APPENDIX
LIST OF SYMBOLS

a	A calibration constant; for example, it is the service-employment multiplier or population-serving ratio (number of service jobs generated from one household or resident)
$\tilde{a}$	Intercept regression-coefficient as a random variable
$\tilde{a}^*$	Specific value of $\tilde{a}$ corresponding to a sample of data points
a'	Acceleration of a vehicle; also a constant parameter, such as unit cost of commuting (cost per unit-of-distance travelled), or the exponent of the development opportunity W_j at destination j
a_i	Calibration parameter corresponding to the utility increase in zone i, where utility is some measure of composite accessibility to the zone; also the population-serving ratio at zone i
a_t	Estimation-error or noise term for a series of data (t = 1, 2, …) usually in a 'normalized' time-series, or after the data have been differenced to a stationary series; the estimated error or noise in Kalman filtering; also referred to as innovations when it is white noise
a'_i	Physical area of geographic sub-unit i or the demand-generating potential of i
a'_t	Measurement error in a Kalman-filter time-series, representing the difference between observed and measured data
a_D	Error term in a demand econometric-equation
a_S	Error term in a supply econometric-equation
a^W	Weighted labor-force-participation-rate, where the weights are the percentages of regional population in each zone
a^p	The pth-sector employment-growth-rate in the entire study-area
a_{ij}	Parallel to its single-dimension analogue, a_{ij} is an error- or noise-term in the spatial context; it has a zero mean and a constant variance; also stands for the entries in the $\bar{\mathbf{A}}$ matrix
a_i^u	Convex combination of the population-serving ratios, with normalized accessibilities to zone i as weights
a_j^p	Employment multiplier considering the population-serving ratio, i.e., $(1+a_j)$—segregated both by economic-sector p and by zone j here
a^{kl}	Calibration parameter in a predictor-prey equation-set showing the interaction between the kth and lth species
a'_{kj}	The kth output (benefit) measures due to decision-making-unit j considering both non-spatial and spatial attributes (see also $\bar{\mathbf{A}} = [a_{ij}]$)
$a_{ij}^{pq}(k)$	Impact of the pth-state-variable-in-zone-i-at-time-k on the qth-state-variable-in-zone-j-at-time-k+1
a''	Threshold for a high-pass noise-filter
$\mathbf{a} = (\leftarrow a_i \rightarrow)^T$	Vector of calibration coefficients in the second stage of 2-stage least-squares, consisting of q entries; also stands for the vector of the error (noise) terms in a spatial-temporal forecasting-model
$\mathbf{a}'$	Vector whose ith element is the ratio of the-household-income to the gross-output-in-the-ith-industrial-sector
$\tilde{\mathbf{a}}$	Interim error-vector or noise-term in a more efficient calibration-procedure for STARMA
$\mathbf{a}_{ij} = (\leftarrow a_{ij}^k \rightarrow)^T$	Each entry of the $\bar{\mathbf{A}} = [a_{ij}]$ payoff-matrix is replaced by a vector in a linear program, mainly to facilitate a multicriteria, two-person, zero-sum, non-cooperative game; here k is the index for a criterion
α	Calibration constant, or step size in "hill-climbing" algorithms; also the tail of a distribution
α'	Angle between two criterion-functions in multicriteria linear-programming; also a calibration constant
α''	Resulting problem-type after the original problem has been polynomially reduced
α_t	Random-shock or white-noise input-time-series in a transfer-function model
α_{ji}^{qp}	Exponent in a Cobb–Douglas production-function corresponding to the factor input x_{ji}^{qp}
A	Accessibility expenditure for a household (part of locational expenditure); also the area
$A(\cdot)$	Area of $\cdot$
A_i	Weighted labor-force participation-rate, with accessibility from zone i as weights
A_j	Gross acreage of subarea j
A'_j	Useable gross-acreage of subarea j
A_t	Error term in a 'raw-data' time-series
$\bar{A}_j$	Developable acreage in subarea j
A^B	Basic land-use (A_j^B is basic land-use in zone j)

A^R	Retail land (A_j^R is retail land in zone j)
A^U	Unusable land (A_j^U is unusable land in zone j)
$\underline{A}$	Set of arcs in a network
$\hat{A}_j^k$	Net acreage in subarea j devoted to the kth land-use
$\mathbf{A} = (\leftarrow A_t \rightarrow)^T$	Vector of disturbance or error terms in econometric or spatial time-series models, consisting of n observations; in 2-stage least-squares, it consists of q entries, where q is the number of endogenous variables
$\mathbf{A}$	As a matrix (instead of a vector), **A** stands for node-arc incidence-matrix in network-flow programming
$\mathbf{A}' = [A'_{ij}]$	An $n \times n$ square matrix; for a compartmental model, it is the rate-of-change matrix; and for the matrix of secondary (retail)-employment it is the distribution-rate by zone, where $n = n'$.
$\mathbf{A}_0(t)$	Vector showing rate-of-change with the "outside world" over time
$\mathbf{A}'' = [(i,j)]$	Contiguity matrix with nonzero arc-entries where i is incident upon j
$\hat{\mathbf{A}}$	An $n \times n$ matrix, which converts value-added output vector by industrial sectors to the same vector measured in labor-force base
$\mathbf{A}_j$	Vector of socioeconomic variables at location j, representing such activities as population and employment
$\mathbf{A}(j)$	Column vector in the network-simplex tableau for arc j
$\bar{\mathbf{A}} = [a_{ij}]$	Coefficient matrix of linear-programming constraints, where a_{ij} expresses the incidence relationship between row i and column j; an example is the kth output measures due to decision-making-unit j, a_{kj}, in a data-envelopment analysis.
$\mathbf{A}_B$	Basis of a linear program
$\mathbf{A}_N$	Nonbasic part of the tableau in a linear program
$\mathbf{A}^1$	The complicated set of constraints in a mixed integer-program
$\mathbf{A}^2$	The straightforward set of constraints in a mixed integer-program
b	Generally a constant parameter, denoting a growth rate, intercept or slope in a linear equation, or the positive exponent of a spatial cost-function etc.
$\tilde{b}$	'Slope' regression-coefficient as a random variable
$\tilde{b}^*$	Specific value of $\tilde{b}$ for a sample of data points
b^U	Household budget
b_j	The fixed cost of siting a depot at node j
b^j	Travel-cost elasticity for activity j
$b^k(m)$	A scale factor used to adjust the kth zonal-retail-employment from one loop of the Lowry model m to another m+1, where m = 1, 2, …
b_{ki}, b_{ik}	Slack-flow capacity on slack arc (k,i) or (i,k); also the benefit variable in data-envelopment analysis, denoting the weight placed on the kth benefit of the ith alternative
b_{kji}	Benefit variable used in the combined data-envelopment-analysis-and-location model, showing the relative importance of assigning the kth benefit to the demand-facility pair i-j
$\mathbf{b} = (\leftarrow b_i \rightarrow)^T$	Vector of estimated parameters in ordinary least-squares regression or other calibration procedures, consisting of k+1 parameters (including the 'intercept'); also the right-hand-side of a linear or mixed integer program
$\mathbf{b}' = (\leftarrow b'_i \rightarrow)^T$	A given vector of the right-hand-side of a mathematical program; also the fixed external-flows in a network-flow program
$\bar{\mathbf{b}}$	Updated right-hand-side of a linear program during a simplex procedure; also the birth rates in a cohort-survival analysis
$\mathbf{b}^1$	The portion of the right-hand-side corresponding to the complicated set of constraints in a mixed-integer-program
$\mathbf{b}^2$	The portion of the right-hand-side corresponding to the straightforward set of constraints in a mixed-integer-program
β	A calibration constant, such as the positive exponent of a spatial cost-function or the round-trip factor in stochastic facility-location. (This same constant β is also referred to as b)
β'	A calibration constant
β_i	Current level of inventory at location i
β_t	Prewhitened output time-series in a transfer-function model
B	An arbitrarily large integer; also the backshift operator in a time series
B'	Bifurcation set of control variables
B''	Blue-collar employment
B_k	Percentage reflectance in band k of a satellite sensor

B_L, B_R	Left and right boundaries of a firm's market area
B'_k	Number of times a facility is exposed to demands in period k
B^k	Bound value for distance from a vertex, used to locate the intersecting point q_k or a candidate location for a center
$B^M_{\min}$, $B^M_{\max}$	Lower and upper bounds for the border-line length of a subregion
$\mathbf{B} = [b_j]$	Birth matrix with nonzero diagonal-elements showing the 'birth' rate within subarea j
$\mathbf{B} = [b_{ij}]$	Arbitrary matrix in a tableau of network-with-side-constraint program, corresponding to the flow variables
$\mathbf{B}' = [\beta_{ij}]$	Calibration-coefficient matrix in the first stage of a 2-stage least-squares, which measures $q \times k$, where q is the number of endogenous variables and k the exogenous variables
$\tilde{\mathbf{B}} = [\tilde{b}_{ij}]$	Quasi-deterministic transition-matrix in a compartmental model
$\mathbf{B}_i$	Diagonal-block i of the inverse of a network node-arc incidence-matrix, expressed in terms of a spanning subgraph
$\mathbf{B}'' = [b'_{ij}]$	Fixed cyclic-permutation δ' expressed in terms of a matrix operation, where $b'_{i,\delta'(i)} = 1$ and all other elements $b'_{ij} = 0$
$\bar{\boldsymbol{B}}$	Initial basis for a network-with-side-constraint model
c	Cost of operation, unit-cost, or a constant in general (e.g., c_i is the unit cost at location i; c_{kl} is the "interaction cost" of moving materials between workstations k and l in an assembly line)
c'	Proportionality constant
c^k	Weight reflecting the relative importance of home-based retail-trips for purpose k
${}^r\mathbf{c}^s(\mathbf{x})$	rth-stop coverage of state s by routing-variable $\mathbf{x}$
$\mathbf{c} = (\leftarrow c_j \rightarrow)$	Cost vector in the objective function of a linear program, which is also the gradient of the objective function; here c_j is the constant unit-cost
$\mathbf{c}'$	Consumption-coefficient vector, whose ith element is the ratio of the purchased-value-of-the-commodity-from-the-ith-industrial-sector to the household income
$\mathbf{c}_B$	The part of the cost-vector $\mathbf{c}$ corresponding to the basic variables
$\mathbf{c}_N$	The part of the cost-vector $\mathbf{c}$ corresponding to the nonbasic variables
$\mathbf{c}^r$	Binary vector of rth-stage coverage-requirements in the decomposed recursive-program
$\mathbf{c}^{k+r}(k)$	Binary vector of rth-stage coverage-requirements on each origin–destination pair in cycle k; $\mathbf{C}(k) = [\leftarrow \mathbf{c}^{k+r}(k) \rightarrow]$
$\text{conv}(\tilde{Q}')$	Convex combination of discrete points $\tilde{Q}'$ in a feasible region of an integer program
C	Generalized cost to include both time and monetary outlay, or unit composite-cost in general (e.g., C_i is the generalized cost of operation or the inventory-carrying cost at location i, C_{ij} is the composite transportation-cost from location i to j, C^p_{ij} is the composite transportation-cost from location i to j for commodity p etc.)
C'	Number of columns in a lattice, grid or a pixel image; also household expenditure on community amenities (which is part of non-locational expenditure)
C_0	Overhead of a firm
C_o	Operating cost
C_s	Capital cost
C_j	Equity factor in districting algorithms
C_X	Coefficient-of-variation of variable X, or $s_X/\bar{X}$
C_{XY}	Cross-covariance between random variables X and Y
$C(C_{ij})$	Propensity, distribution, or accessibility function between i and j, assuming such forms as exponential function or power function of spatial-cost C_{ij}
$C[a](\mathbf{x})$	Performance of arc or path a as a function flow-vector $\mathbf{x}$
$C'(\tau)$	Accessibility to work-opportunities as a function of time τ
$C^k(\tau)$	Accessibility to the kth non-work-opportunity as a function of time τ
$C_i(\cdot)$	The cost function (including land rent), or performance function, of firm i—expressed in terms of the supply volume V^s_i or other arguments
$C_{ij}(V_{ij})$	Transportation cost between origin–destination pair i–j as a function of flow V_{ij} between them
$C^{k,l}$	Transportation cost between origin k and destination l
$C^{mn}(r)$	Connectivity requirement between origin–destination pair m–n via at most rth-stop itineraries
$\mathbf{C} = [C_{ij}]$	Arbitrary matrix in a tableau of network-with-side-constraint program, corresponding to the non-flow variables; also the covariance matrix

$\mathbf{C} = [\mathbf{c}^1, \ldots, \mathbf{c}^q]^T$	A $q \times n$ matrix of cost coefficients in a multicriteria linear-program, where each criterion j has a cost and a gradient vector $\mathbf{c}^j$
$\mathbf{C}(\cdot)$	State-connectivity function linking to past decisions and connectivity requirements in a recursive program
$\mathbf{C}'$	Diagonal matrix converting the gross-output vector to value-added vector
$\hat{\mathbf{C}}$	Matrix of estimated coefficients in stage 1 of 2-stage least-squares, measuring $q \times k$
$\bar{C}$	Number of cell columns in a grid region or in a raster image
γ	Unit price at the market, Lagrange multiplier, and a calibration constant in general
γ'	Capacity-utilization rate, bounded between zero and unity
γ_j^{pq}	Dual variable associated with the input–output coefficients in an entropy-maximization model
$\boldsymbol{\gamma}' = [q_j']$	Matrix of subareal growth-rates along its diagonal
$\bar{\boldsymbol{\gamma}}$	Economic-base multiplier over a time-increment Δt, combining the activity-rate f and the population-serving-ratio a; $\bar{\gamma}_{ij}$ (with the subscript) would include the locational attributes as captured in work- and nonwork-accessibilities t_{ij} and u_{ij}
$\gamma_i(p,s)$	General 'strain' or the savings from including new-demand i via a triangular-inequality-style route-replacement between points p and s
Γ	The gross economic-multiplier deriving the total employment from the initial basic-employment
$\boldsymbol{\Gamma}$	Vector of economic-multipliers deriving the total employment in the study area from the initial basic-employment, including c_j, f and a
$\boldsymbol{\Gamma}_t$	Observation matrix in Kalman filter; when multiplied against the observed time-series, specifies what is actually observable
$\Gamma(W,p)$	Optimization results from a facility-location model where p facilities are relocated to respond to a maximum demand of W
$\boldsymbol{\Gamma}(k) = [\leftarrow \gamma_i(k) \rightarrow]$	Vector of payoff-function consisting of q entries, where $q \leq$ ήμ
d	Distance or spatial separation; also a proxy for a particular spatial order
d'	Amount of differencing to induce stationarity in a time-series
d''	A decision in a Markovian decision-process
d_i	Distance from location i (notice this is not necessarily Euclidean distance); or deviation from a standard or ideal in dimension i; also the capacity of arc i or the weights in a transfer function
d^k	Minimum threshold of retail-employment by trade-class k; d^R is the threshold for the case when there is only one trade class
$d_j(\mathbf{x})$	Multidimensional decision-boundary in a Bayesian classifier
$d(B) = d_0 + d_1 B + d_2 B^2 + \ldots$	Transfer function in a multivariate time-series, consisting of weights d_0, d_1, d_2, etc. and backshift operators B
d_{ij}	Euclidean distance or the spatial-cost in general between locations i and j
d_{ijk}	Euclidean distance or the spatial cost between locations i and j in state k
d^h_{ij}	Distance or travel time between nodes i and j by salesman or vehicle h
d^i	Time a salesman or vehicle visits node i in a tour or a route
d^{ij}	Distance or time between locations i and j, starting with arrival at i and terminating at arrival at j (notice this is not necessarily the Euclidean distance)
$d(\mathbf{i},\mathbf{j})$	Planar Euclidean distance between two Cartesian coordinate points $\mathbf{i}$ and $\mathbf{j}$
$d(\mathbf{x}_i, \mathbf{x}_{i+1})$	Spatial separation between consecutive stops $\mathbf{x}_i$, $\mathbf{x}_{i+1}$
$\mathbf{d}$, $\mathbf{d}'$	Vector of arc capacities in network-flow programming
$\mathbf{d}^j$	Extreme direction along the jth axis in a linear program
$\mathbf{d}^k = (\leftarrow d_i^k \rightarrow)$	Direction of steepest ascent in the kth step of a hill-climbing optimization-algorithm, as characterized by n components of the vector
δ	Change in a quantity (e.g., δx is the increase or decrease in quantity x); δ_{ij} is the distance savings in directly going from i to j, instead of through an intermediate point k
$\delta(i)$	The steady-state decision whenever the state is i in a Markovian-decision-process
$\tilde{\boldsymbol{\delta}}$	Policy in a Markovian decision-process
$\tilde{\boldsymbol{\delta}}'$	Improved stationary-policy in the policy-iteration procedure of a Markovian-decision-process
δ^*	Optimal policy in a Markovian-decision-process
δ', δ''	Fixed cyclic-permutation

δ_i	Binary decision-variable to be switched on, conditional upon another decision-variable being engaged; also a calibration constant; or a nonnegative real-number denoting the number of legs in a subtour-breaking constraint
$\delta\Omega$	Boundary of the bounded-domain Ω
$\delta(k)$	Savings by using route k
$\boldsymbol{\delta}^+(i)$	Set of nodes reachable from i
$\boldsymbol{\delta}^-(i)$	Set of nodes incident upon i
δ_{ij}	Route-distance savings by including demands i and j in a single, rather than separate tours, in accordance with the Clarke–Wright heuristic
$\boldsymbol{\delta}$	Vector of estimated-parameters in nonlinear regression
$\hat{\boldsymbol{\delta}}$	Least-squares estimate of $\boldsymbol{\delta}$, usually obtained as a conditional estimate
$\boldsymbol{\delta}_j = (\leftarrow \delta_{ji} \rightarrow)^T$	Orthonormal base of the transition-rate space when the system is in compartment j
D	Distance or time of specified length
D'	Data, population density, or a measure of crowding
D''	Dual polyhedron of a linear program; or a subset of nodes/vertices
D_{ab}	Shortest distance from demand or customer a to demand b along a path, or along a tour from depot a to demand b
$D(i)$	Decision set in a Markovian decision-process
$D(a,b)$	Shortest distance along a vehicle route from terminal a to terminal b
D_i	Cumulative distance (along a path) to demand i from a facility
$D_l(V_l^d)$	Demand at location l showing price against flow-quantity; in other words, price paid at demand quantity V_l^d
D_i'	Cumulative distance (along a path) to demand i from all facility candidate-sites
D^k	Total sales or service from facility k
D^H	Upper-bound distance
D^L	Lower-bound distance
D_j^H	Maximum allowable household-density in zone j
$\mathbf{D} = [d_j]$	Death matrix with non-zero diagonal elements, showing the 'death' rate within subarea j
$\mathbf{D}'$	Calibration-coefficient matrix in the first stage of 2-stage least-squares, measuring $q \times q$, where q is the number of endogenous variables
$\bar{\boldsymbol{D}} = [D_{ab}]$	$\lvert I\rvert \times \lvert I\rvert$ matrix of shortest cumulative-distances along a path from vertex a to vertex b
$\bar{\boldsymbol{D}}' = [D_{qk}]$	$\lvert I\rvert \times m$ matrix of distances from vertex q to arc k
Δ_i^j	The difference between two utility measures i and j
$\nabla f(\mathbf{x}) = (\leftarrow \partial f / \partial x_i \rightarrow)^T = (G_x, G_y, G_z, \ldots)^T$	Gradient of a function over n variables
e	The exponent value of 2.7183; also a calibration constant
e'	Number of exogenous variables left in the econometric model after estimation
e''	Number of endogenous variables left in the econometric model after estimation
e_i	Index to denote the ith type of industrial employment; also the ith arc in a network
e_{j_i}	Arc j associated with node/vertex i
$\mathbf{e}^{i(j)}$	Unitary column-vector for arc j with unitary entry in the ith row
ϵ	A very small number or a random perturbation
ϵ_k	Efficiency-measurement error-term associated with the kth input–output pair in empirically curve-fitting a distance function
$\boldsymbol{\epsilon}$	Normally-distributed error-vector with zero mean; when it has a constant variance, it could be a vector of random perturbations in the forecast using a transfer function, due to white noise in the inputs
E	Total employment
E'	Number of exogenous variables
E''	Number of endogenous variables
E^B	Basic employment (E_j^B is basic employment in zone j)
E^R	Service employment
E^k	Retail employment by trade-class k (E_j^k is retail employment by trade class k in zone j)
$E(t)$	Relative smoothed-errors in adaptive-response-rate exponential-smoothing
$\tilde{E}_j$	Employment in the jth zone as projected from an areawide growth-rate for each sector
E_{ijk}	Expected number of demands i in period k at location j
$E(i_1,i_2,h_1,h_2)$	Net change in travel-distance from an exchange of demands i_1 and i_2 between tours h_1 and h_2

$E'(i_1,i_2,h_1,h_2)$	Modified generalized-savings-measure from an exchange of demands i_1 and i_2 between tours h_1 and h_2
$\mathbf{E}$	Row vector of employment-levels, made up of individual zonal employment E_i
f	Average household-size in terms of the number of employed residents per household, or reciprocal of the labor-force participation-rate (also called the activity rate)
$f(\cdot)$	Regular function of the argument (e.g., the criterion function in dynamic programming)
$f(\mathbf{x}_q, \mathbf{x}-\mathbf{x}_q)$	A functional for which the directional derivative is being considered, approaching point $\mathbf{x}_q$ from point $\mathbf{x}$
f'	Functional-attribute score, including spatial separation
$f'(t)$	Cumulative demand at time-period t
f_i	Demand-for-service frequency at location i; also the natural growth-rate of population in subarea i (the activity rate)
f^W	Weighted activity-rate, where the weights are the percentages of regional population at each zone
f_{ik}	Demand-for-service frequency at location i in state k
f'_{ik}	Number of demands k serviced by facility i
f^t_i	Convex combination of activity-rate f_i, where the weights are the normalized accessibilities into zone i
$f^{(l)}_j(\cdot)$	Speed-of-adjustment function for the jth zone and lth activity
f^{mn}_r	rth-stop demand between origin–destination m–n
$\dot{f}(x) = df/dx$	Derivative of function f over variable x
$\mathbf{f}$	Partial-flow pattern in the decomposed RISE algorithm
F	Set of candidate or new facilities to be sited, or an objective functional
$F(f(x)) = F(u')$	Fourier transform of function $f(x)$ in frequency u'
$F'(\mathbf{z})$	Production function with input rates $\mathbf{z} = (\leftarrow z \rightarrow)^T$
$F'(\cdot)$	Regional-growth-rate function
F_k	Fibonacci numbers; also the weighted activity-rate, with work-accessibilities from zone k as the weights
F_X	Derivative of function F with respect to variable X
$\dot{F} = \nabla F$	Gradient of the function F being maximized
F'_i	Unsatisfied demand or remaining service-capacity at each demand-node i to entertain additional vehicle-deliveries
F_{ij}	Accessibility factor between locations i and j, expressed as an inverse function of travel cost
F_{ik}	Probability that a demand from i is of type k
$\mathbf{F} = [F_{ij}]$	Square matrix of population-distribution rate by zone, measuring $n' \times n'$
$\mathbf{F}'(\mathbf{x}) = (\leftarrow F_i(\mathbf{x}) \rightarrow)$	A vector of functions whose interactions $\partial F'_i(\mathbf{x})/\partial x_j \neq \partial F'_j(\mathbf{x})/\partial x_i$ are asymmetric, where $\mathbf{x} = (\leftarrow x_i \rightarrow)^T$ for $i = 1, \ldots, n$
g	A scale factor; when serialized against argument m for example, $g(m)$, it is used to adjust zonal population from one loop of the Lowry model m to another $m+1$, where $m = 1, 2, \ldots$
$g(\cdot)$	A special function of $\cdot$, such as the state equation; the relocation-cost function in stochastic facility-location; or the expected-master-travelling-salesman-tour length in probabilistic travelling-salesman-problem
g_k	Generalized unit-cost at facility k or for vehicle k
g'_i	Load to be picked up at node/vertex i
g''_i	Spatial 'drift' of activities toward location i, in accordance with a profit/benefit motive or some gravitational potential-function
g_{ij}	Short-hand notation for nonwork accessibility between i and j
$\mathbf{g}$	Vector of coefficients associated with the discrete-variables $\mathbf{y}$; when used as a function, it is the subgradient
$\mathbf{g}(j) = (\leftarrow g_{h(j)} \rightarrow)^T$	Vector of input measures for a decision-making unit j
G	Number of salespersons in a travelling-salesman problem, or the number of vehicle-tours out of a depot
G'	Maximum fleet-size available at a depot; or share of the population which are immigrants
$G(\cdot)$	Multiple-travelling-salesmen expected-tour-length-function involving k salespersons
$G(\xi)$	Generating function for the probability distribution $P_0, P_1, P_2, \ldots, P_n$ where ξ takes on values of $0, 1, 2, \ldots, n$
$G(\boldsymbol{\xi}, t)$	Generating function for the probability distribution $P(\mathbf{X}^*_0, \mathbf{X}^*, t)$; where $\mathbf{X}^*_0$ is the initial-condition vector, $\mathbf{X}^* = [X^*_1(t), X^*_2(t), \ldots, X^*_n(t)]^T$, and where the n-dimensional-vector $\boldsymbol{\xi}$ takes

	on values of $\boldsymbol{\xi}^{\mathbf{X}^*} \equiv (\xi_1^{X_1^*}, \xi_2^{X_2^*}, \ldots, \xi_n^{X_n^*})^T$, for $\lvert\xi_j\rvert<1$. Thus for the stationary, irreducible Markov-process, it assumes the form $P(X_0^*) + \xi_1^{X_1^*} P[X_1^*] + \xi_2^{X_2^*} P[X_2^*] + \ldots + \xi_n^{X_n^*} P[X_n^*]$
G_i	Class or group i; also a generalized spatial-statistic for point i
$G_i''(p,s)$	Generalized savings-measure from including demand node i between demand points p and s in a location–routing heuristic
$G_i'(p,s)$	Modified generalized-savings-measure from including node i between points p and s, after considering different depot-based tours
$G_i^*(h'')$	Net change in cost from displacing demand i from tour h to h''
$G_i^{**}(h'')$	Net change in cost from displacing demand i from tour h to h'' considering different fleets
G^{ij}	Transaction of goods and services between the ith and jth industrial sectors
G_{ij}	General location-pair spatial-statistic
G_{ij}^{pq}	Monetary transaction between the qth industrial sector in zone j and the pth economic-sector in zone i in an input–output model; with shorthand notation being G_j^{pq} for consumption and G_{ij}^q for production respectively, considering only the nonzero elements
$\mathbf{G} = [G_{ij}]$	The growth matrix showing the growth springing off from group/location i to group/location j (within a period of time); also a basic-feasible-solution to a simplex-on-a-graph
$\mathbf{G}(\cdot)$	Vector return-function in a recursive program
$\mathbf{G}' = [g_{hj}]$	Input matrix containing the hth input for decision-making-unit j
$\zeta_j^{(l)}(\cdot)$	Economic surplus- or deficit-function at zone j of the lth type
h	Index for a variable; generally to show a fleet type, a category of inputs (costs) in data-envelopment analysis, or the iteration number in a recursive program
h'	Minimum fleet size
$h'(\cdot)$	State-transition function in dynamic programming
h''	Calibration parameter in a dynamic version of a spatial-location model; an example is the time-scale parameter to convert activity to a rate-of-change
h_k	Height of a subregion k
h_{ij}	A rate- or calibration-constant in a deterministic compartmental-model; for example, the interaction between regions i and j in a multiple-region predictor–prey equation-set, or a short-hand notation for work-accessibility
$\mathbf{h}(j) = (\leftarrow h_{k(j)} \rightarrow)^T$	Vector of output-measures for target decision-making-unit j
H	Housing expenditure for a household (part of locational expenditure)
$H(\cdot)$	The Hamiltonian function in terms of the state equation, the costate or adjoint variable, and the figure-of-merit at the present; it also stands for a general function
H'	An upper limit of discrete index h
$H'(\cdot)$	Regional growth-rate function
H''	Set of vehicles in a fleet, or the set of vehicle types in the fleet
$\lvert H''\rvert$	Cardinality of set H'', or the number of members in the set; here it is the fleet size
H^i	Transaction of goods and services to the ith household-sector
H_i	Set of potential tours in which demand i can be included
H_p	Cost of one dispatch on route p
H_r^G	Imports to region r
H_i'	Hazard a node i is exposed to
H_{ij}	Hazard a link (i,j) is exposed to
$H_{ij}'(\cdot)$	Flow-rate function from compartment i to compartment j
H_{ij}^p	Monetary transaction between the household sector in zone i and the pth economic-sector in zone j in an input–output model
η	Elasticity of demand
$\eta_{\alpha/2}$	$100(1-\alpha/2)$ percentile of the standard normal-distribution
θ	A parameter in general; for example, it can show decline in demand per unit-of-spatial-separation; θ_i is the rate-of-decline (or diffusion rate) of inflows into i
θ_t	Coefficient of the tth term in a moving-average time-series
$\theta(B)$	The backshift operation of a moving-average model
θ_{ij}	Proportion of activities (or trips) from origin-location i that end up in destination-location j based strictly on accessibility alone
Θ_{ij}	A short-hand notation for the spatial-interaction term, indicating the proportion of activities (or trips) from origin-location i that end up in destination j—based on both accessibility and the attractiveness at the destination; i.e., the normalized accessibility-function between i and j
$\boldsymbol{\Theta}_k = [\theta_{ijk}]$	A kth-order spatial-matrix of moving-average coefficients
$\boldsymbol{\Theta}(B) = [\theta_{ij}(B)]$	A spatial matrix of moving-average operators

i, j	Indices for nodes/vertices; i normally stands for a demand node and j a facility node; or they can just be any counter
$i(k)$	Beginning node of arc k
$j(k)$	Terminating node of arc k
$\mathbf{i}$	Cartesian coordinates of a demand i
I	Set of nodes/vertices in a network
$I(d)$	The spatial-statistic Moran's-I for a particular spatial-order as defined by the distance-parameter d
$\lvert I \rvert$	Cardinality of set I, or the number of members in the set
I_k	Profit or income for facility k
I_N	Set of unlabelled nodes
I_D	Dual objective-function in recursive program
I'	Household or aggregate income
I'_t	Aggregate income at time t
I'_h	Set of potential demands for exchange, with an existing demand on the tour h
I''	Subset of potential demand nodes within the set I, where demands are non-zero
I_{p_k}	Any subset of nodes in the kth-stop route p_k
$I(i)$	Set of nodes/vertices which are input markets
$I(0)$	Set of nodes/vertices which are output markets
$I(t)$	0−1 indicator-sequence reflecting the absence and presence of an intervention, overlaying the transfer-function on top of the time-series
$I_{i\kappa}$	A binary variable assuming unity if the combination of facilities κ provides a satisfactory service to demand i
I_{Rx}	Total expected-mutual-information between the facility pattern in the region R and the demand spatial-pattern (when $x=I$), or between the facility pattern and an individual demand (when $x=i_k$); i.e., how probable the facility pattern is consistent with what is known about the demand pattern I or individual demand i_k
$I\,[\mathbf{X}(k),\mathbf{\Gamma}(k)]$	kth-stage payoff or objective-function of a recursive program, defined in terms of decision-variables $\mathbf{X}$ and constraint parameters $\mathbf{\Gamma}$
$I(\mathbf{P};\mathbf{Q})$	Information that allows updating a prior probability-distribution $\mathbf{Q}$ to probability $\mathbf{P}$
${}^{r}I^{s}(\cdot)$	Net-benefit function in a decomposed recursive-program
$\mathbf{I}$	Identity matrix
$j^*(k)$	Optimal facility location in state k
$\mathbf{j}$	Cartesian coordinates of a facility j
J	Subset of nodes/vertices in a network, generally the candidate sites for facility location
J_q	Set of candidate production sites
$\lvert J \rvert$	Cardinality of set J, or the number of members in the set
J'	A particular control-point in the bifurcation set
J''	The double values that the state variable assumes, corresponding to the control variable J' in the bifurcation set
$J(i)$	Set of Voronoi polygons adjacent to the ith polygon
$\mathbf{J}_k$	Basis k of a multicriteria linear-program
k	Index to show category k (e.g., Z^k is the kth activity); it marks a node, the commodity, the tree in a forest, or just serves as a counter
$k(\cdot)$	Equation for the control variable over time, expressed in terms of the state, the costate or adjoint variables
k_i	Calibration or scaling constant for zone i in a doubly-constrained gravity model; the Moran's-I or General Spatial statistic; alternatively, it is the propensity to save (invest)
$\mathbf{k}$	row vector consisting of 0, +1, −1 entries marking an orthonormal base of the transition-rate space
K	A discrete or continuous constant, or the upper limit of running index k
$K(t)$	Capital-stock investment over time
K_i, K'_i	Trip-production and -attraction rate at zone i respectively
$\bar{K}^p_j$	A scaling constant; it ensures that the inter-sectorial and inter-zonal flows sum up to the non-labor input to the input–output table for sector-p and zone-j
$\dot{K}_r$	Instantaneous rate-of-capital-accumulation in region r
κ	Combination of three or more facilities that perform a certain function
κ'	The complement of the set κ
κ^h	Cost of operating vehicle h

κ_i^h	Marginal cost of serving demand-node i
K	Combination of three or more facilities
$l(T)$	Total cost of spanning-tree T, which is sum of the arc costs
l'	Discount rate (e.g., on the number of commuting trips, or traditionally in the time stream of cost or benefits)
l^i	Lower bound of a specified time window for a salesman or vehicle to visit node/vertex i
l_j	Calibration constant for zone j in a doubly-constrained gravity model
l_k	Spatial order of the kth autoregressive-term in a spatial time-series
$l^{h''}$	Ordered set of neighboring points (p,s) representing candidate tour h''
$l_{h''/i'}$	Ordered set of neighboring points (p,s) in tour h'' after removing demand i'
$l^{mn}(r)$	Length of an r-stop route originating in m and terminating in n
${}^r\mathbf{l}^s(\mathbf{x})$	Route-length vector at stage r and in state s of a decomposed recursive-program, expressed as a function of the decision variable $\mathbf{x}$
L	Nonempty subset of demand nodes/vertices, where a demand instance may be characterized by having actual demands realized in a node subset L of the network nodes/vertices I; the symbol also denotes twice the boundary length of a district
$\lvert L \rvert$	Cardinality of set L, or the number of members in the set
$\tilde{L}$	Length of the perimeter of a subarea
$\bar{L}$	The length of a queue, including the entity being served
$L(\cdot)$	Lagrangian or maximum-likelihood function
L'	Probability that the location visited is the termination point for the trip
L''	A calibration constant in a bivariate predictor–prey difference-equation-set
L_q	Queue length (excluding the one being served)
L_r	Regional labor-input-factor
$L^{(l)}x_i$	Spatial-lag operator on the value of spatial unit i, where l refers to the lth contiguity-class such as the lth-order neighbors; alternatively, we can write $L^{(l)}x_i$ as a matrix operation to compute the weighted sum of the neighboring values of i contained in vector $\mathbf{x}$, or $(\mathbf{w}^{(l)})^T\mathbf{x}$. In general, $L^{(l)}(\cdot)$ stands for spatial-lag operator of the lth-order, with the 0th-order operator reproducing the observation itself, or $L^{(0)}(\cdot) = \cdot$
$L_T(\cdot)$	Length of a master travelling-salesman-tour, constructed out of the set of nodes/vertices $\cdot$
L_{ij}	Error (in terms of a "loss measure") when a Bayesian classifier mis-assigns a multi-attribute observation $\mathbf{x} = (x_1, x_2, \ldots)^T$ to group j when it actually belongs to group i; usually $L_{ij}= 0$ if there is no error and $L_{ij}= 1$ if there is a misclassification
$L_j(\mathbf{x})$	Average misclassification error (in terms of a "loss measure") when assigning multi-attribute observation $\mathbf{x} = (x_1, x_2, \ldots)^T$ to group j; a couple of computational transformations of this measure are $L_j'(\mathbf{x})$ and $L_j''(\mathbf{x})$
$\mathbf{L} = \left(\mathbf{x}_L(q_1'), \mathbf{x}_L(q_2'), \ldots\right)^T$	Matrix containing the left eigenvectors $\mathbf{x}_L$
λ	Dual variable or Lagrange multiplier, with a specific (not necessarily feasible) solution $\bar{\lambda}$ and the optimal solution λ^*
λ_i'	A normalized weight, where $\Sigma_i \lambda_i'=1$ unless noted otherwise
λ''	Arrival rate for a queuing process
$\boldsymbol{\lambda}^k = (\leftarrow \lambda_i^k \rightarrow)^T$	The kth solution-vector in a Lagrange-relaxation procedure
$\boldsymbol{\lambda}'^*$	Dual optimal-solution to the linear-program subproblem at the last iteration within Benders' decomposition
$\Lambda(\mathbf{J}_k)$	The weight cone for multicriteria linear-program, showing the λ'-weight combinations that characterize a particular solution $\mathbf{J}_k$ among the nondominated set of solutions
m, n	Indices for dimension or for a node/vertex
m'	A calibration constant in a bivariate predictor–prey difference-equation-set
m^*	A critical bifurcation-value in a bivariate predictor–prey difference-equation-set
m^1	A collection of entities of characteristic 1; e.g., the number of complicated constraints in a Lagrangian-relaxation problem
m^j	A collection of entities of characteristic j; e.g., the number of high-frequency direction finders in a bundle located at station j
m_k	Spatial-order of the kth moving-average term in a spatial time-series
m_r	Vehicle-fleet requirement at depot r, or the number of deployed vehicles at depot r
m_i', m_i''	In- and out-movement rate to and from subarea i
$m(k)$	Median for a median-filter using a $k \times k$ mask
$m_1, m_2, \ldots, m_{k'}$	Groups of demand nodes to be served by route $1, 2, \ldots, k'$, with $m_1 + m_2 + \ldots + m_{k'} \leq \lvert I \rvert$
$m'(q)$	Maximum shortest-distance from point q

m'_{ji}	Binary variable that is "switched on" when demand i is allocated to facility j in a combined data-envelopment-analysis/location model; also the benefit valuation for such i–j pair
M	Area specification for a districting model
M_i	Maximum inventory carried at node i
$M_{\max}$	Maximum number of nodes in a vehicle route
$\tilde{M}, \tilde{M}'$	A couple of matchings in a spanning-tree/perfect-matching heuristic for the travelling-salesman-problem
$M(t)$	Absolute smoothed-error (used in conjunction with relative smoothed-error) for adaptive-response-rate exponential-smoothing over time
$M(\Xi)$	Maximum of the weighted distances from the center candidates to each of the demands in the candidate facility-locations Ξ
M'	Non-locational expenditure such as food, clothing, education, savings etc.
M''	A very large number or weight
M_{ij}	Minor of a square matrix
$M(W,p)$	Simulation results of a facility-location model where p facilities are relocated to respond to a maximum load of W
$\mathbf{M} = [m_{ij}]$	Migration matrix showing the migration rate between locations i and j
μ	Mean of a probability distribution
μ'	Service rate of a queuing process; also the number of intermediate stops in the longest vehicle-route
μ_j	Positive weights placed upon an extreme direction $\mathbf{d}^j$ in a linear program
$\mu_i, \boldsymbol{\mu}_i$	Mean of observations in group i in both scalar and vector form
$\mu^{(j)}$	Scaling constant of the error ϵ associated the value v being measured, resulting in $v^{(j)}+\mu^{(j)}\epsilon^{(j)}$
ν	A collection of integer numbers
ν_i	Route shape parameter (serialized by i) used in location-routing heuristics, assuming values such as 1 or 2
ν_t	Noise series in a transfer-unction multivariate time-series
μ^p	Dual variable associated with the control total of areawide-transportation-cost constraint in an entropy-maximization model
Ξ	Collection of candidate facility-locations
$\Xi(X)$	Collection of all candidate facility-locations in the decision space X
$\Xi(\mathbf{y})$	Collection of candidate facility-locations which are open (i.e., for those locations where y_j=)
$\Xi(z)$	Collection of candidate facility-locations in the Z space, whose distance bounds are within z units
ξ	As used in the Minkowski's distance-function, it is the proportion by which factor inputs have to be reduced to reach the efficient point on the production frontier
n'	The number of units in a spatial entity (e.g., the number of zones in a region, the number of subareas in a study area, or the total number of pixels in an image)
n_s	Number of sides in a subareal polygon (e.g., in a Dirichlet tesselation)
$n(a,b)$	Number of stops between origin-terminal a and destination-terminal b
N	Population or number of households (e.g., N_i is the population at location i)
N_j	Number of pattern vectors from class G_j, or the number of nodes or pixel vectors belonging to class j
N'(large)	A large number
$\bar{N}$	Total working population in the study area
N^p	Population working in economic-sector p
N_j^c	Capacity for residential development in zone j
N_i'	Set of spatial units (including facilities) within a distance S from demand i
N_{ij}	Binary decision-variables in a districting model, serving as a 'pointer' across a district boundary separating a geographic sub-unit i and one that is not j; it is unitarilly value if subunit j is acquired and i is not
$\mathbf{N}$	Row vector of zonal population N_i
$\mathbf{N}(k)$	The nonbasic column associated with variable k in a linear-programming tableau
o_i	Export share of region i
$O(l^k)$	Worst-case kth-polynomial computational-complexity for input-data-length l
O_i	Export from the ith region
$O'(P) = \{\leftarrow O_i'(P) \rightarrow\}$	Orientation sequence of a path P, consisting of +1 and −1 entries, depending on the orientation of the arc in the path sequence
O^i	Export from the ith industrial sector, measured in dollars
O_j^i	Export from the ith industrial sector in subarea j, measured in dollars

$\mathbf{O} = (0 \leftarrow O^i \rightarrow)^T$	Export vector in an aspatial input–output model, showing the convention that the first sector (the household sector) has no exports
$\mathbf{O} = (0 \leftarrow O^i_j \rightarrow)^T$	Export vector in a spatial input–output model, where i is the economic sector and j is the subarea
p	An integer number for the number of facilities, the number of services provided, the index for the pth vehicle route, the parameter in the l_p-metric, or the differencing parameter in a time-series
p'	Number of facilities in a subset of the p facilities (i.e., $p' \leq p$)
p_f	Price of fuel
p_g	Price of the good
p_k	Price of a commodity k, with $\mathbf{p}$ standing for a vector of commodity prices
p'_i	Probability of adopting strategy i in a two-person game
$p^{(j)}(\cdot)$	Probability function of choosing alternative j, $j = 1, \ldots, n$
p_{ik}	Empirical probability that demand k patronizes facility i; or the probability of transitioning from state i to state k
$\hat{p}_{ik}$	Estimated value of p_{ik}
$p_{i\cdot}$	Empirical probability that a demand patronizes facility i
$p_{\cdot k}$	Empirical probability that a demand k is being served
p'^q_j	qth factor-of-production input-prices at subarea j
p'_k	Number of facilities of the kth type (as used in a multi-product facility-location formulation)
$\bar{p}(t)$	Capacity expansion at time t
p''	Price of composite consumption-good
p_{ijk}	*Conditional* probability that event-type i occurs at geographic-region j at time-of-day k
$\hat{p}_{ijk}$	Prediction of p_{ijk} based both on the hypothesized intervention model and historical data
$\check{p}_{ijk}$	Analytical prediction of the *relative* probabilities p_{ijk}, for field implementation as a transfer function
$\tilde{p}_{ijk}$	Relative probabilities after intervention probabilities have been implemented, using the transfer function $\check{p}_{ijk}$
$\dot{p}_{ijk}$	Deseasonalized relative-probabilities after intervention probabilities have been implemented
$\mathbf{p} = (\leftarrow p^{(j)} \rightarrow)$	Perron vector whose components are positive and sum to unity
$\mathbf{p}_i(t) = (\leftarrow p_{ij}(t) \rightarrow)^T$	Vector of transitioning probabilities from state i to state j (where $j = 1, \ldots, n$)
$\dot{\mathbf{p}}_i(t) = (\leftarrow \dot{p}_{ij}(t) \rightarrow)^T$	Time-derivative vector of probabilities transitioning transitioning from state i to state j (where $j = 1, \ldots, n$)
P	A path; also a set of vehicle routes generated for a network
P'	Potential surface for destination choice, whose derivative dP'/dC_{ij} is often operationalized by the trip-distribution function
P_D	Dual space of the linear-programming relaxation problem
$P(p)$	Probability that p servers are occupied (busy)
$P(\cdot)$	Probability of an event $\cdot$
P_i	Nearest location for demand or customer i; also the probability that the system is in state i
$P_i(t)$	Probability that the system is in state i at time t
P'_k, $P_{(k)}$	Steady-state probability of being in state k
$P_{id''}$	Steady-state probability that decision d'' is reached while in state i
P_{ij}	Binary decision-variables in a districting model, serving as a 'pointer' across a district boundary separating a geographic sub-unit i from one that is not j; it is unitarilly value if i is acquired and j is not
P_{ijk}	*Joint* probability of event-type i occurring in area j at time k, given that an event-type i occurred at time k
$\check{P}_{ijk}$	Analytical predictions of p_{ijk} aggregated monthly, based on the hypothesized intervention-model
P^{mn}_k	Set of vehicle routes covering origin–destination pair m–n via k-stop itineraries
P^{mn}_c	Set of vehicle routes covering origin–destination pair m–n via connect itineraries
$\bar{P}$	Scale of a facility as represented by its capacity, capital outlay etc.
$\check{P}_l, \bar{P}_l$	Lower and upper bound of the supply at location l
$\bar{P}'$	Aggregate production-function with capital as input
$\mathbb{P}(\bullet)$	Logical predicate over the argument $\bullet$
$P_j(p)$	Steady-state saturation-probability of all p service-units (in stochastic facility-location)

$\mathbf{P} = (\leftarrow P_i \rightarrow)$ or $(\leftarrow V_{ij} \rightarrow)$	Updated probability-distribution for each of the n' subareas or $\lvert I\rvert$ nodes written in a vector form; also be the updated travel-vector between i and j, V_{11}, V_{12}, … , V_{ij}, … , $V_{\lvert I\rvert\lvert J\rvert}$, measuring $\lvert I\rvert \cdot \lvert J\rvert$ long
$\mathbf{P}(t) = (\leftarrow P_i(t) \rightarrow)$	Vector of the state probabilities $P_i(t)$; also the square matrix of transition probabilities over time
$\dot{\mathbf{P}}(t) = (\leftarrow \dot{P}_i(t) \rightarrow)$	Time-derivative vector of state probabilities $P_i(t)$
$\mathbf{P}' = [\mathbf{x}_1, \ldots, \mathbf{x}_n]$	Matrix containing independent eigenvectors $\mathbf{x}(q_j')$, $j = 1, \ldots, n$.
$\mathbf{P}_{t-1,t}$	Variance–covariance matrix for the difference between the observed and estimated Kalman-filter time-series-vector (or the estimation-error vector)
π_i	Dual variable in a network; such as the shadow price at node i, or a real number showing the amount of load carried on board a vehicle at node/vertex i
$\pi^{(j)}$	Probability that an individual reviews his/her choice of the jth compartment in a compartmental model
$\pi_{ij}(\cdot)$	Probability a given individual moves from compartment i to compartment j—as a function of, say, the state variable and time
π_i^j	Dual variable associated with the ith column of the spanning-tree (j=1) or non-spanning-tree (j=2) part of the basis (in a network-with-side-constraint tableau)
$\pi(\bullet)$	Permutation operator on the argument •
$\pi(j \mid i, d'')$	The probability of transitioning from state i to state j during one period of the Markov process, given a decision d'' has been made
Π^n	n-dimensional transition-rate space
${}^r\boldsymbol{\pi}^s(\mathbf{x}, \mathbf{y})$	Vector gross-return-function of decisions **x** and **y** (in a decomposition implementation of recursive-program)
$\boldsymbol{\Pi}(\cdot)$	Vector of gross return-functions of decisions in a recursive program
$\boldsymbol{\Pi}_0(t) = (\leftarrow \pi_{i0}(t) \rightarrow)^T$	Vector of transition rates with the "outside world" over time
$\boldsymbol{\Pi} = [\pi_{kl}]$	Transition-probability matrix in a Markov chain or compartmental model, with each entry denoting the given probability of transitioning from state k to state l; also the matrix of transition rates from state k to state l
$\tilde{\boldsymbol{\Pi}}$	Matrix of transition rates from state k to state l, considering both arrival and service in a queue
q	Index to show a node number, center number, median number, number of substations, or the number of attributes, criteria, endogenous variables, eigenvalues, or differencing parameter in a time series
q_k	Candidate location for a center k
q_{ik}	Probability that an event-type i occurs at time k
q'	Eigenvalue, with $q'_{\max}$ as the principal eigenvalue; also the growth rate of an area (with q_j' being the subareal growth-rate)
q_i'	Probability that strategy i is followed (in a two-person game); also the ith eigenvalue
$q_i(\cdot)$	Inventory-cost functions at demand-node i; or simply the unit cost-of-time (a constant) from demand-origin i
$\bar{q}_j$	Mean queuing delay
Q	Total economic-activity in the study area, such as consumption in dollars or number of trips executed
Q_i	Ratio of two accessibility definitions from location i
$\tilde{Q}_l, \bar{Q}_l$	Lower and upper bounds for the demand at location l
Q'	Total number of servers, or number of suppliers
$\tilde{Q}'$	Set of discrete points in the feasible region of an integer program
Q''	Cost per rejected demand in a loss-system location-model
$\bar{\mathbf{Q}} = [\bar{\gamma}_{ij}]$	A matrix of economic-base multiplier over a time-increment Δt
$\mathbf{Q} = (\leftarrow Q_i \rightarrow)$ or $[Q_{ij}]$	Prior-probability distribution for locating in each of the n' subareas (written in a vector form); or the vector of prior-travel between i and j, Q_{ij}
$\mathbf{Q}_{t-1}$	Variance–covariance matrix of the white-noise vector $\boldsymbol{\alpha}_t$
$\mathbf{Q}'$	The $\mathbf{X}^T\mathbf{X}$ data-matrix in the nonlinear regression of a STARMA model; where **X** is not explicitly given, and has to be numerically estimated
$\mathbf{Q}'' = [q_j]$	Matrix with eigenvalues q_1, q_2, … along its diagonal
r	Rent or mortgage, as part of locational expenditure (e.g., r^i is the rent for a unit of land i at a distance d_i from market, and **r** is the vector of rents among these land units)
r_0	Pearson correlation-coefficient
r_k	Satisficing-level of criterion k; also the autocorrelation of lag-k in a time-series

r'^k	Land-consumption rate per retail-employee of trade-class k
r'	An l_p-metric deviational-measure from a standard or an ideal
$r'(\mathbf{y}',\mathbf{x})$	Generalized-Leontief distance-measure, as a function of inputs $\mathbf{x}$ and outputs $\mathbf{y}'$
$r(\cdot)$	Spatial-separation or response-time function of argument $\cdot$; or the return function in dynamic programming
r_0'	Partial correlation coefficient
r_k'	Partial-correlation-coefficient of lag-k in a time-series
$\bar{r}_j$	The expected response-time of service-unit j, consisting of mean queuing-delay and mean-travel-time to the demand
r_{ij}	Direct user-charge at facility j for user from origin i
$r(i,d'')$	Reward expected at state i by making decision d'' (in a Markovian-decision-process)
r_{XY}, $r(X,Y)$	Sample (cross) correlation-coefficient between random-variables X and Y
$r_{Y\|X_iX_j\ldots}(X_k)$	Partial-correlation-coefficient between Y and X_k, given $X_i, X_j, \ldots$ are in the equation already
$r_i'(\cdot)$	Euclidean distance between demand i and a facility
$\hat{r}_{lm}(k)$	kth-order spatial-temporal-autocorrelation between the lth and mth neighbors of the subject site
R	A closed region in Euclidean 2-space; the set of n subregions $\{R_1, R_2, \ldots, R_n\}$; or the multiple correlation-coefficient
$R(J)$	The set of n subregions, each identified by its service-facility location $\mathbf{x}_i$: $\{R(\mathbf{x}_1), \ldots, R(\mathbf{x}_n)\}$
R_T	Total physical region made up of subregions $R_1, R_2, \ldots, R_n$; these regions can be of higher dimensions than the Euclidean 2-space
R_+^n	Domain of continuous non-negative variables in Euclidean n-space
$\|R(k^*)\|$	The area of the largest empty-circle with center at k^*, located at any vertex of the bounded Voronoi-diagram
$\|R(\mathbf{x})\|$	The area of subregion $R(\mathbf{x})$; $\|R(\mathbf{x}_i^*)\|$ is the area of the optimal ith Voronoi polygon, with its facility at $\mathbf{x}_i^*$
R'	In stochastic facility-location models, R' is the required time in dispatching a special reserve-service-unit from a neighboring jurisdiction
R^2	Coefficient-of-multiple-determination in regression
$\bar{R}^2$	Coefficient-of-multiple-determination after adjusted for the degree-of-freedom
$R^2_{Y\|X_1,X_2,\ldots,X_k}$	Coefficient-of-multiple-determination between Y and $X_1, X_2, \ldots, X_k$
$R'(\mathbf{y}')$	Set of input requirements $\mathbf{x}$ to produce $\mathbf{y}'$ in a production function
R''	The entire image or entire region
$R(+\|-)$, $R(-\|+)$	Finite predictor/prediction-space used in spatial-temporal canonical-analysis
R_i	Subregion i within the entire region R''; also the production in subregion i
R_i'	Normalizing constant in a spatial-interaction function, or the denominator of the function Θ_{ij}
R_i^p	Production output of the pth industry in zone i
$\bar{R}$	Number of row cells in a grid region, a raster image, or a lattice
R^i	Monetary output from the ith industrial-sector
R_j^i	Monetary output from the ith industrial-sector located in subarea j
$R_s(d)$	Norm deviate of the generalized spatial-statistic (analogous to the two-tailed t-statistic)
$\bar{R}_j^p$	The observed value of non-labor input to the input–output table for sector-p and zone-j
$\mathbf{R} = (yz^e \leftarrow R^i \rightarrow)$	Output vector in an aspatial input–output model, showing the production in each economic-sector, starting with output from the household (or labor) sector (measured in wages) and followed by the first, second, … industrial sectors i
$\mathbf{R} = (yz_j^e \leftarrow R_j^i \rightarrow)$	Output vector in a spatial input–output model, showing the subareal production in each economic-sector i, starting with the subareal output from the household (or labor) sector (measured in wages) and followed by the first, second, … industrial-sectors by subarea j
$\mathbf{R}' = [\mathbf{x}_R(q_1'), \mathbf{x}_R(q_2'), \ldots]$	Matrix containing the right eigenvectors $\mathbf{x}_R$
$\mathbf{R}''$	Commodity-value-added output-vector
$\mathbf{R}_t$	Variance–covariance matrix of the measurement error (or noise) in a Kalman-filter time-series
ρ	Parameter or dual variable to account for the delivery-vehicle capacity
$\breve{\rho}(\tilde{\mathbf{B}})$	Spectral radius of matrix $\tilde{\mathbf{B}}$
$\rho' = \lambda''/\mu'$	Utilization rate of a server in a queuing system, or ratio of the arrival rate λ'' and service rate μ'
ρ''	Intensity of activity in a subarea

ρ_j Utilization-rate of a service-unit j in stochastic facility-location; also the import rate of region j

ρ^p Productivity-in-the-pth-economic-sector per unit-of-labor

ρ_{ij} Trade coefficient between regions i and j

ρ^{pq} Technical coefficients showing the transactions between the pth and qth economic-sectors in an input–output model

ρ_j^{pq} Technical coefficient at the receiving-sector zone-j

ρ_{ij}^{pq} Technical coefficients showing the transactions between the pth economic-sector in zone i and the qth economic-sector in zone j in an input–output model

$\boldsymbol{\rho}$ Matrix of technical or input–output coefficients $[\rho^{pq}]$, trade coefficients $[\rho_{ij}]$, or combined spatial-technical coefficients $[\rho_{ij}^{pq}]$

$\hat{\boldsymbol{\rho}}$ Diagonal matrix of trade coefficients, $[\rho_{ii}]$

$\boldsymbol{\rho}^j = [\rho_h^j]$ A matrix of economic-multipliers for the jth economic-sector, disaggregated by each zone-h

ρ_S, ρ_T The consumption and production multi-sectorial components of the input/output-coefficient-matrix ρ, derived from row- and column-sum normalization of transaction flows respectively, with $\rho_S\rho_T = \rho$; the spatial, multi-subareal version assumes $G_j^{pq}/G_j^{\cdot q} = \rho_j^{pq}$ and $G_{ij}^{\cdot q}/G_{\cdot j}^{\cdot q} = \rho_{ij}^{q}$

$\hat{\rho}_{XY}$ Population cross-correlation between random-variables X and Y

$\hat{\rho}^2$ Relative size of the variance; $(1 - \hat{\rho}^2)$ is the variance reduction

s Source of a network

s_p Autoregressive season-length in a seasonal time-series

s_q Moving-average season-length in a seasonal time-series

$\underline{s}$ Prescribed frequency-of-visit at a node/vertex

s_X Standard deviation of the random-variable X

$s(j)$ Sum of vertex(node)–arc(link) distances for facility j (the smallest sum identifies the general median)

$s'(j)$ Sum of point–arc distances for facility j (the smallest sum identifies the general absolute median)

s^2 Sample variance, with s being the standard deviation

s_{ij} Length of the border separating geographic sub-unit i from sub-unit j; also surviving ratio of cohort-group j from cohort-group i

s' Average size of a site; or the ratio between the demand potentials at sites i and j

s'' Slack node/vertex in a network

S A set of alternatives (e.g., the set of solutions that satisfies a predetermined goal or standard, the branch-and-bound search-space in a linear-programming relaxation etc.)

$S(\bullet)$ Sum-of-squares surface constructed out of the parameters • in nonlinear regression

S' Consumers' surplus (or net benefit) to a tripmaker in making a trip; alternatively it refers to a predetermined maximum-service-distance in discrete facility-location

S'' Another set of alternatives (for example, the set after introducing a new alternative)

S_k Set of demand vertices or nodes that would be covered by a center at q_k

$S_i(p',q')$ The increase (or savings) via a triangular-inequality-style inclusion (or exclusion) of demand i between the adjacent points (p',q')

$S_i(l_{h''},i')$ Increase in travel-distance from serving demand i via tour h'' (after the former-demand i' has been removed)

S^i Marginal-cost function for path i

$S_l(V_l^S)$ Supply function showing price against flow quantity, in other words price charged at supply-quantity V_l^S

S'_{kj} Unit benefit of assigning the kth activity (or activity from zone k) to zone j

S_{jk} The kth site-specific attribute of the jth facility (such as the acreage of a state park)

$S^{k,l}$ Marginal-cost function between origin k and destination l

$\mathbf{S}_{ij}$ Vector of level-of-service variables between locations i and j, including such variables as travel time and travel cost

σ Standard deviation of a probability distribution

σ^2 Variance of a probability distribution (see also the sample-variance s^2)

σ' Vendor score or simply a constant in a model

σ_i Real number showing the 'odometer' reading of a vehicle at node/vertex i

$\sigma_{\hat{Y}}^2$ 'Tilting' effect, as measured in terms of the variance, on the regression line (due to the randomness of the regression coefficients)

$\sigma^2_{M'}$	'Tilting' effect, as measured in terms of the variance, on the regression line—when an additional data-point x' is added to the regression
σ^2_Y	Total regression-based prediction- or estimation-error, as expressed in terms of the variance of the predicted- or estimated-values Y
$\sigma^2_{Y'}$	Total regression-based prediction-error, as expressed in terms of the variance of the predicted values Y'
$\sigma^2_{M'*}$	Variance of a normally-distributed set of residuals, around the sample regression-line at $X = x^*$
σ^{pq}_{ij}	Calibration coefficient such as the subareal investment-coefficient or the marginal capital-output-ratio, quantifying the multiplier effect of investment among economic sectors and between subareas
σ^2_j	Variance (or second moment) of service-time at service-unit j
$\boldsymbol{\sigma}^h = (\leftarrow \sigma^h_i \rightarrow)$	Vector of dual-variables corresponding to the ith constraints defining the hth travelling-salesman-polytope
$\boldsymbol{\sigma} = [a_j]$	Zonal population-serving-ratios along the diagonal of an $n' \times n'$ matrix
$\boldsymbol{\Sigma} = [\mathrm{cov}(\epsilon_i \epsilon_j)]$	Error covariance-matrix
t	Time dimension or simply a counter for a series of data (e.g., $N(t)$ is the population at time t, Δt is a time increment)
t'	Subareal share of transportation-accessibility-to-employment
t_b	Student-t statistic for calibration-parameter b
$t_{\alpha/2,\, n-2}$	t-statistic at $100(1-\alpha)\%$ confidence-level and $n-2$ degrees-of-freedom
t_N	Sink node/vertex of a network
t''	Technical-attribute score
t^k	Step size in iteration-k of a hill-climbing optimization-algorithm
t_0	Dwell time at a terminal
t^h_j	Delivery- or dwell-time at node j by salesman or vehicle h
t_{ij}	Normalized work-accessibility-function between i and j
${}^r\boldsymbol{t}^{s}(\mathbf{x},\boldsymbol{\Phi},\mathbf{V})$	Cost of providing service at state s and stage r of a recursive-program
$\tilde{\boldsymbol{t}}$	Random service-time on-scene $\tilde{t}_i$ or off-scene $\tilde{t}_j$
$\bar{\boldsymbol{t}}$	Expected value of on-scene service-times to all demands i
$\bar{t}'$	Ratio between intra-nodal distances at i and j
$\bar{t}_j$	Average service-time for a service-unit stationed at depot j, consisting of on-scene service-time at the demand t^1_i and the off-scene service-time at the depot t^2_j
$\mathbf{t} = [t_{ij}]$	Matrix of normalized work-accessibilities, measuring $n' \times n'$
$\mathbf{t}^k = [\tau^k_{ij}]$	Matrix of travel-times between i and j
τ	Time duration (e.g., τ_{ij} or $\tau(i,j)$ is the travel time from location i to j)
τ'	Calibration constant in a dynamicized input–output model
τ_k	A user-defined scalar in the subgradient optimization routine ranged (say) between 0 and 2
$\tilde{\boldsymbol{\tau}}$	Random variable for service-time in a queuing process; $\tilde{\tau}_{j\vert i}$ is the random service-time for demand i from depot j
$\bar{\tau}_j$	Expected one-way travel-time to a random demand from depot j
$\bar{\tau}'_j(k)$	Expected travel-time from j to all demands in state k
T	Transportation cost as part of locational expenditure; also quantifies other technological factors
$T_\cdot$ or $T(\cdot)$	A-priori travelling-salesman-tour as a function of $\cdot$
T'	Minimum spanning-tree of a graph
T''	Multi-graph, derived from the minimum spanning-tree by duplicating every arc of the graph; also an instance of the travelling-salesman problem
T_N	Alternate sink-node/vertex in a network for excess flows
T_j	Number-of-neighbors surrounding geographic sub-unit j
T'_i	Proportion of sales from subject location to demand at i
T''_i	Electrical-flow capacity of a substation i
T_{ij}	Number of ith-group neighbors for a jth-group geographic sub-unit
$\hat{T}_{ij}$	Current estimate on random-variable T_{ij}
$\mathbf{T}$	Diagonal matrix of zonal activities such as population
$\mathbf{T}(\cdot)$	Vector of cost-functions in a recursive-program
$\boldsymbol{T}_B$	Basis for a simplex-on-a-graph, represented graphically as a tree

u	Accessibility-to-population, or a calibration parameter in general; for example, u_{ij} is the normalized nonwork-accessibility between i and j
$u(t)$	The set of infinite control-paths between the initial point $t=a$ and end point $t=b$
u'	Frequency of a signal
u''	Ratio of the maximum travel-distances between nodes i and j
$u_i(t)$	Dual variables in a recursive-program for t = 1, 2, …
u^i	Upper bound of a specified time-window when a salesman or a vehicle visits node/vertex i
$\bar{u}_{ij}$	Capacity on arc (i,j) in a network
$^r\boldsymbol{u}^s(\mathbf{x},\mathbf{y})$	Inference dual-variable to show the value (or shadow price) of relaxing an rth connectivity-requirement at state s
$\mathbf{u}$	Surplus variables in a linear program; also a subset of control-variables $\mathbf{U}$
$\mathbf{u}' = [u_{ij}]$	Matrix of nonwork accessibilities, measuring $n' \times n'$
U	Utilities (e.g., U^* is the maximum amount of utility from a given income or budget)
$U(h)$	Route length or the range of a vehicle tour for vehicle type h (h = 1, 2, …)
U'	Maximum route-length or range among a fleet of vehicles, $U' = \max_h [U(h)]$
$U(t)$	Control variables over time t
$\mathbf{U} = (\leftarrow U_j \rightarrow)$	Vector of control-variables in control theory (slow variables), usually expressed as a function of t; U_j also stands for just the jth canonical-variate
$\mathbf{U}$	Diagonal matrix of zonal activities such as employment
$\mathbf{U}(k) = [\leftarrow \mathbf{u}^{k+r} \rightarrow]$	Matrix of inference dual-variables in a binary recursive-program
v	Value or utility function, or simply the metric resulting from such a measurement
v_{ij}	The composite travel-cost, or the "utility function," between zones i and j, combining time, cost and other travel impedances into a single metric
$v(k)$	Average filter using the kth-order neighbors
v'	A given parameter (such as housing subsidy per household)
v''	Velocity of a service vehicle in stochastic facility-location
v_i	Dual variable associated with node/vertex i
v_w	Walking speed
$v_{\max}$	Maximum velocity of a vehicle
$v^{(j)}(\cdot)$ or $v^j(\cdot)$	Deterministic value-function for alternative j
$\bar{v}_{ij}$	The reduced-cost for arc (i,j) in network-flow programming
$\mathbf{v}_i = (\leftarrow v_i^j \rightarrow)$	An eigenvector consisting of as many entries as the number of alternatives; this is equivalent to $\mathbf{x}_i = \mathbf{x}(q_i')$
$\mathbf{v}$	Surplus variables in a linear program
V	The amount of economic activities, traffic flow or patronage (e.g., V_i is the amount of activities or trips originating or terminating at location i, and V_{ij} is the exchange of economic activities or traffic movement between locations i and j); $\hat{V}$ is the estimated value and V^* is the observed value.
$V(h)$	Capacity of vehicle-type h, where h = 1, 2, …
$V'(h)$	Capacity remaining on each vehicle h
$V'(\cdot)$	Normalized vehicle-capacity
V^d	Inverse demand-function, or the price schedule expressed as a function of a firm's (firms') total output; V_i^d is the excess demand at subarea i
V'	Set of vertices or nodes in a graph or network
V_i	The ith canonical-variate
V_{ij}	Flow between origin–destination pair i–j; $\tilde{V}_{ij}$ is the lower bound and $\bar{V}_{ij}$ is the upper bound
V_{ijk}	Probability that a demand i of type k is received by facility j
V_{ij}^k	Trips of type k from i to j
$\hat{V}_{ij}$	Predicted interactions between subareas i and j
$\tilde{V}_{iq}^d$	Amount supplied by all the firms other than q to demand-location i
V_i^s	Output of firm i; also standing for the excess supply of a firm located in subarea i
ϕ	Calibration constant representing such parameters as the trip-generation rate or response rate of the system
ϕ^h	Polytope (feasible region) defined by the hth travelling-salesman-problem
ϕ'	Probability distribution (e.g., probability that the surplus resulting from the trip to j has a value in the neighborhood of S')

Φ	Cumulative distribution (e.g., $\Phi(v) = [F(v)]^n$ is the cumulative distribution-function of the largest-utility v among n independent samples; $\Phi_{ij}(S')$ is the cumulative-distribution-function of the surplus accruing from the preferred (optimal) trip between location i and j)
ϕ_k	Coefficient of the kth-lag term in an autoregressive-time-series
$\phi(B)$	The backshift operation of an autoregressive model
$\hat{\phi}_k$	Partial-autocorrelation-coefficient for the kth-lag term in an autoregressive-time-series
$\hat{\phi}_{kl}$	Partial-autocorrelation-coefficient at temporal-lag k and spatial-lag l in an autoregressive spatial-time-series
$\boldsymbol{\phi}(\cdot)$	Flow-vector function at stage s of a decomposed recursive-program
$\boldsymbol{\phi}(\mathbf{x})$	Demand density-function on Voronoi polygons
$\boldsymbol{\phi}$	Vector of pertinent flows at stage r and state s of a decomposed recursive-program; these flows can be expressed in terms of the pertinent demand-vector **f**
$\boldsymbol{\phi}^T = (\leftarrow \phi_i \rightarrow)$	Vector of autoregressive coefficients in a conditional spatial-econometric model
$\boldsymbol{\Phi}_k = [\phi_{ijk}]$	A spatial autoregressive-coefficient matrix of order-k
$\boldsymbol{\Phi}(B) = [\phi_{ij}(B)]$	A spatial autoregressive-operator matrix
$\boldsymbol{\Phi}^k(\cdot) = [\leftarrow \boldsymbol{\Phi}^{k+r} \rightarrow]$	Matrix of flow-vectors $\boldsymbol{\Phi}^{k+r}[\leftarrow \mathbf{x}^{k+r}(k) \rightarrow]$
$\boldsymbol{\Phi}^{k+r}[\leftarrow \mathbf{x}^{k+r}(k) \rightarrow]$	Flow-vector at the kth cycle and rth stage, showing origin-destination-connectivity as a function of the iterative multi-stop routing-decisions
χ^2	Chi-square statistic
$\boldsymbol{\varphi}$	Expected cost between stockout and storage in a newsboy problem
$\boldsymbol{\varphi} = [f_j]$	Zonal activity-rates along the diagonal of the $n' \times n'$ matrix
ψ	Value of a given function; e.g., Sierpinski's-curve value
ψ_j	Weights used in time-series forecasting
$\Psi^n_{k=1}(l_k)$	Dynamic-program recursion-function for computing the shortest-route-length l
Ω	Dual variable corresponding to the terminal capacity constraint—a parameter to account for the given warehouse capacity; also regular vector space
$\bar{\boldsymbol{\Omega}}$	A bounded domain including the boundary $\delta\Omega$
$\Omega_q = \{\mathbf{x}_q\}$	A feasible region within the vector space Ω; e.g., a set of constraints in a spatial-equilibrium model, expressed in terms of the flow decision-variables $\mathbf{x}_q$ for each of the suppliers q
Ω_{ij}	Percentage-change-of-patronage at facility j from the demands that originate at i
$\Omega(B) = \sum_i \Omega_i B^i$	Backshift operator containing the dynamic multipliers Ω_i in a set of dynamic simultaneous-equations
$\boldsymbol{\Omega}_{t-1,t}$	Transition matrix in a Kalman filter
$\acute{\eta}_k$	Connectivity requirement on the origin–destination pairs during the kth cycle
$\acute{\eta}_k(r)$	Connectivity requirement on a subset of the origin–destination pairs during the rth stage in the kth cycle; i.e., the number of constraint functions defining the local flow-pattern in a recursive program for the RISE algorithm
w	A constant, or an aggregate weight-parameter, placed on a variable or an estimator-measure (such as Moran's-I, and its variance, plus the mean and expected variance of the general spatial-statistic)
w_k	A constant or a weight placed on entity or attribute k; when these weights are normalized and summed to unity, we write $\sum_i \lambda_i' = 1$
w^k	Weight reflecting the relative importance of workplace-based retail-trips for purpose k
$\tilde{w}_1, \tilde{w}_2$	Weight-parameters used in the formulas for the variance of Moran's-I
w_k'	Width of a subregion k
w_t'	A white-noise series, consisting of a sequence of uncorrelated random-variables, each with zero mean and finite variance; engineers consider them as independent 'shocks' that are transformed by a "transfer function" to another time-series whose successive values are highly dependent.
w_p''	Frequency on route p
w_{ij}	Weight placed on the demand-facility pair i–j or the weight placed on arc flow (i,j), otherwise referred to as cost coefficients in the equivalent linear-program; also denotes the weight entry in a spatial-weight-matrix **W**, with $0 \le w_{ij} \le 1$
$w_{ij}(d)$	Binary valuations of w_{ij} when an activity at j is within a distance d from i
w_{ijp}	Frequency on the (i,j) segment of route p
w^j_i	Weight contribution toward criterion i by alternative j

${}^{r}\mathbf{w}^{s}(\boldsymbol{\phi},\mathbf{V})$	Vector of route-frequencies at stage r and state s of a decomposed recursive-program
$\mathbf{w} = (\leftarrow w_i \rightarrow)^T$	Eigenvector consisting of q entries—this is equivalent to $\mathbf{v}_i$ and $\mathbf{x}_i$; also the cost vector in a network-flow program
$\mathbf{w}^{(l)} = (\leftarrow w_{ij}^{(l)} \rightarrow)^T$	The vector of spatial-weights associated with the lth contiguity-class; an example is the weights associated with the lth-order neighbors—notice this is equivalent to the spatial operator $L^{(l)}(\bullet)$
W	White-collar employment; also work load or demand placed on a service-unit
W_i	Size of demand or activity at i, which is proxy for development opportunity at the zone; $\mathbf{W}'$ is the vector of development-opportunities among all zones
W_q	Delay time in queue
W_T	Total time in system, including delay time in queue and the time being served
$W(t)$	Rate of investment in new capacity over time
W_i'	Revised size of demand or activity at i
W_{ij}	Service-effectiveness weight expressed as a function of the separation between demand i and facility j; i.e., the further apart i and j are, the less effective it is for service to be rendered
$\bar{W}_i^p$	Observed value of attractiveness or the opportunity of zone-i as a location for industry-p
W_i^h	Observed zonal-residence attractiveness or opportunity
W_i^p	Observed zonal-shopping attractiveness or opportunity
$\mathbf{W} = [w_{ij}]$	A $q\times q$ pairwise-comparison weight-matrix used in the analytic hierarchy process; also denotes the weight matrix in spatial econometric-models, measuring $n\times n$
$\mathbf{W}' = [W_{gh}]$	An $n'\times n'$ activity derivation-and-allocation matrix of Lowry–Garin model, with each entry denoting a zone pair g–h
$\mathbf{W}'' = [w_j]$	The diagonal matrix consisting of per-capita value-added productivity (wage rate)
$\mathbf{W}^j$	Activity derivation–allocation, transition or spatial-weight matrix for the jth activity in a Lowry–Garin model
$\mathbf{W}^{(l)} = [w_{ij}^{(l)}]$	Spatial weight-matrix for the lth-contiguity class; with the normalized spatial-weights sum to unity $\sum_j w_{ij}^{(l)}=1$, and $\mathbf{W}^{(0)}=[w_{ij}^{(0)}]=\mathbf{I}$, or the $0th$-order neighbors being the subject entry itself.
$\mathbf{W}_t$	Gain matrix in Kalman filter, representing the net percentage of measurement-error or noise that is left after filtering
$(\mathbf{W}^{(l)}\mathbf{y})_{\neg y_i}$	Preprocessing of data $\mathbf{y}$ by removing the subject ith-entry, and then replace it with a value resulting from 'filtering' with a spatial-'mask' $\mathbf{W}^{(l)}$ of order l
x^*	Sample observation or the optimal value of x
x'	A particular observation for the random-variable X
x_t'	Actual, accurate data in a Kalman-filter time-series (to be differentiated from what is observable)
$x_0, x_0', x_0'', \ldots$	Decision boundary between pattern groups 1 and 2, 2 and 3, 3 and 4, etc.
x_{ij}	Allocation of demand i to facility j; or flow from i to j
x^i	Flow on path i in a network
x_i^p	Equilibrium economic-activity at each subarea i and sector p
$\hat{x}_i^p$	Projected sales of product p in subarea i
x_{ijk}	Allocation of demand i to facility j in state k
x^{mn}	Lost calls between origin–destination pair m–n
$x^{m,n}(C^{m,n})$	Demand-for-transportation between origin–destination pair m–n as a function of the transportation cost between them
x_p^{mn}	Binary link-allocation of demand between origin–destination pair m–n to non-stop route or itinerary p
x_{ji}^{qp}	Input of commodity-q from subarea-j in the production of commodity-p in subarea-i
x_{mip}^{mn}	Binary allocation of demand m–n on route p as indicated by the usage of segment (m,i) in the itinerary
$\mathbf{x} = (\leftarrow x_j \rightarrow)^T$	Vector of decision-variables, or empirical readings (such as change-in-accessibility for all the activities j)
$\mathbf{x}_q$	An interior point in the feasible-region Ω_q
$\mathbf{x}_t = (x_1, x_2, \ldots)^T$	Observed readings in a time-series
$\mathbf{x}_t' = (x_1', x_2', \ldots)^T$	Actual readings over time in a Kalman-filter time-series
$\mathbf{x}_L$	The left eigenvector of a square matrix
$\mathbf{x}_R$	The right eigenvector of a square matrix

$\mathbf{x}^i$	The *i*th discrete-point proposal in a branch-and-bound tree, corresponding to a constraint in the Lagrangian-dual linear-program
$\mathbf{x}^k$	The *k*th basic-solution in a linear-program, or the *k*th set of decision-variables (e.g., solution alternative in a branch-and-bound tree, the location of the *k*th-facility, or the routing decision-variables for the *k*th-vehicle)
$\mathbf{x}_s^0$	Coordinates for the origin of a trip
$\mathbf{x}_t^0$	Coordinates for the destination of a trip
$\mathbf{x}^{i_k}$	The *i*th discrete-point proposal in a branch-and-bound tree during the *k*th-step of the subgradient-optimization procedure of Lagrangian relaxation
$\mathbf{x}^*(\mathbf{x}_s^0)$	Nearest public-transportation terminal for a trip starting at origin $\mathbf{x}_s^0$
$\mathbf{x}^*(\mathbf{x}_t^0)$	Nearest public-transportation terminal for a trip terminating at destination $\mathbf{x}_t^0$
$\hat{\mathbf{x}}_t' = (\hat{x}_1, \hat{x}_2, \ldots)^T$	Estimated-values of the observations in a Kalman-filter time-series
$\mathbf{x}^{k+r}(k)$	The *k*th iterative multi-stop-routing decision-variables for the *r*th-stage
$\bar{\mathbf{x}}^{k+r}(k)$	Realized values for the *k*th iterative multi-stop routing-decision-variables in the *r*th-stage
X	The decision-variable X; or the decision or alternative space in multi-criteria decision-making
X'	The state-space in Markovian-decision-processes
$\bar{X}$	Average of the independent random-variable X in a regression model
X^p	Control-total of areawide-transportation-cost for commodity p
$X(t)$	Random-variable for the state at time t
X_k	Random-variable for the state at stage or time k
$X_i(\cdot)$	Accessibility from origin i to all destinations as a function of such parameter as travel cost
X'_{lj}	Activity-*l*'s accessibility to zone-*j*
X_{ij}	Observed patronage of facility j by demand from location-i
X_i^k	Amount of activity k in zone i
$\mathbf{X} = \begin{bmatrix} \leftarrow\mathbf{x}_1\rightarrow \\ \leftarrow\mathbf{x}_2\rightarrow \\ \cdot \\ \cdot \end{bmatrix} = [X_{ij}]$	Exogenous- or independent-variable $n\times(k+1)$ matrix in ordinary-least-squares regression, corresponding to n observations and $(k+1)$ calibration-parameters
$\mathbf{X}(t) = (\leftarrow X_i(t)\rightarrow)^T$	Vector of state-variables in control theory (fast variables), expressed as a function of t in terms of the individual state variables $X_i(t)$ for states $i = 1, \ldots, n$
$\mathbf{X}(0) = \mathbf{X}_0 = (\leftarrow X_i(0)\rightarrow)^T$	Initial condition of the state-vector at time 0 for states $i = 1, \ldots, n$
$\mathbf{X}^*_{\max}(t)$	The most-likely state
$\mathbf{X}(k) = [\leftarrow\mathbf{x}^{k+r}(k)\rightarrow]$	Matrix of binary-decision-variables in a recursive-program during the *k*th-cycle and the *r*th-stage
$\mathbf{X}_l(\Delta) = (\leftarrow X_{lj}(\Delta)\rightarrow)$	Activity-*l*'s accessibility to individual-zone-*j* expressed as change in the regional-share-in-accessibility
$\mathbf{X}'' = (\leftarrow X_i''\rightarrow)$	Stationary states in system of interacting differential-equations
$\mathbf{X}^j = [X^j_{gh}]$	A matrix of accessibilities between zones g and h for activity j
y	Wage rate for a household or total wages across the labor-force
y^*	Sample observation or the optimal-value of y
y'	Regression-based prediction corresponding to a given x'
y_p	The *p*th-component of the **y**'-vector in a network-tableau
y_t	Ordinate of an observed-data-point in the series $t = 1, 2, \ldots$
$\hat{y}_t$	Estimated ordinate of an observed-data-point in the series $t = 1, 2, \ldots$
y^q	Household-wage expenditure on the *q*th industrial-sector
y_{jk}	Binary-decision-variable to assign facility to node-*j* in state-*k*
y_{ijk}	Binary-decision-variable to indicate that node/vertex-*i* is served by facility-*j* in state-*k*
y_k^{mn}	Binary indicator that there is *k*th-stop service between origin–destination pair *m*–*n*
$y_{u(k),v(l)}$	Binary decision-variable to indicate moving a facility from node/vertex u to v as the state transitions from k to l
$\mathbf{y} = (\leftarrow y_j\rightarrow)^T$	Vector of integer-variables in a mathematical-program, or simply a point within the regular vector-space
$\mathbf{y}_q$	A point other than $\mathbf{x}_q$ within the feasible-region Ω_q
$\mathbf{y}' = (\leftarrow y_i'\rightarrow)^T$	A vector of criterion-measures consisting of attributes i; also the updated or 'refreshed' column in a network-flow-tableau during the simplex-iterations
$\mathbf{y}''$	Interim solution in Benders' decomposition
$\mathbf{y}(k)$	The updated (or 'refreshed') *k*th column in a network-tableau

$\mathbf{y}^j = (\leftarrow y_i^j \rightarrow)^T$	A vector of criterion-measures for alternative j, or the jth group of y_i-variables (e.g., the delivery commitment of vehicle j toward demand i)
Y	The decision-variable Y, or random-variable notation of the explanatory or dependent variable in ordinary-least-squares regression; also the regional income
$\bar{Y}$	Mean of the random-variable Y
Y'	Outcome or criterion space of multi-criteria decision-making; also the prediction random-variable in regression
Y''	The combinatorial space of the discrete-variables y_i
Y_{ij}	A spatial-variable defined by the coordinates i and j—a variable that is related to its neighbors in both axes of this coordinate system; this cross-product is the covariance between the observations at i and j
$\mathbf{Y} = (\leftarrow y_i \rightarrow)^T$	Explanatory- or dependent-variable vector in ordinary-least-squares regression, consisting of n observations; $\hat{Y}$ denotes the estimated-values of random-variable Y
$\mathbf{Y}^{ij}(k) = [\leftarrow y_l^{ij} \rightarrow]$	Binary parameters of each constraint-function in recursive programming (p' in total), where i is the state-index and j the stage-index; $\mathbf{Y}(k) = \begin{bmatrix} \uparrow \\ \mathbf{Y}^{i,k+r} \\ \downarrow \end{bmatrix}$
$\mathbf{Y}(\cdot)$	State-connectivity linkage-function of past decisions and available vehicle-capacity in a recursive-program
$\mathbf{Y}'$	Labor-force-value-added output-vector
z	Objective-function of an optimization-problem; also used to denote the activity-generation rate
z'	A bound on z
$z(j)$	Objective-function value of the jth alternative
z_c	Largest demand-facility assignment-distance
z_i	Amount of product or services sold at demand-point i; or a transformed observation from the raw-data Z_i
z_t	Stationary time-series with zero mean
z_{IP}	An integer-programming objective-function that is to be estimated by Lagrangian-relaxation
$\hat{z}_t$	Stationary time-series with non-zero mean; also the estimated-value in an adaptive time-series
z_j'	Binary variable to denote the location of a facility at j; z_j is used after y_j when there is more than one type of facility to be located
z_0^j	Amount-of-output produced at supply-facility or plant j
z_{0i}^j	Amount-of-output produced at plant j and sent to output-market i
z_j'	The optimal benefit of opening facility-j in a generalized p-median-problem (as defined in a subproblem of Lagrangian-relaxation solution)
z_{ij}	\`Trunk' traffic from supply-source i to distribution-center j
z_i^j	Amount of input-i used by plant-j
z^{e_t}	Employment by the e_tth-type industry
z_i^e	Number-of-households in zone-i employed by industry
$z_{ij}^{e_t}$	Supply-of-labor by household in zone-i to zone-j for employment by the e_tth-type industry
z_L^i	Lower-bound of objective-function-value at iteration-i
z_U^i	Upper-bound of objective-function-value at iteration-i
z'	Lower or upper bound of objective-function-value
z_{ij}	Binary indicator-variable to show whether a multiattribute observation $\mathbf{x} = (x_1, x_2, \ldots)^T$ for a pixel of color j has been properly classified into group i; $z_{ij}=1$ when it is properly classified into group i (or $i=j$) and $z_{ij}=0$ when it is improperly classified ($i \neq j$). In vector notation for two groups i and j, we write $\mathbf{z}_i = (z_{ii}, z_{ij})^T = (1,0)^T$; and the random variable corresponding to $\mathbf{z}_i = (z_{ii}, z_{ij})^T$ is $\tilde{\mathbf{z}}_i = (\tilde{z}_{ii}, \tilde{z}_{ij})^T$.
z_{ij}'	Impedance between zones i and j
z_{LD}	Objective-function-value of a Lagrangian-dual
z_{LP}	Objective-function-value for a linear-program relaxation
z_{LR}	Objective-function-value for a Lagrangian-relaxation problem
$\grave{z}_i$	Goods in storage at location-i
$\mathbf{z}$	vector of $\mathbf{Z}$ values induced for stationary and with mean set to zero; also stands for endogenous variables in an econometric model

$\mathbf{z}_j$	Vector-of-pixels **z** for group *j* in a Bayesian classifier
Z	Activity level (where the activity can be population, employment, grey values, or any economic or non-economic activity)
$Z(i)$	Expected-value of the decision made at state-*i*
$Z'(i)$	Expected-value of the improved-decision made at state-*i* according to Howard's policy-iteration
Z_j	Objective-function value or activity level at location-*j*
Z_t	Raw-data time-series before inducing stationarity
Z_t'	Actual, accurate daa in a Kalman-filter time series (to be differentiated from what is observable)
$\dot{Z}_t, \ddot{Z}_t$	First and second differencing of time-series Z_t
Z'	Preference structure in multi-criteria decision-making
Z''	Deviation-measures from the efficient-contour of unity in the Minkowski distance-function
Z_{ij}	Value of spatial-data at grid-point *i*–*j*; often simplified to read Z_j to stand for the spatial-data value at location-*j*
Z_j^l	Value of the *j*th spatial-data at spatial-lag *l*
Z_+^n	*n*-dimensional Euclidean-space of positive discrete-values
$\mathbf{Z} = (\leftarrow Z_i \rightarrow)$	Vector of exogenous-variables Z_i of such activities as population and employment in each zone-*i*; $\mathbf{Z}_0$ is the initial-values of **Z**
$\mathbf{Z}(t)$	Density or relative-frequency of the state-vector $\mathbf{X}(t)$; in other words, the normalized state-vector
$\mathbf{Z}_j = (\leftarrow Z_{ji} \rightarrow)$	The *j*th-activity assigned to zone-*i*
$\mathbf{Z}^i$	Vector of the *total*-population/employment activity-levels at time-period (iteration) *i*, with $\mathbf{Z}^0$ as the given final-period *basic-activities* (from which other activities are generated)