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lexicon

NOTICE

A UTPS LEXICON

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prepared by

Rock Creek Associates

under subcontract to

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prepared for

UTPS LEXICON

FOREWORD

Have you ever seen a student nod off or take on a bewildered
stare while his teacher is presenting his best lecture? I have,
and I was the teacher! The student who was going blank did not
completely understand all the words I was using. But if I had
stopped in midparagraph to define every technical term, I would
have put to sleep the majority of students who already understood
the words.

Have you ever read a recondite document--like the UTPS Refer-
ence Manual--and come across numerous words that you did not un-
derstand? You wish the author could define his terms, but you
know that it would be impractical to encumber a program writeup
with definitions of all its technical terms. It is already too
much to read. Because the word is arcane, you find no help in
your standard English dictionary. Frustrated and uncertain, you
forge ahead reading anyway, hoping the meaning of the word will
magically materialize in the context of the gibberish appearing
before your suddenly sleepy eyes.

If you have had either of the above experiences, then you al-
ready know why we produced this UTPS Lexicon. The UTPS vernacu-
lar is necessarily large and complex, borrowing from statistics,
economics, engineering and computer science. Few people are in
command of all its terms. We urgently needed a single reference
which defined every technical term in the UTPS documentation.
Now we have it. This is it. We pass it out to our students in
our training courses and to the UTPS software users. Now I see
fewer blank stares in the classroom, and our users see less gib-
berish and more information in the program writeups.

The style of the Lexicon warrants explanation. It is called a
Lexicon instead of a dictionary or a glossary for three reasons.
First, it does not pretend to be as rigorous as a technical dic-
tionary. Second, it eschews the terse dryness which typifies a
glossary. Third, it provides subjective (even humorous) and his-
torical perspectives. All three reasons have a single purpose,
which aims at providing a word's easy first definition. For more
detail and orthodoxy, the Lexicon points its reader to additional
references.

The content of the Lexicon transcends that of an esoteric ref-
erence work intended exclusively for the UTPS software user.
Over ninety per cent of its entries describe quantitative methods
without any reference to UTPS.

It is, therefore, a good reference document for all of our planning jargon. In fact, it is probably the best single place to look for an introductory definition to any word in land-use, transportation, or operational transit planning. This is a valuable book for anyone in our business.

All my boasts notwithstanding, as a general reference for the planner, this book is still incomplete. Many words are missing, some entries need better writing, and there are too few outside references. Indeed, even some of its UTPS terms could stand improvement. Nevertheless we are publishing it in its present imperfect state. Perfection is an endless pursuit. We needed something now, and what you see is much better than what we had.

To reduce its shortcomings and to continue its usefulness to our profession, we must frequently update this Lexicon to give it new definitions and refine old ones. To facilitate its modification, the text resides on magnetic medium in our handy word processor, where we can change it quickly and print a revised version with the touch of a button. We plan on revising it regularly.

The source of the UTPS Lexicon's future improvements should be you, the transportation planning professional. If you read an entry that displeases you or notice something missing, please write me with your suggested improvement. If your idea is used, you will receive credit in the Lexicon. We expect and hope that this first edition will draw lots of mail, so that the second will be much better. Please write me with any thoughts you have.

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ACKNOWLEDGEMENTS

NOTES

1. Bold-faced items within entries refer to other entries in the lexicon. Some items appear more than once, in different forms. Their definitions appear under the form more usual in UTPS. For example: At **ROW** the reader is referred to **right-of-way;** but at **Standard Metropolitan Statistical Area** the reader is referred to **SMSA.**

Bold-faced cross-references are not always in precisely the same form as the entries referred to. Thus **arrays** might refer to **array** and **depreciation** might refer to **depreciation cost.**

2. In the early drafts of this lexicon, the compilers attempted to adhere closely to conventional mathematical symbolism with its panoply of brackets, braces, radicals, Greek letters, and squiggles of various and often obscure origins. Anyone who has attempted the ungrateful task of seeing such notation into print will appreciate our uncomfortable posture--torn between a puristic and antiquarian love of the traditional notation and a harsh, modern, practical desire for a text that could be retained and updated in a word processor with little manual intervention. In choosing, somewhat reluctantly, to gratify the latter desire, we wanted to avoid the mind-numbing Fortranoid majuscule so often seen of late in technical writing. To this end we have based our symbolism somewhat loosely on SDL (Software Design Language), which has recently been developed by UMTA as a standard language for software design specifications. We had intended to present a considerable discussion of the conventions of this notation but were daunted by the onerous demands of a rigorous development of the language. (Those interested may find a thorough treatment in the SDL Reference Manual soon to be published by UMTA). A review of the notation in this lexicon did not reveal anything that should trouble a reader accustomed to conventional notation and who can tolerate such displays as

$$n! = product \ (for \ i: = 1 \ to \ n: \ i).$$

Without further apology or explanation, the compilers proffer this notation, with tears in their eyes, but comforted by their belief that they are on the crest of the wave of the future--or at least near a ripple headed in that direction.

A-95   Circular from U.S. Office of Management and Budget to guide Federal agencies on cooperation with state and local governments in evaluation, review, and coordination of Federal assistance programs and projects.

AADT   Annual average daily traffic.

AAWDT   Annual average weekday traffic.

absolute difference   The result of the subtraction of the smaller from the larger of a pair of numbers. The absolute difference of two numbers is the **absolute value** of their difference.

absolute value   The absolute value of a positive number is that number; of a negative number, the negative of that number; and of 0, 0. The absolute value of 4 is 4; the absolute value of −4 is also 4. That is to say, throw away the minus signs.

abstract mode   A **mode** characterized in a **model** only by its particular **disutilities** and not by a mode-specific equation or **bias coefficient**. See **abstract model**.

abstract model   A modal choice or demand model framed in terms of **abstract modes**. If a **mode choice model** always yields the same estimate of modal share for two different modes that have the same values for their descriptive **variables**, then that model is said to deal with abstract modes. In this case, the model does not look at the type of the mode (auto, rail rapid, bus) but only at its cost, time, convenience, reliablility, comfort, safety, and whatever. Then, based on these values, it arrives at a prediction of a modal share. Those unburdened by experience might expect that this is a property of all respectable mode choice models. However, for whatever reason—fallacious model structure, inadequate variable definition, or omission of significant variables (probably all three)—mode choice models in important prac-

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tical applications have never used an abstract mode formulation. One form of abstract model has had the honor of being dubbed the *naive model* in a recent short European transportation glossary.

abstract network   A **network**, such as a **spider network** or an **airline network**, that deals with **nodal** relationships independently of actual connecting **links**. An abstract network may represent processes which in reality do not at all resemble a network as commonly understood.

acceleration lane   A lane that allows a vehicle entering a roadway to reach a speed adequate for safe and non-interfering entry into the traffic stream on that roadway.

accessibility index   The denominator of the **gravity model** taken as a measure of the potential of a given area to interact with other areas as a function of its transportation system and land-use characteristics. This is taken as a measure of the relative accessibility of an area.

access integral   An **accessibility index** computed in the context of an analytic **model** where the assumed form of the **productions** and **attractions** allows the substitution of integrals for sums.

access, random   See **random access**.

access time   When the whole phrase *access time* is used, the normal understanding is that it refers to the entire time required for travelers to move from their **origin** to a **line-haul** vehicle. This should not be confused with the common use of the term *access* in relation to the time required to enter a vehicle, as in the sentence: "One characteristic of the standard bus is quick access and egress."

accrual basis   An accounting method in which receipts and expenditures are recorded when a service is rendered or goods are received, rather than at the time of payment. Opposed to **cash basis**.

activity allocation model   A mathematical formulation used to predict the geographical distribution of land-use activities.

activity system   In the study of transportation **alternatives** for an area, all non-transportational elements pertinent to the study are called the activity system.

actual headway   The actual fixed time between consecutive vehicles serving a line.

ACV   Air cushion vehicle.

address   1. An identification, by a name, label, or number, of a register or location in computer storage.

2.   In Census discussions or in survey work, this word will take on its usual meaning of geographic *location*.

ADT   Average daily traffic.

advance request   Requests for **DRT** service made substantially before the time or date the service is needed.

AFC   Automatic fare collection.

aggregate   To gather into a total, or, especially in transportation planning usage, into subtotals. If you have travel data stratified into low, low medium, high medium, and high income categories, and you add together the two middle categories to produce low, medium, and high income data, you have aggregated. Likewise, individual data can be aggregated into **zonal** data, and zonal data into **district** data. Sometimes data are called *aggregate,* not because they have been aggregated, but because they are felt not to be detailed enough.

aggregate data   Data on groups of travelers--aggregated usually by **analysis zone:** fraction using transit, mean income of a Census **tract,** trips per dwelling unit, etc.

aggregate demand model   A **model** describing travel in terms of large aggregates of tripmakers. Zonal or district **parameters,** such as total **trip ends** or percent of **person trips** made on transit, are related to socioeconomic or transportation system characteristics. An instance would be the prediction of transit **ridership** in a **zone** or **district** based on its total population, mean income, and percent automobile ownership.

Aggregate demand models are often criticized for their failure to attempt to deal with the true determinants of the travel behavior of an individual traveler. Compare **behavioral model.**

AGM   A Gravity Model. The **UTPS gravity model** calibration and application program.

AGT   See **automated guideway system.**

airline distance   A distance measured in straight-line miles (or kilometers) between two points. Also, "as the crow flies."

algorithm   A method of calculating carried out in a finite number of steps according to entirely explicit rules. Algorithms are usually repetitive and cycle back on themselves. In transportation planning there are many algorithms in use, as in the case of finding the shortest distance between two **nodes;** and algorithms have been developed especially for transportation analysis. Algorithms are characterized by a degree of mindlessness that makes them especially suitable for computer implementation.

Generally, algorithms are any procedures used in calculations to simplify operations. The methods of performing long division and extracting square roots are widely used algorithms. The term algorithm is an erroneous refashioning of *algorism* (presumably on the basis of *arithmetic),* the name of the Arabic system of enumeration--or what we ordi-

narily call the decimal system. The algorism is named after Mouhammed ibn-Mousa al-Khawarizmi, who was alive in 825 AD.

all-or-nothing assignment   The process of allocating the total number of **trips** between two points to a single **path,** usually the one with the minimum **impedance.**

allocation model, activity   See **activity allocation model.**

allowances   In transit operations, extra pay elements included in a driver's wages, beyond base pay, to compensate for **travel, makeup, report,** and **clear time.**

alphameric   Contraction of **alphanumeric.**

alphanumeric   Exactly what this term covers is somewhat uncertain. The alphanumeric characters (or symbols) always include the ten number signs and the twenty-six letters of the standard alphabet. They might or might not include standard punctuation marks or special characters (such as & or %). In its widest usage the term includes the whole available character set of a computer or of a conventional system of character representation, such as **EBCDIC or ASCII.** The term (or its abbreviation, *alpha)* is frequently used to indicate a particular data format.

alternative   Generally, one of a set of transportation proposals under comparative study.

For demand modeling purposes, a unique combination of number or frequency of **trips,** time of travel, **mode** of travel, trip destination, and travel routes.

Some assert, on good historical and etymological grounds, that *alternative* should be used only to mean the choice between two things, and that expressions such as *choice, possibility,* or *option* should be used when considering three or more. They argue that the loose use makes the word unavailable in its strict sense. However that might

be, the usage in transportation planning is quite consistent; and as in **alternatives analysis,** the word conveys the sense of any number of options. The rather finical Usage Panel of the *American Heritage Dictionary* gives some comfort to transportation planners in this case, since only 42 per cent of its members wish to restrict *alternative* to a choice between two things.

alternatives analysis   1) The collection of procedures used to study and assess alternatives for the purpose of selecting one for implementation.

2) The Federal (UMTA) procedure mandated in 1975 for studying alternative major transit investments as a part of the choice process and required to receive federal support for such projects.

3) Not "a set of invisible analytic hoops through which UMTA asks local agencies to leap in order to defer decision on Federal investment in local fixed guideway options," as a vicious canard claims.

amortization period   That period over which a **capital cost** is fully depreciated. Also, debt service period. See **depreciation cost.**

analysis area   Any geographical area under analysis, usually a **zone** or group of zones.

analysis of variance   A statistical method that attempts to analyze the variance (in the sense of variability) of a set of sample observations into components, some of which are related to the subgroup to which the observations belong. The analysis extracts from the total sum of squared deviations that portion which is due to group membership.

analysis unit   Any geographic area chosen for analysis, such as a **zone** or a group of zones.

annual element   A list of transportation improvement projects proposed for a single year; an element of a Transportation Improvement Program. See **TIP**.

A-node   The prior member of a pair of **nodes** defining a link that is under consideration. Also, from-node or i-node.

AP-42   U.S. Environmental Protection Agency document: "Compilation of Air Pollution Emission Factors."

arc   Equivalent to **link** in the abstract sense of an element in a **network** representation.

area occupancy   The area provided per person in any movement area of a transit station, e.g., ten square feet. A concern in station design and in considerations of pedestrian movement. See **Fruin level of service.**

area type codes   UTPS highway link-data codes indicating the density of areas traversed by **links.** Typical codes: 1 = **CBD** (central business district); 2 = CBD fringe; 3 = residential; 4 = OBD (outlying business district); 5 = rural. See **facility type code.**

argument   An **independent variable** upon whose value the value of a function depends. In the function x**2, x is the argument of the function. The value of the function, if x = 3, is 9.

arithmetic mean   See **mean.**

arithmetic operator   An **operator** indicating the arithmetic operations of addition, multiplication, subtraction, and division (and frequently, exponentiation and root extraction).

array   The most general term for some significant arrangement of elements in space. The space is not restricted to three dimensions. The elements are usually numbers or things like them and are thought of as disconnected from each other. Their locations may be defined by the value(s) of an **index** or indices. Examples of arrays are **matrices, vectors,** tables, score sheets, tensors, and calendars. Unfortunately,

in planning the terms *array*, *matrix*, and *table* are often used indiscriminately.

The term *array* within certain computer languages refers to an arrangement of items in storage for which indices are provided to facilitate retrieval.

arterial street A major street or high capacity highway, primarily for through traffic, usually with unlimited access to adjacent streets.

articulated bus A bus with two body sections connected by a flexible joint. Such buses usually have greater capacity than the normal bus, and can achieve greater driver productivity by increasing the number of persons carried per driver. Since they bend when turning, they can turn the corners of narrow streets--corners that standard buses cannot negotiate at all or cannot negotiate without disrupting traffic. Many articulated buses in England are of German manufacture, and the British have taken to calling them "bandy buses"--after the German *Bandwurm* (tapeworm). The phrase is headed this way.

ARZ Auto restricted zone.

ASCII American Standard Code for Information Interchange. A system of character coding developed by the U.S. Standards Institute in which **alphanumeric** and special characters are represented by **binary bits** in groups of 7--allowing 128 different symbols to be coded. The ASCII system, unlike **BCD,** can distinguish capital and small letters.

assembly Process whereby instructions written in a symbolic form are changed into **machine language** by a **computer program** (usually called an assembler). One of its most characteristic features is that, in the main, one line of **assembly language** code produces one line of **machine language** code.

assembly language A symbolic language suitable for **assembly.**

assignment See **trip assignment.**

assignment, equilibrium   See **equilibrium assignment.**

assignment, stochastic   See **stochastic assignment.**

attitudinal data   Data describing the judgements, views and perceptions of a discrete group of people in relation to existing or proposed transportation services and issues. For example, what is the affected public's attitude toward a transit system, not only in terms of their interest in using the system but in terms of their perceptions of the system's social and economic effects on their area? Most of the time, such data concern practical questions such as the public's willingness to pay to ride a proposed transit system.

This information is normally gathered by surveys. Compare **behavioral data,** because actual behavior and attitudes are not necessarily congruent.

attraction   1.   Loosely, anything that draws travelers and requires some accommodation by transit or highway.

2.   In transportation planning, the term is sometimes synonymous with destination, except for **home-based trips.**

3.   The attractive power of a **zone,** measured in trip destinations.   See **production** and **home-based trip.**

attribute file   A data storage configuration in which an individual list or **array** is created for each item, whether **zonal** data, **link** data, survey or other data. Each attribute file contains a list of values describing a particular item. For example, an attribute named "population" might consist of zonal population values for the study area. If there are 98 zones in the area, then attribute "population" would have 98 elements. An attribute named "link VMT" might consist of **VMT** values for each highway link in the study area. If there are 3110 links in the area, the attribute "link VMT" would have 3110 elements. A group of many attributes comprises an entire attribute file.

attribute values, list of   See **LAV.**

automated guideway system   As a transit system, one in which fixed-guideway vehicles move without the intervention of an onboard operator.   The **Morgantown** system is an instance, and **BART** was intended to so function.

Also used as the name of a speculative **dual mode** system in which a standard vehicle, properly equipped, would operate on a highway designed to assume control of the vehicle. There is no such system in public use.

automatic programming   Technique whereby the computer itself will translate into a machine-sensible language a program written in a "higher level" language such as **FORTRAN, COBOL,** PL/1, or Pascal.

auto occupancy   The average number of people in an auto. This may be estimated implicitly with a **trip generation model** which estimates transit-person and highway vehicle **trip-ends** separately, or explicitly as part of a **sequential** demand estimation approach. Most often, the explicit approach involves the use of a distinct auto-occupancy model operating on the highway person trip (or trip-end) output by a **modal split** model.

Auto occupancy is also occasionally estimated by treating auto as a number of different modes, depending on the number of occupants. See **mode.**

auxiliary lane   The portion of roadway adjoining the traveled way designed to accommodate parking, speed change, climbing, or other purposes supplementary to through traffic movement.

average   A representative number. There are many types of averages; compare **mean, median** and **mode.** If a distribution is symmetric, then the (arithmetic) mean equals the median equals the mode (if there is one). As a distribution is **skewed,** the mode will be located at its maximum, and the mean will move in the direction of the longest tail. The median will usually lie 2/3 of the way from the mode to the

mean. This relation can be used to estimate (not very accurately) one of these quantities when the other two are known.

When some other meaning is not clear from the context, the average usually indicates the arithmetic mean, although frequently in income statistics the median is used as the average.

average deviation   Also, mean deviation. The average of the absolute values of the deviation from the **mean** (or median). Used as a measure of **dispersion**.

BACKPAC   That portion of the **FHWA** battery that contains utility programs, land-use analysis programs, updated programs from **PLANPAC, BMD** statistical programs, and others.

backtracking   See **non-backtracking**.

Backus-Naur Form   See **BNF**.

bandy bus   See **articulated bus**.

banner   The large capital letters and numbers produced by the **software** of many computers and used for run headings.

bar chart   Differs from a **histogram** in that the histogram implies a grouping of underlying **continuous** data; whereas a bar chart is used for **discrete** data.

BART   Bay Area Rapid Transit. Rail rapid system for Oakland, California and environs.

base headway   The *scheduled* time between transit vehicle trips along the same route during an **off-peak** period (usually midday).

base period   That period during the day when transit operations are unaffected by peak-period scheduling and vehicle requirements. Usually from 9 a.m. to 4 p.m. on weekdays. The vehicles needed for base-period service are the base-period fleet. See **peak-hour factor**.

base year   In transportation planning, a previous year to which the major portion of the data used in a transportation study relates.   It is a year against which travel forecasts are compared.

batch mode   Submission of computer jobs as a unit (traditionally, but no longer necessarily, in the form of punched card decks) and the receipt of output as a unit (frequently, over the counter at a computer site).   Opposed to **interactive**. Also sometimes, inaccurately, opposed to **time-sharing**. (Time-sharing batch processing is possible.)

baud   The number of **bits** per second that can be transmitted in a given computer system.

More generally, it is a unit of signalling speed (as in telegraphy) named after the French inventor J.M.E. Baudot.

BCD   Binary coded decimal.   A system of character coding in which digits, alphabetic characters, and special symbols are represented by groups of six **binary bits,** allowing 64 different symbols to be coded.   See **EBCDIC**.

behavioral data   Data that describe the responses to available transportation choices of individual travelers or of coherent groups of travelers with presumably highly similar responses.   See **behavioral model** and **attitudinal data**.

behavioral model   A difficult term to deal with briefly.   According to an UMTA glossary, it is "a demand estimation approach which has a psychological cause-effect theoretical base reflecting responses to environmental or system changes."   This is good as far as it goes, although *econometric* might well have been substituted for *psychological*. The use of the term stems from a reaction in the Sixties on the part of some planners and theoreticians against then-current models.   These models usually had weak (or no) theoretical underpinnings, had coefficients fitted by regression

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analysis, and were insensitive to anything other than travel time and cost. The cry was for models to be behavioral, **disaggregate,** and **policy-sensitive.** (Although these three terms are distinct in meaning, they overlap in practice and were applied somewhat interchangeably.) The stipulation that models be behavioral was a way of requiring that their structure reflect hypotheses that bore some plausible relationship to the decisions of real people facing real choices. Like most laudatory terms, *behavioral* has been somewhat cheapened over its lifetime--having been used on occasion to tout the most improbable models. For further discussion and references, see the TRB Special Report No. 149, *Behavioral Demand Modelling and the Value of Time,* also P. Stopher and T. Lisco in *Proceedings 1970,* Transportation Research Forum.

beltway   Normally part of the Interstate system, beltways are designed to route Interstate through traffic around large municipalities, and they normally form something like a belt around an urban area. Typically these become essential parts of a local road system, and a large portion of beltway traffic is not Interstate through traffic. In some places there are beltways that predate the Interstate system.

   Since beltways are not straight, they are usually **coded** as intersecting freeway segments.

benefit-cost analysis   See **cost-benefit analysis.**

best fit   In the process of fitting some (usually analytical) mathematical function to **observed** data, the question naturally arises: which mathematical function? It is generally desired to find one that fits best by some standard. The ocular-satisfaction standard is called "eyeballing it in." Other more rigorous standards include **least-squares** fitting and fitting to minimize the sums of the absolute deviations.

These standards are frequently called *goodness-of-fit* measures.

best path   A **path** upon which a maximum or minimum value of a selection criterion occurs.

bias   1.   In a physical object, some (possibly hidden or occult) property that makes the results of (usually statistical) experiments on it be other than that which theory has led us to expect. A loaded die is biased in this sense. This notion is a great prop to theory: only when a physical object consistently and inexplicably thumbs its nose at theory does one begin to suspect that the theory might be in error instead of the object defective.

2.   In a measuring device, some quirk in it that leads to a consistent tendency towards erroneous results. This differs from inaccuracy, in that bias is a *tendency* in some *direction*, whereas pure inaccuracy is a scatter about the true value.

3.   In **parameter** estimation, the estimator is said to be biased if it does not, on the average, equal the quantity it is supposed to estimate. The **variance** of a **sample,** for instance, is a biased estimator of the variance of a **population.** (The variance of a sample of n, when multiplied by $n/(n-1)$, is an unbiased estimator of the variance of an infinite population.)

bias coefficient   The name of a constant expression, if any, in multi-linear regression equations or other models. It is frequently assumed to account for **variables** not explicit in the equation, since it also may be viewed as representing the share of the market for each mode if all had equal disutilities.

bi-modal   1.   In statistics, indicates the lack of a single, unique **mode** in a distribution.

2.   In transportation planning, having to do with a choice between two travel modes (as in bi-modal splitting).

3.   Not **dual-mode.**

binary coded decimal   See **BCD.**

binary choice model   A demand model used in **mode split** based on the assumption that travelers make one of only two possible choices.   Binary choice models sometimes extend to the multimodal case by representing it as a series of choices between pairs of nodes.

binary number   The binary number system (also called the system to the base 2) uses only two symbols (0 and 1) to express numbers.   They are the most basic numbers used to describe the internal operations of a computer because of their analogy with on-off switching.   It is a positional system exactly analogous to the decimal system (which uses the base 10, with its ten symbols: Latin *decim)* except for the smaller number of symbols.   The binary expression, 111 + 100 = 1011, and its decimal equivalent, 7 + 4 = 11, are mathematically equivalent and operationally analogous.

It should be remembered that there is nothing necessary or inevitable about decimal systems of enumeration; civilized societies have developed other systems.   The popularity of the decimal system is no doubt due to the prevalence of ten fingers (Latin *digitus* = finger).

bit   A single character of a computer system of representation having just two characters, such as either of the binary **digits** 0 or 1.

block   1.   The smallest of the Census geographical areas, typically containing about 100 persons.   About forty blocks make up a Census **tract.**

2.   The composite of trips assigned to a transit vehicle for a day of operation.

3. A length of rail track of defined limits on which the movement of and separation between trains is governed by some external control system.

4. A group of cars classified for movements to the same yard or terminal.

5. The operating schedule of a transit vehicle, including **revenue** and **deadhead** service.

6. A group of computer words considered as a unit by virtue of their storage in successive locations.

7. A data record in a computer or storage medium defined by its physical characteristics (e.g., on magnetic tape, being surrounded by stretches of blank tape) rather than by the information it contains. Also called physical record. Contrasted with **logical record.**

8. The length of street frontage between two successive cross streets.

block diagram　　A broad flow-chart showing the relation of major program components.

BMD program　　Also BIOMED, BIMED, and BMDP. A once much-used statistical package, originally designed for biomedical applications at the University of California, Los Angeles. It contains 60-odd programs, mainly written in **FORTRAN.** Its programs were designed to analyze the results of experiments; although some of them were highly unsuitable for the analysis of survey results, they have been used to do so in many transportation studies.

B-node　　The second member of a pair of **nodes** defining a link under consideration. Also, to-node or j-node.

BNF　　Backus-Naur Form or Backus Normal Form. A computer metalanguage--that is, a language in which computer languages are discussed or defined. Since BNF is used extensively in **UTPS** program writeups, a description of some of its major symbols is given here.

1. <> left and right broken brackets are used to con-
tain one or more characters representing an entity within
the metalanguage. Although it is no essential part of the
definition, the "one or more characters" within the brackets
usually in some (metametalinguistic?) sense define the enti-
ty--e.g., <digit>, <field description>.

2. ::= this symbol means *is defined as.*

3. | this symbol means *or* and separates multiple def-
initions of the same entity.

In general any other mark or symbol denotes itself.
These symbols and the character set of the language are com-
bined to give metalinguistic formulas which define, very
frequently in a recursive manner, the larger constructs of
the language under discussion.

BPR   Bureau of Public Roads. Now defunct as a separate entity
(absorbed into the Federal Highway Administration).

bucket rounding   A technique of controlled computer **rounding**
using a bucket (storage location) which effectively controls
total rounding and prevents it from introducing large errors
into the sum of the rounded quantities. Considerable errors
are possible in the sums of a large series of numbers which
have been rounded by conventional techniques.

bus bay   A branch from or widening of a road that allows a bus
to make a passenger stop outside the normal traffic flow. A
bay not only reduces the obstruction of traffic but can con-
tribute to passenger safety.

bush   A collection of all the **efficient paths** between some
origin and all destinations. Used in **stochastic assignment**
as the equivalent of a shortest path **tree** in **all-or-nothing
assignment**. Contrast **tree** and **vine**.

bus lane   See **busway**.

bus platoon   Several buses operating in close proximity (with
short headways) on the same route.

bus rapid transit   A bus system that operates on a special facility, probably a **busway,** that allows high speeds.

busway   A special roadway, sometimes exclusive, for buses. It can be a separate **right-of-way** or merely a reserved bus lane on a highway. It can be at grade or otherwise.

byte   A definite portion of consecutive **binary** digits considered as a unit.

   The smallest **addressing** and character manipulation unit of storage in IBM/360, consisting of eight **bits** or two hexadecimal digits (four bits each).

CALCOMP   A computer plotter produced by the California Computer Products, Inc. It is something of a standard, and other plotters frequently have **software** to allow them to accept input in CALCOMP format.

calibration   The procedure used to estimate the **parameters** of a **model** or to adjust a model to replicate actually measured conditions.

   This term is quite general and does not imply that any particular technique, such as **regression analysis,** has been applied. Trial and error is also calibration.

calibration file   A **matrix** (input to **ULOGIT** and **UFIT)** with rows corresponding to observation and columns to variables. That is, each row contains all the **variables** relating to one particular observation. The **dependent** (or mode) **variables** contain the number of travelers using the various **modes.** The other variables are usually **disutilities** associated with the various modes which may, at the option of the user, function as **independent variables. Weight** variables may be included to contain (potential) weight factors.

call   In the execution of the **computer program,** the transfer of control to a specified **subroutine.**

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capacity   Frequently the maximum number of vehicles and/or people that can be carried past a point on a transportation system in a specified time, at a specified **level of service**.

However, compare the following discussion from a recent (1975) discussion of the capacity of a railroad line:

A number of definitions of capacity were considered in attempting to develop the most useful definition. *Ultimate capacity*, where absolutely no more trains can be forced through the line, is too unstable and dependent upon how trains are scheduled and what failures occur. An *economic capacity*, where an optimal balance of operating and capital costs would occur, is not within the scope of the project and would probaby be too site-specific for a general analysis such as this. Other possible definitions, such as an arbitrary percent delay of total running time or an *operationally stable capacity* where a line would recover from a disruption in service of moderate length (e.g., 4 hours) and return to normal service levels, were also rejected as too arbitrary or unstable. The most useful and stable definition appears to be one based on the maximum allowable time for the most delayed train to traverse the line. It was discovered that maximum time could be related to average delay and would allow the user to define capacity constraints based either on minimum level of service (maximum acceptable trip time) or minimizing the need to re-crew trains because of the 12 hour on-duty time limitation imposed by the Hours of Service Law. It should be noted that since the parametric runs were designed to represent "typical day" operations, this approach would not eliminate all trains that exceed the time limit.

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Unusual delays or catastrophic failures could still result in some trains exceeding the time limit. (Prokopy and Rubin, 1975; emphasis added.)

Quoted in Vol. 1 of M. Manheim, *Fundamentals of Transportation System Planning*. The reader is referred to Chapter 7 of this work for further discussion.

The important thing to remember is that *capacity* (even of a vehicle) is seldom rigorously defined. The seating capacity of a bus is fairly definite, but the standing capacity must be evaluated against some **level-of-service** measure. It follows that an entity may hold (or service, or process) more than its capacity, even more than its **crush capacity**.

capacity pricing   See **congestion pricing**.

capacity restraint   Any **traffic assignment** procedure sensitive to the interrelations of highway **capacity** and **congestion** and that considers multiple point-to-point **paths** is said to take account of capacity restraints. Typically, the assigned volume on a link will be compared with the practical capacity of that link, and the operating speed on that link will be adjusted to reflect the relationship between speed, volume and capacity. These procedures are **iterative** and frequently are terminated when they reach (or approach) **some** satisfactory **equilibrium**. Capacity restraints are especially useful when the (highway) system being modeled is operating under **congested** conditions.

CAPGUIDE   *CAPM Users' Guide*. A manual that describes various applications of the program **CAPM**.

capital alternatives, low   See **low capital alternatives**.

capital cost   To be distinguished from **operating,** non-recurring, or infrequently recurring costs. Costs of transportation systems such as purchase of land, construction of terminals, and acquisition of vehicles. Maintenance cost is not a capital cost.

Like all cost components, the classification of a cost as *capital* depends on accounting conventions. Disputes must be settled by recourse to the art of accountancy.

CAPM   The **UTPS** Community Aggregate Planning Model. A computerized highway **sketch planning** model, its applications include the analysis of urban development patterns, alternative system investments, air quality impacts, and energy consumption. A users' guide, *Highway Sketch Planning: CAPM*, contains detailed discussions of input, output, assumptions, and **algorithms.** There are **coded** examples of various applications.

captive rider   A traveler limited by circumstances to one **mode** of transportation. In some cases this includes a traveler who must use a private automobile.

In relation to transit, the term is used to identify a traveler who does not have an automobile available for a trip and must use public transit.

This term has no connection with **captive vehicle.**

captive vehicle   A vehicle operating under the control of an **automated guideway system.** This term has no connection with **captive rider.**

car equivalency, passenger   See **passenger car equivalency.**

car occupancy model   One of a number of **models** used to convert **person trips** into vehicle trips.

car pool   To be distinguished from **van pool.** A voluntary arrangement for ride-sharing among a group of persons with conveniently similar origins and destinations. In certain locations, travelers in car pools are rewarded by rush-hour access to lanes reserved for automobiles with more than three passengers.

case study   A simplified but realistic study application of a planning technique. Many of the major modules of **UTPS** are supported by case studies.

cash basis   An accounting method in which income is recorded as received and expenditures recorded as made. Contrast with accrual basis.

cash flow, discounted   See net **present value.**

cataloged procedure   A set of **JCL** statements that has been assigned a name and normally placed in a **partitioned dataset** known as a procedure library. A cataloged procedure is invoked by coding its name on an **EXEC** statement.

CATS   Chicago Area Transportation Study

CATS assignment   This is an incremental **trip assignment** technique. In it, link **impedances** are recalculated to adjust for **congestion** after each set of n **paths** has been **loaded.** A primitive but inexpensive **equilibrium** technique, developed in the early days of **CATS.**

CATS option   An option to perform a **CATS assignment.**

CATS tree   A **tree** constructed using the **CATS option.**

CBD   Central Business District, generally an area of intense commercial development in the center of a **region.** For more than 125 cities CBD's have been officially designated by the Census Bureau. These are made up of whole numbers of Census **tracts.** The CBD defined in a transportation study may differ from the Census definition.

c.d.f.   See **cumulative distribution function.**

cell   The smallest element in a tabulation or **matrix.** Typically cells contain the count of persons, **trips,** or other items having the characteristics determined by their row and column headings. The contents of a cell is called the cell value.

central business district   See **CBD.**

center of gravity   See **centroid.**

central processing unit   See **CPU.**

centroid   A point taken as representative of a **region**. The centroid could be defined (for all regions encountered in transportation planning) as the point whose coordinates are the **mean** value of all coordinates in the region. However, it is customary in theoretical discussions also to consider the **distribution** of **trip** activity within a region so that the centroid of a region may be strictly defined as the center of gravity of an area (or plate) the shape of the region, whose density at any point is proportional to trip activity density at that point.

In practice, the centroid is frequently estimated by inspection: "eyeballed in."

CGUIDE   *UCEN70 Users' Guide,* a manual that describes various applications of the program **UCEN70.**

checkpoint   A point at which a computer run may be terminated, examined, and optionally restarted with or without changed **parameter** values.

checkpoint service   **DRT** service in which vehicles do respond to demand but move only to a predetermined place or set of places (checkpoints). In a checkpoint system, **many-to-many, many-to-one,** and **subscription services** are all possible.

chi-squared test   Also χ^2 test (both chi and χ are pronounced kie to rhyme with tie). A **statistical test** with various applications, based upon the **distribution** of a quantity called the chi-squared statistic. Its commonest use is as a **goodness of fit** measure. The chi-squared in a given situation is the sum of all the values of the square of the difference between the observed and expected values divided by the expected value. If observation fits expectation perfectly, the value of chi-squared will be zero. In general it is clear that low values of chi-squared indicate good fit and large values poor fit.

The question naturally is: how small is how good? This question is answered by comparing the calculated chi-squared statistics with tables available in standard statistical handbooks. The procedure is the same in principle as checking for the significance of a deviation from the mean in the case of a normally distributed **variable,** but more complicated in practice; because, while in the normally distributed case only one quantity--the size of the deviation--is important, in the case of chi-squared two quantities, the size of chi-squared and the **degrees of freedom,** which is related to **sample** size, have to be reckoned with.

chit   As part of **paratransit** service in some areas, some travelers (e.g., the elderly) are provided coupons for the purchase of private services (such as taxicabs) when other transportation is unavailable. These coupons, called chits, are redeemable by the private service as payment for services rendered.

choice model, specific   See **specific choice model.**

choice rider   A traveler who can choose one **mode** of travel from a variety of modes available to him. Contrast **captive rider.**

circuity factor   The ratio of actual travel distance to geographic distance. Usually used to estimate street (or highway or network) miles from a measure of geographic distance. Its value depends on network **geometry** and whether it attempts to adjust for the errors introduced by measurement from **centroid** to centroid. In practice, it frequently ranges from 1.2 to 1.4, depending on the street pattern. Also called street network adjustment factor.

clear time   The time needed for a driver to complete sign-off procedures at the end of his run. Also frequently called turn-in time.

closure   See **convergence.**

cluster development   The development of major **activity systems** around the periphery of an urban area to such a degree that the importance of the **CBD** is reduced.

CMS   1. Center-line miles.

   2. Conversational Monitor System.

COBOL   A contraction of Common Business Oriented Language. Primarily used as a high-level language for commercial applications.   Some **UTPS** subroutines are written in COBOL. Its handling of input and output is generally superior to **FORTRAN,** and it is admirable for the concern with data structure it imposes on a programmer; nevertheless, programming in COBOL is like swimming in molasses.

coded decimal, binary   See **BCD.**

coding   The translation of a **program** into a sequence of explicit instructions that can be directly executed by a computer (**machine language** coding), or of instructions using symbols for operations and addresses (symbolic coding), or of instructions that will be **assembled** or **compiled** into instructions that some specific computer can execute.

coefficient of determination   The square of the product-moment **correlation** between two **variates.**

coefficient of variation   The **standard deviation** expressed as a fraction or a percentage of the **mean.** Used as a measure of relative **dispersion.**

coefficients   1.   The numerical part of a term, as opposed to the **literal** part; e.g., the 2 in 2*a*x.

   2.   All factors of a term, except for a certain one, of which the product is said to be the coefficient; e.g., the 2*a in 2*a*x.   This is most commonly applied to the constants as opposed to the **variables** in a term.

   3.   Loosely, any quantity, especially in set expressions, such as **coefficient of determination** or **correlation coefficient.**

Note: The phrase "the coefficients of an equation" usually refers to the constant term and the coefficients of all the variables as a set.

cold start   A pollution concern. High pollution occurs when a motor vehicle is started after being off for at least four hours (one hour for a catalyst-equipped vehicle).

collection tour   Tour made by a **DRT** vehicle in **many-to-one** service to pick up passengers.

collector-distributor street   A street that gathers and disperses traffic between the larger **arterial** highways and local streets, that has intersections at grade, and that is important in providing complete movement to and from first origins and final destinations.

command language   A source language or **source code,** usually containing procedural instructions. Such a language has capabilities of causing the execution of many functions, most of which are basic or used repetitively.

common   A computer storage area containing data available (perhaps under various names) to all the **subroutines** of a computer program.

commute, reverse   See **reverse commute.**

commuter rail   See **rail transit.**

comparative statement   In transit scheduling, a sheet showing a condensed major schedule data comparison between the most recent schedule and the schedule in effect.

comparison mode   A mode of operation of **AGM** in which it compares **estimated** and **observed trip tables.**

competing opportunities model   A mathematical **trip-distribution** model that distributes **trips** from one **zone** to each other zone--in proportion to the probability that the trips have not found a prior destination in zones ranked closer to

the zone of origin. Similar in general assumptions to the **intervening opportunities model,** although different in working out, calibration and resulting assignment. For more detail see A.R. Tomazinis, *A New Method of Trip Distribution in an Urban Area* Bulletin No. 347, Highway (now, Transportation) Research Board, 1962.

compile   To cause instructions written in a high-level language to be translated into **machine language** (or, formerly, into **assembly language).**

composite disutility   Modelers have sometimes found themselves in need of a way of representing a number of distinct transportation choices as if they were only one choice. The problem then arises of assigning a **disutility** to this compound, or perhaps epicene, mode. Desperate modelers try desperate solutions: **arithmetic mean,** highest value, lowest value, **harmonic mean.** The proper method for compounding disutilities cannot be discussed in the abstract, but only in relation to the model structure in which they are to function as predictors of demand or mode choice. R. Dial has pointed out in a mysteriously unpublished paper that reasonable models can be formulated for which perfectly adequate composite disutilities can be formulated. Usually, however, the solution lies in a reformulation or a new model.

composite modal split   See **modal split.**

compress   1. To store data in a more compact form.

2. To reduce the size of a **trip table.** Also **squeeze.** Usually this will involve **aggregating** a trip table at the **district** level up to the **zonal** level using a series of **zonal district equivalencies.**

3. To make more available space in a **partitioned dataset** by closing up the gaps formerly occupied by deleted members. When the **dataset** is squeezed, the gaps are closed up, producing usable space at the end.

computer graphics   Automated techniques for displaying data graphically--as in the form of maps, **histograms,** charts-- using a computer and its associated output devices such **as** the printer, pen-plotter, or cathode ray tube (CRT).   With computer graphics, large amounts of data can be easily displayed and interpreted.

computer program   Usually, a series of instructions input to a computer to cause it to perform a specified series of operations.   Some would object to this definition as more properly applying to computer code.   According to this school, a computer program is more abstract than a computer code **and** represents the complete plan for the solution of a problem, which might be represented in some non-implemented **algorithmic** language or diagrammatic form.   This school is definitely the minority.

conditional expressions   These expressions allow the programmer to perform tests to determine where the program should **go** and what it should do, depending on the result of some condition tested.   Particularly in the **select block** of **UFIT and ULOGIT,** conditonal expressions are handled with an IF (condition) THEN (action if condition met) ELSE (action if condition not met) format.

conditional probability   The probability that one event (E) will occur given that another event (F) occurs. Usually symbolized as $P(E/F)$.   If $P(E/F) = P(E)$ and $P(F/E) = P(F)$, E and F are said to exhibit statistical independence.   The probability of rolling 12 with unbiased dice is 1/36.   The conditional probability of rolling 12, given that one die shows a six, is 1/6.

conductance factor   The reciprocal of an **impedance.**

confidence interval   The purpose of sampling is to **estimate** some **parameter** of the **population.**   The estimated parameter differs from the true value by some unknown amount, which

may be zero, quite large, or anything in between. Using the sample data and statistical theory, an interval can be calculated about the estimated parameter within which the (unknown) **population** value probably lies.

The truth or falsity of the statement that a population value lies within any particular limits (less than its full range) is unknown in any particular case; however, it is possible to calculate the probability that it will lie within certain limits if the sampling process is repeated often enough. An interval calculated about an estimated parameter that is wide enough to include the true parameter 95% of the time is called a 95% confidence interval.

The upper and lower bounds of a confidence interval are called the confidence limits. The 68% confidence interval is common since its upper and lower limits are one **standard deviation** above and below the estimated **mean** in the case of **normally distributed** populations. It should be noted that the upper and lower confidence limits are not necessarily equidistant from the estimate, but in practice they nearly always are so. The size (or width) of the confidence interval for normal populations is a function of the **standard error of the estimate.**

congestion   Loosely, crowdedness viewed as undesirable. Strictly, a facility may be said to be congested (seriously or significantly) when the time taken to traverse (or be processed by) the facility becomes (seriously or significantly) dependent on the demands on the facility.

congestion pricing   Various forms of proposals that vehicles or people be charged a special toll for entering the **CBD** or other congested facility.

consist   (noun; accent on first syllable) Make-up or composition of a train by number, class, type or arrangement of cars.

constrained coefficient   In the typical **calibration,** a number of **coefficients** are estimated simultaneously according to a

specified **goodness-of-fit** criterion. These coefficients will naturally lie where they fall. Almost anyone who has dealt with large automatic calibrations of multivariate **models** performed upon imperfect **datasets** will have had the experience of having some of the coefficients fall in extremely awkward terrain. It may well be that the **best fitting** model predicts that an increase of subway fare will decrease not only subway trips but also auto trips, or some other counter-intuitive result. For a further discussion of this problem, see **multicollinearity**.

One quick solution to the problem can be to constrain some or all of the model coefficients to lie within bounds suggested either by theory or intuition. **ULOGIT** allows considerable flexibility in constraining coefficients by bounding them on either side or by equating coefficients between different expressions. The latter feature would be useful in case one wished (for instance) to investigate the possibility of fitting a model with identical coefficients for the characteristic **variables** of each mode, leaving only the **bias coefficient** to express the mode dependency.

constraint   A relationship among the **variables** in an optimization problem which all solutions must satisfy.

continuous distribution function   See **distribution function**.

continuous variable   If a **variable** is said to be continuous, it is assumed that between any two of its values, no matter how close, more precise measurement can determine an intermediate value. There are sound theoretical reasons to disbelieve that this is true of most things, and in practice all variables are **discrete**, with different degrees of graininess. The difference between discrete and continuous variables lies in how we choose to regard them, with what analytical tools we treat them, and ultimately what success we attain as a result of our choice.

contraflow lane   A highway or street lane on which, during certain hours of the day, transit or other designated vehicles operate in the direction opposite to the direction of traffic on that lane during the rest of the day while vehicles in adjacent lanes continue in the original direction of flow.

control block   The section of an input stream containing the **control cards.**

control card   Input cards containing control statements, by which the user controls the operation of **UTPS** programs. All control cards are optional, since **default values** have been set for all the **parameters** they contain.

control data   In transit scheduling, basic and derived statistics regarding line and system operations, sometimes referred to as secondary data. Used with the primary data on passenger loads and required **running times** to control the schedule-making process.

control language, job   See **job control language.**

convergence   In general, the property possessed by a **function** when it approaches a limit.

In transportation planning, the term is usually related to the idea of the convergence of a sequence. A sequence is said to converge if, and only if, the difference between every pair of adjacent terms can be made arbitrarily small, provided the pair be taken sufficiently far out in the sequence.

In practice, some **iterative process** is said to converge when the planner is satisfied that the difference between the results of two successive iterations is small enough.

conversion   Also data conversion. The process of changing information from one format to another.

conversion, no-hit   See **no-hit conversion.**

cordon counts   Counts taken at **cordon lines.** For example, a count of persons and vehicles entering and leaving the central business district, by location and time of day is called a **CBD** cordon count.

cordon line   An imaginary line enclosing a study area. See **screen lines.**

core allocation, dynamic   See **dynamic core allocation.**

correlation   A direct or inverse relation of **variables.** The direct relation (when the two variables tend to increase together) is positive correlation. The inverse relation (when the two variables tend to decrease together) is negative correlation. See **correlation coefficient.**

correlation coefficient   A measure of the interdependence of two **random variables** that ranges in value from -1 to +1: -1 indicating perfect negative correlation, 0 indicating lack of correlation, and +1 indicating perfect positive correlation.

correlation ratio   A **goodness-of-fit** measure more suitable in some instances than the **correlation coefficient.** For a more detailed discussion see "Goodness of Fit Measures for Probabilistic Travel Demand Models," by P. Stopher, *Transportation,* Vol 4 No. 1, pp. 67-83, Spring, 1975.

corridor   A broad geographical band that follows a general directional flow connecting major origins and destinations of **trips** and that contains a number of streets and highways and transit route alignments.

cost-benefit analysis   Also CBA. The exact definition of cost benefit analysis and the precise distinction between it and **cost-effectiveness anaysis** is not well settled. The following definition (from *A Glossary of Terms Used in the Federal Budget Process,* GAO, March 1981) probably represents a consensus about as well as any short definition.

An analytical technique that compares the social costs and benefits of proposed programs or policy actions. All losses and gains experienced by society are included and measured in dollar terms. The net benefits created by an action are claculated by subtracting the losses incurred by some sectors of society from the gains that accrue to others. Alternative actions are compared to choose one or more that yield the greatest net benefits, or ratio of benefits to costs.

The inclusion of all gains and losses to society in cost-benefit analysis distinguishes it from cost-effectiveness analysis, which takes a more limited view of costs and benefits. (For distinction, see Cost-Effectiveness Analysis.)

There are a number of vexing theoretical and practical problems in cost-benefit analysis. Perhaps the greatest is the adequate quantification of benefits; selecting the set of alternatives for analysis is also a very real problem. Spurious benefit categories are created frequently. There may be a very uncertain handling of **transfer payments.** **Double counting** is common. The most serious practical problem is that such analysis is typically performed (or guided) by interested parties who nearly always have a bias against the existing system. Or they have an (at the very least) emotional commitment to a specific replacement for it. With so much in cost benefit analysis cloudy and judgemental, an analyst must be a strict moralist (or somewhat inattentive) not to have his results swayed by self-interest. See **Jericho technique.**

cost-effectiveness analysis   Also CEA. Difficult in these days to distinguish from **cost benefit analysis.** The GAO Glossary cited in the previous article defines it as follows.

An analytical technique used to choose the most efficient method for achieving a program or policy goal. The costs of alternatives are measured by their

requisite estimated dollar expenditures. Effectiveness is defined by the degree of goal attainment, and may also (but not necessarily) be measured in dollars. Either the net effectiveness (effectiveness minus costs) or the cost-effectiveness ratios of alternatives are compared. The most cost-effective method chosen may involve one or more alternatives.

The limited view of costs and effectiveness distinguishes this technique for cost-benefit analysis, which encompasses society-wide impacts of alternatives. (For distinction, see Cost-Benefit Analysis.)

The distinctions made between CEA and CBA, while not uncommon, are by no means universal. Most experts think there is a real difference between CBA amd CEA but have difficulty in articulating it and, when they do, in coming to agreement with their colleagues. A common distinction within transportation studies would involve maintaining the definition given above of cost effectiveness but treating cost benefit analysis as a less comprehensive assessment which deals only with priceable costs and benefits. From this point of view CBA is an element of CEA. It should be emphasized that no clearcut distinctive definitions of CEA and CBA can be deduced from the many contexts in which they have been employed.

coverage   1. If a vehicle is not in **line-haul** operation, it is operating in the coverage mode. The typical coverage vehicle is the bus, operating on streets or highways with nontransit vehicles--and with the same constraints.

2. The percentage of activities within an **analysis unit** within reach of a given transportation system.

3. The percentage of people living within a given distance, usually 1/2 mile, of a transit line.

CPU   Central processing unit. That portion of the hardware of a computer which directs a sequence of automatic operations,

interprets the coded instructions, and signals the computer circuits to execute instructions.

CR   Commuter rail.   See **rail transit**.

critical density   Critical traffic density.   That density of traffic when a roadway is at **capacity**.   At density either higher or lower than critical density, traffic volume decreases.

critical movement analysis   A procedure for determining **capacity** and **level of service** at signalized intersections.   The analysis considers an intersection as a whole operating unit and treats the effects of lane **geometry** and signal operation.   The conflicting volumes per lane per hour through an intersection are summed and compared with a standard to determine a **level of service**.   Also, critical lane analysis.

critical volume   A traffic volume for a given street which produces the largest flow past a given point in a given time.

cross classification analysis   A technique in which the change in one **variable** can be measured when the changes in two or more other variables are accounted for.   Essentially, **independent variables** are each stratified into two or more appropriate groups, creating an n-dimensional matrix.   Observations on the dependent variable are then allocated to the various **cells** of the **matrix,** based on values of several independent variables, and then averaged.   This technique does not rely so heavily on the assumed distribution of the underlying data and, as such, is sometimes referred to as a nonparametric or distribution-free technique.

cross-elasticity   See **elasticity**.

crossfooting   Footing is the vertical addition of a column of numbers; crossfooting is the horizontal addition of a row of numbers.   A common check of tabularized data is to compare the sum of the footing with the sum of the crossfooting.   If

the two sums are not equal, some error is indicated, unless the discrepency is due to **rounding**. Sometimes the whole process of performing this check is called crossfooting.

crossover   1. Two turnouts, with track between, that connect two nearby and usually parallel railway tracks.

2.   Pedestrian or vehicular **links,** at grade or **grade separated,** across a transportation facility.

cross-section   A study of actual travel behavior in a real system at one point in time. Cross-section studies sample different sectors of the market at the same time. Their most complete form is the origin-destination survey, in which a sample of flows is collected--with data for different origin-destination pairs on volume, **level of service,** and **activity-system** characteristics. See **time series.**

cross-tabulation   Tabulations of data structured by other data characteristics. If you have presented a trip table where the rows are classified by income group and the columns by car ownership, you have produced a cross tabulation of trips. The **footings** will contain total trips classified by car ownership and the **cross-footings** by income.

CRT   Cathode ray tube (as in computer display)--as on a TV set.

cruise speed   The speed that a vehicle maintains when neither accelerating nor decelerating.

crush capacity   The capacity of a vehicle, including standing passengers, at which no other passengers can enter. Presumably, the maximum capacity; but see **capacity.**

CSTUDY   A UTPS users' guide that contains information for the first-time user of **UTPS** and describes a **case study** using UTPS.

CTA   Chicago Transit Authority.

cumulative distribution function   Also c.d.f. and **distribution function.** The cumulative distribution function gives the

probability that a **random variable** has a value less than or equal to some specified value which is the **argument** of the function. It can be viewed as an integral of the **probability density function**.

cumulative rounding   See **rounding**.

cursor   A special symbol (varying by system) used to indicate the position of the next character to be processed on a **CRT** display.

cut and cover   The construction of an underground facility by excavation and refilling.

CUTD   *Characteristics of Urban Transportation Demand.* A **UTPS** handbook for urban transportation planners to use in estimating the various components of urban transportation **demand**. It contains characteristics of urban bus, rail, and highway systems--and of urban trip-making. It provides basic inputs to the urban transportation planning process as well as ways to check results for reasonableness and relevance. An appendix, in a second volume, contains detailed data on individual cities: roads, routes, stations, etc.

cutline   An imaginary line placed at a strategic location in order to intercept all **links** in a specific **corridor**. In a checking mode, cutline counts and **trips assigned** to the given corridor would be compared as a check of survey accuracy or of model **calibration**. In a system evaluation mode, **parameters,** such as assigned **trips** divided by **network** capacity or average speeds on all links defined by the cutline, are used as measures of corridor **congestion**.

CUTS   *Characteristics of Urban Transportation Systems.* An element of **UTPS** designed to be a single reference source for the most important contemporary urban transportation systems. Assesses only **supply** or performance; (for demand, see **CUTD.)** The **parameters** used are speed, **capacity, operating**

cost (vehicle), energy consumption, pollution, **capital cost,** and accident frequency.

cycle time   The period in seconds required for one complete sequence of traffic signal indications.

cycled service   A **DRT** service in which vehicles are regularly scheduled.   However, the assumption is highly flexible scheduling to meet the needs of a distinct group of passengers.

DAR   See **Dial-a-ride.**

data   To the confounding of many, the plural of *datum*.

data conversion   See **conversion.**

data description   See **DD.**

dataset name   A **JCL** parameter specifying a user-supplied name given to an **OS dataset.** Also, DSN.

DD   Data description.   A DD statement is a **JCL** statement that identifies a dataset and describes its attributes.   It is a symbolic link which allows users to relate one named dataset within their program to different physical data sets at different executions.

deadhead   To move a vehicle without passengers or freight for the purpose of changing the vehicle's location.   A vehicle so moved.

debt service period   See **amortization period.**

debugging   The art of detecting, locating, diagnosing, and correcting errors in **computer programs** or systems. Program errors can be classified as logical or syntactical--the former caused by a failure to understand a problem, the latter caused by incorrect **coding.** All four elements of debugging --the detection of errors through erroneous output, the location of the offending bits of code, the precise diagnosis

of the error, and the introduction of corrections which cause no new errors--can be extremely arduous and vexing.

decision table   A method of exhaustively tabulating the possible conditions that can occur (in some situation) and the correct response to each of the conditions. They are supplements to or equivalents of flow charts. Complex processes can be represented by decision tables or sequences of them, and languages exist for the direct **conversion** of decision tables to **source codes** for conversion to computer code.

default value   A design value typical of the conditions being described. It is usually a **mean** or **median** value and often reflects substantial empirical knowledge. It can be used by planners where site-specific details are not available. Frequently computer systems are programmed to supply default values for **parameters** for which no values are input.

degrees of freedom   This term has a number of applications. The common factor is some such idea as the number of ways an entity may simultaneously freely vary or the number of coordinates which must be specified to determine a system. It is probably impossible to frame a definition of this term that is at once precise, general, and elementary.

In practice the degrees of freedom should simply be thought of as a **parameter** of a number of important statistical distributions, the determination of which will always be clearly indicated for a particular case by any good statistical handbook.

delay   At traffic signals, the stopped time delay per approach vehicle, in seconds.

delimeter statement   A **job control** statement used to mark the end of data. The characters 1* appear in columns 1 and 2 of this control statement.

demand   1. Desired use (e.g., auto trips), often used in relation to **supply** (e.g., **congestion** of roads) and the determi-

nation of how this leads to some **equilibrium** position.

2. In an economic sense, based on the theory and methodology of consumer demand, demand is a schedule of the quantities of travel consumed at various levels of price or levels of service offered by the transportation system. Demand is not a fixed amount of travel, but a function of **level of service.**

Nearly all urban travel forecasting methods are based on the concept that travel demand and transportation facility supply interact in a transportation network as in a market to produce an equilibrium flow pattern.

Economics deals with effective demand, that is, not only the desire to purchase but the ability to pay. The relationship between the amounts of goods that will be bought and the various prices at which they are offered is expressed in a demand schedule--or portrayed graphically by a demand curve. The degree to which demand responds to price is call its **elasticity.**

demand model   A mathematic formulation that attempts to relate estimates of total travel to the values of **variables** which characterize the system and the population of potential users. It is not easy to characterize demand models in general, since their inputs and outputs can depend greatly on their location among other elements of the transportation planning process. Usually the demand model module does not so much estimate **demand** (in the strict sense) as produce gross numbers which--after being distributed, modally split, assigned, and iteratively adjusted on the basis of **equilibrium** considerations--produce an estimate of one point on the demand curve.

demand-actuated system   A **demand-responsive** transportation system.

demand-responsive   In transportation planning, demand-responsive services normally meet the needs of single passengers

or small groups of passengers in response to their specific requests for service at a specific time and location. See **dial-a-ride** and **PRT**.

density function   See **probability density function**.

dependent variable   The **variable** thought of as determined by the **independent variables**. In the form $y = f(x)$, y is the dependent variable. Specifically, the variable chosen as the variable to be predicted by a calibrated **model**. The choice of which variable is to be dependent is in many situations purely arbitrary from a mathematical point of view, nevertheless extra-mathematical considerations frequently lead the variable thought of as caused to be called dependent.

depreciation cost   A quantity representing the decrease in property value by wear, deterioration, or obsolescence. It is established by standard accounting procedures and not by inspection or estimates of actual physical depreciation.

derived variable   A **variable** derived as a function of one or more **parameters**: miles per gallon, average **auto occupancy** and the like. Except in special cases, statistical measures of the derived variable, such as **mean** and **variance**, cannot easily be determined from the corresponding measure of the variable(s) from which they are derived. To neglect this fact is to make an elementary but frequent mistake. For example, the mean of the reciprocals is not the reciprocal of the mean. If three autos get 15, 20 and 25 miles per gallon, the average is 20 miles/gallon. The average gallons/mile is not 1/20 but 47/900. (This is, interestingly enough, the reciprocal of the **harmonic mean** of the miles per gallon.)

A similar problem can arise in **regression analysis**: If you are interested in fitting a model of the form $z=x^{**}a^*y^{**}b$ and, as is common, use a **logarithmic** transform to obtain the form $\log(z)=a^*\log(x)+b^*\log(y)$, which you then fit, you will not have determined the values of a and b that

minimize the residuals of the first form, but of the second; and the two operations do not produce the same result, except in the case of perfect **correlation.** The difference between the **parameter** estimates derived in the two ways will go up as the correlation goes down.

design hourly volume   The amount of traffic which a transportation facility is designed to carry in one hour. Sometimes DHV.

design speed   The vehicle speed for which a transportation facility is designed.

desire line   A line on a map that describes the ideal (most desirable, theoretically) route for a **trip:** a straight line joining the origin and destination. Desire lines normally are plotted with widths proportional to the trip volumes along the hypothetical routes.

destructive trace   A barbarism. Not a **trace** in any sense, but merely a single printout of a **tree,** instead of separate printout for each path in a tree.

deterministic assignment   An assignment without probabilistic elements. An assignment process that will always produce the same outputs, given the same inputs. The opposite of **stochastic assignment.** An **all-or-nothing** assignment is an instance.

deterministic model   A **model** that expresses the interaction of system elements without probabilistic elements.

DHV   See **design hourly volume.**

Dial Algorithm   An efficient computer technique for finding and loading **bushes.**

dial-a-ride   A general term for a variety of **demand-responsive** transportation systems. The best known dial-a-ride systems are the van services that transport elderly and handicapped people in response to their telephone requests.

DIALUTPS   This service (Daily Information Available Locally) is available to all **UTPS** users.   Information regarding UTPS, new documentation or **software** availability, users problems, etc., is input to DIALUTPS on a daily basis, excluding holidays and weekends. One can reach this service via telephone using a local terminal or teletype. Information on how to do this is provided with UTPS tapes.

diamond lane   A lane with painted diamond signs on the pavement to mark it as a priority lane for high-occupancy vehicles. Usually the priority is enforced only at certain times of day.

direct access   An **auxiliary storage** device in which the time to retrieve data items is independent of their location.   Opposed to a serial device such as magnetic tape. Also **random access**.

direct assignment model   A **model** that simultaneously (in a single equation) predicts all travel choices for **aggregate** groups of individuals. This would be opposed to the traditional **four-step method**.

direct demand model   A model that simultaneously (in a single equation) predicts the **demand** level for a given system without breaking the process into elements of total demand estimation and **modal choice**.

direct elasticity   Opposed to **cross-elasticity**. See **elasticity**.

disaggregate behavioral demand model   See **disaggregate data** and **behavioral model**.

disaggregate data   Data at the level of individual choice are said to be disaggregate. Ordinarily they represent a set of survey data on a trip-by-trip basis in which an individual item will contain the perceived **disutilities** of each available choice and some indication of the choice made, fre-

quently by having a set of **variables** for each **mode** in which the chosen mode's variable has a value of 1 and all other modes 0.

disaggregate demand model   Obtained by using observations of individual travel choice behavior for model **calibration.** These models are usually probabilistic.   See also **aggregate demand model.**

discounted cash flow   See **net present value.**

discount rate   A specific rate of interest which is assumed and used in the determination of the **net present value.**   It reflects the notion that a monetary value in the future is worth at present only what it would be necessary to invest at present (at the specified rate) in order to equal the monetary value at the future time.   As the discount rate gets larger, long-term costs and benefits become less and less important as compared with present ones.

discrete   Not **continuous.**

discrete runtime service   See **cycled service.**

discriminant analysis   The central purpose of discriminant analysis is to solve classification problems.   If you have been able to make a number of measurements of the skulls of a large number of Neanderthal men, Cro-Magnon men, and Welshmen, and then are presented with a series of skulls of unknown origin, discriminant analysis presents one of the most satisfactory methods of assigning each skull to the group it is most like, in other words, in which it **best fits.**   The extension of this to the separation of transit riders from automobile drivers from carpool users is straightforward.

disjoint distribution   Two **distributions** with a **correlation coefficient** of zero (i.e., uncorrelated) are said to be disjoint.

dispersion   The variation or scattering of data about an **aver-age** value. See **variance.**

disposable income   "More fully, disposable personal income--which is the income remaining to persons after personal tax and nontax payments. Personal taxes include state and federal income taxes as well as personal property taxes and estate and gift taxes. Nontax payments include fines and fees for such services as education and hospitals. Disposable personal income is the amount of money which individuals can use either to make personal outlays or to save."

The previous paragraph is directly from the *Dictionary of Economic and Statistical Terms* of the U.S. Department of Commerce. This source does not clarify whether the items mentioned are exhaustive or merely exemplary. Other sources define this term as the residue of personal income after all tax payments.

distance fare   Fare based on distance travelled.

distribution   1. The **frequency distribution.**

2. See **trip distribution.**

distribution function   A somewhat unsettled term. Most modern books agree that it is synonomous with **cumulative distribution function,** but it was once much used (especially in the form **probability distribution function)** to mean what it has become customary to call a **probability density function.** This latter usage is still very common in discussing the density functions associated with the Normal, Poisson, χ^2 and other common distributions. If one sees in a textbook the Poisson density function it will almost invariably be labeled the *Poisson distribution.*

These terms are usually reserved for continuous distributions. The discrete analog of the density function is usually called the **frequency distribution.**

distribution function, cumulative   See **cumulative distribution function.**

distributor tour   In **many-to-one service,** a run made by a **DRT** vehicle to drop off passengers.

district   A grouping of contiguous **zones.**

disutility   An **impedance** thought of in an econometric context, specifically as an **independent variable** in a **demand** or **modal choice** model.

diversion assignment   Allocation of the vehicular **trips** for a given origin destination pair to two routes, based on the travel **impedances** of each. Usually, one is a **freeway** route and the other a non-freeway route.

diversion parameter   A **parameter** which controls the sensitivity of a **diversion assignment** to **disutility** differences. Compare **theta parameter.**

diverted demand   Traffic that is diverted from a facility or route because of improvement in another facility or route. See **induced demand.**

division   Usually, a group of transit **lines** that operate out of a common storage depot. Also called terminal. Sometimes several garages are combined into one regional division.

DMSM   *Demand Model Selection Manual.* Guides planners in developing criteria and formulating hypotheses to govern the selection of **demand models.** This element of **UTPS** also contains a valuable general discussion of planning considerations.

double counting   A term used to describe a phenomenon in **cost-benefit analysis.** This is not necessarily a crude mistake but can be a fairly refined error--counting a benefit once by evaluating an intangible and then again as part of a change in rent. A concrete instance of this in a transportation study would be, when evaluating the benefits to a region of improved transportation service, first to count

the value of the time saved by the users and then to add in
the increase in property values. Presumably the latter is
at least in part a capitalization of the former and adding
in both as independent benefits constitutes a hard to speci-
fy amount of double counting.

double precision   A format that allows a number to have (rough-
ly) twice as many significant figures as is usual in a par-
ticular device.

downtown people mover   See **DPM**.

DPM   Downtown People Mover. Not a **people mover** in the older
sense but a kind of downtown **PRT**.

driving time   The time spent traversing the distance between
zones, not including **terminal time** at each end of the auto
trip.

DRT   **Demand-responsive** transportation system.

DRYRUN   A **UTPS** option that allows a program to be checked prior
to **execution**: all **keywords** are verified and **core require-
ments** are printed out.

DSN   See **dataset name**.

DSNAME   See **dataset name**.

dual-mode system   A system in which a single vehicle may oper-
ate both on **automated guideway systems** and on ordinary
streets. There is no such system in operation or under con-
struction.

dummy index   In an expression such as sum(for j: = 1 to n :
w(j)), j is called the dummy index, since it could be re-
placed by any other free index without changing the value of
the expression. The dummy index is said to be summed out.
The term is also used for the index over which a product is
performed, as the j in n! = product(for j: = 1 to n : j).

dummy link   In **network coding,** a **link** added for system access
and egress.

dummy variable   1. The **variable** with respect to which an integration is performed.

2. A variable introduced into a **regression analysis** in lieu of a stratification. It usually takes on the values 1 or 0, depending on whether an observation has or lacks a specific attribute.

dump   To record or print out all (or a large section) of the internal storage of a computer. Usually a **debugging** technique.

dwell time   The period, precisely measured, from the time a bus or train stops at a station to the time it begins to move again.

dynamic core allocation   A method of obtaining the computer memory storage necessary for the execution of a **program**. This technique allows the memory size required for a problem to be a function of problem size at each application.

dynamic simulation   See **simulation**.

EBCDIC   Extended Binary Coded Decimal Interchange Code. A system of representing numbers, letters, and special characters in eight **binary bits** or two hexadecimal digits. Pronounced EBB-see-dick.

effective movement area   In a transit station, the effective movement area is the difference between the total (or empty) movement area and the queue area.

efficient path   Any path from an origin to a destination along which each successive **node** is further from the origin than it predecessor. The set of efficient paths between two points contains the shortest path and (possibly) many others. See **bush.**

egress time   When the whole phrase, *egress time,* is used, the normal understanding is that it refers to the entire time required for travelers to move from **line-haul** vehicles to

their destination. This should not be confused with the common use of the term *egress* for the time required to leave a vehicle, as in the sentence: "One characteristic of the standard bus is quick access and egress "

elasticity   In economics, an elasticity is frequently defined as the percentage decrease in a **dependent variable** when price increases by 1%. (This usually refers to **demand,** but **supply** elasticities are also possible.) It should be noted that this definition leads to a positive value for the typical price-elasticity of demand. In transportation planning it is common to consider the elasticity of demand with respect to any other **independent variables** of the system, such as time, which determine demand.

A direct elasticity is the relative change when both the dependent and **independent variables** pertain to the same **alternative,** e.g., transit **mode** choice and transit service frequency. A cross elasticity is the relative change when the dependent and independent variables pertain to different alternatives, e.g., transit mode choices and auto travel time.

If the elasticity is greater than one, the demand is said to be elastic. If much greater than one, highly elastic. High elasticity is typical of the demand for luxury items. If the elasticity is less than one, the demand is said to be inelastic and, as it approaches zero, to be highly inelastic. The demand for necessities is characteristically inelastic. An elasticity of zero would indicate that, at least over some range, consumers would pay any amount for a fixed quantity of a product but would not take more even if it were free. The demand for salt, perhaps, approximates this behavior.

In econometric modeling, the elasticity of x with respect to y--often called the point elasticity--is usually taken as a limit, as the fractional change goes to zero:

$$E = x/y * derivative(x:y)$$

Note that elasticity as defined here has an opposite sign to the elasticity as defined above.

A method of calculating elasticity frequently found in transportation applications is the ratio of the fractional change in demand (D,d) to fractional change in price (P,p):

$$E = (D-d)/d * p/(P-p)$$

(where capital letters have been used for the new values and small letters for the original values). This quantity is also called the shrinkage factor. It has the same sign as the point elasticity. It has the disadvantage of not being a point function (as the other two definitions are) and of not being a very accurate estimate of the point elasticity. A better estimate can be arrived at by using the formula

$$E = (D-d)/(D+d) * (P+p)/(P-p)$$

This is sometimes called the chord elasticity, and sometimes, rather improperly, the arc elasticity.

It should be remembered that the elasticity functions like a continuously compounded interest factor: if a commodity has a constant unit (point) elasticity, it is true that a 1% increase in price will cause almost exactly 1% decrease in demand. But a 10% increase in price will cause a 9.1% decrease in demand and a 25% increase will cause a 20% decrease.

For further discussion, see Michael A. Kemp, "Some evidence of transit demand elasticities," Urban Institute Paper, June 1973 and Herman Wold and Lars Jureen, *Demand Analysis,* Wiley, 1973.

endogenous variable   See **exogenous variable.**

entity file   A data storage configuration, where for a number of individual elements or entities, such as a **link,** a **zone,** or a survey record, a series of data or individual **attribute values** are created.   Each entity contains many data attribute values.   For example, an entity named "zone 12" might consist of the value of zone 12's population, average income, and dwelling units.   An entity named "link 101102" might consist of the **VMT** and facility-type attribute values for the link from **node** 101 to node 102.   A group of many entities comprises an entire entity file.

entry point   The first instruction of a **subroutine** to be executed.   Not necessarily the first instruction.   A subroutine can have multiple entry points corresponding to different functions to be performed.

enumeration district   *Ad hoc* Census districts set up to conform to the boundaries of cities and Congressional districts. Unlike **tracts,** they are frequently not uniform from Census to Census.

environmental impact statement   A document required by the National Environmental Policy Act.   All Federal agencies must prepare such a statement of the significant environmental effects of all major proposals.

EPA   Environmental Protection Agency.

equated coefficient   See **constrained coefficient.**

equation system, simultaneous   See **simultaneous equation system.**

equilibrium   The static state of balance between travel **demand** as influenced by travel **impedance** and travel impedance as influenced by travel demand (congestion).   As the amount of travel on a route increases, a point will be reached where no additional travel is attracted because of high travel

costs and times due to **congestion.** This point would be the equilibrium state. The concept of transportation supply/demand equilibrium relates to many types of demand-related choices: (1) location of activities (land use), (2) frequency of trips (trip production), (3) trip destination (trip distribution), (4) modal or route choice, and (5) time of travel.

equilibrium assignment   The assignment of vehicles to **links** in such a way that travelers cannot reduce their **travel time** from origin to destination by switching to another **path.** See **Frank/Wolfe gradient procedure.** For a general discussion see R. Eash, B. Janson, D. Boyce "Equilibrium Trip Assignment: Advantages and Implications for Practice," TRR 728, 1979.

equivalences, zonal-district   Zonal-district equivalences.

event   In simulation, the occurrence of a change at a point in time. An event may cause a change in the value of some **attribute** of an entity. It may create or remove an entity (e.g., a passenger), or it may start or stop an activity at a **link** or **node.**

excess time   Time delay associated with travel to or between major transit routes, e.g., walking, waiting, or transferring.

execute   To interpret a machine instruction and perform the indicated operations upon the operand(s) specified.

Also: to perform that operation on all those instructions that make up a job.

exogenous variable   A **variable** representing a quantity which is considered as controlled or coming from outside the process under consideration. Opposed to endogenous variable. The line between them is not clearcut. A variable can be exogenous in one **model** and endogenous to another. Even in con-

sidering the same system, two analysts might draw the line at different places, depending upon their assumptions about the nature of influences at work. In the context of a particular model, an exogenous variable is one whose values are given to the model, an endogenous variable is one determined within the model.

expand To disaggregate a **trip table** from the **zonal** level to the **district** level. A function of **USQUEX**. See **zonal-district equivalencies**.

expansion factor A value used to adjust a **sample** to represent an entire **population**. If different subpopulations are sampled with different degrees of coverage, then more than one expansion factor may be used in estimating population **parameters**.

express service An imprecise term. Although high speed is sometimes involved in express service, express travel is normally expedited by its having no stops or very few stops between origin and destination. Express service might well operate in ordinary street traffic.

expressway A divided highway for through traffic with full or partial access control and a high incidence of **grade separation** at major intersections.

external station A location at the external **cordon line** where driver interviews are conducted.

extract To remove from a computer word only those characters occupying certain specific locations, thereby deriving a new computer word. Usually accomplished with a **mask**.

facility type codes UTPS highway link-data codes that indicate physical types of facilities. Typical codes: 1 = freeway; 2 = expressway; 3 = two-way arterial; 4 = one-way arterial; 5 = centroid connector. See **area type code**.

factor   1. Any of two or more quantities which form a quantity (the product) when multiplied together. Each of the quantities is said to be a factor of the product.

2a. To multiply a number by a factor. 2b. To resolve a number into its factors, in any way. This process gives a unique result only if all the factors are prime numbers.

3. To expand a sample to represent a population.

factoring   In general, multiplying by any **factor,** usually by an **expansion factor.**

fatal error   An error which causes the termination of computer processing.

F distribution   The sampling distribution of the ratio of the values of two independent **random variables** having the **chi-squared** distribution, each divided by its **degrees of freedom.** Used in the testing of hypotheses about the equality of **variance** in two **populations.**

feeder service   A service that transports passengers to a station or transfer point for further transportation service by **line-haul** vehicles.

F factor   Friction factor; an impedance-dependent factor used in the **gravity model**

F file   A file of F **factors.**

FHWA   Federal Highway Administration.

FHWA battery   See **PLANPAC** and **BACKPAC.**

FIFO   The queue discipline of first-in first-out. Compare **LIFO.**

flag   An indicator in a **computer program** that some condition has occurred or some operation has been performed.

floating point   A format for representing and a computer technique for storing non-integer numbers over a wide but finite and system-dependent range of magnitudes.

flow data   Information about *actual* traffic volumes in real systems. This would always be an input and never an output.

flow map   A map that represents *actual* transportation routes with lines of width proportional to their volumes. Compare **desire line**.

footing   See **crossfooting**.

forecast year   That year for which transportation improvements are designed. Compare and contrast **base year**.

FORTRAN   A contraction of *formula translation*. A programming language written in terms very similar to algebraic notation. Its use does not require intimate knowledge of computers. It is especially useful in solving mathematical problems. Most **UTPS** source codes are written in FORTRAN.

four-step planning process   The traditional transportation planning process as developed over the past thirty years, primarily as a tool for street and highway planning. The four steps are:

a. **trip generation,** which forecasts numbers of **trips;**

b. **trip distribution,** which determines where they will go;

c. **modal split,** which chooses one of the available **modes;** and

d. **trip assignment,** which determines routings.

The primary result of this process is a usage forecast for a transportation system. The chief difficulty with this process is that it treats consecutively decisions which are made simultaneously. This can be alleviated somewhat by iterating the whole process or components of the process (to reach **equilibrium** in assignments, for example) to insure enough feedback to check on assumptions.

Frank/Wolfe gradient procedure   Used for the minimization of non-linear functions subject to linear constraints. It is used in **UTPS** to perform a **capacity-restrained** assignment.

Fratar distribution   A **trip distribution** approach that uses a **base-year** trip table and **growth factors** for **analysis units** to estimate a future year **trip table.** Named after Thomas J. Fratar.

This technique has been criticized because it lacks system sensitivity and because interchanges that had no travel in the base year are automatically assigned no travel in a **forecast year.** Also, the Fratar method sometimes fails to **converge;** it is a dangerous tool for the solution of large problems.

freeway   A divided highway with access restricted to interchanges and with **grade separation** at all intersections. The word is much more broadly used in common speech. The supposition is that *freeway* was originally opposed to *tollway.* Oddly, it seems now an exclusively urban term: the same road that runs through the countryside and small towns as an Interstate somehow becomes a freeway when it gets to the city.

frequency distribution   A table (or any other representation) which shows the classes into which data have been grouped and the number of items in each class. A frequent method of representing a frequency distribution is the **histogram.** The frequency distribution is the **discrete** equivalent of the **probability density function** of **continuously distributed variables.**

For coin-tossing: $P(H) = P(T) = 1/2$; or for a pair of dice $P(2) = P(12) = 1/36$, $P(3) = P(11) = 1/18$, $P(4) = P(10) = 1/12$, $P(5) = P(9) = 1/9$, $P(6) = P(8) = 5/36$, $P(7) = 1/6$. (It is understood that the expression $P(x)$ means the probability of x occurring.)

frequency function   See **distribution function.**

frequency polygon   If the midpoints of the upper boundaries of the class intervals in a **histogram** are connected by straight lines--with the lines brought to the x-axis for the two bounding and any included empty classes--the result is a frequency polygon.

friction factor   See **F-factor.**

fringe parking   Parking facilities located outside the central business district but serving transit or carpool travelers to the central business district.

Fruin level of service   Sets of **area occupancy** classifications developed by J.J. Fruin to connect the design of pedestrian facilities in transit stations with **levels of service.** There are several sets, including one for level corridors and one for stairs.   The classifications run from A to F, from best to worst.

fudge factor   A disreputable **weight.** In its extreme form it is the ratio of the actual result to the desired result.   More acceptably: a **parameter** of a model adjusted to produce more pleasing results.   To use fudge factors is to engage in a kind of back-alley **calibration.**

fully-competitive model   A member of a family of models developed by J. McLynn that are not afflicted with the somewhat disingenuously named property of "independence of **irrelevant alternatives.**" These models were originally formulated as involving only presumably small correction terms to be applied to current **product-form** models and have been successfully tested in several applications.   It is unfortunate that there is no readily available **software** allowing easy **calibration** of this promising class of models, which is constructed so as to perform at least as well as **logit models.**

function   To say that y is a function of x, or y = f(x), means (among many other things) that the value of y depends on the value of x. You need to know the value of x to calculate the value of y. It frequently means that all you need to know to calculate y is x and the form of the functional relationship; e.g., y = exp(.2*x) or y = x+1. But this is not necessarily the case, since y may also be a function of z or any number of other unmentioned **independent variables.**

The value of y can also depend on the value of unspecified **coefficients.** In the expression y = ax, the difference in the way y depends on a and on x is largely a matter of how you hold your head. It is usually safe to assume that the functions dealt with in transportation planning are single-valued, that is, only one value of y corresponds to a value of x--although not necessarily vice versa. A function need not be expressed in the form y = f(x); any set of rules or processes that, given a value of x, produces a value of y, determine y as a function of x.

Travelers into the darker regions of certain mathematical jungles return with tales of all sorts of fearsome functions with marvelous properties. Those stories entertain, but bear little upon the docile functions usually found grazing peacefully upon the sunlit plains of transportation planning.

generalized cost   See **disutility.**

generated demand   See **induced demand.**

geometric mean   The geometric mean of two numbers is the square root of their product. Thus the geometric mean of 5 and 20 would be 10; not 12 1/2, their **arithmetic mean,** or 8, their **harmonic mean.** (Generally for positive numbers, the geometric mean will be smaller than the arithmetic and larger than the harmonic mean.) A formula to generalize to N numbers is

$$\log(G) = \text{sum(for i: } = 1 \text{ to N: } \log(x(i)))/N$$

The geometric mean is particularly useful if you are dealing with growth or decay following or presumed to follow an exponential pattern. If you know the population of an area in 1970 and 1980 and wish to estimate it for 1975, the geometric mean might well be more appropriate than the arithmetic mean.

geometry   Sometimes means "the way things are laid out." To consider lane geometry is to take into account the way the lanes are laid out.

global   A **variable** known to a main program and all of its **subroutines** by the same name is said to be a global variable. To be distinguished from a **common** variable.

GM   See **Gravity Model**.

goodness-of-fit measure   See **best fit**.

grade separation   An intersection of paths accommodated by an overpass or underpass (any combination of highway, rail, pedestrian, etc.).

gradient   The gradient of a **function** is a **vector** (associated with every point for which it can be defined) pointing in the direction of the greatest rate of change for the function. The magnitude of the vector is the maximum rate of change of the function. For a suitably docile function, the component of its gradient in *any* direction is its rate of change in that direction.

gradient procedure, Frank/Wolfe   See **Frank/Wolfe gradient procedure**.

graph   A graph consists of **nodes**, some or all of which may be connected to each other (or to themselves) by directed line segments called **arcs**. An arc that begins and ends at the same node is called a loop. A graph that allows up to p arcs to join a pair of nodes is called a p-graph. A p-graph

without loops or isolated nodes is called a network and is a convenient abstract representation of the transportation **network.**

These definitions are not universally adopted. Some discussions treat *network* and *graph* as synonymous.

gravity model   A mathematical **model** of **trip** destination based on the premise that trips produced in any given area will distribute themselves in accordance with the accessibility of other areas and the attractions they offer.

The expression for the trips from i to j--T(i,j)--is given by

$$T(i, j) = C(i)*P(i)*A(j)*F(i, j)*K(i, j),$$

where,

P(i) = total trip **production** at i,

A(j) = total trip **attraction** at j,

F(i, j) = calibration   term   for   interchange   ij; **F factor,**

K(i, j) = socioeconomic adjustment factor for interchange ij; K **factor** and

C(i) = 1/sum (for all m: A(m)*F(i, m)*K(i, m))

The gravity model is very old in transportation studies, with applications going back to the last century. If--as was common in early studies--the production and attractions are taken to be proportional to the population and the F factor, inversely proportional to the square of the distance between zones i and j, then the analogy between the form and Newton's Law of Universal Gravitation will be seen.

gridline   An imaginary line that divides a study area into two parts. Unlike the **screenline** or **cordon line,** the gridline need not follow a natural barrier. It is used to check traffic counts, **trip end** assignments, survey accuracy, and **model calibration.**

growth factor   The ratio of future to **base-year trip ends,** or future to base-year population, etc.

GRT   Group Rapid Transit. A way station on the route of the **PRT's** funeral procession.

GUIDE   *UMODEL Users' Guide* is a manual describing various applications of the program **UMODEL.**

guideway system, automated   See **automated guideway system.**

harmonic mean   The reciprocal of the mean of the reciprocals. The **mean** of the reciprocals of 4 and 6 is 5/24. The reciprocal of this is 4.8, the harmonic mean of 4 and 6.

headway   The distance or time that separates vehicles moving in the same direction on the same line or track. It is written that a strict measurement of headway is of the time and distance that separates the front ends of such vehicles. There are no doubt cases when such precision in timing is necessary, but watch out not to stand too close to the right-of-way.

headway, actual   See **actual headway.**

headway, base   See **base headway.**

headway factor   A time in minutes, that both **nominal headway** (NH) and **maximum headway** (MH) must be a multiple of. The headway factor can be specified to assure "clock-face" headways or to synchronize scheduled lines with a common transfer point. When **INET** recomputes the nominal headway (NH), it is constrained to be a multiple of the headway factor (FH).

headway, nominal   See **nominal headway.**

headway order   In scheduling, a form used for prescribing **headways** for a new schedule.

headway sheet   A listing of trips sorted by arrival time at a maximum load point. Also schedule timetable.

heuristic   Pertaining to exploratory methods of problem sol-

ving, trial and error solutions; aiding discovery; tricks or strategems used to facilitate discovery. Methods of finding good--but probably not best--solutions. From Greek verb *heurisko:* "I find out." (Archimedes lived in a time and place of the ancient Greek world where they dropped the 'aitches. Consequently he said "Eureka" for the perfect tense of this verb.) Opposed to **algorithmic.**

hexadecimal A number system using the base sixteen. There are sixteen symbols, 0-9, A, B, C, D, E, F. They conveniently represent the internal operation of such computers as the IBM 360, where two hexadecimal symbols can represent the contents of one **byte** and the 256 possible members of the **EBCDIC** character set.

hierarchy of operations A set of precedence rules which determines the order in which a computer will **execute** multiple **operators** within a single **source code** statement, insofar as that order is not made clear by the use of parentheses.

histogram A bar chart representing the relative frequencies of the outcomes of a **discrete random** process. It corresponds to the plot of the **frequency distribution** in the **continuous** case.

historical record A **binary coded network** file used in **FHWA** and **UTPS** highway **traffic assignment** programs to provide **link** volume, distance, **travel time,** speed, **capacity,** and other descriptive information.

hit A match made when a computer file is searched for a specific data item; a correspondence between the label of a stored item and a search key. If you look up *puce* in a dictionary and find it, you have made a hit. Compare **no-hit conversion.**

home-based trip A troublesome phrase. A trip with either its origin or destination at home. Both the trip from home to

work and the trip from work to home are spoken of as home-based; in such cases, home is not an **attraction**.

homoscedasticity   Also homoskedasticity. (Regardless of spelling, the sixth letter is usually hard.)   A condition in which the **variance** of observations is independent of the value of the observations.

hook   The connection at a terminal of a transit trip arrival and departure.

horizon, planning   See **planning horizon**.

household record   **UMODEL** input on punch cards or card image records.   A household record is usually a record with a field identifying the origin end of the record and a field indentifying the destination end of the record.   In most cases it is expected that such household records will be the trip records from an origin-destination study.

HR   *Highway Network Builder/Updater.*   An element of **UTPS** that reads user-prepared input data describing a highway network and outputs an **historical record** acceptable to **UROAD**.

HUD   U.S. Department of Housing and Urban Development.

HUD format   An alternate format for **trip tables** and **skim trees** accepted by **UTPS** programs.   It does not contain comment records and has a slightly more restrictive physical format than the standard UTPS formats.

IGTDS   Interactive Graphic Transit Design System.   A computer graphics package that allows man-computer **interaction** for the rapid generation and evaluation of short-range transit improvements.   IGTDS is concerned solely with the analysis of **node** oriented transit systems, those that serve **trips** from multiple destinations to a single destination.

immediate request   In **DRT** service, a request made for service by a traveler in anticipation of immediate response.

impact analysis   Also impact evaluation. That part of the transportation planning process in which there is an evaluation of the effects of an existing or proposed transportation system on its **infrastructure.** The usual concerns are air pollution, energy consumption, and accidents. (An **environmental impact statement** is required by law to accompany all proposals.) There can be many other concerns, such as socioeconomic effects.

impact statement, environmental   See **environmental impact statement.**

impedance   Generally, any condition that restricts or discourages travel; or a measure of that condition. The term is most usual in a modeling context, where an impedance is any one of the generalized costs of travel accounted for explicitly within the **model.** Time and costs are the usual impedances; but discomfort, hazard, and unreliability are frequently considered in theory and occasionally even in practice: See **Jericho technique.** See **disutility.**

impedance exponent   The exponent on an **impedance** term in a **product form, demand** or **modal split** model.

independence of irrelevant alternatives   See **irrelevant alternative.**

independent variable   See **variable.**

index   1. A number used to point out a specific characteristic or operation--or a specific item among a set of items (Latin index: a pointer, forefinger). Most subscripts and some superscripts are indices in this sense. (However, the most common use of a superscript is to indicate exponentiation.)

2. A number used to measure changes in economic quantities. It sets the level in some arbitrary **base year** at 100 and scales the values for other years proportionally. An example of this kind of index is the cost-of-living index.

3. One of a set of numbers used to locate a specific **cell** in an **array** .

induced demand   Traffic that is drawn to a facility or route, not by an increase in general traffic but by an improvement in the facility or route.   Induced demand may represent **trips** that would not be made in the absence of the improvement.   Compare **diverted demand** and **latent demand.**

inelastic   Having an **elasticity** of less than one.   If your demand for a product is inelastic, you will spend more money on it as its price goes up.   In the extreme case of inelasticity—called perfect inelasticity or zero elasticity—you would buy the same amount of a product regardless of its price.

INET   A **UTPS** integrated transit network program that creates, modifies, and prints a computerized description of a transit **network.**   Its input consists of a highway network, as built by UTPS program **HR,** and transit line data.   The transit network desciption is used by other UTPS programs for further analysis of transit service and patronage.   INET determines transit speeds in **mixed traffic** automatically, as a function of auto speeds, as obtained from a **loaded highway** network, and permits **grade-separated** transit systems to be **coded** easily and directly without reference to the highway network.   It provides optional reports which assist in the determination of **headways,** construction of line schedules, and estimation of **operating costs.**

infrastructure   In transportation planning, the word is quite loosely used, primarily to describe all the relevant elements of the environment in which a transportation system operates.   Relevance is established in various ways in various studies.

in-phase operation   An arrangement of **cycled service** by which **DRT** vehicles in **many-to-one** operation arrive at the trans-

fer point at the same time but do not meet every **line-haul** vehicle. Under this arrangement, the **feeder** vehicles do not service the entire feeder area but are assigned to subareas. Compare **out-of-phase operation.**

interactive Relating to a form of computer processing in which results are returned so quickly that the user, who remains connected to the system via a remote terminal, can respond in order to continue or reinitiate processing. Interactive processing can allow a programmer to build a program while connected to a computer. Interactive systems are also time-sharing. The term is frequently (although not quite accurately) opposed to **batch** processing.

Interactive Graphic Transit Design System See **IGTDS.**

intercept The distance from the origin to the point at which a line, curve, or surface cuts an axis. The intercept on the abscissa or x-axis is called the x intercept—and likewise for the other axes. For the line $2x + 3y = 12$, the x intercept is 6 and the y intercept is 4.

interchange 1. The system of interconnecting ramps between two or more **grade separated** highways.

2. An interchange between two **zones,** whether contiguous or not, is any significant relation between them expressed as a **matrix** entry in the row relating to one zone and the column relating to the other. This term is used especially if the matrix is a **trip table.**

3. A transfer point.

interface Interact or interaction. More commonly in transportation planning: a point of interaction.

Intermodal Planning Group A Federal committee established in each of the ten Federal regions. Primarily composed of field planning representatives from the Federal Aviation Administration, the Federal Highway Administration, and the

Urban Mass Transportation Administration, its purpose is the coordination of action among these groups.

internal rate of return   A **discount rate** for a project which produces a zero present net worth for that project when applied to the time stream of costs and benefits of the project.   Used as a measure of merit for a project.   It is a somewhat tricky measure since it does not have a unique value for some possible time patterns of costs and benefits.

internal trip   A **trip** whose origin and destination are both within a study area.

interrupted flow   Vehicle movement under restraint by signals, stop signs, and intersections.   Compare **uninterrupted flow.**

intervening opportunities model   A mathematical **trip distribution** model, based on probability theory, that distributes trips from one **zone** to each other zone in proportion to the product of probability that the trips have not found a prior destination in zones ranked closer to the zone of origin and the probability that the candidate destination zone provides an acceptable destination.   See S. A. Stouffer, "Intervening Opportunities: A Theory Relating Mobility and Distance," *American Sociological Review,* vol. 5 no. 6 pp 845–867, 1940 and M. Schneider, *Panel Discussion on Inter-Area Travel Formulas,* Bulletin No. 253, Highway Research Board (now, Transportation Research Board), 1960.

inverse   Used variously in the sense of *undoing*. The inverse of a number is its reciprocal. A **matrix,** when multiplied by its inverse (if there is one), gives the unit matrix.   The natural **logarithm** and the exponential function undo each other ($\ln(\exp(x)) = \exp(\ln(x)) = x$) and are therefore said to be inverse to each other.

IPS   Interactive Planning System.   An extension of **UTPS** still in the development stage.   It will provide the planner with

a capability for **interactive** management, analysis, and display of planning data.

iron cross   A form of display used in **UTPS**. It compares two **matrices** showing the absolute and percentage differences between them in **cross-classification**.

irrelevant alternative   A loaded term. In a reasonable world, this would mean a travel **alternative** that need not be considered because it is dominated in all its attributes by other options. Perversely, it is usually used to stigmatize a perfectly relevant (and innocent) alternative whose effect upon the relative market shares of two other **modes** has not been rationally evaluated due to a structural defect in several popular **modal** **split** models. See **fully-competitive model** and **product-form model**.

isochrone   A line drawn on an **isochronal map** connecting all time points that are some specified travel time from an origin point. Frequently isochrones are drawn in 5 or 10 minute intervals. The Greek *isos* means equal; *chronos*, time.

isochronal map   A map with a series of **isochrones**, usually at some standard interval, and centered on some fixed origin.

issue analysis   A detailed list of steps that can be taken to evaluate a chosen forecasting strategy. An elaborate and helpful issue analysis is outlined in Chapter VI of the **UTPS** *Demand Model Selection Manual*. See **DMSM**.

ITAM   Interactive Traffic Assignment Model. A **UTPS** computer graphics package that allows man-computer **interaction** for the generation and evaluation of short-range and mid-range transit improvement. ITAM responds to questions about service **supply** in relation to shifting patterns of **demand**. ITAM allows a planner with a good understanding of the problem to generate and evaluate improved transit designs quickly without having to use mathematical programming techniques. Performance measures of two **alternatives** can be displayed simultaneously. See **IGTDS**.

iterative process   Strictly, merely a repeated process; but this term nearly always implies that the later repetitions make use of the results of, or are somehow modified by, the previous repetitions.

JCL   Job control language. A control language used with various IBM operating systems. All jobs to be executed by these systems must be accompanied by one or more JCL statements that contain information required by the operating system to schedule, initiate, and control the processing of jobs.

Jericho technique   In Joshua vi, it is recorded that, the Israelite army having seven times marched around the city of Jericho, and blown trumpets, and raised a great shout, the walls of the city collapsed. The city was taken and utterly destroyed. In imitation of this strategem, modern analysts are wont to march around problems seven times shouting "linear programming" or "cost-benefit analysis." The results are not always so satisfying as they were to the Children of Israel.

JFILE   A **dataset** or file used for the storage of **matrix data** for travel **analysis zones**. This term is a **UTPS** convention.

jitney service   The word *jitney* comes from an old American slang term for five-cent piece, but its origins are much clearer than its meaning. Some people use it to mean some sort of **feeder** service, others to mean **DRT** or even **paratransit**. Certainly it is some service that is not **line-haul**. If you have a jitney to deal with, you had better go look at it to see what it is.

job control language   See JCL.

joint probability   Pairs, or larger numbers, or **random variables** are often encountered that are in some sense associated. Each member of the pair can be studied as a random variable in its own right (see **marginal probability**), but it

is frequently important to study them in a context of their common or joint behavior. This leads to a generalization where the **cumulative distribution function** and densities of more than one variable are considered.

journey time In transit operations, a time allowance, paid for at the straight time rate, which permits a conductor or operator who is relieved at the end of his day's work at a point distant from his station to return to the station to sign off.

Julian date Has nothing to do with the Julian calendar, which is named after C. Julius Caesar (veni, vidi, vici). It was named in honor of Julius Caesar Scaliger by his son Joseph Justus. (Although we hear little about them these days, the two Scaligers, *padre* and *fils,* were very sharp cookies indeed.) The Julian date of any day is its number, reckoning consecutively, taking January 1, 4137 B.C. as day 1. The system was introduced in 1583 in J.J.'s *De Emendatione Temporum.* The starting date was not Scaliger's notion of the creation of the world. There was a good reason for its choice, but it is too complicated to go into here. The Julian date of March 17, 1980 was 2, 444, 316.

keyword One of a series of words used to override **default values** in **UTPS** programs.

K factor An adjustment factor applied to a **gravity model,** based, in theory, on specific, relevant social and economic conditions that affect travel patterns. See **fudge factor.** To be distinguished from **F Factor.**

kiss and ride A mode of arrival, usually at suburban commuter stations, in which automobiles stop briefly near the entrance, deposit or collect passengers, and proceed without parking. The kiss is not mandatory. In some cases it would be highly improper.

lag operator   An operator available in **UFIT** to facilitate **time series analysis.** It allows the user to refer at any given time period to the operation of the previous time period.

land-use model   A tool for predicting the future spatial allocation of urban activities given total regional growth, the future transportation system, and other factors. See S. Putnam et al., "Urban Land Use and Transportation Models: A State-of-the-Art Summary," Transportation Research, 1975, Vol. 9, pp 187-202.

lane analysis   See **critical movement analysis.**

latent demand   **Trips** which, though at present not made, would be made if transportation system improvements were made or if access were provided to specified segments of the population. Compare **diverted demand** and **induced demand.**

LAV   In a computer file, a collection of the **attributes** of a **zone** (population, number of dwelling units, etc.). The contents of a **ZFILE** are lists of attributive values. For one attribute the LAV will contain its value for all zones.

layout sheet, terminal   See **terminal layout sheet.**

layover time   Out-of-service vehicle time, usually at a transit line terminal. The layover time typically includes an allowance to use in putting the vehicle back on schedule. Also turnaround time, out of service time, recovery time, recovery, and dropback.

least squares estimate   A **parameter** estimate derived by the **least squares method.**

least squares method   A method of choosing the **parameters** of a function in order to make it give a **best fit** to **observed** values. In the least squares method the parameters are chosen so as to minimize the squares of the deviations between the predicted and observed values. In the case of a single set of measurements, this method gives the arithme-

tic **mean** as the best value. When fitting a set of observations to a straight line, the method is called **linear regression**. **Polynomial fitting** can also be viewed as an extension of the least squares method.

level of service   1. See **service level**.

2. At a signalled intersection, level of service is determined by the vehicle delay and **volume/capacity ratio** and expressed by a series of letter grades from A (low v/c ratio and delay) through E (high v/c ratio and delay) and F (blocked).

levitation, magnetic   See **magnetic levitation**.

lexicon   "[LGk *lexicon*, fr.neut of *lexikos* of words, fr.Gk *lexis* word, speech (fr. *legein*, to speak) + *-ikos* -ic-more at legend] 1 : a book containing an alphabetical...arrangement of the words in a language or of a considerable number of them and their definitions : dictionary, wordbook... 2 : the vocabulary of...a set of documents...of a subject..." *(Webster's Third)*.

license plate survey   In general, a system that allows a survey of travel behavior without stopping automobiles and inquiring of their drivers.

The usual license-plate survey involves the notation of license plate numbers on vehicles passing a certain point, the discovery of the names and addresses associated with those numbers, and the mailing of survey forms to the persons in question. These forms might ask any number of questions about trip purposes, routes, number of riders, and so on.

In some parking studies, as in resort towns, the purpose of the survey might be simply to determine how parking demand distributes itself between visitors and local inhabitants. A license plate survey may also be used around a **cordon** area to identify points of entry and exit of specific vehicles.

LIFO   The queue discipline of last-in first-out.   Compare
      FIFO.

light rail   See **rail transit.**

likelihood estimation, maximum   See **maximum likelihood estima-
      tion.**

likelihood function   See **maximum likelihood estimation.**

limiting headway   A **headway** dictated by policy considerations
      rather than by the volume of traffic to be carried.

line   1.   The course or way on which transit service is sche-
      duled.   Also, route.

      2.   A service operated as an integrated package from one
      schedule, consisting of a main service between two extreme
      terminals sometimes supplemented by additional service to
      one or more branches or to intermediate turnback points.

      3.   In **network coding,** a route and its service level,
      including **mode** designation (type of service), line number,
      head-way (frequency of service), and sequence of transfer
      points **(nodes).**   These describe the line's route as an
      ordered set.

linear combination   If p and q are two entities susceptible to
      multiplication and addition and a and b are real numbers,
      then a*p + b*q is said to be a linear combination of p **and**
      q.   This extends and generalizes in a number of more and
      less obvious ways.

linear dependence   If a set of **vectors** is linearly dependent,
      then a set of scalars can be found, not all zero, so that
      a(1)*v(1) + a(2)*v(2) +...+ a(n)*v(n) = 0.   If a set of en-
      tities manifests linear dependence, then at least one of **the**
      set is a **linear combination** of some of the others.

linear equation   1.   The equation of a straight line when plot-
      ted in Cartesian coordinates; a*x+b*y = c gives all **straight**
      lines in the x-y plane.

2. An equation in which the **variables** appear only to the first power and in which no term occurs that contains the product of two variables.

linear interpolation   A method of estimating the value of a function between two adjacent tabulated values by substituting for the true value of the function, a value computed along the straight line joining the two tabulated values. If you know the value of exp(1.2357) and exp(1.2358), the value of exp(1.23576) by linear interpolation would be estimated as exp(1.2357)+6/10(exp(1.2358)-exp(1.2357)).

linearization   1. To render linear, as by applying a **logarithmic transformation** to a **product-form model.**

2. To approximate with linear functions, as in **linear interpolation.**

linear least squares regression   See **regression analysis** and **least squares-method.**

linear logit form   Same as **linearized logit form.**

linear programming   Not directly related to computer programming, although most linear programs are solved on a computer. Linear programming is concerned with the maximizing or minimizing of a certain quantity (called the objective function) which can be stated as a **linear equation** in the various activities within the system. The maximization is subject to constraints which are stated as linear inequalities in terms of the activities of the system. This means that one looks for a maximum (or minimum) value of the objective function which also satisfies all the inequalities. In general, it turns out that only those points which lie at the intersection of two or more constraints need to be investigated when searching for an extreme value. This technique can be very useful in those rare cases where its assumptions are fulfilled. In transportation planning, linear programming is largely a **Jericho technique.**

linear regression analysis   See **regression analysis.**

line capacity   The maximum volume of passengers or vehicles that can be moved over a line segment during a period at minimum allowable **headway.**

line-haul   This term is used in several different ways. It should always be read with careful attention to its context.

In some transportation studies line-haul facilities are those transportation facilities to which exclusive paths are dedicated for the use of transit vehicles. When a vehicle operates on exclusive guideways such as railroad tracks or a bus lane on an expressway, it is considered to be in line-haul operation. When line-haul operations are described in this way, the mode of operations opposed to line-haul is **coverage.**

Otherwise line-haul is used to describe **express service,** or even main line service as opposed to **feeder.**

line-haul time   The time spent by a traveler on that **line-haul** system which accounts for the major portion of a **trip** distance. For instance, if a traveler uses **feeder service** to get to a **rapid rail** system, only the time spent on the rapid rail system is line-haul time.

line miles   Or line kilometers. Not **route miles.** The sum of the one-way lengths of all streets, highways, and **rights-of-way** traversed by a transportation system, *regardless* of the number of routes. Line-miles include exclusive rights-of-way and controlled facilities.

line volumes   The number of **passengers** carried on a transit line during a given period.

link   1.   In a transportation system, an element connecting two adjacent **nodes.**

2.   The **path** of a transit line between two transfer points.

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3.   That section of a transportation **network** that lies between two nodes.

4.   In computer operations, to perform the functions of a **linkage editor**.

linkage editor   A routine which consolidates separate sections of **object code** (called modules) for common loading and **execution**.

link volumes   The total number of highway vehicles or transit **passengers** assigned in planning to a network **link**. Note that highway link volume is measured in vehicles and that transit link volume is measured in **passengers**.

list of attributive values   See **LAV**.

literal   A character **string** to be stored and reproduced literally. A literal is indicated in various ways, commonly by placing it within a single quote: 'A', 'now is the time' or '03-15-74'.

load   1.   To assign **trips** to a **network**.
2.   To put data into storage.

loaded network   See **load** and **network**.

load factor   In general, the occupancy of a vehicle or system divided by its capacity. This seems simple enough. However, occupancy is often ill-defined (does it include crew or free riders?); as for capacity, see **capacity**. In practical instances, the numbers for occupancy and the numbers for capacity are readily available. The trick is to be certain what the numbers mean.

loading standard   The maximum desired load (in passengers) used to determine **headways** for given sizes and types of vehicles for different periods of the day. The loading standard is sometimes expressed as the ratio of schedule load to seating capacity.

load module   A member of a **partitioned dataset** consisting of machine interpretable processing programs.

load summary, passenger   See **passenger load summary.**

local bus   In **critical movement analysis,** a local bus is any bus that stops at the intersection under analysis.

logarithm   The logarithm of a number is the power to which it is necessary to raise a given number (called the base) to produce the number.   Since $3**4 = 81$, 4 is the logarithm of 81 to the base 3.   Logarithms were once much used to expedite multiplication, division, raising to powers, and extracting roots.   In transportation modeling, however, the value of logarithms derives mainly from their property of **transposing** a series of products into a series of sums (logarithmic transformation), thereby allowing multi-linear regression fitting of **models** that would otherwise be intractable.

   If the base of a system of logarithms is e (2.71828...), those logarithms are called natural logarithms and have the property of being the inverse of the exponential function. If the base is 10, they are called common or Briggsian logarithms.   Either type may be used in making a **logarithmic transformation.**

logarithmic transformation   See **logarithm.**

logical operator   A symbolic representation of an operation such as conjunction, disjunction, or negation.   Also called a Boolean operator.

logit function   The logit function, or transformation, of x is given by $L = \ln(x/(1-x))$.

logit model   A popular **model** in **modal split** estimations.   It is a **product-form** model and can be developed in a number of ways.   It is perhaps best described as a model which postulates that the **logarithm** of the ratio of the use of two-**modes** depends on a **scaled impedance** difference of the two modes and _only_ upon this. (If the reader works this out for the bimodal case, he will see the relationship to the **logit**

function.) This simple way of putting it highlights its chief difficulty, namely that the above ratio does not depend on anything else occurring in the market. This awkward property is sometimes rather disingenuously referred to as "independence of **irrelevant alternatives.**" Chancres have been called beauty marks.

log-likelihood function   The **logarithm** of the **likelihood function.**

long-range planning   In preparing a long-range transportation plan for a region, forecasts of travel are made for each of a number of different plans to provide a basis for designing and comparing **alternatives** in terms of their benefits to groups of potential travelers. The benefits are then weighed against investment and **operating costs,** the consistency of the various plans with the long-term development and environmental objectives of the region, and other factors. The time horizon for these studies is normally 20 years. These issues can be addressed using the **UTPS** sketch planning tool--or the network feasibility analysis tool (with a high degree of aggregation).

long-run demand   A **demand** estimate taking account of a (proposed) system's effect on the pattern of urban travel behavior.

look-up table   The input table of certain **UTPS** programs, such as **UMODEL** and **UMATRIX,** used to represent a set of **stratified curves** that are hard to describe mathematically.

loose end   In transit operations, a driver work schedule one to three hours long.

low-capital alternatives   Transportation **alternatives** that can be implemented relatively rapidly at low initial or **capital cost;** e.g., changes in operating policies (fares, frequencies, traffic signal systems, and bus routes) and changes in

regulations (automobile-exclusion areas, parking time limits, reserved bus lanes). Low-capital alternatives have often been neglected in the past in favor of alternatives involving investments in major new fixed facilities (expressways and rapid transit lines). Compare **TSM.**

LRT Light rail transit. See **rail transit.**

LRV Light rail vehicle. See **rail transit.**

machine language Strictly, a computer language that can be directly executed without any translation. In these degenerate days symbolic and **assembly languages** that are "close" to machine language are sometimes so called. See **object program.**

MACMAN The UNIMAC macro-library management routine, a **UTPS** program developed by the U.S. Census Bureau. It performs all services pertaining to **partitioned datasets.** It creates a **random access** library on disk, adds **macros** to this library, updates the macros, and performs utility functions (listing, copying, unloading to tape, reallocating, renaming, and punching).

macro Short for macro-instruction. A computer instruction in a high-level language which generates many instructions when translated into a lower-level language.

macro-analysis Analysis of groups and aggregates as opposed to individuals; large-scale analysis. A relative term in many instances. Opposed to **micro-analysis.** Compare **sketch planning.**

MAGLEV See **magnetic levitation.**

magnetic levitation The raising of a vehicle above its guideway by magnetic force, either by repulsion or attraction.

makeup In transit operations, **allowance** required to satisfy minimum daily hour or piece-pay hour requirements. Also, pad.

manual calibration   Calibration of a **gravity model** with user supplied **friction** and **K-factors.**

manual technique   An analytical operation carried out without computers.

many-to-many service   In **DRT** systems, service that collects passengers at points of their choice and delivers them to destinations of their choice. The best known such service is **dial-a-ride.** Compare **many-to-one service.**

many-to-one service   A **DRT** system in which passengers can travel from any point in a service area (for instance their homes) but in which all passengers travel to a single destination. Compare **many-to-many service.**

marginal probability   When a probability, P(A) or P(B), is computed from a **joint probability** function, P(AB), it is termed a marginal probability. The method of computation is as follows, if we assume that event B can happen in n ways: $P(A) = P(AB_1) + P(AB_2) + ... + P(AB_n)$. Although these definitions all involve two events, A and B, they can be extended to any number.

marginal sums   See **crossfooting.**

market segment   A socioeconomic group that is homogenous at least to the extent that in similar circumstances its members are assumed to exhibit similar travel behavior. The low income elderly may be considered a market segment.

The identification of market segments is one of the steps in the implementation of many **demand models.** Although market segments are eventually **aggregated,** knowledge of them in the **disaggregate** is necessary to an understanding of the principles implicit in their aggregation.

mask   Also filter or extractor. A pattern of characters used to **extract** from or alter the contents of a computer word. Usually used in conjunction with **logical operators.**

matrices   Firmly established, alas, in a sturdy mispronunciation, as the plural of **matrix**.

matrix   An **array** of symbols, called elements in rows and columns, in two dimensions, used as a form of tabulation. The order of the elements is significant, and the location of any one element is conventionally indicated by subscript **indices**: $a(i, j)$ is the element in the ith row and jth column of the matrix A.

matrix compression   See **compress**.

matrix expansion   See **expand**.

matrix, impedance   An **array** of zone-to-zone trip **impedances**, e.g., travel times and travel costs.

matrix scaling   The process of adjusting a **trip table** so that it has new row and column totals but at the same time preserves some of the patterns of interrelation of the original trip table. The analyst wants to specify new row and column totals because of new information on the changes (usually growth) of **productions** and **attractions** in the analysis zones. The **Fratar method** is one traditional solution to the problem.

UMCON implements a non-iterative **scaling** process which can handle large **matrices** in a relatively short computing time, and it has none of the awkward **convergence** properties of the Fratar method.

matrix, trip   See **trip table**.

maximum likelihood estimation   One method of determining the **parameters** in a **model** is based on the idea of choosing them so that a model is selected in which the observed result has the greatest probability. This is accomplished in a rather straightforward manner by defining a likelihood function associated with the data and determining which parameters maximize this function for the **observed** data.

MBTA   Metropolitan Boston Transit Authority.

MBUILD   A **matrix** building program that constructs matrices from input origin-destination survey trip cards, other card image sources, or **calibration files** as output from **UMODEL**. Matrices may be built from a single **block** of input records based on user-specified criteria, such as **trip purpose,** time-of-day and vehicle type. In addition to matrix building, MBUILD also contains editing and screening capabilities to assist in the detecting of erroneous or illogical values. A **lookup table** capability allows **factoring** of trips and facilitates the renumbering or regrouping of zonal data. User-specified logical expressions (if A then B else C) permit extensive data preparation and screening. With some trickery, MBUILD can also yield **attribute file** data.

mean   A number taken as representative of a set of numbers. Various techniques of choosing the representative number lead to quantities such as the **geometric,** arithmetic, and **harmonic** mean. In absence of clear indication to the contrary, *mean* should be interpreted as *arithmetic mean* -- identical with the **average** of elementary school: the sum of a set of items divided by the number of items in the set. Other representative numbers are **mode** and **median.** A representative number, to qualify as a mean, must have the characteristic that its value is affected by the specific value of every item in the set.

median   1. A representative number. See **average.**

2. The middle measurement. That is, if a series of measurements is arranged in ascending order, the median is the value of the middle measurement--if the number of measurements is even, the median is interpolated between the middle numbers of the set of measurements. (The usual method of interpolation, if the two middle measurements differ, is to average them.)

meso-level planning   Tactical planning, dealing with many fewer alternatives than **sketch planning.**   The traditional **four-stage planning process** takes place at the meso-level. Dis-aggregate **demand** forecasting techniques are applicable at this level.   The cost of examining an **alternative** at the meso-level is usually 10-20 times its cost at the sketch level. Opposed also to **micro-analysis.**

Metro   Sometimes METRO. The name for several rail rapid systems, including those of Paris, Tokyo, Montreal, and Baltimore. In Washington the term applies to all operations of the Washington Metropolitan Area Transit Authority--or to the Authority itself. Apparently, this term is now considered by some as a generic term for "subway."

metropolitan planning organization   Frequently capitalized. Also MPO. The organization designated by a Governor as responsible, together with the State, for comprehensive transportation planning according to 23 U.S.C. 134, 23 U.S.C. 104(f)(3), and 49 U.S.C. 1064 (g)(1) and (1), in which the organization is mandated as the forum for cooperative decision making by principal elected officials of local governments.

mezzanine area   That part of a transit station which is a passenger collection area separated from the transportation **right-of-way.** Although *mezzanine area* is an established term in transportation analysis, the area is not necessarily at mezzanine level, but may be on the same level with or below the right-of-way.

MH   Maximum headway. The upper bound to which **INET** can adjust the **nominal headway** (NH) to save a vehicle-crew.   Hence there is a nominal headway slack of (MH-NH) minutes allowed. MH is used by the **UTPS** program **ULOAD** to calculate a headway based on the **ridership** at a line's **peak** load point.   ULOAD

is constrained never to calculate a headway greater than the specified maximum. Hence MH can be thought of as a "policy" or "courtesy" headway.

micro simulation   **Simulation** for the purpose of detailed design analysis.

micro-analysis   Opposed to **macro-analysis**. In transportation planning, microanalysis becomes applicable as the time to implement a project grows near. At this level of analysis one might make a detailed evaluation of the extension, rescheduling, or repricing of existing bus services; analyze passenger or vehicle flows through a transportation terminal or activity center; or compare possible routing and shuttling strategies for a **demand-responsive** system. Analysis at this level is expensive and is usually restricted to subsystems whose implementation is imminent and in which design refinements would likely bring substantial increases in service or reductions in cost.

midibus   A bus with a capacity of 20 to 30 seated passengers.

minibus   A bus with a capacity of 8 to 20 seated passengers.

minimum path   See **network**. That route of travel between two points, the use of which requires the smallest accumulation of time, distance, impedance or any **parameter**. For a full and useful discussion see C. Witzgall, J. Gilsinn, and D. Shier, "Shortest paths in networks" in W.E. Boyce (ed.), *Case Studies in Mathematical Modeling*, Pitman, 1981.

mixed traffic   Highway traffic in which transit vehicles operate in the same lanes and under the same constraints as other vehicles.

modal choice model   See **mode choice model**.

modal split   The distribution of **person-trips** among travel **modes**, viewed either as a real-world event, or as a phase in the transportation planning process. Modal splitting,

accomplished by a **mode choice model,** is incorporated into various stages of the analysis. In the traditional **four-step process,** modal splitting is between trip **distribution** and trip **assignment,** a location that has seemed so curious to many planners that almost all other possibilities have been experimented with. **Simultaneous models** eliminate the modal splitting phase, as such, by incorporating it into various other components.

mode 1. A mode of travel is a means of travel (bus, walking, rail); usually the term is used straightforwardly. However, in certain transportation studies the term is used with considerably more specificity than might be apparent at a glance. For instance, in a highway study automobiles with one passenger, automobiles with two passengers, and automobiles with three or more passengers might be thought of as operating in three different modes, even though they are all (in the general sense) in the highway or automobile mode. Indeed, drivers and riders might be distinguished.

2. A representative number: The most common observation for a **discrete** distribution. For a **continuous** distribution it is a relative or absolute maximum.

mode choice model   Also modal choice model. A **model** used to forecast the proportion of total **person-trips** on each of the available transportation **modes.** When modern methods of transportation planning were evolving in the 1940's and early 50's, they were essentially highway studies, and the only mode considered was the automobile, with public transportation either ignored or handled by **growth factor** projections. When the public transportation **alternative** began to be seriously considered, the earlier methods usually employed **binary choice models,** some of which did not generalize satisfactorily to the case of more than two modes. In recent years, the study of three or more modal choices (auto

driver, carpool passenger, bus, rail rapid) has not been un-
usual. It has been customary to employ models that are in-
herently multi-modal, even in cases where only two choices
are available. A number of techniques have been developed.
Structurally, they are generally **regression** equations, tabu-
lar **cross-classifications,** or **stratified curves.**

The inputs and outputs of a mode choice model cannot be
defined precisely in the general case, since they vary de-
pending on the location of the **modal split** in relation to
the other elements that make up the transportation planning
process. Its location before **trip assignment** in the **four-
step process** makes the modal split take place in a kind of
analytical twilight and has produced that ambiguous crea-
ture, the **composite disutility.**

model   A mathematical formula that represents the actions and
interactions within a system so that the system may be eval-
uated according to various conditions: land use, economic,
socioeconomic, transportation, etc.

Monte-Carlo technique   A **simulation** technique in which a **random
number** generator is used to assign the numerical values of
some components in the system being analyzed. It is usually
assumed that a large number of repetitions of the simulation
will produce reliable data on the means and distributions of
the outputs. See **iterative process.**

Morgantown PRT   Morgantown (West Virginia) Personal Rapid Tran-
sit. **PRT** here is a courtesy title.

movement analysis, critical   See **critical movement analysis.**

MPO   See **metropolitan planning organization.**

multicollinearity   A term used to describe the common situation
in multiple **regression analysis** where the correlation is
high between two or more of the **independent variables.** This
is the bugbear of elaborate **demand** and **modal split models**

with numerous modal time and cost variables appearing in the regression equation. All of these will be highly correlated with distance (usually unrepresented)--and consequently with each other. The presence of multicollinearity does not normally prevent the fitting of **models** but rather leads to fits with a very low **stability.** A refitting with only a slightly differing data set can lead to widely different **coefficients** in the resulting model.

multi-path assignment The assignment of **trips** between **centroids** to more than one route.

multiple correlation coefficient See **correlation coefficient.**

multiple regression See **regression analysis.**

MUNI The San Francisco Municipal Railway Company.

NAAQS National Ambient Air Quality Standards. Standards issued by the Office of Air Quality Planning and Standards of the Environmental Protection Agency. Revised periodically and published in the *Federal Register*, the standards (one for each pollutant) are for hydrocarbons, lead, nitrogen dioxide, ozone, particulate matter, and sulphur dioxide.

NAG A highway **network** aggregation program that extracts network **supply** and travel **demand** information about a subarea of a region. Called **windowing,** this process yields a network in the standard **HR** format with **trip tables** depicting regional trips truncated at the point they cross the subarea boundary. Typically, the network is then updated to reflect a finer level of detail, and the trip table is expanded to reflect smaller **zones.** Hence a more detailed analysis within the subarea is possible at a reduced computing cost.

negative trip A possible intermediate result in a **matrix scaling** process. They can also occur in **UROAD** in determining the difference in two **trip tables.**

net present value The net present value of some future amount of money (whether a receipt or an expenditure) is the amount of money which would have to be invested (at a specific interest rate—called the **discount rate)** in the present in order to equal that amount in the future. Since $1000 invested at 6% for 20 years will be worth $3207.13, the net present value (in 1980) of $3207.13 (in 2000) is $1000.00. Similarly, at a 10% discount rate, the net present value in 1980 of $1000.00 (in 2000) is $148.64. If a project has expenditures and receipts spread out through time, the net present value of the project is the sum of all the individual annual quantities, each discounted to bring it to the present. An analysis of this type is frequently referred to as an analysis of the discounted cash flow. Any benefit of disbenefit that can be converted to a monetary value can be analyzed in this way.

network 1. A system of **links** and **nodes** that describes a transportation system.

2. The configuration of routes and stops that constitutes a total system.

3. A **graph** depicting direct connection (arcs) between points (nodes).

network coding The process of abstracting details of a real transportation network and recording them in a form suitable for computer processing, as by INET or HNET. Depending on the application, the information may be as simple as time on a link or it may include operating cost, tolls, turn penalties, headway, and route type. Since coding a network can be a very costly process, it is well to determine carefully in advance the minimum information necessary to answer questions that will be asked during an analysis. The art in network coding is to portray the transportation network with the minimum amount of detail required for the planning ap-

plication: coding very coarse networks for sketch planning and highly detailed ones for a **TSM** type analysis. Beginning coders have a costly propensity to over-code a network. The result is an unnecessarily large and detailed network that takes too much time and money to analyse.

Network Development Manual   An overview of **UTPS** network analysis programs. Detailed discussion of the preparation and **coding** of transit networks--and of the problems that might be anticipated in the process. It is a **network** coding manual.

new options   Transportation options that involve the use of new technology (tracked air-cushioned vehicles, automated guideways), new operating policies (time-of-day fare differentials on transit), new regulations (vehicle exclusion zones, bus priority lanes), or new institutional arrangements (incorporation of taxi service into public transit authorities).

new roads   Roads built where no roads existed before. Not used to refer to highway improvement, however major.

nodal potential   Either the sum of node **productions** (trips originating at the node) or the sum of node **attractions** (trips having the **node** as a destination).

node   1. A point on a map where features intersect, end, or curve sharply.

    2. After a **network** is **coded,** a node is spoken of as any intersection of **links.** In the identification of nodes for coding puposes, however, a node is usually considered as a point in the transit network at which a transfer can be made from one travel **mode** to another; and so not all intersections, transit stops, and stations are nodes.

Since one travel mode is walking, one might suppose that any stop is a node. However, transfers to the walk or auto mode are not necessarily at nodes, unless these transfers are to eligible auto connector or walk links.

no-hit conversion   The action taken by a program when it fails to secure a **hit**.

nominal headway   An estimated **headway** input to **INET** and subject to revision in the process of computation.

nomograph   Any device (usually a chart) which allows a person to take a straight edge and determine output values (given certain input values) without making calculations.

non-backtracking   A **path** is called non-backtracking if it consists only of **links,** the beginning **nodes** of which are always closer to the **origin** than their end nodes.

NOPS   New Orleans Public Service, Inc.

normal distribution   Also Gaussian distribution (or curve) or normal curve of error or error function (erf, for short). The familiar bell-shaped curve. The number of its names is exceeded by the ways of deriving it, which is exceeded by its applications. It is called a two **parameter** curve, since it is completely determined when its **mean** and **standard deviation** are known. An easy way to develop it is to regard it as the limit of a **binomial distribution:** if you worked out the theoretical distribution of the number of heads in a series of tosses of 100 unbiased coins and plotted the frequency polygon, the result would look very much like a normal distribution with a mean of 50 and a standard deviation of 5.

normalize   Usually, to apply **weights** to a set of quantities so that the set attains some property taken as a norm for it. Frequently normalized quantities have been adjusted so that they sum up to one--or to some control total. If you have

a **model** of how **trips** are influenced by changing socioeconomic **variables** you might use this model to update a 1970 **trip table** to 1980. If you compared the total trips summed over the elements of the forecast table with some independent observation or estimate of total trips, you would most likely find some discrepancy. If you then created a **fudge factor** to remove the discrepancy, by multiplying it into each of the forecast trip table elements, you could be said to normalize the estimates.

normally-distributed Distributed in accordance with the **normal distribution function**

NTIS National Technical Information Service, (U.S. Department of Commerce); 5285 Port Royal Road; Springfield, VA 22161; (703) 557-4600 (main number), (703) 557-4650 (order desk). **UTPS** documents can be purchased from NTIS.

null hypothesis The hypothesis that the effect being tested for is non-existent and that the variation in a **sample** is purely **random.**

NYCTA New York City Transit Authority.

O and D Origin-and-destination. See **trip.**

OBD Outlying business district.

object program The **machine language** that a **compiler** produces from a programmer's **source** program in a high-level language. It is what the computer actually executes.

observed Observed data are those produced by on-the-spot identifications or judgements by a reliable observer, e.g, the number of people using a feeder-bus line or the condition of a road bed. These are to be distinguished from information generated by statistical analysis, standard tables, **models,** etc.

Sometimes this term is used much more generally. For instance, observed values can be those values which simply are known to a planner, the result of common sense and experience; and in this sense the term refers to values to be distinguished from values produced by analytical procedures.

occupancy model, car   See **car occupancy model**.

off-line   1. Operation of input/output and other devices not under direct computer control; most commonly used to designate the transfer of information between magnetic tapes and other input/output media.

2. Not in the main flow of traffic or processes.

off-line station   A station in which the vehicle stop is not on the main line.

ogive   Pronounced OWE-jive. See **cumulative distribution function**.

off-peak   This term is variously understood. In some cases it refers to any period of travel outside the **peak period**. In other cases it refers to any period or travel outside the peak-hour but excluding the **base period**. In yet other cases it is the opposite of peak; that is, it refers to that period in which the least travel occurs on a system.

on-and-off check   A check, usually by a person on a transit vehicle, of the number of people that get on and off at each stop along a route.

on-line station   A station in which the vehicle stop is on the main line.

one-piece run   A driver work schedule approximately eight hours long and with the driver staying on one vehicle.

operating costs   To be distinguished from **capital cost**. Those recurring costs in a transportation system, such as salaries and wages, maintenance, energy, taxes, insurance, and sup-

plies. There is some difference in the way transportation analysts treat **depreciation** and interest payments--as there is in the way transit management treats them. Some call them operating costs, and some do not. Care should be taken to discover the precise meaning of the phrase in context. (In **CUTS,** the operating cost data do not include **depreciation** and interest.)

operating ratio   The ratio of **operating costs** to operating revenue.

operating speed   The highest safe speed of which a vehicle is normally operated on a given way.

operating system   Often OS. The scheduling program in every IBM 360/370 computer. OS controls what jobs are executing, allocates resources (core, peripheral devices), and examines the **JCL** for correctness.

operator   This term is used in many ways. Often it means the driver of a transit vehicle. In transportation planning an operator is frequently the owner or managing authority of a transportation system. Also, the person who runs a computer is a computer operator.

opportunity cost   The opportunity cost of a project is the additional return (revenue) that could be made by investing the money elsewhere; it is the generalized cost attributable to doing one thing instead of something else. If resources are invested in a subway system, one possible cost to be considered is the foregone opportunity to invest that money in (say) improved bus service. This concept combines definiteness and vagueness in a remarkable way: it seems to define not one but a number of costs, each with respect to various alternative investments. *The* opportunity cost can be taken as the cost (1) of not making the best transportation **alternative** investment possible, or (2) of not making

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the best investment out of a set of predetermined transportation alternatives, or (3) not investing the money at the best available rate in the money market. The **discount rate** is presumably chosen so as to represent opportunity costs. Since the consideration of opportunity cost is more often threatened than undertaken, it can be called a **Jericho technique.** See **cost-benefit analysis** and **discount rate.**

opportunities model, intervening   See **intervening opportunities model.**

opportunity model   See **competing opportunities model.**

origin   A tricky word: not always the same as a **production.** See **trip** and **home-based trip.**

OS   See **operating system.**

outlier   In **residual analysis,** it frequently occurs that some point or points are greatly separated from the other observations, which tend to cluster around the predicted values much more closely. If these points are significantly separated from the pack, they are called outliers. They frequently represent mistranscribed data, and this possibility should be checked first.

If the data are correct, they should be checked to see whether they are disturbed by some factor which should either be included in the **model** or, perhaps, used to exclude the deviant observations from the **calibration** set.

Occasionally, even in well-verified **datasets,** extreme outliers will inexplicably occur. It used to be recommended by some that extreme outliers be rejected and the model recalibrated. This practice has been widely condemned by theoreticians and is no longer engaged in--or at least no longer admitted to. (According to unverified reports, the practice has recrudesced under the sonorous title of *metric trimming.)*

out-of-phase operation   An arrangement of **cycled service** by which **DRT** vehicles in **many-to-one** operation do not arrive at the transfer point at the same time but do meet every **line-haul** vehicle. Under this arrangement, **feeder** vehicles cycle through the entire service area, with the result that **schedule delay** is greater than in **in-phase operation** (but possibly offset by a decrease in transfer time).

overall speed   Total distance divided by total time, including all delays.

overflow   The condition which arises when the result of an arithmetical operation exceeds the capacity of the allotted storage area in a digital computer. This usually produces an error message.

overlay program   A program in which certain controlling segments can use the same core space as other controlling segments at different times.

owl run   In transit operations, a run which operates during early morning hours, until the resumption of regularly scheduled daytime service.

pace   The ten-mile per hour range in speeds in which the greatest number of observations are recorded in the **frequency distribution** curve of speeds. It is identified by a ten-mile per hour speed increment which "cuts off" the peaks of the frequency distribution curve.

pad   See **makeup.**

P and A   See **production** and **attraction.**

parallel-resistance analogy   A method of combining **impedance** by different **modes** into a **composite disutility** by adopting the method used to determine the total resistance of resistors in parallel: the reciprocal of the composite impedance is the sum of the reciprocals of the individual impedances.

parameter   1. In statistics, any measurable descriptive char-
acteristic of a **population.** Also called a statistic.

2. In modeling, the term is frequently synonymous with
independent variable or variable **coefficient.** To illus-
trate the distinction in ordinary usage, a model might be
likened to a mill. The data are grist for the mill, and the
parameters control how fine the mill grinds.

This word has had a recent vogue and is often used mis-
takenly for *perimeter* by people who ought to know better.

paratransit   Public transportation services outside the conven-
tional fixed-route, fixed-schedule systems. Normally such
service is available to the public on demand. Paratransit
does not include such things as taxicabs or any other pri-
vate service. However, see **chit.**

park and ride   An arrangement which allows transit riders to
use parking facilities adjacent to a station or stop. On a
sign it means the same as *parking lot*. This term suggests
location away from the central business district. Park and
ride differs from **fringe parking** in that fringe parking is
not necessarily associated with a transit station but might
simply be near a transit stop or a **feeder** service leading to
a transit stop.

partial correlation coefficient   See **correlation coefficient.**

partitioned dataset   An IBM 360/370 **dataset** that has an identi-
fying name (DSNAME) and contains many members within the
dataset with different names (member names).

passenger   This term usually takes its obvious meaning. How-
ever, in automobile transportion studies, the driver of a
private automobile is usually not counted as a passenger.
It is important that if the same person takes several **trips**
he is counted as several passengers.

passenger car equivalency Also PCE. For a given vehicle, the number of through-moving vehicles it is equivalent to, based on its **headway** and delay creating effects. PCE values for various vehicles can range from 1.0 to 7.0 and higher and will depend on vehicle type and operational considerations. Average PCE values for trucks and buses is around 1.5 to 2.0.

passenger car volume In **critical movement analysis,** the volume of passenger cars plus the volume of all other vehicular types in **passenger car equivalences.**

passenger flow The count of the number of **passengers** that pass a certain point during a certain period.

passenger mile Or passenger kilometer. The measure of the transportation of one **passenger** one mile (or kilometer).

PATH Port Authority Trans-Hudson Railway.

path Any series of **links** where each succeeding link has as its beginning node the ending **node** of a previous link. See **tree, vine, bush.**

pathbuilding The process of determining expected **paths** for **passengers** making interzonal **trips.**

path diversion parameter A **parameter** in **UROAD** which determines the sensitivity, to differences in freeway and non-freeway **impedances,** of the formula used to allocate traffic between freeway and non-freeway routes.

path skimming A barbarism. Determining the total value of some **attribute** on a **path.** For instance, to add up the travel distance on each **link** on a shortest time path is to skim the minimum time path for distance.

pay time In transit operations, the pay period for any driver run. This includes **platform** time, **allowances,** and overtime.

PCC   A PCC trolley car. Introduced in 1935, the PCC car offer-
ed better performance and greater capacity than previous
streetcars and was and is in widespread use. Many people
think the PCC was named indirectly after Herbert Hoover,
because it was the result of the deliberations of the Presi-
dent's Conference Committee carried on between 1930 and
1935. Actually, the deliberations were by the Electric
Railway Presidents' Conference Committee; the car's great
success must be said to have had many fathers.

   PCC cars seem to last forever, and they are cheaper to
rebuild than to replace. They are still the typical street-
car, although none have been manufactured for domestic use
since the late 1940s. They were a popular export, and some
are now being repatriated.

PCE   See **passenger car equivalency.**

peak hour   The hour during which the maximum traffic occurs.
Compare **base period.**

peak-hour factor   1. Also called peak-hour ratio. The ratio
of peak-hour traffic and the traffic during an established
base period.

   2.   In **critical movement analysis,** a measure of the
peaking characteristics within the **peak hour:**

   PHF = (peak hour volume) / (period volume).

   3. Also a ratio of the volume during the peak hour to
the maximum rate of flow during a selected period within the
peak hour. As a measure of peaking characteristics, its
maximum attainable value is one.

peak-hour ratio   See **peak-hour factor.**

pedestrian assistance system   See **people mover.**

Penn-Jersey model   Interarea travel **model** developed as part of
the Penn-Jersey Study.

people mover   Any system designed to facilitate or speed the movement of people on foot. Escalators are people movers, but the phrase usually suggests such devices as the "moving sidewalks" in large airports. *People mover* in **DPM** is used in a different sense.

period volume   A design volume, based on the flow rate within the peak 15 minutes of an hour and converted to an equivalent hourly volume:

> PV = 4 * (highest 15-minute volume). See **design hourly volume**.

peripheral parking   See **fringe parking**.

person trip   A **trip** made for any purpose, by any (usually vehicular) travel **mode**, by one person. Unless there is clear suggestion to the contrary, this should be considered a one-way trip. See **passenger**.

personal rapid transit   See **PRT**.

phase   At a signaled intersection, that part of the signalling cycle that directs one traffic movement or more than one traffic movement with simultaneous right of way.

physical record   See **block**.

pivot point elasticities   **Elasticities** assumed to be constant. Used in simplified analytical procedures to predict the changes in **demand** caused by small changes in the values of **parameters** in known or previously predicted flow patterns.

planning horizon   That point in time which marks the end of a period for which planning is being carried out.

> Oddly, sometimes, despite the use of the word horizon, the phrase seems to mean an entire planning period. This peculiarity of usage should be watched out for.

Planning Work Program, Unified   See **Unified Planning Work Program**.

PLANPAC   That portion of the **FHWA** battery containing a core set of **computer programs** for dealing with urban transportation problems. See **BACKPAC.**

platform time   The time a transit driver is on his assigned vehicle, excluding **allowances.**

platform labor cost   The *total* cost for the services of trainmen or bus operators during **platform time.**

platooning   1. The forming of groups (by vehicles or pedestrians).

    2. The treatment of individuals as small-group members in **critical movement analysis** under crowded conditions.

plotting character   A character used to represent a point in a plot. In a **scattergram** it is usual to have a series of plotting characters to represent the different number of points (or observations) that can occur in one **cell.**

pointer   A computer storage position which holds the current **index** of an item to be treated in a **sequential** process.

policy issues   Issues within the control of (usually Governmental) policy makers which affect transportation. They are commonly, but somewhat illegitimately, contrasted with more direct determinants such as travel time and cost. The term is naturally something of a omnium gatherum: parking supply, fees, tolls, pool preferences, restricted lanes, congestion pricing, marketing schemes, special prohibitions, flexitime, reversible and contra-flow lanes, and many other things have been considered policy issues or variables.

policy-sensitive model   A model that responds to **policy issues.** They are frequently called for in Requests for Proposals. A rather strange advance request. Any model is sensitive to those many policy issues most of whose effects can be captured in changes in time and cost; to stipulate, however, that a model should be sensitive to an unspecified

range of policies reflected neither in its assumptions nor in its calibration is to demand the serendipitous. The moral: sensitivities do not fall out of a model; they must be built into it.

polynomial fitting   The fitting of a **dependent variable** to a power series in some **independent variable,**

$$y = a(o) + a(1)*x + a(2)*x**2 +...+ a(n)*x**n$$

The **parameters** a(i) are usually estimated by the **least squares method** or some other criterion of **goodness of fit.**

population   Each and every member of some group of interest for the purposes of statistical description or inference. It is assumed that the definition of a population is so framed that in the case of every entity we can say whether it is a member of that population or not. Also called the universe.

pre-emption, signal   See **signal pre-emption.**

present net value   See **net present value.**

price index   See **index.**

printer-plotter   The line printer used as a plotting device.

probabilistic assignment   See **stochastic assignment.**

probability density function   A non-negative function whose integral from a to b (a > b) gives the probability that a corresponding **random variable** will assume a value on the interval from a to b.

The interpretation of a **continuous distribution function** is not so clear as that of its **discrete** analogue, the **frequency distribution function.** The value phi(x(0)) of the distribution function is not the probability that x(0) will occur. (However phi(x(0))*delta is approximately the probability that x will be in some small interval of width delta around x(0) and integral(over x from s to t:phi(x)) is the probability that x will be between s and t.) A more satis-

fying if less intuitive interpretation of a distribution function is to regard it as the first derivative of a **cumulative distribution function.**

probable phase   The **phase** of a multiphase traffic control signal which is most likely to occur under some given traffic conditions.

probit model   A model bearing the same relation to the probit function as the **logit model** does to the **logit function.** The form of the probit function, a sort of cumulative normal distribution, is not displayed in this edition in order to avoid *odium typographicum*. Viewed as transforms, the logit and probit both convert other functions into s-shaped curves. Probit models have some interesting theoretical advantages over logit models; it is uncertain whether they have practical advantages. For an excellent, detailed, and more affirmative treatment, see C. Daganzo's *Multinomial Probit,* Academic Press, 1979.

processing unit, central   See **CPU.**

product form model   A model in which **demand** or **modal split** is proportional to a product of **disutility** functions.

production   The home end of a **home-based trip.** For non-home-based trips production is usually synonymous with origin. See **attraction** and **trip.**

   Trip production should not be confused with **trip generation.**

profile, route   See **route profile.**

programming, linear   See **linear programming.**

progressive signal system   A signal system in which successive signals controlling a given street are coordinated. A typical coordination is the timing of signals to accommodate vehicles moving at a constant speed.

prohaptor   The complex anterior attachment organ of a typical monogenetic trematode.

proportional assignment   A **trip assignment** process which is not **all-or-nothing**.

prospectus   A document which describes the scope of a planning program, procedures for carrying out a planning process, the responsibilities of participating agencies, and the schedule of major products to be delivered by the end of the program year.

prototype line   The route in each **corridor** for which all **node** numbers are explicitly **coded**. Compare **reference line**.

PRT   Personal Rapid Transit. The underlying assumption is that public transportation can be a viable alternative only if it incorporates some of the flexibility and convenience of the private automobile. The pure form of this concept would presumably involve the use of small automated vehicles, operating on an exclusive (probably elevated) guideway laid out in a dense network, offering no-stop O/D service between **off-line** stations. The proposal has aroused great interest and enthusiasm, but attempts to promote it as an alternative have foundered on its vast **capital cost.** In an attempt to keep the proposal afloat, it is customary to jettison its distinctive features until the only thing that remains of the PRT is the name. PRT cannot be said to have failed; it has never been seriously tried.

pseudo-random numbers   Sets of apparently **random numbers** of suspicious antecedents. See the fourth paragraph of **random.**

pseudo r-squared   A measure of **goodness of fit** used for **logit** models in a manner analogous to the use of **r-squared** in **regression analysis.**

pull-in   In transit operations, the time at which a vehicle arrives at the storage depot.

pull-in time   In transit operations, the time assigned to move a vehicle from its last scheduled stop to the storage depot. Also, stem time.

pull-out   In transit operations, the time at which a vehicle departs the storage depot.

pull-out time   In transit operations, the time assigned to move a vehicle from the storage depot to its first scheduled stop. Also, stem time.

purged variable   A predicted **variable** substituted for an **observed** variable in a later stage of a **regression analysis**.

quadratic programming   A body of technique developed to find extreme points of non-linear objective functions. An extension of **linear programming**.

quartile   One of those items that divide a set of data in ascending order into four parts in such a way that each part contains the same number of items. The second quartile is also called the median.

　　See **median**, where there is a discussion of the methods of dealing with the division points that lie between observations.

quota sampling   A sampling technique that sets a quota for certain classifications of the **population** sampled--on the basis of the proportion of each classification in the total population (universe).

rail rapid   Also **metro** and, popularly, subway. See **rail transit**.

rail transit   In transportation planning rail transit is normally understood to include light rail transit (LRT), rail

rapid transit (RRT), and commuter rail (CR). The conditions which govern their distinction are outlined below.

	LRT	**RRT**	**CR**
right-of-way	mostly mixed some exclusive	exclusive	exclusive
grade crossings	many	none	few
level	usually at grade	rarely at grade	frequently at grade
entry	usually low or no platform	high platform	mixed
stops	frequent and urban	fewer	fewest and mostly non-urban
speed	lower	higher	higher
consist	one or two cars	usually multi-car	commonly multi-car
stops	simple stops	stations	mixed
vehicles	trolleys, **PCC, LRV**	range of typical subway cars	range of typical rail cars
power	electric	electric	diesel or electric

random A tricky word. The first two definitions from Webster's *New World Dictionary:* "impetuous and haphazard movement or course of action: now only in *at random,* without careful choice, aim, plan, etc.; haphazardly -- *adj.* 1. lacking aim or method; purposeless; haphazard 2. not uniform; especially of different sizes. . . ."

Clearly these are not the meanings normally encountered in transportation planning. Makers of tables of random numbers would be dismayed to be thought of as purposeless or as

lacking method; it would be a grave defect in their products if they were not uniform--in the statistical sense of *uniformly distributed*.

A technical definition of *random* might read "produced in accordance with a **distribution function**." This definition is more satisfactory if understood to apply to each item individually. If you were told that 100 tosses of a coin produced 53 heads and 47 tails, you would have no reason to suspect **bias** in the coin. But if it were added that all the heads occurred first or that the outcome alternated between runs of two heads followed by two tails for the first 80 tosses, you would be well advised to be suspicious.

The problem remains that the above definition is a statement about the *source* of the numbers, rather than a statement about the numbers themselves. Random numbers are like organic carrots: once they are shipped to you there is no clear-cut way to discover that they are what they claim to be; the best you can do is examine the one for insecticide residues and the other for suspicious patterns. Sometimes numbers that are not random in their origins, but are felt to have the same effect as random numbers in practice, are called *pseudo-random*. Numbers of this type are frequently generated by library subroutines and for many purposes are as good as the real thing (which might be to say that they are the real thing). It is well to know if your random number generator is of the type that produces the same sequence of numbers every time it is applied. Otherwise you may waste a rerun of a simulation by not adding to the number of sample points generated. *Random* is frequently used where **uniformly distributed** would be more appropriate.

A final problem with the suggested definition: no matter how often you roll a die with all six of its faces marked six, you will always get six. A distribution extending to only one outcome is not rigorously excluded from the

definition of **distribution function;** therefore it seems that a sequence entirely of the same object *could* be called a random sequence, but it would do considerable violence to intuition and ordinary usage.

The reader who has endured this series of cavils to the end is perhaps sustained by the hope of discovering a fool-proof definition of *random* -- a hope doomed to frustration here. Only high mathematical legerdemain produces quite precise definitions of such terms as **random variable.** This success--which ignores rather than solves most of the problems discussed above--brings to mind Goethe's remark that mathematicians are like Frenchmen: as soon as you say something to them they translate it into their own language and it no longer means what you said.

random access   Same as **direct access.**

random number   Tables of random numbers consist of a long sequence of the digits (0-9) generated with a uniform probability **distribution** and usually tested after the fact for various kinds of **bias.**

random variable   See **variate.**

rank   The rank of a square **matrix** is the maximum number of linearly independent rows that it contains. See **linear dependence.**

rank indicator   A quantity, varying between zero and one, associated with each estimated **coefficient** in **UFIT.** Variables associated with low rank indicators are likely candidates for exclusion from the **model.**

rapid rail   See **rail transit.**

rapid transit   See **rail transit** and **bus rapid transit.** This term is often used when a reference only to rail rapid transit is intended.

rate of return   The rate of **discount** which reduces a stream of cash flows to zero.   The rate at which the present value of expected capital outlays is exactly equal to the present value of expected cash earnings on a project.

record   See **block** and **logical record**.

reference line   One of a number of coincident transit lines which is taken as a base in **network** coding.   Other transit lines sharing its route are **coded** in a shortened manner by reference to it.   Compare **prototype line**.

REFMAN   UTPS Reference Manual that describes the various control cards,   **datasets,** and standards used in UTPS.

regression analysis   The analysis of paired data in order to determine a line which gives the **best fit** to the points in the sense of a **least-squares** estimate.

relief point   Designated **point** on a transit line at which crew members are exchanged, eat, rest, or finish a piece of work.

relief time   The time, specified on the **run guide,** at which crews relieve and are relieved at **relief points**.

report time   In transit operations, the time necessary for a driver to prepare for a run.

reserved word   A **string** of characters set aside in a high-level language to represent some particular entity or function, and not available for any other purpose, such as a **variable** name or file name.

residual analysis   An analysis usually performed as an appendage to a **regression analysis** or other curve fitting technique.   In it, the residuals (the differences between the observed and estimated values) are systematically investigated for significant patterns.

resource constraint   A difficulty or limitation imposed by inadequate or limited resources.   A very grand term for some-

thing so simple as a shortage. It is best reserved for a concept within the context of a **model,** in which the limitation can be formal constraints.

revenue passenger   A **passenger** who pays a fare. This might seem obvious, but in some areas the number of non-fare-paying passengers can be significant: public employees who use passes, transportation system employees who ride to and from work (at rush hour) without paying fares, and so on.

revenue service   Vehicle movement for the purpose of carrying **revenue passengers.**

reverse commute   Travel from home to work or from work to home against the main flow of traffic. A person who lives downtown and works in the suburbs will perform a reverse commute.

rewind   To return a magnetic tape to its first data point.

ridership   Number of riders. Not riders as a general class.

right-of-way   1. Often ROW. Usually this term means that land owned by or under the direct control of a transportation system and on which its vehicles operate. In some cases it is used much more loosely, as to refer to a bus route. (As might be expected, the confusion is rare in discussion of rail systems.)

2. The precedence (as at an intersection) accorded one vehicle or person over another.

3. More rarely, the legal right of passage over another person's land.

rigor and generality   The glories of pure mathematics; the curses of applied mathematics, where they clog exposition and darken insight. It is profitless to defend transportation planners from functions everywhere continuous but nowhere differentiable or from the pythonic coils of space-filling curves. Perhaps that same kindly and ameliorative

spirit that has removed bugbears from children's literature should be encouraged to extend its sway to undergraduate mathematics. Perhaps then some homely spirit of particularity would also be seen pruning luxuriant subscripts and discouraging abstractions more likely to astonish than illuminate. There will be some loss no doubt, but it can be borne. It has never been clear why urban transportation planning need be developed with more rigor and generality than quantum electrodynamics.

rings   Districts in circumferential groups; usually number outward from the **CBD,** which may be ring 0.

ring/sector method   A method of identifying, ordering and/or numbering **analysis units** by use of **rings** and **sectors.**

RMSE   **Root mean square** error.

robustness   Most statistical procedures depend upon assumptions about the distribution of the **population** to which way they are applied. If the inferences drawn are not highly dependent on these assumptions, then the procedure is said to be robust. Similarly for any process not highly affected by small errors in its assumptions. Robustness is a kind of theoretical **stability.**

root-mean-square   The square root of the average of the squares of a quantity. For instance, the mean square of 2, 4, 6, 8 can be found as follows:

Sum of squares: 2**2 + 4**2 + 6**2 + 8**2 = 120.

Arithmetic mean of this: 120/4 = 30.

Square root of this: sqrt(30) = 5.4777...,

the square root of the arithmetic mean of the squares.

rounding   A process of choosing the most suitable quantity with a given smaller number of digits to represent another quantity with a greater number of digits.   Rounding differs

from **truncation**, in that in the latter the excess digits are simply discarded, whereas in rounding the last retained digit is sometimes adjusted upwards by one as compared with its value in the unrounded version. (When the digit 9 is adjusted upward to 0, there is naturally a leftwards carry of 1.)

A sound rule: When the first of the digits to be discarded is

  a) less than 5, truncate;

  b) greater than 5 or 5 followed by any digit(s) other than zero(es), round up;

  c) 5 exactly, truncate if the last digit to be retained is even, round up if it is odd.

In a computer, ordinary rounding, such as takes place at conversion of **floating point** to integer, is accomplished by adding .5 to the number and truncating. Although the rules given above could easily be programmed, that is not the usual; when greater accuracy is required, some such process as **bucket rounding** is employed.

route miles Not **line miles**. The sum of the round trip lengths of all routes operated, regardless of how often different routes traverse the same streets, highways, and rights-of-way.

route profile A chart of **passenger** boardings and alightings along a bus route during an operating day. The stops are listed vertically and the sequence (in time) of stops horizontally.

ROW See **right-of-way**.

row-type model A **model** whose specifications include the summing of a particular **variable** for all destinations of an origin zone--i.e, a row of a **matrix**. This sum can comprise one or more functions. Examples of row-type models are the

gravity model and the distribution-split model of the default model in **UMODEL.** Most iterative models are row type models and vice versa, although this is not always true.

RRT See **rail transit.**

r-squared The square of the **correlation coefficient.** A measure of **goodness of fit.** Very often r^2.

RTA The Cleveland Regional Transportation Authority or the Chicago Regional Transportation Authority.

run cut sheet In scheduling, a form used for the perfomance of all steps in the procedure of **run cutting.**

run cutting In transit operations, the process of dividing blocks, as shown on the **terminal sheet,** into pieces of work for crew assignments.

run guide In transit scheduling, a form that furnishes transit drivers with all information needed to make their runs.

run sheet A copy of the **run cut sheet** for information and record.

running time Travel time between **time points** along a line in service.

running time sheet A form showing **running time** data to guide schedule-makers.

running time form Used for the summary and analysis of **running time** data.

scalar Usually means a garden variety number as contrasted with a **vector** or **matrix.**

scaling See **weighting** and **factoring.**

scattergram Also scatterplot and scatter diagram. A plot of pairs of **random variables,** used to detect **correlations** and the form of a possible relation between pairs of variables.

schedule   1. A listing in time sequence of every trip and every **time point** of each trip from open to close of service on a transit line.

2. In transit operations, a document describing routes, type and number of vehicles, storage locations, times to depart from and return to the point of storage, times to arrive and depart each **terminal** and **time point** on each trip, times and places drivers should start and complete work, and the time plus **allowances** for which they are to be paid.

schedule delay   Delay experienced by transit passengers because transit schedules do not match their travel needs or desires.

scratch file   A file that is built (in a computer) in the process of solving a problem, but whose contents do not become part of the output. It is scratched.

screenline   An imaginary line, frequently following physical barriers, that splits a study area into two parts and along which traffic counts and interviews may be conducted--normally to check accuracy of travel survey data.

Section 5   The section of the UMTA Act of 1964, as amended by the Urban Mass Transportation Assistance Act of 1974, that provides a six-year mass transportation (capital or operating) assistance program for urbanized areas apportioned by a statutory formula.

Section 8   The section of the UMTA Act of 1964 establishing the planning requirements to conduct technical studies. Formerly called Section 9.

Section 9   See **Section 8.**

sector   A group of contiguous **districts** centering on the **CBD.**

select block   Normally only one **select statement** occurs in a **UTPS** program. **ULOGIT** and **UFIT** allow multiple select statements and these are grouped in the select block.

select statement   A **UTPS** input statement beginning &SELECT, which is used to select among major program output options, or components of the system, for analysis.

self-calibration   A mode of application of **AGM** in which it estimates **K-factors** and **F-factors**.

sensitivity analysis   A phase in the testing of travel **demand models.** This analysis ascertains how the model estimates changes in **demand** caused by changes in policy variables: changes in speed limit, parking costs, service levels, residential density, etc. In model testing, the criterion is usually common-sense experience.

SEPTA   Southeastern Pennsylvania Transit Authority. Philadelphia and environs.

sequential model   A **demand model** based on the assumption that travel decisions are made in a sequence of steps; e.g., whether or how often to travel **(trip distribution),** which mode to choose **(modal split),** and which route to choose **(trip assignment).**

service level   Also called level of service. Any combination of operating conditions that allows a given facility to accommodate traffic volumes. More simply: how much service there is.

service time   Time required to serve an individual **passenger** in a transit station. See **access time, egress time,** and **travel time.**

service volume   The maximum number of vehicles that can pass a given point during a specified time period at a specified **service level.**

shadow area   The shadow area of **zone** i, with respect to zone j, is that area between zone j and the study area boundary directly reachable from zone j only by going through zone i.

share model   See **modal split** model.

Shirley project   A demonstration project in 1971-75 performed in the Shirley Highway corridor in the Washington area. It produced evidence that a properly designed express bus system could compete with the automobile as effectively as **rail rapid**.

short-range planning   In planning a new transit route or service, forecasts of the **ridership** for various choices of routes, schedules, and fares provide estimates of revenues, to be compared against costs and other considerations. Similarly, as the implementation of specific facilities draws near (6 months to 5 years), detailed design information is required by the design engineer or architect. For this time frame, **UTPS** provides both the network feasibility analysis tool, used at a high level of detail, and the **microanalysis** tool.

short-run demand   **Demand** estimates based on the fixed set of urban activities on which the travel forecast is based.

signal pre-emption   The alteration of a signal system by the operator of a vehicle.

significance test   A mathematical procedure applied to empirical data to decide, on the grounds of probability, whether or not an hypothesis is tenable. In transportation planning, the usual significance test is for **goodness of fit.**

significant difference   Loosely, an important difference. Technically, a difference that is significant in the sense of having passed a **significance test.**

Simplified Aids for Transportation Analysis   A **UTPS** compendium, in one volume, of six independent transportation planning aids that do not require computers and have low data requirements. The current set treats autos and travel, park-

ing demands, fringe parking, ridership and cost, and route evaluations. There is an annotated bibliography of analytical aids.

simulation   The representation of a dynamic assemblage of interacting components or processes in a form or design that simplifies study, usually using a computer for computation, comparison, and analysis. A simulation program is a complex **model** of the system or process to be analyzed.

simultaneous equation systems   A set of equations, all satisfied by the same values of the **variables.** For example x + y = 2 and 3x + 2y = 5, treated as independent equations, are each satisfied by an infinity of pairs of values of x and y; but, treated as a system of simultaneous equations, they are satisfied by x = 1, y = 1 and by these values only. Frequently, sets which may or may not have common solutions, but are to be treated together to investigate for common solutions, are also called simultaneous equations. Simultaneous equations which fail to have a common solution are said to be inconsistent: x + y = 1 and x + y = 2 are clearly inconsistent. Simultaneous equations may also fail to have a *unique* common solution because they have either a finite or an infinite number of common solutions. This can occur when some of the equations in the set do not really give additional information about the relation, such as x + y = 1 and 2x + 2y = 2. In this latter instance there is said to be a **linear dependence** between the two cases. In large or complicated systems it naturally is not always easy to detect dependencies or inconsistencies by inspection, although straightforward mathematical methods will settle these questions for simultaneous **linear** equations.

simultaneous model   A **demand model,** used in forecasting, that works on the assumption that transportation consumers make

choices based on a single decision in which they consider, simultaneously, trip frequency, time of day, destination, mode, and path. Compare **direct assignment model.**

singular   If the **rank** of an n*n **matrix** is less than n, the matrix is said to be singular.

sketch planning   The preliminary screening of possible transportation configurations or concepts. It is used to compare a large number of proposed policies in enough analytical detail to support broad policy decisions. Useful in both long- and short-range regional planning and in **corridor** analysis, sketch planning (at minimal data costs) yields **aggregate** estimates of **capital costs** and **operating costs,** patronage, corridor traffic flows, **service levels,** energy consumption, and air pollution. Planners will normally stay in the sketch-planning mode until they complete their comparisons of possibilities or find a strategic plan worthy of consideration at a finer level of detail. Compare **mesolevel** and **micro-analysis.**

skew   Not symmetric.

skim tree   A barbarism. A **matrix** of some **attribute** such as travel time, cost, or distance between every pair of **zones** as accumulated over the shortest path connecting the zones.

slope   For a straight line, the slope is the ratio of rise to run or the tangent of the angle that the line makes with the x-axis (the two definitions are equivalent). For more general curves, the slope (at a point) is the slope of the line tangent to it (at that point)--provided there is one. Most curves employed in modeling in urban transportation will have slopes practically everywhere. It should be observed that the word *tangent* used in the first sentence of this definition refers to the trigonometric function, while afterward it refers to the tangent line, which is a kind of

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limiting secant that touches at only one point. This subject, one of the main topics of Introductory Calculus, is too vast to be pursued in this lexicon.

SMSA Standard Metropolitan Statistical Area. An area composed of counties (or, in parts of New England, of townships) defined by the Census Bureau according to a number of criteria of size, contiguity, and interaction. These criteria and their applications are discussed at length in the *Census User's Guide,* and more briefly in the annual *Statistical Abstract.* Since the Census Bureau is determined that the SMSA's shall consist of a whole number of counties, SMSA's take on shapes on a map that might surprise the uninitiated. It would be dangerous to assume that SMSA's conform to popular conceptions of "Greater Little Rock" or "Metropolitan Cleveland." To risk simplism: the geography of an SMSA is not only demographic but economic. To help planners convert Census data into units appropriate to transportation analysis, there is the **UTPS** element **UCEN70.**

software The totality of programs and routines used to perform the processing or extend the capabilities of a computer. Opposed to *hardware.* In an extended sense it includes all documents ancillary to the computer (such as manuals, circuit diagrams) or to programs (flow charts, users' guides, case studies).

Software Systems Development Program: Introduction to Urban Travel Demand Forecasting Introduction to travel forecasting with **UTPS:** methodology, available tools, input and output requirements, levels of effort. Three parts: *Summary; Volume I: Demand Modeling; Volume II: Evaluation.*

source code A high-level language used by programmers to control computer operations, such as **FORTRAN, COBOL,** or **ALGOL.** The source code, in the strictest view, is not a **computer program** but the input to a specialized piece of **software**

called a compiler. See **compile.** The output is either a **machine language** or, at the very least, much closer to it than the input.

sparsity   A **matrix** with very many zero entries is said to be sparse.

special generators   Concentrations of activities of such unusual size or nature as to warrant special consideration in **trip generation:** hospitals, schools, stadiums, etc. See **activity system.**

specific choice model   1. A **model** based on the assumption that it is necessary to identify travel-choice **variables** by the names of their **mode,** destination, time of day, or other characteristic.

2. An equation or graphic technique used to simulate travel patterns, particularly those in urban areas.

spider network   Also spiderweb network. An abstract transportation **network** for a given area that is composed only of connections between neighboring **zone centroids** without respect for physical system layout. It is frequently used for comparing results of travel forecasts with surveyed trips.

split run   In transit operations, a driver work schedule with an extended **swing** and **spread** time.

spread   The total time between the sign-on and sign-off of a driver run. Also, the time between two parts of a transit operation.

spread pay   The extra pay associated for **two-piece** runs having a **spread** exceeding certain limits determined by collective bargaining agreements or management policy.

squares, least   See **least squares.**

squeeze   See **compress.**

stable   A process is said to be stable when small changes in the input produce only small changes in the output. Likewise in the case of a solution: if small changes in the **parameters** of a problem produce only small changes in its solution, the solution is said to be stable. Since the measure of uncertainty of our knowledge of many parameters is quite large, it is essential for satisfactory solutions to manifest a degree of stability no greater than the uncertainty of the parameters. See **sensitivity analysis** and **robustness**.

staged regression   The use of the output of one regression as input for the next.

standard deviation   A common measure of the variability of a set of numbers. It is the square root of the average of the squares of the deviations from the mean. It is denoted by σ or sigma, and it is also referred to as the **root mean square** deviation.

standard error   The estimated **standard deviation** of the estimated **coefficient** value when the latter is viewed as a **random variable**. The practical implication is that, for more than 25 accepted observations, the true value of the coefficient is with probability 68% within one, with probability 95% within two standard errors from the estimate.

standard error of the estimate   The **standard deviation** of the observed values about a regression line. In a simple **linear regression** of y on x, the standard error of the estimate is s(y)*sqrt(1-r**2) where s(y)**2 is the **variance** of y and r is the **correlation** between x and y.

Standard Metropolitan Statistical Area   See **SMSA**.

standard urban bus   A self-propelled bus that accommodates both seated and standing passengers. The assumption is short rides in **mixed traffic,** frequent stops, and quick access and egress. It is the typical city bus.

state of the art   Means something like "the best we are reasonably sure of (or have) now." The term is used to assert that something is neither outmoded nor untested, neither obsolete nor merely experimental.

statistic   See **parameter**.

stem time   Pull-in time or pull-out time.

stochastic   The terms *stochastic* and **random** are, for nearly all practical purposes, synonymous. However, sometimes stochastic implies a random process spread out in time; and the use of the term does avoid confusion with the popular understandings of *random*. For example, the phrase *random assignment* would convey an inaccurate notion of the process involved. However, too often *stochastic* is used merely as an honorific version of *random*, an instance of the common tendency towards *obscurius pro obscuro*.

stochastic assignment   An **assignment** technique that allocates point-to-point travel to more than one **path** by using a set of probabilities to estimate the expected number of **trips** on each relevant path. These probabilities are computed as a function of a path characteristic, such as **impedance**. See R. Dial, "A probabalistic multipath assignment model which obviates path enumeration" *Transportation Research* 5, 83-111.

stochastic variable   See **random variable**.

stochastic variable   See **variate**.

stop delay time   Deceleration time + **dwell time** + acceleration time.

straight run   In transit operations, a regular run in which the trips follow one another without interruption. Or, a driver work schedule approximately eight hours long which has a restricted **swing** time. Also, base run.

strategic planning   Usually **sketch planning,** and contrasted with **tactical planning.**

stratified curve   It is not uncommon in transportation planning to have a **continuous variable** (y) given as a function of one continuous variable (x) and a **discrete** variable (n)--e.g., **mode** share as a function of **disutility** difference and income level.   In this case a series of curves, one for each value of n, showing y as a function of x can be plotted in the xy-plane in one diagram.   These are called stratified curves.

stratified sampling   A method of sampling in which the population is divided into strata of relatively uniform characteristics from each of which a sample is collected.

street network adjustment factor   See **circuity factor.**

string   A term so general that it is difficult to define.   Any sequence of characters (or blanks) thought of as a unit constitutes a string.

structured program   A continuous set of logical computer instructions **coded** in such a manner that they can be used sequentially in small segments, usually fifty instructions or less per segment, so that each segment can be read literally from top to bottom, with complete assurance that in the segment under consideration all control paths are visible.

subdivision sheet   In transit operations, a form showing in, out, total, and **relief times.** Used in **run cutting.**

subroutine   Usually, a section of **coding** so arranged that control may be transferred to it from a master routine and so that, at the conclusion of the subroutine, control reverts to the master routine "at the same place" from which control was transferred.   Sometimes this is called a *closed subroutine* to distinguish it from more general uses of the term.

In general, any sub-unit of a routine which contains the instructions to carry out a well defined operation.

subscription service   A **DRT** system in which passengers reserve service on a regular basis.

subtended volume   If you view an object such as your hand
against a distant surface, that object blots out a portion
of the surface. This projection of the object upon the sur-
face is called the subtended area of the object on the sur-
face. Between the object and its projection on the surface
a volume is also blotted out; this is the subtended volume.
The magnitude of a subtended volume depends on the shape of
the subtending object, the shape of the subtended surface,
their orientation with respect to each other, the distance
between them, and the viewpoint.

suburban transit bus   Sometimes called suburban coach. A self-
propelled bus to serve seated passengers that has some of
the amenities appropriate to longer trips, such as overhead
parcel racks.   Used primarily in service with very few
stops. The configuration is that of the ordinary inter-city
bus.

super district   An analysis area which is an aggregate of **dis-
tricts**. A **sketch planning** term.

supply   In economic theory, the willingness of producers or
suppliers to sell a given amount of goods and services at a
given price at a given time. As in the case of **demand**, this
amount should be thought of as a schedule or a graph con-
taining a supply curve. However the urban transportation
market might be characterized, it is only remotely related
to the sort of non-monopolistic market which conventional
economic theory relishes; and therefore, in most discussions
of transportation, supply is usually taken to mean the fixed
amount of available service. Sometimes, the word functions
as an adjective meaning "related to transportation hardware
or service policy," as in the phrase *supply side*. (No rela-
tion to the nonce-phrase *supply-side economics*)

surveillance   Annual maintenance of land use, socioeconomic,
and transportation data necessary to ongoing land use and

transportation planning when comparisons and evaluations of existing conditions and forecasts are required.

swing   The time between two pieces of a **two piece run,** excluding allowances. Also called intervening time.

symbolic parameter   A symbol that appears in a **cataloged procedure.** Values are assigned to the symbols when the procedure in which they are referenced is executed.

system planning   Wherein the **alternatives** to be analyzed are few, but detail is sufficient to estimates of land development impacts, system costs, major facility and **corridor** volumes, **levels of service,** energy use, major air quality effects, accidents, and so on.

tactical planning   Usually **meso-level** planning, contrasted with **strategic planning.**

TAZ   Transit analysis zone. See **analysis area.**

tenure   The manner of holding property, especially in Census data. For example, whether owner or renter.

terminal   1. An area or a building that serves for pick-up, transfer, or discharge of passengers or goods.

2. An off-street facility for turning vehicles around.

3. An elaborate transit stop at the meeting point of several **routes** or **modes.**

4. Either end of a transit route, regardless of the presence of special facilities. Also, terminus.

terminal layout sheet   In transit operations, a form on which the scheduled departure times of trains from line terminals are laid out prior to final adjustment.

terminal sheet   In transit operations, the final timetable of vehicle operations. Frequently called headway sheet or rotation sheet.

terminal time   1.   Not the same as, but an element of, **access** and **egress time.** The time spent by a traveler before entering or after leaving a vehicle on operations such as parking, walking to the vehicle, and so on.

2.   In the operation of transit vehicles, the time allowed at a terminal between arrival and departure for turning vehicles.

terminus   See **Terminal.**

theta parameter   The calibration **parameter** for the built-in distribution/mode-split model in **UMODEL.**   It is a **diversion parameter.**   Also the diversion parameter of the **probabilistic assignment** option of **UROAD.**

three-piece run   A regular run in which a driver's work is not continuous, but divided into three parts.   In the two intervals the driver is not paid unless there is **spread pay.**

through bus   1.   In **critical movement analysis,** a bus not scheduled to stop at the intersection under analysis.

2.   In the scheduling of buses, the phrase is usually applied to matters of passenger routes instead of vehicle routes.   For instance: a "through bus" from New Orleans to New York City is a bus on which a New Orleans-New York passenger may remain during the whole trip, without transfering.   Clearly this is a "through bus" only for the New Orleans-New York passenger, and not for passengers with different origins and destinations who might transfer on or off the bus.

time point   In transit operations, a line location for which vehicle arrival or departure times are specified.

time series analysis   The analysis of data collected, observed, or recorded at regular intervals of time.   More specifically the separation of these data into components representing seasonal, cyclical, and secular changes--either to isolate

the components for separate study or to remove them from the data (to produce, e.g., "seasonally adjusted" figures). Sometimes used, very loosely, to indicate the analysis of data that are not **cross-sectional.**

time sheet, running   See **running time sheet.**

time summary, running   See **running time summary.**

TIP   Transportation Improvement Program. Program or schedule of intended improvements covering a 3-5 year range made in the process of applying for grants-in-aid from the U.S. Department of Transportation. See **TSM.**

title cards   The first element of the **UFIT** control card file deck might be one or more title cards. They might contain any information desired in their first 72 columns. All title cards are printed on the first page of output, and the first title card appears at the top of every page.

trace   A diagnostic **debugging** technique that provides an analysᶦs of all, or of selected, executed instructions and writes it on an output device (or stores it on an output medium) as each instruction is executed. Typical criteria for selecting instructions would be their type (e.g., transfer instructions), location (e.g., in a specific area of a program where an error is occurring), or location of operand. Where tracing is performed on transfer instructions, the term *logical trace* is sometimes used.

tract   Census tracts are small, permanently established geographical aeas into which large cities and their environs are divided for statistical purposes. They average about 4000 in population and subdivide into about 40 **blocks.** They are chosen by local committees, with permanence and homogeneity as the most important desiderata. These two goals come to odds over time, in which case permanence is usually preferred to homogeneity. The range of population for most

tracts is from 2500 to 8000, with institutional and **CBD** tracts allowed smaller populations. Splitting is customary when a tract population exceeds 16,000; tracts of less than 1000 are usually merged. In the rare cases when changes occur between Censuses, compatibility tables are prepared and published with the Tract Reports. See **UCEN70.**

Census tracts were proposed and designed for New York City by Walter Laidlaw in 1906. In the 1910 Census, eight major cities were tracted. The number has since steadily grown until, by the 1980 Census, more than 70% of the total population lived in tracted areas.

traffic   In transit scheduling, **passengers.** Elsewhere the term takes all the meanings the traffic will bear.

traffic analysis zone   See **TAZ.**

traffic assignment   See **trip assignment.**

transfer impedance   An **impedance** value used to represent the **cost** to a passenger of changing a service or mode. It is important to remember that the transfer impedance attempts to represent the generalized cost of transfering (fee, delay, inconvenience) and not just the out-of-pocket charges.

transfer matrix   A **matrix** of **transfer impedances.**

transfer payment   Income flows which represent a change in the distribution of national wealth, but which are not compensation for a current contribution to the economic process.

transfer point   See **node.**

transgeneration   A feature of many **regression analysis** and other model **calibration** programs that allows the creation of new **variables** at the time of execution of the program. Typically the transgenerated variables are new **independent variables** which are functions of the original set of input

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explanatory variables, but many other variations are possible (using **lag** or count operators). A common application is the use of the **logarithmic transformation**.

transportation costs   Those **operating costs** of a transportation system that derive *entirely* and *directly* from transportation operations: driver wages, supervision, energy, and associated administrative costs.

Transportation Improvement Program   See **TIP**.

Transportation System Management   See **TSM**.

transposition   The process of rotating a **matrix (trip table)** about its main diagonal produces the transpose of the matrix.   The transpose of a **production-attraction** trip table (say, output by a gravity-type distribution) is factored and added element by element to a **factored** production-attraction trip table to yield an origin-destination trip table.

t-ratio   The value of a **regression coefficient** divided by the **standard error**. It can be subjected to a Student's t-distribution test for **significant difference** from zero.

travel   In transit operations, the paid time for drivers between relief points or between a **relief point** and the storage depot.

travel time   Sometimes traveltime. This phrase is used so variously that care should be taken to discover its meaning in context. Usually it means the time a traveler needs to make a **trip,** including both time in-vehicle and **terminal time.** Sometimes it includes **access time** and **egress time.** Rarely, it means only the time spent in a vehicle. It can mean round-trip travel time.

travel time ratio   Travel time between points by a faster route divided by travel time between the same points by a

slower route.   A term that occurs in **diversion assignment,** usually referring to the ratio of freeway and non-freeway time.

tree   1. A **graph** or **network** in which some one **node** is joined to every other node by a unique **path.**

  2. A shortest path tree is a record showing the shortest routes and **travel times** from a given **zone** to each node in a network.

tree skimming   See **path skimming.**

triangularize   To convert an ordinary one-way **trip table** into a **triangular trip table** by adding the table to its transpose. See **transposition.**

triangular trip table   A **trip table** reflecting the total two-directional flow for each **analysis unit.**

trip   A one-direction movement which begins at the **origin** at the start time, ends at the destination at the arrival time, and is conducted for a specific purpose. See **trip purpose.**

trip assignment   The process whereby **trips** (usually described by **mode, origin,** destination, and time of day) are distributed among (assigned to) the various available **paths** or routes in a **network** according to one of a number of assignment models. This process is one of the steps of the traditional **four-step process** of transportation planning. Since in realistic applications assignments are made to routes based upon factors that depend upon and change with the number of trips assigned, considerations of **equilibrium** usually necessitate that assignment be an **iterative process.**

trip attraction   See **attraction.**

trip cards   Data cards containing survey-derived **trip** information and related information. The data for each surveyed trip are punched in on the trip card.

trip distribution   The process in which **trips** defined by **origin** are distributed among the various available destinations.   A step in the **four-step** planning process.   Common trip distribution models are the **gravity model** and the **opportunity model.**

trip ends   The **origins** or destinations of **trips.**   The total number of trip ends in an area equals twice the number of trips to or from it.

trip end summary   A summary table for each **zone** presenting the number of **trips** into a zone, the number of trips out of it, the number of **internal trips** and other summary information.

trip generation   1.   The process in which zonal **trip ends** in an **analysis area** are computed.   A phase of **sequential demand estimation.**   It includes both trip production and trip attraction.

2.   A phase of the modeling process in which there is analysis and application of the relations of tripmaker, land use, urban area, and tripmaking.   The analysis should produce estimates of numbers.

3.   A general term describing the analysis and application of the relations among tripmakers, urban area, and tripmaking.   It determines the number of trip ends in any part of an urban area.   It is a step in the sequential, **aggregate** forecasting process in which trips defined by **origin** or destination (but not both) are predicted based on the characteristics of the **activity system** and, in some applications, some measure of transportation service to or from the **zone.**   The output of trip generation is a one-dimensional **array** of trips into or out of a zone for input to **trip distribution** models.

trip length distribution   A distribution of ·the number or the percentage of trips made at various intervals of trip time or distance--a common output used primarily for checking and validation.   Also trip length frequency distribution.

trip production　　See **production.**

trip, person　　See **person trip.**

trip purpose　　The purpose of a **trip.** In transportation planning trip purposes are thought of as those purposes which account for a great bulk of the travel in ordinary life: work, shopping, amusement, recreation, school, and so on. Only occasionally are more specialized trips (or less specialized trips) the subject of study.

trip shed　　Also, traffic shed. A contiguous and uniform area viewed as a producer or attracter of an exceptionally large number of (similar) **trips.** A term created on the analogy of a sturdy misuse of *watershed.*

trip splitting　　The process by which the **production-attraction trip tables,** output by a **trip-distribution model,** are converted to a table of origin-destination movements. See **transposition.**

trip table　　1. A table showing the number of **trips** between **zones** classified by **mode,** purpose, time period, type of vehicle, or other category.

　　2. A **matrix** of the number of passenger or vehicle trips from one area or zone to another.

　　3. A matrix of the number of trips from each zone to all other zones.

tripper　　In transit operations, a driver assignment that does not require a full working shift, usually intended to serve peak period demand.

trip table, triangular　　See **triangular trip table.**

trolley bus　　Sometimes called electric bus or trolley coach. A bus powered from overhead electric lines. Since it does not run on a track, it can maneuver in **mixed traffic** much like an ordinary bus.

truck   A vehicle having six or more wheels on the pavement. This definition sounds arbitrary; but it reflects the understanding in transportation studies that trucks are identified as vehicles that make demands on a road system that are different from those made by standard passenger automobiles. Such vehicles as pickups and delivery vans are popularly and sensibly (given their configuration) thought of as trucks; but in fact they operate in traffic like standard automobiles, and in transportation planning they are not treated as trucks.

truncation   The discarding of the less significant digits of a number without any **rounding.**

try-out schedule   A projected schedule for proposed transit operations: best routes, most appropriate vehicles, most economical **run cutting.**

TSM   Transportation Systems Management. That element of **TIP** (Transportation Improvement Program) that proposes non-capital-intensive steps toward the improvement of a transportation system, such as refinement of system and traffic management, the use of bus priority or reserved lanes, and parking strategies. It includes actions to reduce vehicle use, facilitate traffic flow, and improve internal transit management.

t-test   A **significance test** of a statistic distributed according to Student's t-distribution. Commonly used to compare two observed **mean** values.

turn   The passing from one **link** to another in a **network.** Note that this term is used in a much more general sense in the analysis of transportation networks than it is in life.

turn-in time   See **clear time.**

turn penalty   The time added to the **travel time** of a **trip** when a **turn** is made in the **network**. The turn penalty will most often be zero; a positive value will usually not be employed unless the **turn** (in a network sense) represents a difficult turn in the ordinary sense.

turn prohibitor   A mechanism for defining, in **network coding,** a non-permitted **turn.**

two-piece run   In transit operations, a driver run approximately eight hours long with a break off the vehicle.

UCEN70   A Census data processing program that provides the ability to extract data from the 1970 Census summary tapes for 1st, 3rd and 4th counts. The program summarizes Bureau of Census tabulations from Census geography (i.e., **block-groups, tracts)** into user-defined transportation geography (e.g., **zones, districts).** Data are output in the UMATRIX **attribute file** format which can then be directly manipulated by other **UTPS** programs such as **UMATRIX, UMODEL** or **AGM. UCEN70** will be replaced by **UCEN80** when 1980 data are available.

UCOST   The cost of providing services attributable to each vehicle-crew unit for each line. It can be used with T-COST and D-COST to develop rough **operating cost** estimates for service for each line.

UFIT   The **UTPS regression** program. It allows planners to formulate, test, and apply **models** easily and in a structured manner using a high-level **command language.** It accepts **calibration files** from **UMODEL** or raw data in card image format. Conditional expressions can be used to screen observations. UFIT can create, update, and transform data for **regression** or **residual analysis** or for other input to programs **ULOGIT** or **UBUILD.** UFIT also permits planners to put bounds and equality constraints on the coefficients to be estimated. See **constrained coefficient.**

UFMTR   The **UTPS matrix** formatting program. It prints out, in juxtaposition, the contents of selected portions of multiple matrices. If the matrices are **trip tables,** UFMTR can also report the number of **trips** leaving, entering, and remaining in each **zone.** UFMTR can also produce plots of **trip length distributions,** graphically relating an **impedance** matrix to a trip matrix (e.g., a fare matrix and a trip matrix would be input to obtain a plot of the number of interzonal trips paying a given fare). It can also produce **scattergrams** comparing two or more matrices. All these functions are necessary to display the matrices input and output by other programs.

UINTRO   The **UTPS** introduction. It is an initial orientation to UTPS: documentation, programs, manuals, training sessions, and related guidance.

ULOAD   The **UTPS** transit passenger loading program. It reads a **trip matrix,** such as that output by **UMODEL** or **UMATRIX,** and assigns its elements to the corresponding interzonal shortest **paths** described in **UPATH's** output. ULOAD assigns each **trip** to the non-transit access **links** and to the transit sub-routes which serve the trip best with respect to the initial **origin** and final destination. It can also plot the loaded network as a map depicting link usage. ULOAD allows the **assignment** of only those trips using selected combinations of lines and/or non-transit links and outputs a standard matrix file containing only these trips.

ULOGIT   The **UTPS** logit **calibration** program. It calibrates **models** (usually **modal choice models)** of the **linear logit form.** It uses a **maximum likelihood estimation** technique so that **disaggregate** (trip based) **data** can be used as input. It allows **constraint** of **parameter** estimates by the user. It reads an input calibration file from **UMODEL.** It outputs parameter estimates, statistics, and plots related to **goodness of fit.**

UMATRIX   The **UTPS** matrix manipulation program. It accommodates the large variety of data required for transportation planning, including **matrix** data, household surveys, zonal-based demographics, and **network** supply characteristics. Using a simple algebraic **command language,** the UMATRIX user can access and differentiate various input data types and modify, update, and create new data required for **demand** estimation, **trip assignment,** and system evaluation. UMATRIX provides the user with **arithmetic** and **logical operations** to help transform and create aggregate and disaggregate data. Special functions are available, such as matrix **transposition,** which facilitate the splitting of **trip tables** from **P&A** form to **O&D** form. **Lookup tables** help to edit and screen survey data. In addition, **attribute** data, whether **zonal, link,** or household based, can be created in UTPS-compatible form from card images. A **printer plotter** posts, at the zonal **centroid** location, values of any matrix row or zonal data item.

UMCON   The **UTPS matrix conversion** program. It creates, copies, modifies, and merges matrices. In any one execution, its input can include **trip tables, impedance** matrices, etc., in card format or as output by the IBM 7090 **BPR** highway programs, the **PLANPAC** program battery, the **HUD** transit programs, and the UTPS programs. Its output permits the same flexibility of **format** as its input, including the ability to output card image records. Its matrix modification capabilities include the ability to **scale** matrices to new row and column totals, a **Fratar-like** process, and the alteration of individual matrix elements.

UMODEL   The **UTPS demand model** program. It is a **software** framework which accommodates virtually any demand or **modal choice model.** A complex program, it should only be used when the model to be applied is too complicated for the programs **AGM,**

UMATRIX or **UFIT.** UMODEL contains a **default** demand model for users who require a first-cut demand estimate without spending the dollars and time to construct and **calibrate** their own model. UMODEL reads a user-provided, **Fortran** coded **subroutine** which specifies model formulas or diversion curves, relevant land use (zonal) data, and transportation system characteristics (matrix data); and it outputs origin/destination demand matrices with observed trip matrices or **disaggregate data** and generates statistics useful in model calibration. UMODEL can create **calibration files** for use in the programs UFIT, **ULOGIT** and **UREGRE.**

UMTA   Urban Mass Transportation Administration.

UNET   The **UTPS** transit **network** program. It creates, modifies, prints, and plots a computerized description of the transit network. Its inputs are **link** data that describe the physical network (guideway) and line data that describe all routes. Obsolete with the introduction of **INET,** this program is included in UTPS merely to support users who wish to delay their use of INET.

unbiased   See **bias.**

Unified Planning Work Program   A document describng all work of state and local agencies involved in continuing planning.

uniformly distributed   If a **random variable** can take on a number of possible values, and all these values are equally likely, the random variable is said to be uniformly distributed. There is a uniform distribution of integer results in the range 1 to 6 when an **unbiased** die is thrown. (This illustration is open to a charge of circularity, since the way to test whether a die is biased is to determine if throwing it produces uniformly distributed results.) This phrase applies equally to—and is used more frequently of—a **continuously** distributed variable.

uninterrupted flow   Vehicle movement without constraint by signals, stop signs, or intersections.   Compare **interrupted flow.**

unit elasticity   See **elasticity.** If you have a strict budget for some product so that you spend the same amount on it regardless of the price, your demand is said to exhibit unit elasticity.

UPATH   The **UTPS** transit pathfinder program.   It reads a transit **network** description and outputs a description of best **paths** between all or selected **nodes** in the system.   It can produce a fare **matrix** or a distance matrix.   Like all transit-related programs in UTPS, UPATH can read either **UNET** or **INET** networks.

UPSUM   The **UTPS** transit **path** summarizer program.   It traces across each path output by **UPATH,** and calculates the components of **impedance** associated with each interzonal transit **trip.**   UPSUM provides **matrices** disclosing the number of transfers and in-vehicle and out-of-vehicle time between all pairs of **origins** and destinations.   These **datasets** are invaluable in **demand** forecasting and system evaluation.

URD   A standard prefix to **UTPS** tape names.

UREGRE   The **UTPS regression** program.   It reads either raw data or the condensed output of **UMODEL,** along with a user-provided set of regression model specifications, and calculates the linear **multiple regression parameters** and **goodness of fit** estimates.   A **residual analysis** is also available.   It is included in UTPS only to support users wishing to delay their use of **UFIT,** which replaces it.

UROAD   A generalized highway **traffic assignment model.**   It finds shortest **paths;** skims paths for interzonal costs, times, and distances; loads paths with **all-or-nothing, stochastic,** and/or **capacity restraint** techniques.   It produces reports and plots describing the **network.**

USQUEX   The **UTPS matrix** expander and compressor program. It is used to change the size of matrices or rearrange their rows and columns. It can **compress** a large matrix to a smaller table by combining certain rows (and columns) into **districts,** or it can **expand** a matrix by assigning fractions of certain rows (and columns) to new **zones.**

USS   **UMTA** station simulation **model.** A computer **simulation** program used to determine space and facilities necessary in a transit station to provide an acceptable service of a given pedestrian flow. USS is used at different phases of the station design: to evaluate initial design **alternatives** and also to refine a selected design. It is a **discrete** event, **Monte-Carlo** type simulation model programmed in **Fortran** for use on IBM 360/370 computers.

USTOS   The **UTPS** station-to-station transit volume analyzer program. It reports **passenger** flows between selected **nodes** (stations) in the system. Based on **UPATH's** best paths, it determines the access and egress station for each zone-to-zone **trip.** The output of USTOS is useful for station design, access planning, and revenue forecasting.

UTD   An abridged acronym for the three-volume **UMTA** publication, *Introduction to Urban Travel Demand Forecasting.* This manual provides a comprehensive overview of the methodology of travel forecasting, the analytical tools available and their appropriateness for typical problems the transportation planner faces, input requirements, outputs needed for proper evaluation, and appropriate levels of effort for the various stages of analysis.

utility program   A member of a standardized set of programs maintained at a given institution to assist in the operation of a computer in such processes as sorting, **tracing,** data **conversion,** or input. Also called a *utility routine.*

UTOWN   A hypothetical urban region used in the **UTPS Case Study** and as an illustrative base for various studies.

UTPS   Urban Transportation Planning System. A coordinated collection of computer software, technical manuals, and other analytic aids developed and distributed by UMTA and the Federal Highway Administration (FHWA).

UTPS provides tools which can deal with the highly complex variables and constraints involved in transportation planning. The information and information handling requirements for estimating demand, evaluating alternatives, and assessing energy, environmental, and economic impacts make UTPS essential.

Capabilities of UTPS include estimation of land development impacts, transportation system costs, travel demand forecasts, major facility and corridor travel volumes, energy use, major air quality effects, and accidents. It can be employed to answer questions at a microscopic, detailed, street-by-street level for short-range problems. For more macroscopic decisions, sketch planning methods are available at a reduced level of effort and lower cost.

The computer package consists of a number of related and permutable programs. Each program represents a separate step in the local transportation planning process which might include network preparation, travel demand estimation, and assignment of travel to the network. At each step, modifications can be made to model the transportation option that is to be tested: for example, roads or transit lines might be added to or deleted from the network in the first step, land use changed to generate more trips in the second, and highway capacities changed in the third. There are also several programs which can be used to prepare plots, tables, or graphs to compare results from different alternatives. The content of UTPS is continually evolving. Old tools are improved and new tools are added as new policy and technical requirements surface or R&D breakthroughs occur.

wallpaper   Strips of computer output containing sections of a map, chart or diagram too large to be produced in a single piece on the **printer-plotter.**

weaving   The crossing of traffic streams traveling in the same general direction along a significant length of highway, without the aid of traffic signals. Weaving sections are typically formed when two one-way roadways merge to form a single roadway and then diverge again. A typical example is a cloverleaf intersection at which northbound traffic leaving to go west on a cross road must cross the entering stream from the eastbound lane of the same cross road.

weight   A term almost as vague as **coefficient.** A weight is a member of a set of coefficients in some sort of one-to-one correspondence with a set of **variables,** used to perform some desired adjustment on the variables. The use of the term is largely conventional. Weights **normalize,** smooth **time series,** and reflect importance or reliability in **regression analysis.** They are similar to **fudge factors** but much more respectable.

weighting   The application of **weight** to a number.

windowing   Extraction of **supply** and **demand** information from a subarea of a regional **network.** In the UTPS application, the process yields two outputs: a subarea network and up to four subarea **trip tables.** In typical applications, the subarea network is then updated to reflect more detail, and the trip tables are expanded to reflect smaller **zones.** This makes possible a fine-grained analysis within the subarea that returns information about region-wide traffic flow at reduced computing costs.

WMATA   Washington Metropolitan Area Transit Authority. See **METRO.**

word   A group of characters or bits, treated, stored, **addressed,** and transmitted as a unit. Word lengths may be fixed or variable, depending on the computer, and words may be subdivided into **bytes.**

work file   A file used for intermediate storage.

Work Program, Unified Planning   See **Unified Planning Work Program.**

x-y coordinates   A pair of numbers showing the distance of any point in a plane from each one of a pair of mutually perpendicular reference lines, called the x and y axes. It is customary to give the x-y coordinates of the **centroid** of any analysis **zone.**

ZFILE   A data set or file composed of **LAVS** used originally for the storage of zonal data. The term has been generalized to include any file, regardless of its content, that has the structure of a ZFILE, in which, for a given **attribute,** all of its values for the various **zones, links,** etc. are given. The term is a **UTPS** convention.

ZIO   **ZFILE** Input/Output Routines. Fourteen **subroutines** used for basic input/output reporting and file management.

zonal district equivalences   An input to **USQUEX** which determines what **district** a **zone** belongs to. Cards of the following format are used: &EQUIVDIST=3, Z=2, 7, 18, 22. Internally this becomes a **vector** whose ith component is p, where p is the number of the **district** to which the ith zone belongs.

zones   Geographical areas, intended to be relatively homogeneous in land use or activity, that make up a study area. The representative point of a zone is its **centroid.** Zones are thought of as the basic geographical units of the sources of travel **demand.**

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16. Abstract

    Created as a dictionary reference for the user of the Urban Transportation Planning System (UTPS), this lexicon is a glossary of nearly 1000 words and phrases in common use among transportation planners who perform computer-aided analyses of multimodal transportation networks. Its principal purpose is to assist the user of the UTPS computer programs. It consists primarily of definitions of technical terms which appear in UTPS documentation. In addition it contains some terms used in the definitions of the primary terms. Although this lexicon neither is nor intends to be exhaustive, it does nevertheless cover a very wide spectrum of the technical vernacular of the transportation planner. It is in fact the most complete transportation planning glossary in print.

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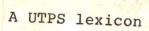**Form DOT F 1700.7** (8-72)   Reproduction of completed page authorized

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W. Wolfe, Middle Tennessee State University

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