERENCE

"Estimation of Parking Facility Usage." Traffic Quarterly (no date), pp. 68-78.

DESCRIPTION

This article describes a method for estimating the use of and revenues from providing new off-street, short-term parking facilities within a CBD. This approach assumes that the market for a single, new off-street parking facility is composed of:

- Diverted Parkers - parkers using existing curb and off-street spaces in the area served by the new facility who find the new facility offers a relative advantage in terms of price, location, convenience, or accessibility.

- Induced Parkers - new parkers induced or attracted to the facility by the existence of additional parking combined with the generating power of the business, commercial, and other development in the area.

- Displaced Parkers - parkers patronizing an existing facility which is modified, moved, enlarged, or displaced to make way for another type of parking facility or for changes in size or method of operation.

- Shifted Parkers - parkers whose place of parking shifted due to a change of destination.

- Translated Parkers - parkers using a facility as part of a trip, partly by one mode and partly by another, such as mass transit.

- Converted Parkers - parkers who previously used mass transit because of the lack of adequate or convenient parking.

The step-by-step procedure used in the procedure includes:

- determining the facility's zone of influence;
- taking inventory of the use characteristics within the zone of influence;
- computing the total annual volume of displaced, diverted, and induced parkers;
- estimating the future growth of parking volume;
- testing the reasonableness of the estimate by the capacity of the facility to handle the estimated volume, by the traffic capacity of the street system to absorb the additional loads, and against the operating results of existing facilities in the zone of influence; and
- translating the annual parking volume into revenue based on an assumed average parking time per car and the rate structure.

XI. ENVIRONMENTAL IMPACT ANALYSIS

This section provides summaries for three analytical aids, each of which represents a simplified approach to environmental impact analysis.

SOURCE

David A. Doctor
Green River Area Development District
P.O. Box 628
Owensboro, Kentucky 42301
(502) 685-2938

REFERENCE

"A Manual Model to Predict Highway Related Carbon Monoxide Concentrations." Detroit: Southeast Michigan Council of Governments, (1975). Available from James Thomas, Manager of Information Services, SEMCOG.

DESCRIPTION

This analytical aid is based on a manual model developed to predict a region's highway related carbon monoxide concentrations under different conditions. The model incorporates the variables describing meteorologic conditions including both atmospheric stability and wind; vehicle mix by age and the associated vehicle miles traveled; vehicle type, distinguishing between light and heavy duty vehicles; carbon monoxide emissions by year modified by average link speed; traffic volume measured for the peak-hour and eight-hour hourly average, and pollutant dispersion factors for both horizontal and vertical directions. With an accurate description of a facility's design, use characteristics and meteorological conditions, a very accurate prediction may be made of the carbon monoxide concentrations on or near the facility.

SOURCE

David A. Doctor
Green River Area Development District
P.O. Box 628
Owensboro, Kentucky 42301
(502) 685-2938

REFERENCE

B. A. Kugler, G. S. Anderson, D. E. Commins, and A. G. Piersol. Establishment of Standards for Highway Noise Levels. Vol. III: Highway Noise Propagation and Traffic Noise Models." Prepared by Bolt Beranek and Newman, Inc. for the National Cooperative Highway Research Program.

DESCRIPTION

This model provides a preliminary method for predicting a region's highway related noise levels so that potential problem areas can be identified. The model is based on a simplified method which computes approximate highway noise levels on a large scale using a limited amount of data. It incorporates the variables of traffic volume, vehicle type (distinguishing between light and heavy duty vehicles), vehicle speed, observer distance, and roadway design.

SOURCE

Paul Gilbert
Orange County Environmental Management Agency
400 Civic Center Drive West
Santa Ana, California 92701
(714) 834-3482

REFERENCE

"Procedure for Noise Determination for Arterial Highways." Office of County Surveyor and Road Commissioner, County of Orange, April 1974.

DESCRIPTION

This analytical aid provides a procedure for determining roadway noise levels by using both the FHWA Report No. 117 "Highway Noise Design Guide" (1971) and the "HUD Noise Assessment Guidelines" (August 1971). Noise analysis charts were prepared using the FHWA method for typical major, primary, secondary, and commuter arterial highways. These charts can be used to obtain existing, tenth-year, and ultimate noise levels at various distances from the roadway centerline. A simple graph of distance from centerline versus noise levels for existing, tenth-year, and ultimate traffic volumes can be quickly constructed from these charts for inclusion in, for example, an Environmental Impact Report.

XII. MISCELLANEOUS ANALYSIS AIDS

This section provides annotated summaries for six analytical aids which offer simplified approaches to the analysis of traffic safety, traffic operations, intercity travel, and air travel, respectively.

SOURCE

John Ahrendes, Project Planner
International Bechtel Incorporated
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Amman, Jordan
Telex: 1508 WATEKA J0

DESCRIPTION

This analytical aid provides a condensed version of the Highway Capacity Manual chapter on capacity of limited access highways. This condensed version was prepared by students attending California State Polytechnic University.

SOURCE

Bill Barker
North Central Texas Council of Governments
P.O. Drawer COG
Arlington, Texas 76011
(817) 461-3300

REFERENCE

Network Analysis in Geography. Peter Haggett and Richard J. Chorley. New York, New York: St. Martin's Press.

DESCRIPTION

This book provides an analytical method (page 124) for estimating the average trip length in a small area (CBD, dial-a-bus service area, etc.).

SOURCE

James B. O'Grady
Department of Transportation Services
City of Arvada
8101 Ralston Road
Arvada, Colorado 80002
(303) 421-2550

REFERENCE

Memorandum to the Jefferson County School District R-1 from the Department of Transportation Services of the City of Arvada, November 19, 1975.

DESCRIPTION

The analytical aid described is used to determine when flashing lights should be used on school buses that are loading and unloading children at schools. Guidelines have been developed from the safe stopping sight distance (SSSD) requirements of the American Association of State Highway and Transportation Officials. These standards relate the use of the flashing lights to street width, vehicle speed, and the distance and relative position of the stopped school bus from nearby crosswalks.

SOURCE

John B. Peers
Alan M. Voorhees & Associates, Inc.
7798 Old Springhouse Road
Westgate Research Park
McLean, Virginia 22101
(703) 893-4310

REFERENCE

"Intercity Travel Sensitivity Analysis: Memoranda No. 1, 2, and 3." Alan M. Voorhees and Associates, Inc. December 22, 1975.

DESCRIPTION

Three memoranda describe the Intercity Travel Sensitivity Analysis models developed as part of the Sacramento-Stockton-San Francisco Corridor Study. The first memorandum defines the background for the sensitivity analysis and the direct-demand models developed as part of the Corridor Study. The second memorandum details the testing scenarios used during the study and defines the individual "measures" that form the basic components of the scenarios. These measures included socioeconomic changes, transit system changes, and auto system changes. The final memorandum graphically displays the individual measures and provides an evaluation of their impact on travel demand.

The complete report can serve as an analytical aid for developing and easily calculating the results of alternative scenarios and assumptions. If a scenario is developed which has a number of alternative measures (e.g., population, vehicle ownership, changes in transit time and auto time, fares, and cost of auto travel), a new estimate of demand can be made for each alternative.

SOURCE

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Montreal, Quebec
Canada
(514) 283-4072

DESCRIPTION

This analytical aid describes a simple signal timing technique. If the travel time between two traffic signals is less than one quarter or greater than three quarters the cycle length, then the offset should be simultaneous. If the travel time is between one quarter and three quarters of the cycle length, then the offset should be alternate. This procedure works for two way progression signalling only.

SOURCE

Kent L. A. Zimmerman
Statewide Planning Program
265 Melrose Street
Providence, Rhode Island 02907
(401) 277-2656

DESCRIPTION

Airline personnel regularly detach a portion of a passenger's ticket when issuing a boarding pass. It is a simple matter for them to note on a prepared form the final destination listed on the ticket for every passenger boarding the flight. This information can then be used by a state planning program to determine the trend pattern of passengers enplaning at the airports serving the state.