

# **UrbanSim Reference Guide**

Version 0.9

University of Washington  
Urban Simulation Project  
<http://www.urbansim.org>

August 2000

## Acknowledgements

The development of the current version of UrbanSim has been funded in part by the National Science Foundation, grant CMS-9818378, “Reusable Modeling Components for Simulating Land Use, Transportation and Land Cover,” and by the University of Washington, Puget Sound Regional Synthesis Model project (<http://prism.washington.edu>).

We also wish to acknowledge the sponsors of earlier versions:

- Oahu Metropolitan Planning Organization, which funded the initial design specifications for UrbanSim, developed by Paul Waddell through Urban Analytics, and specific extensions to address anticipated development events.
- Oregon Department of Transportation, which funded the prototype version of the UrbanSim model, as part of the Transportation and Land Use Model Integration Project (TLUMIP).
- National Cooperative Highway Research Program 8-32(3), “Integration of Land Use Planning and Multimodal Transportation Planning,” which funded the development of the Beta Version of the UrbanSim software implementation, documentation, and the development of the UrbanSim web site.
- The Governor’s Office of Planning and Budget, State of Utah, which funded the application of the model to the Greater Wasatch Front area, and numerous refinements of the model system.

## Development Team

The development of the current version of UrbanSim was undertaken by the University of Washington. The project was directed by Paul Waddell, Associate Professor of Public Affairs and of Urban Design and Planning, in coordination with Alan Borning, Professor of Computer Science and Engineering, Marina Alberti, Associate Professor of Urban Design and Planning, and Scott Rutherford, Professor of Civil and Environmental Engineering. Michael Noth, PhD candidate in Computer Science and Engineering, developed the software architecture and led the software development effort. The software development team included Michael Becke and Nathan Freier. Software development for UrbanView, a visualization system integrated into UrbanSim, was led by Denise Pinnel and A.J. Brush, with assistance from Mathew Dockrey. Gudmundur Ulfarsson, Kevin Krizek, John Carruthers and Robert Willis assisted with data analysis and model calibration.

For further information on the model, including download information and updates, please consult the UrbanSim web site at <http://www.urbansim.org> or contact Paul Waddell, [pwaddell@u.washington.edu](mailto:pwaddell@u.washington.edu), or Alan Borning, [borning@cs.washington.edu](mailto:borning@cs.washington.edu). We would appreciate any feedback or suggestions. However, UrbanSim is offered on an as-is basis, with no warranty expressed or implied, and we cannot promise that we will be able to address any particular suggestion or bug report.

## Table of Contents

<b>1.0</b>	<b>Overview of UrbanSim</b> .....	<b>1-1</b>
1.1	Introduction.....	1-1
1.2	Behavioral Approach.....	1-2
1.3	Model Structure.....	1-4
1.4	Temporal Dynamics.....	1-5
1.5	Integration with Transportation Models.....	1-6
1.6	Software Design.....	1-7
1.7	Planning and Policy Analysis.....	1-9
1.8	Relationship to Other Operational Land Use Models.....	1-13
1.9	Status of the Current Release.....	1-13
<b>2.0</b>	<b>Model Description</b> .....	<b>2-1</b>
2.1	Economic Transition Model.....	2-1
2.2	Demographic Transition Model.....	2-1
2.3	Employment Mobility and Location Models.....	2-2
2.3.1	Employment Mobility Model.....	2-2
2.3.2	Employment Location Choice Model.....	2-2
2.4	Household Mobility and Location Models.....	2-4
2.4.1	Household Mobility Model.....	2-4
2.4.2	Household Location Choice Model.....	2-5
2.5	Land Price Model.....	2-7
2.6	Accessibility Model.....	2-8
2.7	Real Estate Development Model.....	2-9
2.7.1	Summary.....	2-9
2.7.2	Data.....	2-9
2.7.3	Structure.....	2-11
2.8	User-Specified Events.....	2-12
2.9	UrbanSim Output.....	2-12
<b>3.0</b>	<b>Installation and Use</b> .....	<b>3-1</b>
3.1	The GNU Public License.....	3-1
3.2	Installation.....	3-1
3.2.1	System Requirements.....	3-1
3.2.2	Installing Java.....	3-2
3.2.3	Installing UrbanSim.....	3-2
3.2.4	Installing the Sample Project.....	3-2
3.2.5	The Project Directory.....	3-2
3.3	Creating Scenarios and Running the Model.....	3-3
3.3.1	Running the Model.....	3-3
3.3.2	Input Files.....	3-3
3.3.3	Time Configuration.....	3-4
3.3.4	Control Totals.....	3-4
3.3.5	Land Use Plan Policies.....	3-5
3.3.6	LDRM Input.....	3-6
3.3.7	Space Utilization per Employee.....	3-7
3.3.8	Development Events.....	3-7
3.3.9	Employment Events.....	3-8
3.3.10	Policy Events.....	3-10
3.3.11	Inputs From Travel Models.....	3-10
3.3.11.1	Car Ownership Probabilities.....	3-10

---

3.3.11.2	Composite Utilities .....	3-11
3.3.11.3	Highway Travel Times .....	3-12
3.4	Outputs from UrbanSim.....	3-12
3.5	Runtime Options.....	3-12
3.5.1	ModelCoordinator Command Line Arguments .....	3-12
3.5.2	Debugging Flags .....	3-14
<b>4.0</b>	<b>Appendix: File Contents and Formats.....</b>	<b>4-1</b>
4.1	File Formats .....	4-1
4.2	CommonData .....	4-2
4.3	Coefficients.....	4-5
4.4	Scenario Files.....	4-13
4.5	Exported Files .....	4-16

---

## 1.0 Overview of UrbanSim

### 1.1 Introduction

UrbanSim is a software-based system designed to support metropolitan planning and policy analysis. The objective of the UrbanSim project is to make available for Metropolitan Planning Agencies, States, and other interested parties a set of analytical tools to support informed strategic planning to improve decisions about transportation, land use and the environment that affect the sustainability and quality of life in communities.

This Reference Guide is organized as follows. Section 1 provides an overview of the model, its behavioral formulation, and its implementation as a software tool for integrated land use and transportation planning; Section 2 describes the model structure and specification of the component models within the UrbanSim system. Section 3 provides a user guide to the installation and use of the model, and a sample project database from Eugene-Springfield, Oregon. Section 4 provides an inventory of the files and their contents. Further information is available from our web page <http://www.urbansim.org>. In particular, see the “papers” section of the web site for research papers on the application of the model, theoretical basis, and its software architecture.

The software is provided at no charge through non-proprietary, open-source licensing (the GNU General Public License) to facilitate its use and extension by others, and to support collaboration in a non-restrictive environment. Researchers, planners, and consultants are encouraged to download the model, use it, extend it, and redistribute it. Additional information on the license and its requirements are given in Section 3.1.

Key features of the model include:

- The model simulates the key decision makers and choices impacting urban development, in particular, the mobility and location choices of households and businesses, and the development choices of developers;

- The model explicitly accounts for land, structures (houses and commercial buildings), and occupants (households and businesses);

- The model simulates urban development as a dynamic process over time and space, as opposed to using a cross-sectional or equilibrium approach;

- The model simulates the land market as the interaction of demand (locational preferences of businesses and households) and supply (existing vacant space, new construction, and redevelopment), with prices adjusting in response to short-term imbalances between supply and demand;

- The model incorporates governmental policy assumptions explicitly, and evaluates policy impacts by modeling market responses;

- The model is based on random utility theory and uses logit models for implementation of key demand components;

- The model is designed for high levels of spatial and activity disaggregation, based on a grid of user-defined spatial resolution;

- The model addresses both new development and redevelopment.

Key features of the software implementation of the model include:

The model and user interface are written in Java;  
The user interface focuses on policy assumptions and the creation and evaluation of scenarios;  
The model is implemented using object-oriented programming to maximize software flexibility;  
The model inputs and results can be displayed using UrbanView, an integrated visualization system, or can be exported for viewing within an external GIS software system.  
Model results are written as text files for external use.

## 1.2 Behavioral Approach

The UrbanSim model is based on a view of urban development as it evolves over time and space as the composite outcome of the interactions of individual choices and actions taken by households, businesses, developers, and governments. The structure of this model includes components reflecting the behavior of households, businesses, developers, and governments, all interfaced through the land market. This behavioral approach provides a transparent theoretical structure that is much less like 'black-box' or abstract urban models that do not clearly identify agents and actions being modeled. As such, it becomes much more straightforward to incorporate policies explicitly and to evaluate their effects.

Table 1 presents some of the key decision-makers and their decisions or actions that pertain to urban development in general and to land use and transportation in particular. The decisions made by households, workers, businesses, and developers are modeled, and the decisions by the public sector are treated as exogenous, and are input to the model in the form of policy scenarios.

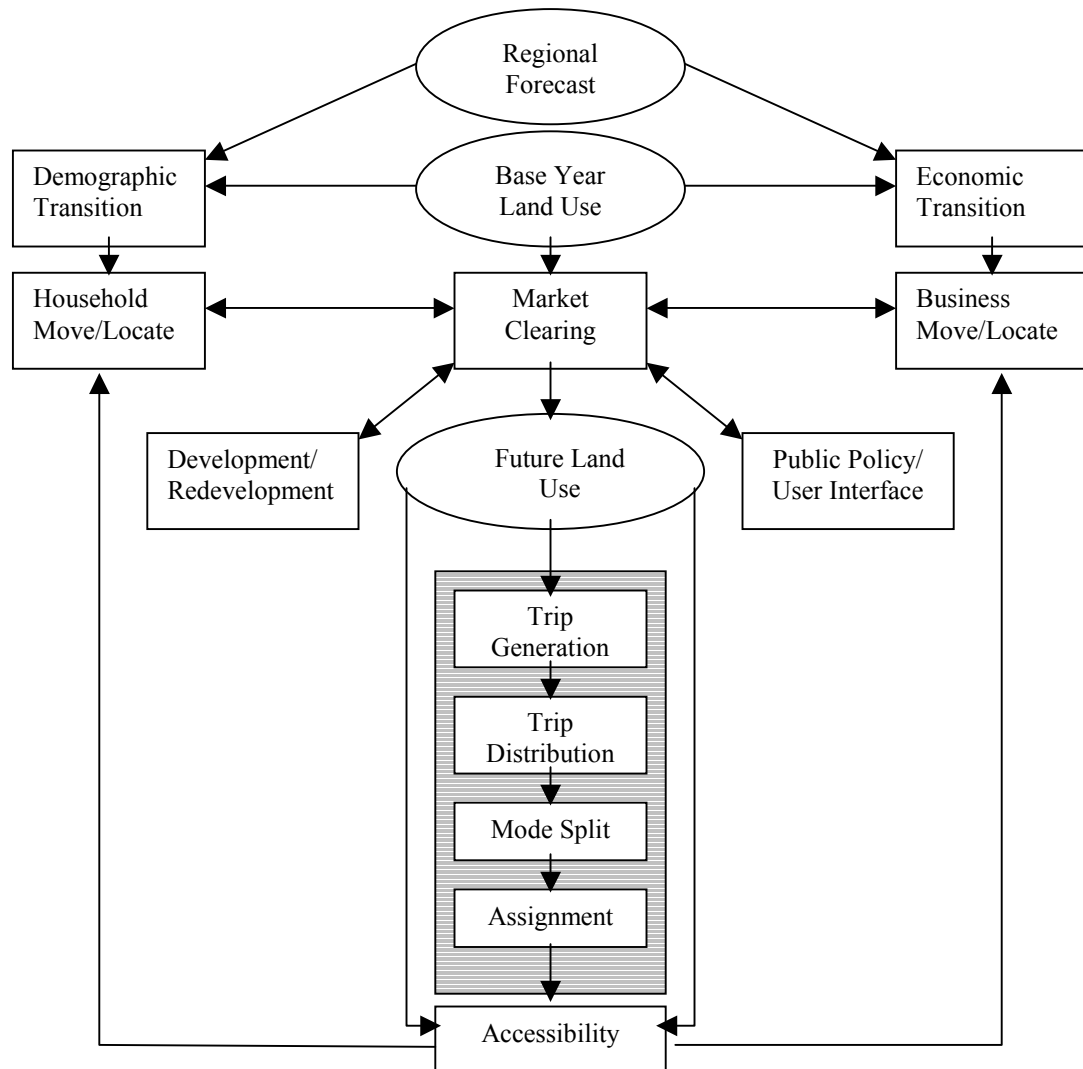
Treating urban development as an interaction between market behavior and governmental actions is designed to maximize the realism of the model as well as its utility for assessing the impacts of alternative governmental plans and policies related to land use and transportation. The model design is intended to enhance the strategic planning capabilities of Metropolitan Planning Organizations and other state and local agencies needing to evaluate Growth Management Policies such as urban growth boundaries, assess consistency of land use and transportation plans, and address conformity with respect to air quality implementation plans.

**TABLE 1.**  
**Decision-makers and Choices Affecting Urban Development**

<b>Decision-makers</b>	<b>Choices/Actions</b>	
<i>Market Decisions (Endogenous)</i>		
Household	<i>Mobility (move or stay)</i> <i>Location (where to move)</i> <i>Housing Type (single/multi)</i>	Housing Tenure (rent/own) <i>Housing Price</i> Auto Ownership
Worker	Labor Force Participation Job Change Full-time/Part-time Multiple Jobs	Workplace Choice Wage to Accept Mode of Transport to Work Trip Linking
Business	<i>Number of Employees</i> Wages to Offer <i>Type of Space (office, retail, etc.)</i> Tenure (rent/own)	Lease/Purchase Cost (willingness to pay) <i>Mobility (move or stay)</i> <i>Location (where to move)</i>
Developer	Land Purchase Infrastructure Investment <i>New Development</i>	<i>Redevelopment</i> <i>Land Use</i> <i>Density</i>
<i>Public Policy Decisions (Exogenous)</i>		
Municipality	Tax Rate Tax Abatement/Incentives Zoning <i>Land Use Plan</i> Urban Design	<i>Development Fees</i> Amenities (Parks) Services (Fire, Police) <i>Infrastructure</i> (Transportation, Water, Sewer)
Transit Agency	<i>Transit Infrastructure</i>	<i>Levels of Service</i> Transit Fares
Lender	Loans for Mortgages	Development Loans Interest Rates
School District	Tax Rates	School Quality
Other Local, State, Federal Agencies	<i>Fees, Regulations governing land use, transportation, environment</i>	<i>Highway, Rail, Ports, Airports</i>

Note: Choices in *italics* are currently addressed in UrbanSim

FIGURE 1. Functional Structure of UrbanSim



### 1.3 Model Structure

The flowchart in Figure 1 presents a graphical view of the key components of the model system, each of which is described briefly in this section. The model components represent the behavior of households, businesses, developers, and governments, interfaced through the land market. The model draws on random utility theory for its theoretical foundation, and builds on techniques of disaggregate choice modeling widely used in mode choice models. In extending the discrete-choice modeling framework to households and businesses, the model employs a framework that is behaviorally transparent, theoretically sound, and computationally tractable.

Exogenous inputs to the model include base year land use, population and employment, regional economic forecasts, transportation system plans, land use plans, and land development policies such

as density constraints, environmental constraints, and development impact fees. The user interacts with the model through input files that define scenarios combining assumptions and exogenous inputs. The model is then executed using a given scenario, and the results of one or more scenarios can be examined and compared using various output analysis tools.

The model endogenously predicts the location of employment and households; the location, type, and quantity of new construction and redevelopment by developers; and the prices of land and buildings. Two modules, demographic and economic transition, predict changes in the distribution of households and employment by type (e.g., age, income, and businesses by industry) at the regional level, consistent with the population and employment growth forecasts.

In the household mobility and location models, the system simulates household decisions about whether to move or remain in their current residence, and if they choose to move, their selection of a housing type and location. These choices are modeled in much the same way as mode choices of commuters, using multinomial logit estimation techniques. In the business mobility and location models, businesses make similar choices regarding mobility, building type and location choice. Household and business characteristics influence choices, as do location attributes such as accessibility and prices.

In the development component, the model simulates developer choices to convert vacant or developed land to urban uses, including the type of improvements and density based on site characteristics, market conditions, and subject to constraints imposed by governmental policies such as zoning and infrastructure availability.

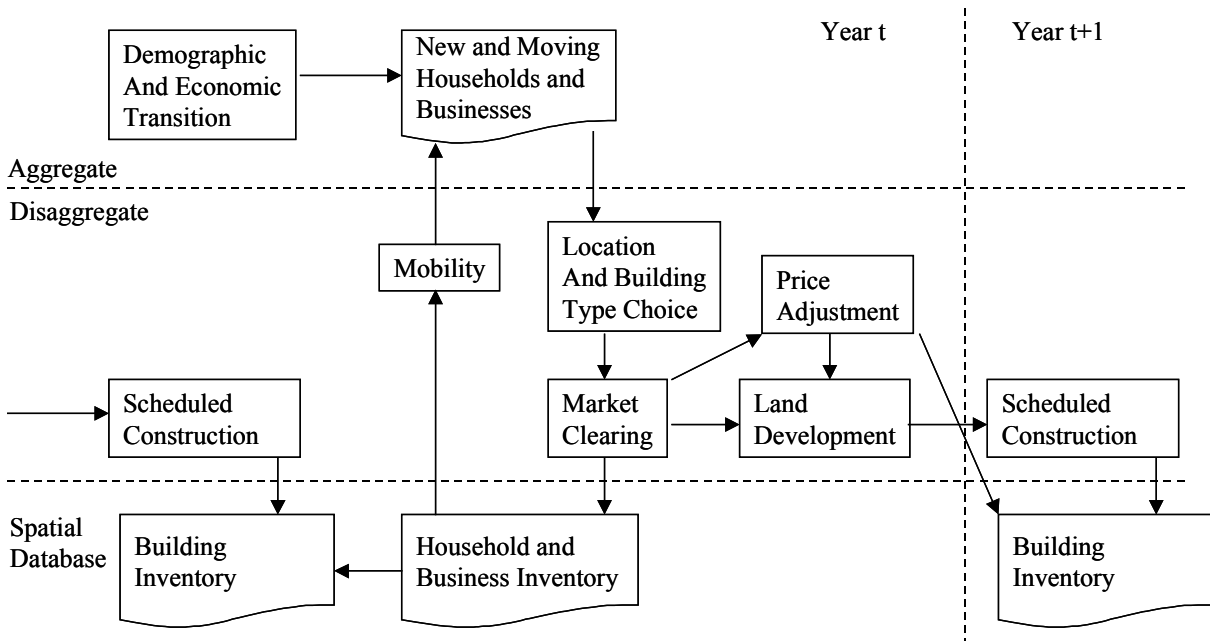
These interactions of households, businesses, developers, and governments produce outcomes representing the distribution of population and employment, as well as the prices, uses, and density of land development. These results are written out for any desired year that the travel models will be run. The data are fed into an external travel model to produce new travel times, costs, and patterns by mode. (Various travel models can be used, such as a traditional four-step travel model, or an activity-based model.) The analysis then uses these travel times to compute new accessibility indices in subsequent years, until the travel models are run for the next target year.

## 1.4 Temporal Dynamics

UrbanSim is based on a one-year timetable, since many of the actions modeled take place over durations of less than or approximately one year, including household and business location changes. Longer time frame actions, such as introducing major transportation system changes, are addressed by inputting them in a particular year, from which time the model can account for the influence of this change over subsequent years (see Figure 2).

Households, businesses, and developers are assumed to be price takers. This means that for each one-year increment, UrbanSim adjusts prices annually. This occurs after computing the total demand for each location and building type within the location choice components of the model and before developers estimate profitability of alternative construction projects. Developers then undertake new construction and redevelopment based on current market information, including current demand, and priced as adjusted to reflect the current period supply and demand. New construction then becomes available at the beginning of the next year, for new and moving businesses and households. Land development decisions are presently assumed to occur within one year, although multi-year construction timetables for large construction projects are more realistic and will be implemented in later planned enhancements to the basic model.

FIGURE 2. Temporal Dynamics

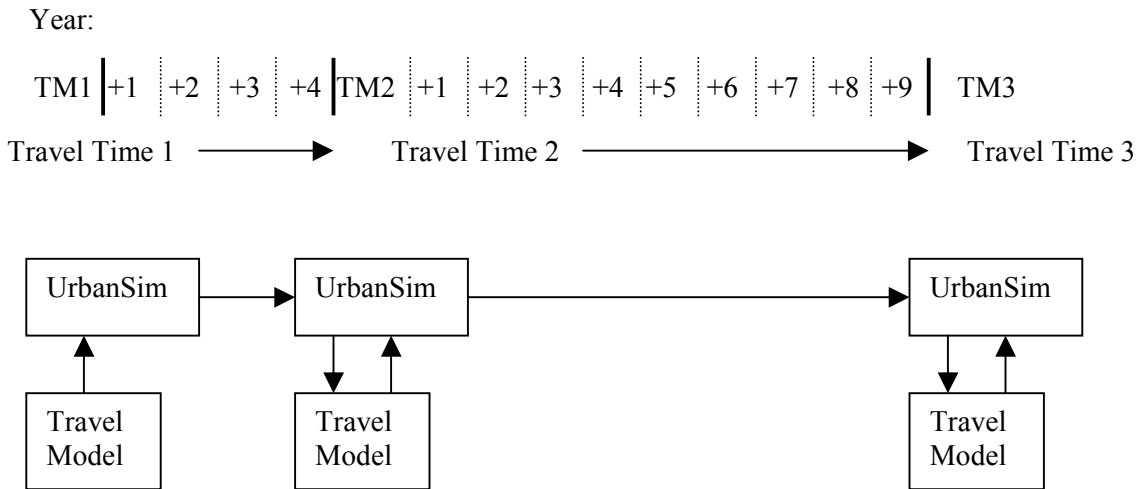


## 1.5 Integration with Transportation Models

The urban simulation model integrates with travel forecasting models through a longer-term temporal dynamic to account for changes in the transportation system, and reflects these through accessibility indices in the model. Figure 3 illustrates this sequencing.

Note that although travel times are only updated for years in which the travel models are run, two considerations apply. First, the urban model uses accessibility indices to measure the relative accessibility to various activities from each potential location. The activity levels are updated annually by the model, so that although the travel times and utilities remain constant until the subsequent travel model run, the accessibility indices change according to the changing distribution of activities. Second, major transportation improvements are likely to be fairly discrete in time, such as the opening of a new section of a freeway. The user determine the appropriateness of the travel model years with respect to the significance of the transportation system changes in intervening years. If the user desires to run the travel model for every year, the UrbanSim can accommodate it, though this will be slower and probably unnecessary.

**FIGURE 3.**  
**Land Use-Transportation Sequence**



(TM = Travel Model Year)

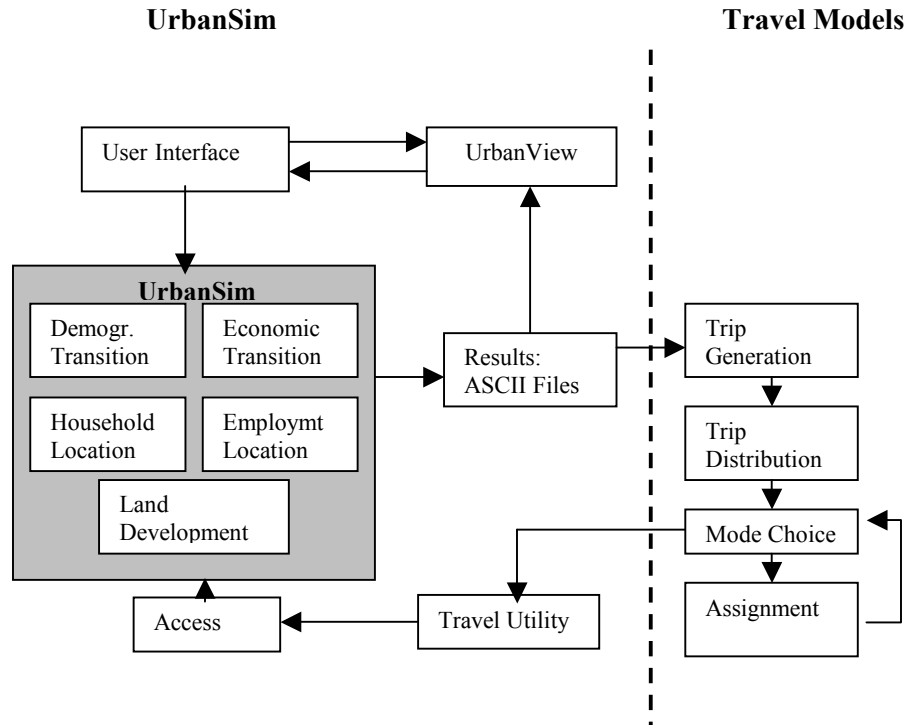
In operation, when the urban model reaches a travel model year, it writes results for that year into external data files in dBase format, and suspends operation until the travel model sequence is executed using the current land use data. Once new travel time matrices are created from the travel model run, the urban model simulation is resumed by the user and proceeds to run until the next travel model year, at which this process is repeated. One would prefer a fully integrated software environment in which both the travel and land use models reside, but this is well beyond the scope of the current project. Beyond the logistical effort required to execute a series of separate programs for the travel model components and the urban simulation model, however, it is not clear that there is a substantial loss of functionality. A truly integrated land use-transportation model would require complete integration of theory, estimation, and software, and most likely a microsimulation implementation. The design of the current land use model has been constructed to support extension to a microsimulation implementation (the developer component is already a microsimulation), and to integrate with activity-based travel forecasting models such as those under development in Portland and Honolulu.

## 1.6 Software Design

The software implementation of UrbanSim includes the core model components identified in Figure 1. The relationship of these components to each other and to the travel model is depicted in Figure 4. The user interface is the focus of attention for interacting with the model through the creation and testing of policy scenarios.

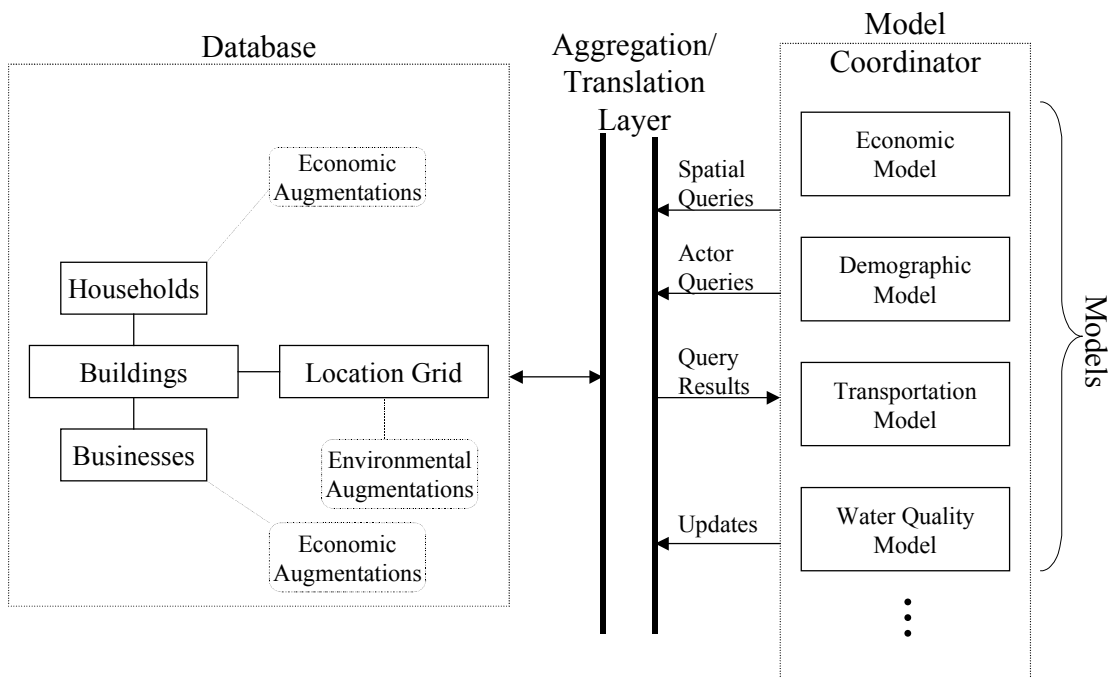
The model components of UrbanSim are implemented in object-oriented software, using the Java language. The current version of the software is implemented in Java JDK 1.3, and should run on all platforms supporting this Java implementation. The object-oriented design provides flexibility in reusing software components, and conceptually, fits well the theoretical structure of this model.

FIGURE 4. UrbanSim Software Components



The software architecture of UrbanSim has been developed since 1998 as a modular and extensible system, as shown in Figure 5. The software architecture is described in more detail in (Noth, Borning, Waddell 2000).

FIGURE 5: Modular Software Architecture



---

## 1.7 Planning and Policy Analysis

The relationship between land use and transportation has been an enduring subject of both theoretical and empirical study. Urban form, whether it is compact, multi-nodal, or sprawling, has enormous impact on the type and cost of transportation systems needed to serve the residents of a metropolitan area. On the other hand, the type and location of major transportation facilities greatly influences urban form. It seems intuitive that land uses and transportation influence each other, that the spatial distribution of activities creates the need for travel, and that the transportation system in combination with this spatial activity distribution creates patterns of accessibility that in turn influence the location choices of households and firms. Although the literature reflects a broad understanding of this complex relationship—and some of the literature dates back several decades—surprisingly little of this understanding has been reflected in planning practice or analytical models. Transportation planning and local “comprehensive” planning continue to take place quite separately, resulting in combinations of public policies that rarely reinforce one another and that often work at cross purposes (Kelly 1994).

Most metropolitan planning organizations (MPOs), for example, are responsible for preparing long-term forecasts of travel demand—and land use is a critical component of such a process. However, MPOs have historically prepared long-term travel demand forecasts based on land use assumptions about the future that were not influenced by the transportation plan. On a more local level, planning commissions, presumably with the advice of their professional staffs, make decisions about new developments that become new neighborhoods. They recommend new zoning ordinances (traditionally considered the “work horse” for land use plans) to governing bodies. Engineering or public works departments make decisions about the construction of new arterial and other roads, often without consulting either their respective planning commissions or planning staffs (Kelly 1994).

The Clean Air Act Amendments of 1990, the 1991 Federal Intermodal Surface Transportation Efficiency Act (ISTEA), and its successor TEA21, urge such practices to change. Both the CAAA and ISTEA mandate linking land use and transportation planning to ensure that relationships between land use and transportation are accounted for. Increasing interest in developing sound and consistent plans and policies for land use and transportation has resulted in an observable trend over the past decade or longer for MPOs to move beyond the traditional long-term baseline forecasting requirements that have dominated planning practices for decades. Baseline forecasts are now being used for strategic planning and policy analysis; and, there is an increasing need to employ land use and transportation models as a primary tool for such analysis. In fact, as becomes evident from the kinds of policy requirements in many state agencies, the application of the models to strategic planning and policy analysis may become their primary use in the future. As such, the first policy priority for new land use models is to provide a meaningful mechanism to incorporate the impacts of transportation system and travel demand changes on land use outcomes. These impacts include, at a minimum, the spatial distribution of population and employment by type, and the mix and density of land uses. In order to accomplish these objectives, as well as many of the policy analysis objectives identified below, the new models also address impacts on the land market in the form of land and housing.

### 1.7.1 Policy Requirements

If urban models are to be used as a tool for strategic planning and policy analysis, then they need to be able to account for myriad policies prescribed by various levels of government. At the federal level, the Clean Air Act Amendments (CAAA) and the Intermodal Surface Transportation Efficiency Act (ISTEA) mandate linking land use and transportation to ensure their relationships are accounted for in the planning process.

The State of Oregon provides a useful point of reference. Three policy initiatives in the State of Oregon combine to form what is perhaps the most proactive state program in the United States to manage urban growth and its consequences effectively. The Oregon Transportation Plan (OTP) explicitly links transportation and land use, and provides a multi-modal context for statewide transportation plans and project development. The Transportation Planning Rule (TPR) specifies the relationships between transportation and land use. It defines the characteristics of acceptable transportation plans, establishes standards for transportation system performance, and requires explicit linkages between local land use and transportation planning processes. The Oregon State Benchmarks (OSB) establish measurable performance standards for a wide range of state and local governmental activities including transportation and land use. These three documents converge on the following policy objectives that are particularly germane to the development and use of the urban simulation model.

- Consistency between transportation and land use planning
- Consistency with comprehensive plans and urban growth boundaries
- Minimize development pressures on the urban fringe
- Support compact, mixed use development including infill and redevelopment
- Evaluate land use alternatives for meeting transportation needs
- Limit parking supply in metropolitan areas
- Access management
- Statewide economic development
- Transportation system efficiency
- Multi-modal accessibility
- Demand and congestion management
- Reduce automobile reliance and state VMT per capita

It is important to draw a distinction between policy objectives and policy instruments. While the objectives listed above are clear, they represent desired outcomes rather than the means for achieving these outcomes. Specific policies and investments are the instruments for achieving these objectives. The relative effectiveness of alternative investments and policies in achieving these policy objectives depends on many factors, including the interaction between policies, and the reactions of individual households and firms to the policies in their location and travel behavior. It is this interaction between the policies and the marketplace that often produces unanticipated consequences from well-intentioned policies. A key design goal of the UrbanSim modeling system is to provide an analytical tool for strategically assessing the interactions between government actions (land and transportation policies and investments) and urban markets for land and transportation.

Land use and transportation policies can be categorized into regulatory, pricing, and infrastructure actions. Regulatory actions often take the form of restricting actions in some systematic way, such as zoning constraints on the physical development of land that restrict developers to certain land uses and densities. Pricing policies such as taxes, development impact fees, and congestion pricing affect economic decisions made by businesses and households through their individual choices in the markets for land and travel. Infrastructure investments impact accessibility, travel costs, and development costs, and thereby influence physical development and location choices indirectly but significantly.

In the UrbanSim model, policy analysis is focused on the creation and evaluation of policy scenarios, which combine policy assumptions and provide inputs to the model. The following section describes the use of scenarios in the model.

### 1.7.2 Scenarios

The UrbanSim model system allows users to specify policy inputs and assumptions, generate scenarios and compare them, compute evaluation measures, and query the database of results. The user interface is focused on the interaction of the user with the inputs to each scenario that consists of a particular combination of development policies represented in appropriate input data such as comprehensive plans, infrastructure plans, development fees, urban growth boundaries, and other policies. These policies are linked to locations at a grid cell, zonal, municipal, county, or metropolitan scale. Users may edit policy variables imposing constraints (e.g., land use plans) or influencing costs (development fees). The UrbanView visualization component provides the user with charts and maps to aid in evaluating policy outcomes or objectives.

A major advantage of the urban simulation model is its use as a tool for comparing different land use policy alternatives—an essential part of planning and a critical tenet of planning theory. The days of working with a single land use forecast are past (Douglas 1995). For example, what would be the impacts if development were restricted to within a growth boundary? How effective are different policies in encouraging nodal development? The urban simulation model accounts for these alternatives by developing scenarios in which the user alters certain policy functions, together with population projections (some of the exogenous variables mentioned earlier). These scenarios provide the basis for the suitability, growth, and allocation scenarios to be developed in the remainder of the model.

Developing a scenario requires an estimate of the regional population and employment growth over the desired forecasting time horizon (often 20 years). Aggregate population and employment are exogenous values considered across the metropolitan area of study. The standard procedure for many MPOs is to use state or federal forecasts of regional population and growth. State law may mandate the use of these state forecasts. In other cases, regions make their own estimates of regional control totals because they want to refine state estimates using more local information (i.e., its current size, growth history, and/or growth policies). These estimates may be obtained from another agency (such as a state economic agency) or estimated using one or more techniques such as demographic forecasting and regional economic models. The user prescribes a start year and an end year for the time period of analysis and identifies the reporting years for which model results should be written to external databases in dBase format.

Broadly speaking, government agencies influence the land development process via two principal means: land use regulation (considered here to include land classification and density, environmental protection, tax abatement, development policies), and infrastructure provisions, including financing options that impose impact fees for infrastructure extension. While there are endless permutations and many local conditions to consider when doing an analysis, most alternative scenarios attempt to shape the structure of urban development towards one or more of the following basic forms:

- concentrating development within a specified area,
- focusing growth in transportation corridors or in centers connected by multi-modal transportation,
- locating some of the growth in new or existing satellite communities,
- emphasizing growth in parts of the region with underutilized infrastructure.

The methods for creating policy scenarios to apply to UrbanSim are described below.

#### *1.7.2.1 Land Use Plan*

Land use plans and the process of land use planning, as described by Kaiser and Godschalk (1995), usually involves integrating four separate prototypes (land use design, land classification plan, verbal policy plan, and the development management plan). The process results in a contemporary hybrid

plan that not only maps and classifies land use in both specific and general ways, but also proposes policies and management measures. The process of prescribing land use categories is essentially the land use design plan, the most traditional form of land use planning. It proposes a long-range future urban form as a pattern of prescribed land use designations, within which various uses are permitted under current zoning. For example, in the City of Eugene, the land use plan identifies almost two dozen different land use designations (i.e., educational, light-medium industrial, medium-density residential). Within each of these designations the urban development is spelled out as a mixture of retail, office, industrial, residential, and open spaces, public land uses, and a circulation system.

Interpreting the comprehensive land use plan is part of constructing a forecasting scenario. Each land use plan designation may be restricted by the user to be converted into one or more actual land uses. For example, the plan designation of ‘agricultural’ may be allowed to convert to no other urban category under restrictive growth policies, or to single-family residential, or other uses, under less restrictive growth policies. The comprehensive plan guidelines for a local region should spell out the intended interpretation of these plan designations, but the user of the model may wish to assess the impact of altering these constraints as a matter of policy testing.

In addition to prescribing the types of actual land uses to which land in each plan designation may be converted, density of development may also be constrained. Land use plans usually assign density constraints to each land use category. Residential land uses are usually regulated, simply enough, by the number of units per acre. All other uses that involve development are usually prescribed as a range of densities, most often expressed as a floor area ratio (FAR). This a ratio of the total built area (times the number of levels) to the total site area. The combination of land use mix and density constraints are accounted for in the current model through a classification into development types, and policies are interpreted in terms of their effects on these development types.

#### *1.7.2.2 Environmental Factors*

Increasingly, environmental factors are being considered in the development of land use plans. Local zoning codes usually identify areas where such factors are an issue, and adopt additional development constraints. This urban simulation model accounts for development constraints among environmental factors by identifying the grid cells which may be affected and allowing the user to tailor the development regulations that apply to these areas.

Examples of environmental factors used in current applications of the model include:

- Areas with slopes greater than 25%,
- Areas delimited as part of a stream buffer,
- Wetlands,
- Floodplains,
- Areas considered to be in 100 year floodplain areas,
- Areas included as part of transmission easements.

The model accounts for areas with the above conditions by allowing the user to modify the allowable development regulations in the protected area.

#### *1.7.2.3 Urban Growth Boundary*

The second prototype of land use planning described by Kaiser and Godschalk (1995) consists of land classification planning which is a proactive effort by governments to specify where and under what conditions growth will occur. It is usually less specific about the pattern of land uses within areas specified for development. Often known as urban containment techniques, it has two principal purposes: (1) to promote compact and contiguous development patterns that can be efficiently served

by public services, and (2) to preserve open space, agricultural land, and environmentally sensitive areas that are not currently deemed desirable for development (Nelson, Duncan et al. 1995). It does so by prescribing areas where development will be encouraged (referred to as urban, transition or development areas) and areas where development will be discouraged (referred to as open space, rural, conservation, or critical environmental areas). For each area, policies about the type, timing, and density of allowable development and development incentives or constraints apply. The most common form of urban containment and the policy alternative employed in the urban simulation model is the use of an urban growth boundary (UGB). The user may treat the UGB as a policy constraint, analogous to an environmental constraint, by tailoring the development regulations that apply to the land area outside the UGB. Other policy targeted areas can be incorporated into the model as overlays and treated in a similar way, such as enterprise zones or other special planning districts.

### 1.8 Relationship to Other Operational Land Use Models

UrbanSim differs significantly from several existing operational modeling approaches, including the spatial-interaction DRAM/EMPAL models developed by Putman (1983); the spatial input-output TRANUS and MEPLAN models, developed respectively by de la Barra (1989) and Echenique et al. (1990); the GIS-based California Urban Futures Model developed by Landis (1994; 1995), and the CATLAS (and later METROSIM) model developed by Anas (1982). All of these models are discussed in detail in various reviews, (Anas, 1987; Harris, 1985; Kain, 1987; Paulley and Webster, 1991; Southworth, 1995; Wegener, 1994, 1995; Miller, Kriger and Hunt, 1998; Parsons Brinckerhoff, 1998), another is in progress by the EPA. Compared with these models, UrbanSim is unique in the following ways:

- Dynamic structure of year to year evolution of urban development (as opposed to long-run equilibrium assumptions);
- Explicit accounting of land, structures and occupants;
- Microsimulation of move and location choices of individual households and jobs;
- Microsimulation at the grid cell level of land development and redevelopment;
- Disaggregation of the household and employment location choice to the level of grid cell;
- User-defined classification of household and business types;
- Integration with existing four-step and new activity-based travel models;
- Explicit input of public sector choices as policy scenarios.

### 1.9 Status of the Current Release

The current version of the software implementation is being released at the current time with the expectation that it is operational, and can be used with the accompanying sample project to learn in some detail about the capabilities and limitations of the model system. The development team plans to make several significant additions to the system which will be incorporated into upcoming releases, as these extensions are completed. The following is a summary of these extensions:

- A graphical user interface based on XML for managing all the model inputs and outputs and controlling its operation.
- Completion of data preparation tools to assist users in developing their own local databases for model application.
- Completion of the UrbanView visualization system, which is not included in this release.
- Completion of calibration tools to assist users in preparing data for calibration, and undertaking the estimation of model coefficients.

These extensions are currently implemented, but not yet robust enough or documented well enough for the current release. Notices regarding all future releases will be put on the project website.

---

## 2.0 Model Description

### 2.1 Economic Transition Model

Employment is classified by the user into employment sectors based on aggregations of Standard Industrial Classification codes. Typically 10 to 15 sectors would be defined, with variation in the level of detail on the basis of the local economic structure. Aggregate forecasts of economic activity and sectoral employment are exogenous to UrbanSim, and are used as inputs to the model. These forecasts may be obtained from state economic forecasts or from commercial or in-house sources, and are input into the EmploymentControlTotals.tab file for the start and end year of the forecasting horizon, and for any intermediate years for which the forecasts are available. Control totals are interpolated linearly for years in between those years for which the user has input control totals. The user may specify annual control totals if desired, or totals for selected benchmark years, or minimally a single end year control total for the forecasting horizon.

The Economic Transition Model manages the integration of these exogenous forecasts of aggregate employment by sector with the model database, by computing the sectoral growth or decline from the preceding year, and either removing jobs from the database in sectors that are declining, or queuing jobs to be placed in the location choice model component for sectors that experience growth. If the user supplies only total employment control totals, rather than totals by sector, the sectoral distribution is assumed consistent with the current sectoral distribution.

In cases of employment loss, the probability that a job will be removed is assumed proportional to the spatial distribution of jobs in the sector. The jobs that are removed vacate the space they were occupying, and this space becomes available to the pool of vacant space for other jobs to occupy in the location component of the model. This procedure keeps the accounting of land, structures, and occupants up to date.

New jobs are not immediately assigned a location. New jobs are added to the database and assigned a null location, to be resolved by the Employment Location Choice Model.

### 2.2 Demographic Transition Model

The Demographic Transition Model accounts for changes in the distribution of households by type over time, using an algorithm analogous to that used in the Economic Transition Model. These changes result, in reality, from a complex set of social and demographic changes that include aging, household formation, divorce and household dissolution, mortality, birth of children, migration into and from the region, changes in household size, changes in income, among others. The data (and theory) required to adequately represent all of these components and their interactions are not readily available. Instead, the Demographic Transition Model, like the Economic Transition Model described above, uses external control totals of population and households by type (the latter only if available) to provide a mechanism for the user to approximate the net results of these changes. Analysis by the user of local demographic trends may inform the construction of control totals with distributions of household size, age of head, and income. If only total population is provided in the control totals, the model assumes that the distribution of households by type remains static.

As in the economic transition case, household births are added to a list of movers that will be located by the Household Location Choice Model. Household deaths, on the other hand, are accounted for by

this model by removing those households from the housing stock, and by properly accounting for the vacancies created by their departure.

## 2.3 Employment Mobility and Location Models

Employment mobility and location choices are, of course, made by firms. However, in the current version of UrbanSim, we use individual jobs as the units of analysis. This is equivalent to assuming that businesses are making individual choices about the location of each job.

### 2.3.1 Employment Mobility Model

The Employment Mobility Model predicts the probability that jobs of each type will move from their current location or stay during a particular year. This is a transitional change that could reflect job turnover by employees, layoffs, business relocations or closures. Similar to the economic transition model when handling job losses in declining sectors, the model assumes that losses due to mobility are proportional to the spatial distribution of jobs in the sector. If mobility rates are set to zero, the model operates in incremental mode, and will not allow the possibility of decline in jobs. All additions to employment are managed through the employment location model. This is the approach taken in current applications of UrbanSim (for which we do not have available longitudinal data on employment).

However, with appropriate data, mobility probabilities could be estimated as a binary logit model. The model system may be extended in the future to allow specifying mobility and location choice as a nested logit specification. Since it is possible that the relative attractiveness of commercial space in other locations compared to an establishment's current location may influence their decision to move, we could structure the mobility model as the higher (marginal) level in a nested logit model with the lower (conditional) level location choice. In this way, the model would use information about the relative utility of alternative locations compared to the utility of the current location in predicting whether jobs will move.

Note that in many cases, specification of the mobility model as a nested logit is not warranted, or is not supported by the data available for calibration. In such cases, the mobility decision is treated as an independent choice, and the probabilities can be estimated either as a binary logit or estimated by simple mobility rates directly observed over a recent period for each sector are used as the predicted probabilities. The current implementation of the model treats these as independent predictions.

As in the case of job losses predicted in the economic transition component, the application of this model requires subtracting jobs by sector from the buildings they currently occupy, and the updating of the accounting to make this space available as vacant space. These counts will be added to the unallocated new jobs by sector calculated in the economic transition model. The combination of new and moving jobs serve as a pool to be located in the employment location choice model. Vacancy of nonresidential space will be updated, making space available for allocation in the employment location choice model.

### 2.3.2 Employment Location Choice Model

In this model, we predict the probability that a job that is either new (from the Economic Transition Model), or has moved within the region (from the Employment Mobility Model), will be located at a particular site. In the current implementation, locations are defined by 150 by 150 meter grid cells, although this size is a user-specified option. The model is specified as a multinomial logit model, with separate equations estimated for each employment sector.

For both the employment location and household location models, we take the stock of available space as fixed in the short run of the intra-year period of the simulation, and assume that locators are price takers. That is, a single locating job or household does not have enough market power to influence the transaction price, and must accept the current market price as given.

The variables included in the employment location choice model are drawn from the literature in urban economics. We would expect that accessibility to population, particularly high-income population, increases bids for retail and service businesses. We also expect that two forms of agglomeration economies influence location choices: localization economies and inter-industry linkages.

Localization economies represent positive externalities associated with locations that have other firms in the same industry nearby. The basis for the attraction may be some combination of a shared skilled labor pool, comparison shopping in the case of retail, co-location at a site with highly desirable characteristics, or other factors that cause the costs of production to decline as greater concentration of businesses in the industry occurs. The classic example of localization economies is Silicon Valley. Inter-industry linkages refer to agglomeration economies associated with location at a site that has greater access to businesses in strategically related, but different, industries. Examples would include manufacturers locating near concentrations of suppliers in different industries, or distribution companies locating where they can readily service retail outlets.

One complication in measuring localization economies and inter-industry linkages is determining the relevant distance for agglomeration economies to influence location choices. At one level, agglomeration economies are likely to affect business location choices between states, or between metropolitan areas within a state. Within a single metropolitan area, we are concerned more with agglomeration economies at a scale relevant to the formation of employment centers. The influence of proximity to related employment may be measured using two scales: a regional scale effect using zone-to-zone accessibilities from the travel model, or highly localized accessibilities using neighborhood queries surrounding the grid cell. Most of the spatial queries used in the model are of the latter type, since the regional accessibility variables tend to be very highly correlated, and because agglomerations are expected to be very localized. Note that the use of radial queries surrounding grid cells also avoids the problems of arbitrary zonal aggregations.

Age of buildings is included in the model to estimate the influence of age depreciation of commercial buildings, with the expectation that businesses prefer newer buildings and discount their bids for older ones. This reflects the deterioration of older buildings, changing architecture, and preferences, as is the case in residential housing. There is the possibility that significant renovation will make the actual year built less relevant, and we would expect that this would dampen the coefficient for age depreciation. We do not at this point attempt to model maintenance and renovation investments and the quality of buildings.

Density, the inverse of lot size, is included in the location choice model. We expect businesses, like households, to reveal different preferences for land based on their production functions and the role of amenities such as green space and parking area. As manufacturing production continues to shift to more horizontal, land-intensive technology, we expect the discounting for density to be relatively high. Retail, with its concentration in shopping strips and malls, still requires substantial surface land for parking, and is likely to discount bids less for density. We expect service firms to discount for density the least, since in the traditional urban economics models of bid-rent, service firms generally outbid other firms for sites with higher accessibility, land cost, and density.

We might expect that certain sectors, particularly retail, show some preference for locations near a major highway, and are willing to bid higher for those locations. Distance to a highway is measured

in meters, using grid spatial queries. We also test for the residual influence of the classic monocentric model, measured by travel time to the CBD, after controlling for population access and agglomeration economies. We expect that, for most regions, the CBD accessibility influence will be insignificant or the reverse of that in the traditional monocentric model, after accounting for these other effects.

Calibration of the model is based on a geocoded establishment file (matched to the parcel file to link employment by type to land use by type). A sample of geocoded jobs in each sector is used to estimate the coefficients of the location choice model. As with the Household Location Choice Model, the application of the model produces demand by each employment type for cell locations.

In application, the model processes each job in the mover queue individually, and queries grid cells for alternative locations to consider. These alternatives are sampled in proportion to the capacity of the built space in the cell for accommodating jobs, and the number of alternatives to consider may be determined by the user. Note that jobs may be located in housing units, as is increasingly the case with home-based employment through telecommuting and small independent home-based businesses. A logit model is applied to estimate the probability that the current job will move to each of the alternative job spaces under consideration. Monte carlo simulation is used to generate a decision to locate in a particular alternative, and once this choice is made, the job is assigned to the cell, and the respective quantities of vacant and used space in the cell are updated. If a preferred alternative for a job becomes unavailable during a simulation run, having been chosen and occupied by a previously locating job, the currently locating job is assigned its next best available alternative.

The independent variables used in the employment location choice model can be grouped into the categories of real estate characteristics, regional accessibility, and urban-design scale effects as shown below:

*Real Estate Characteristics*

- Prices
- Development type (land use mix, density)

*Regional accessibility*

- Access to population
- Travel time to CBD, airport

*Urban design-scale*

- Proximity to highway, arterials

*Local agglomeration economies within & between sectors: center formation*

## **2.4 Household Mobility and Location Models**

### **2.4.1 Household Mobility Model**

The Household Mobility Model is identical in form to the Employment Mobility Model described above. The same algorithm is used, but with rates or coefficients applicable to each household type. For households, mobility probabilities can be estimated for each type of household using a household survey, or if necessary, from the Public Use Microdata Sample file from the 1990 census. This will reflect differential mobility rates for renters and owners, and households with and without children, etc. Logit models predicting probability of household mobility over a given span can be calibrated with independent variables based on the household characteristics such as age group, children present, number of workers, each interacted with a dummy variable representing the choice to stay.

As with employment, the mobility choice could be estimated as a higher level nested logit model that uses building type and location choice as lower levels. Alternatively, it may be estimated using an independent binary logit, or simply by computing the mobility rates for each type of household from recently observed mobility.

Application of the Household Mobility Model requires subtracting mover households by type from the housing stock by cell, and adding them to the pool of new households by type estimated in the Demographic Transition Model. The combination of new and moving households serves as a population of households to be located by the Household Location Choice Model. Housing vacancy is updated as movers are subtracted, making the housing available for occupation in the household location and housing type choice model.

#### 2.4.2 Household Location Choice Model

In this model, in analogy with the employment location model, we predict the probability that a household that is either new (from the transition component), or has decided to move within the region (from the mobility component), will choose a particular location defined by a grid cell. As before, the form of the model is specified as multinomial logit, with random sampling of alternatives from the universe of available housing units.

Location choice models may be estimated for households stratified by income level and by the presence or absence of children, or by other life cycle characteristics. Alternatively, these effects can be included in a single model estimation through interactions of the household characteristics with the characteristics of the alternative locations. The current implementation is based on the latter but is general enough to accommodate stratified estimation. The variables included in the household location model, and their theoretical justification, are discussed below. The variables are drawn from the literature in urban economics, urban geography, and urban sociology. An initial feature of the model specification is the incorporation of the classical urban economic trade-off between transportation and land cost. This has been generalized to account not only for travel time to the classical monocentric center, the CBD, but also to more generalized access to employment opportunities and to shopping. These accessibilities to work and shopping are measured by weighting the opportunities at each destination zone with a composite utility of travel across all modes to the destination, based on the logsum from the mode choice travel model.

These measures of accessibility should negate the traditional pull of the CBD, and for some population segments, potentially reverse it. In addition to these accessibility variables, we include in the model a net building density, to measure the input-substitution effect of land and capital. To the extent that land near high accessibility locations is bid up in price, we should expect that builders will substitute capital for land and build at higher densities. Consumers for whom land is a more important amenity will choose larger lot housing with less accessibility, and the converse should hold for households that value accessibility more than land, such as higher income childless households.

The age of housing is considered for two reasons. First, we should expect that housing depreciates with age, since the expected life of a building is finite, and a consistent stream of maintenance investments are required to slow the deterioration of the structure once it is built. Second, due to changing architectural styles, amenities, and tastes, we should expect that the wealthiest households prefer newer housing, all else being equal. The exception to this pattern is likely to be older, architecturally interesting and high quality housing in historically wealthy neighborhoods. The preference for these alternatives could be accommodated through a combination of nonlinear or dummy variable treatment for this type of housing and neighborhood.

A related hypothesis from urban economics is that since housing is considered a normal good, it has a positive income elasticity of demand. This implies that as incomes rise, households will spend a portion of the gains in income to purchase housing that is more expensive, and that provides more amenities (structural and neighborhood) than their prior dwelling. A similar hypothesis is articulated in urban sociology (see for example, Massey, 1992), in which upward social mobility is associated with spatial proximity to higher status households. Both of these hypotheses would predict that households of any given income level would prefer, all else being equal, to locate in neighborhoods that have higher average incomes. (UrbanSim does not attempt to operationalize the concepts of social status or social assimilation, but does consider income in the location choice.)

The age hypothesis and the two income-related hypotheses are consistent with the housing filtering model, which explains the dynamic of new housing construction for wealthy households that sets in motion a chain of vacancies. The vacancy chain causes households to move into higher status neighborhoods than the ones they leave, and housing units to be successively occupied by lower and lower status occupants. At the end of the vacancy chain, in the least desirable housing stock and the least desirable neighborhoods, there can be insufficient demand to sustain the housing stock and vacancies go unsatisfied, leading ultimately to housing abandonment. We include in the model an age depreciation variable, along with a neighborhood income composition set of variables, to collectively test the housing filtering and related hypotheses.

Housing type is included in the model as a set of dummy variables for alternative development types. Development types correspond to the density and land use mix within a cell, with multiple categories of residential development, and mixed use development encompassing both commercial space and residential housing. These are discussed further in the documentation of the real estate development model.

Among the features that households prefer are a compatible land use mix within the neighborhood. It is likely that residential land use, as a proxy for land uses that are compatible with residential use, positively influences housing bids. On the other hand, industrial land use, as a proxy for less desirable land use characteristics, would lower bids.

The model is calibrated using a random sample of alternative locations, which has been shown to provide consistent estimates of the coefficients. In application for forecasting, each locating household is modeled individually, and a sample of alternative cell locations is generated in proportion to the available (vacant) housing. Monte carlo simulation is used to select the specific alternative to be assigned to the household, and vacant and occupied housing units are updated in the cell.

The market clearing mechanism used to assign households and jobs to available space, then, is not done through a general equilibrium solution in which we assume consumers and suppliers optimize across all alternatives based on perfect information, and zero transaction costs, with prices on all buildings at each location adjusting to the general equilibrium solution that perfectly matches consumers and suppliers to clear the market. Rather, the solution is based on an expectation of incomplete information and nontrivial transactions and search costs, so that movers obtain the highest satisfactory location that is available, and prices respond at the end of the year to the balance of demand and supply at each location.

The independent variables can be organized into the three categories of housing characteristics, regional accessibility, and urban-design scale effects as shown below.

*Housing Characteristics*

Prices (interacted with income)  
Development types (density, land use mix)  
Housing age

*Regional accessibility*

Job accessibility by auto-ownership group  
Travel time to CBD and airport

*Urban design-scale (local accessibility)*

Neighborhood land use mix and density  
Neighborhood employment

## 2.5 Land Price Model

UrbanSim uses land prices as the indicator of the match between demand and supply of land at different locations and with different development types, and of the relative market valuations for attributes of housing, nonresidential space, and location. This role is important to the rationing of land and buildings to consumers based on preferences and ability to pay, as a reflection of the operation of actual real estate markets. Since prices enter the location choice utility functions for jobs and households, an adjustment in prices will alter location preferences. All else being equal, this will in turn cause higher price alternatives to become more likely to be chosen by occupants who have lower price elasticity of demand. Similarly, any adjustment in land prices alters the preferences of developers to build new construction by type of space, and the density of the construction.

We make the following assumptions:

1. Households, businesses, and developers are all price-takers, and market adjustments are made by the market in response to aggregate demand and supply relationships. Each responds, therefore, to previous period price information.
2. Location preferences and demand-supply imbalances are capitalized into land values. Building value reflects building replacement costs only, and can include variations in development costs due to terrain, environmental constraints or development policy.
3. There is a normal, or structural, vacancy rate, based on normal turnover in the market, and this is the relevant threshold to consider for price adjustments.

Land prices are modeled using a hedonic regression of land value on attributes of the land and its environment, including land use mix, density of development, proximity of highways and other infrastructure, land use plan or zoning constraints, and neighborhood effects. The hedonic regression may be estimated from sales transactions if there are sufficient transactions on all property types, and if there is sufficient information on the lot and its location. An alternative is to use tax assessor records on land values, which are part of the database typically assembled to implement the model. Although assessor records may contain biases in their assessment, they do provide virtually complete coverage of the land (with notable exceptions and gaps for exempt or publicly owned property).

The hedonic regression equation encapsulates interactions between market demand and supply, revealing an envelope of implicit valuations for location and structural characteristics. These relative prices have been documented to be relatively consistent over time, with the acknowledgement that the relative values at specific locations change as their underlying characteristics change (DiPasquale and Wheaton, 1997). If the hedonic regression includes variables that are to be maintained as part of the simulation system, then these can be used to update relative prices over time.

In addition to these relative prices captured by the hedonic regression, the overall price level within the market for each type of real estate moves over time in response to shifts between supply and demand. These fluctuations can be tied to the relationship between the actual market vacancy rate and the long-term structural vacancy rate. As the current vacancy rate falls below the structural rate, price levels rise, and when the current vacancy rate exceeds the structural level, they fall.

These two effects on prices are combined in the land price model. The filled hedonic regression equation is used to establish relative prices, and the intercept of the equation is adjusted based on the relative position of the current and structural vacancy rate, as follows:

$$p_{ilt} = \alpha + \delta \left( \frac{V_s - V_t}{V_s} \right) + \beta X$$

where

- $p_{ilt}$  is the price of land per acre of development type  $i$ , at location  $l$  in time  $t$
- $V_t$  is the current vacancy rate at time  $t$ , weighting local and regional vacancy
- $V_s$  is the long-term structural vacancy rate
- $X$  is a vector of locational and site attributes
- $\alpha$ ,  $\delta$  and  $\beta$  are estimated parameters

Prices are updated annually, after all construction and market activity is completed. These end of year prices are then used as the values of reference for market activities in the subsequent year.

The independent variables influencing land prices can be organized into site characteristics, regional accessibility, urban-design scale effects, and market conditions, as shown below:

*Site characteristics*

- Development type
- Land use plan
- Environmental constraints

*Regional accessibility*

- Access to population and employment

*Urban design-scale*

- Land use mix and density
- Proximity to highway and arterials

*Market Conditions*

- Vacancy rates

## 2.6 Accessibility Model

Since this model is not of the monocentric or spatial interaction genre, in which the choice of workplace is exogenous and residential locations are chosen on the basis principally of commute to the city center or to a predetermined workplace, we deal with accessibility in a more general framework. Accessibility is considered a normal good, like other positive attributes of housing, which consumers place a positive economic value on. We therefore expect that consumers value access to workplaces and shopping opportunities, among the many other attributes they consider in their housing preferences. However, not all households respond to accessibility in the same way.

Retired persons would be less influenced by accessibility to job opportunities than would working age households, for instance.

We operationalize the concept of accessibility for a given location as the distribution of opportunities weighted by the travel impedance, or alternatively the utility of travel to those destinations. The utility of travel is operationalized as the composite utility across all modes of travel for each zone pair, obtained as the logsum of the mode choice for each origin-destination pair. The resulting access measure for each location is thus:

$$Acc_i = \sum_j^J A_j e^{\beta L_{ij}}$$

where

$A_j$  is the quantity of activity in location  $j$

$L_{ij}$  is composite utility, or logsum (for one car households), from location  $i$  to  $j$ .

$\beta$  is the utility scaling parameter, set to 1

An accessibility procedure reads the logsum matrix from the travel model and the land use distribution for a given year, and creates accessibility indices for use in the household and business location choice models. The general framework is to summarize the accessibility from each zone to various activities for which accessibility is considered important in household or business location choice.

If the user chooses the more traditional travel impedance, such as travel time or cost for one or more modes, then the accessibility index is modified appropriately into an entropy formulation, with  $\beta$  taking a negative value.

Recall that the urban simulation model operates on one year time increments, but that travel model updates are likely to be executed for two to three of the years within the forecasting horizon. The travel times remain constant from one travel model run until they are replaced by the next travel model result. Although travel times remain constant, the numerator in these accessibility indices is continuously updated, so that the accessibility indices change from one year to the next to reflect the evolving spatial distribution of activities.

## 2.7 Real Estate Development Model

### 2.7.1 Summary

Actor:	Real estate developer/landowner
Unit of analysis:	Grid Cell (150 x 150 m)
Dependent Var(s):	Probability of a development event in year $t$ of type $x$
Time frame:	Annual, with multi-year scheduling of development events
Model type:	Multinomial Logit
Model dependency:	PriceAdjModel

### 2.7.2 Data

The real estate developer model simulates the construction of new real estate, either through the construction of new development or the intensification or conversion of existing development. The data is structured as grid cells, currently specified as 150 meter x 150 meter in resolution (though this is a specification issue and not a restriction in the software). Parcel data is preprocessed to obtain the intersection of parcels and grid cells, and then to construct a composite representation of the real

estate development within each cell. Cells are then classified on the basis of their real estate composition, into ‘Development Types’, as shown in Table 2.1:

**Table 2.1: Development Types**

DevType	Name	Units	Sqft	Primary Use
1	R1	1	< 1,000	Residential
2	R2	2 - 4	< 1,000	Residential
3	R3	5 - 9	< 1,000	Residential
4	R4	10 - 14	< 2,500	Residential
5	R5	15 - 21	< 2,500	Residential
6	R6	22 - 30	< 2,500	Residential
7	R7	31 - 75	< 5,000	Residential
8	R8	76 +	< 5,000	Residential
9	M1	1 - 9	1,000 - 4,999	Mixed R/C
10	M2	10 - 30	2,500 - 4,999	Mixed R/C
11	M3	10 - 30	5,000 - 24,999	Mixed R/C
12	M4	10 - 30	25,000 - 74,999	Mixed R/C
13	M5	10 - 30	75,000 +	Mixed R/C
14	M6	31 +	5,000 - 24,999	Mixed R/C
15	M7	31 +	25,000 - 74,999	Mixed R/C
16	M8	31 +	75,000 +	Mixed R/C
17	C1	< 10	1,000 - 24,999	Commercial
18	C2	< 10	25,000 - 74,999	Commercial
19	C3	< 10	75,000 +	Commercial
20	I1	< 10	1,000 - 24,999	Industrial
21	I2	< 10	25,000 - 74,999	Industrial
22	I3	< 10	75,000 +	Industrial
23	GV	< 10	1,000 +	Government
24	VC	0	0	Vacant Dev
25	UN	0	0	Undevelopable

The data to estimate the coefficients for the developer model is derived from preprocessing the parcel and grid data to make heavy use of the year built values of the existing development in the assessor records. The data preparation procedure imputes year built values for those records that are missing by examining the surrounding cells of the same type and drawing from the distribution of observed values. Once the data is complete, historical development ‘events’ are identified for some user-specified period of time, and these events are extracted to a file for further analysis. Events, within this framework, are any changes in the real estate development within a cell that is identified by examining the year built values within the data. This means that the procedure is capable of identifying any new construction that has a year built occurring within the specified time frame. It does not, however, identify events that involve the demolition of buildings at some historical point in time, since there is no current evidence of the existence of demolished buildings within the current assessor records. This procedure could be augmented with data derived from building demolition and permit records, but that has not been accounted for in the current specification.

The result of this procedure, then, is the production of a set of development events that represent all observed transitions between any pairs of development types within each year of the specified

historical time frame. Note that the time slice for determining the existence of an event is annual, since this is the limit of the information on the vintage of real estate. Note also that development events are observed in the data that do not indicate a change of development type, but rather an intensification of use within the range specified in the definition of the development types.

### 2.7.3 Structure

The developer model is structured to predict the probability within a single simulation year of a grid cell experiencing a development event, and if it does experience such an event, identifying the type of event that is most likely. A nested logit model is used to estimate these probabilities. Once these probabilities are estimated for a grid cell, commitment of development is simulated by comparison of the probability to a random number, with results that exceed the random value being committed for development. Implementation of the development takes place by using a development template to obtain the most likely characteristics of the resulting development project within the cell, including the number of housing units, square feet of commercial, industrial and government space, improvement value, and construction schedule. These commitments are then added to the 'development event' queue, to be built (added to the database) as scheduled.

Constraints on development outcomes are included through a combination of user-specified spatial overlays and decision rules about specific types of development allowed in different situations. First, each cell is assigned a series of overlays through spatial preprocessing using GIS overlay techniques. These overlays typically include features such as:

- Land use plan designation
- City
- County
- Wetland designation
- Floodplain/floodway
- Stream or riparian buffer
- High slope areas
- Urban Growth Boundary
- Other environmentally sensitive lands
- Lands in committed use, but not considered 'developed' in a real estate sense, such as federal lands or parks

These overlays can be used to assign user-specified constraints on the type of development that is allowed to occur within each of these overlay designations. The intended constraints are indicated as allowed conversions between each land use plan designation and each development type in a file supplied by the user as part of the construction of a scenario for simulation (PLUDevConversion.tab). Only those conversions that are contained in this file are considered in the model. These constraints are therefore interpreted as 'binding' constraints, and not subject to market pressure. Currently, if users wish to examine the impact of these constraints, they would need to 'relax' a particular constraint within one scenario and compare the scenario results to a more restrictive policy.

The independent variables used in the real estate development model can be organized into categories of site characteristics, urban design-scale effects, regional accessibility, and market conditions, as shown below:

#### *Site characteristics*

- Existing development characteristics
- Land use plan
- Environmental constraints

*Urban design-scale*

- Proximity to highway and arterials
- Proximity to existing development
- Neighborhood land use mix and property values
- Recent development in neighborhood

*Regional accessibility*

- Access to population and employment
- Travel time to CBD, airport

*Market Conditions*

- Vacancy rates

**2.8 User-Specified Events**

Given our current understanding, no model will be able to simulate accurately the timing, location and nature of major events such as a major corporate relocation into or out of a metropolitan area, or a major development project such as a regional shopping mall. In addition, major policy events, such as a change in the land use plan or in an Urban Growth Boundary, are outside the range of predictions of our simulation. (At least in its current form, UrbanSim is intended as a tool to aid planning and civic deliberation, not as a tool to model the behavior of voters or governments. We want it to be used to say “if you adopt the following policy, here are the likely consequences,” but not to say “UrbanSim predicts that in 5 years the county will adopt the following policy.”)

However, planners and decision-makers often have information about precisely these kinds of major events, and there is a need to integrate such information into the use of the model system. It is useful, for example, to explore the potential effects of a planned corporate relocation by introducing user-specified events to reflect the construction of the corporate building, and the relocation into the region (and to the specific site) of a substantial number of jobs, and examine the cumulative or secondary effects of the relocation on further residential and employment location and real estate development choices. Inability to represent such events, in the presence of knowledge about developments that may be ‘in the pipeline,’ amounts to less than full use of the available information about the future, and could undermine the validity and credibility of the planning process. For these reasons, support for three kinds of events has been incorporated into the system: development events, employment events, and policy events. These are described in greater detail in section 3.

**2.9 UrbanSim Output**

The simulation input data and results are maintained in an internal binary data structure for efficiency, but when the simulation reaches a year that has been identified by the user as a ‘Reporting Year’ in the user interface, the model translates key results from this internal structure into external files in ASCII, tab delimited format. The files written out are stored in a scenario directory, with one set of results files for each reporting year. The files written are listed below and their contents detailed in Section 4:

GridDevStatus.tab	Grid cell land use characteristics
GridEmp.tab	Grid cell employment by sector
GridHouseholds.tab	Grid cell households by income, size, workers
ZoneDevStatus.tab	Zone land use characteristics
ZoneEmp.tab	Zone employment by sector
ZoneHouseholds.tab	Zone households by income, size, workers
ZoneHouseholdJoint.tab	Zone household joint distributions by income, size, workers

## References

- Alonso, W. (1964). Location and Land Use. Cambridge, Harvard University Press.
- Anas, A. (1982). Residential Location Markets and Urban Transportation: Economic Theory, Econometrics, and Policy Analysis with Discrete Choice Models., Academic Press.
- Anas, A. (1987). Modeling in Urban and Regional Economics. New York, Harwood Academic Publishers.
- Beckman, R. J., K. A. Baggerly, et al. (1995). Creating Synthetic Baseline Populations. Transportation Research Board Annual Meeting, Washington, D.C.
- Brown, L. A. and E. G. Moore (1970). "The Intraurban Migration Process: a Perspective." Gografiska Annaler, Series B: 1-13.
- City of Eugene (1997). Fee Estimating Guide: Building Permits and Systems Development Charges. Eugene, City of Eugene.
- Clark, W. A. V. and J. Onaka (1985). "An Empirical Test of a Joint Model of Residential Mobility and Housing Choice." Environment and Planning A **17**.
- de la Barra, T. (1989). Integrated Land Use and Transport Modelling. Cambridge University Press, Cambridge.
- DePalma, A. and B.-A. M. (1981). Interactive Dynamic Modeling of Residential Location Choice. International Conference on Structural and Economic Analysis and Planning in Time and Space, Umea, Sweden.
- DiPasquale, D. and W. C. Wheaton (1996). Urban Economics and Real Estate Markets. Prentice Hall: Englewood Cliffs, NJ.
- Douglas, B. (1995). Summary of Workshop Six. Travel Model Improvement Program: Land Use Modeling Conference.
- Ellickson, B. (1981). "An Alternative Test of the Hedonic Theory of Housing Markets." Journal of Urban Economics **9**: 56-79.
- Galster, G. C. (1977). "A Bid-rent Analysis of Housing Market Discrimination." American Economic Review **67**(2): 144-155.
- Hanushek, E. and J. Quigley (1978). "An Explicit Model of Residential Mobility." Land Economics **54**: 411-429.
- Harris, B. (1985). "Urban Simulation Models in Regional Science." Journal of Regional Science **25**(4): 545-567.
- Kain, J. F. and W. C. Apgar (1987). Housing and Neighborhood Dynamics: A Simulation Study. Cambridge, MA, Harvard University Press.
- Kaiser, E. J. and D. R. Godschalk (1995). "Twentieth Century Land Use Planning: A Stalwart Family Tree." Journal of the American Planning Association **61**(3): 365-385.
- Kelly, E. D. (1994). "The Transportation Land-Use Link." Journal of Planning Literature **9**(2): 128-145.
- Lancaster, K. J. (1966). "A New Approach to Consumer Theory." Journal of Political Economy **74**: 132-157.
- Landis, J. D. and M. Zhang (1998). "The Second Generation of the California Urban Futures Model Part I: Model Logic and Theory."
- Landis, J. D. (1994). "The California Urban Futures Model: a new generation of metropolitan simulation models." Environment and Planning B **21**: 399-420.
- Landis, J. D. (1995). "Imagining Land Use Futures: Applying the California Urban Futures Model." Journal of the American Planning Association **61**(4): 438-457.
- Lerman, S. (1976). "Location, Housing, Automobile Ownership, and Mode to Work: A Joint Choice Model." Transportation Research Record **610**: 6-11.

- Martinez, F. (1992). "The bid-choice land use model: an integrated framework." Environment and Planning A **24**: 871-885.
- McFadden, D. (1973). Conditional logit analysis of qualitative choice behavior. Frontiers in Econometrics. P. Zarembka. New York, Academic Press.
- McFadden, D. (1978). Modeling the choice of residential location in spatil interaction theory and planning models. Spatial Interaction Theory and Planning Models. A. Karlqvist, L. Lundqvist, F. Snickars and J. W. Wiebull. Amsterdam, North Holland: 75-96.
- McFadden, D. (1984). Econometric analysis of qualitative response models. Handbook of Econometrics. Z. Griliches and M. Inrilligator. Amsterdam, North Holland. **II**: 1395-1457.
- Miller, E. J., D. S. Kriger and J. D. Hunt (1998). Integrated Urban Models for Simulation of Transit and Land-Use Policies, Transit Cooperative Research Project, National Academy of Sciences.
- Mills, E. S. (1967). "An Aggregative Model of Resource Allocation in a Metropolitan Area." American Econometric Review **57**: 197-210.
- Muth, R. F. (1969). Cities and Housing. Chicago, University of Chicago Press.
- Nelson, A. C., J. B. Duncan, et al. (1995). Growth Management Principles and Practices. Chicago, American Planning Association.
- Nicholas, J. C., A. C. Nelson, et al. (1991). A Practitioner's Guide to Development Impact Fees. Chicago, IL, American Planning Association.
- Noth, M, A. Borning, P. Waddell (2000). "An Extensible, Modular Architecture for Simulating Urban Development, Transportation, and Environmental Impacts." Submitted for publication; draft available from <http://www.urbansim.org>
- Onaka, J. (1983). "A multi-attribute housing consumption disequilibrium model of residential mobility." Environment and Planning A **15**: 751-765.
- Onaka, J. and W. A. V. Clark (1983). "A disaggregate model of residential mobility and housing choice." Geographical Analysis **15**: 287-304.
- Parsons Brinckerhoff Quade and Douglas, I. (1998). Land Use Impacts of Transportation: A Guidebook, Transportation Research Board, National Research Council.
- Paulley, N. J. and F. V. Webster (1991). "Overview of and international study to compare models and evaluate land use transport policies." Transport Reviews **11**: 197-222.
- Putman, S. H. (1983). Integrated Urban Models. London, Pion.
- Quigley, J. M. (1976). "Housing demand in the short-run: an analysis of polytomous choice." Explorations in Economic Research **3**: 76-102.
- Rosen, S. (1974). "Hedonic prices and implicit markets: product differentiation in pure competition." Journal of Political Economy **82**: 34-55.
- Southworth, F. (1995). A Technical Review of Urban Land Use--Transportation Models as Tools for Evaluating Vehicle Reduction Strategies. Oak Ridge, TN, Oak Ridge National Laboratory.
- Strazheim, M. R. (1974). An econometric analysis of the urban housing market. New York, National Bureayu of Economic Research.
- Van Leirop, W. F. J. and A. Rima (1982). Towards an operational disaggregate model of choice for the housing market. Amsterdam, The Free University.
- von Thunen, J. H. (1826). Der Isolierte Staat in Beziehung auf Landwirtschaft und Nationaleconomie. Hamburg.
- Wegener, M. (1995). Current and Future Land Use Models. Travel Model Improvement Program Land Use Model, Dallas, TX, U. S. Department of Transportation.
- Wheaton, W. C. (1977). "A bid rent approach to housing demand." Journal of Urban Economics **4**(2): 200-217.
- Williams, R. C. (1979). A logit model of demand for neighborhood. The economics of neighborhood. D. Segal. New York, Academic Press: 17-42.
- Wolpert, J. (1965). Behavioral aspects of the decision to migrate. Papers and Proceedings of the Regional Science Association.

---

## 3.0 Installation and Use

### 3.1 The GNU Public License

The UrbanSim system and all accompanying software tools are licensed under an open source license, the GNU General Public License (GPL). The text of the license is distributed with the system source code in the file LICENSE, and is also available from the Free Software Foundation's web site at <http://www.gnu.org/copyleft/gpl.html>.

Briefly, the GPL means that we are distributing UrbanSim free of charge, including the source code as well as the compiled code. Anyone can use it and extend it. Nobody is obligated to distribute these extensions, but if they do distribute the system, it must also be licensed under the GPL and follow GPL's requirements, which include making the source code for the extensions available. This in turn allows still others to use the system freely as well. The new version must carry a notice that it is in fact a new version. Any data used to model a region is not part of the program, however, and is not covered by the GPL. Please see the License for the precise conditions – this is just an informal description of its major features.

There are tremendous advantages to this way of doing things. It encourages adoption and experimentation by the community. Since the source code as well as the compiled code is available, others can inspect it and gain a better understanding of the model's operation. It also avoids any problems with an agency or company making part of the system proprietary. There are no other restrictions on using UrbanSim beyond those specified in the GPL. For example, it is fine to use UrbanSim in for-profit as well as in non-profit and governmental activities, to contract to apply UrbanSim to a particular region, or to sell support services for it.

We would appreciate receiving bug reports and any other feedback or suggestions. We plan to continue the development and enhancement of the system, and feedback from users will play an important role in this work. However, UrbanSim is offered on an as-is basis, with no warranty expressed or implied, and we cannot promise that we will be able to address any particular suggestion or bug report. We would also appreciate receiving a copy of any useful addition to the system, for possible incorporation into future general releases. (We're still working out the details of the release process for new versions and enhancements. In many cases it may be more appropriate for developers of major new packages to provide such packages on their own web sites, with a link from our site, rather than to fold the new package into the base system.)

### 3.2 Installation

The UrbanSim system and all accompanying tools and sample data can be downloaded from <http://urbansim.org>. This section describes how to download and install each software or data component on your computer.

#### 3.2.1 System Requirements

UrbanSim has been developed using the Java programming language. The software has been tested on the Microsoft Windows 95/98, NT 4.0 and Linux platforms, and should run on other operating systems supporting Java 2. The memory requirements for running the model depend on the size of the database for the project. The Eugene-Springfield dataset, the sample dataset available for download, contains about 70,000 parcels, 15,000 grid cells, and 271 transportation analysis zones (TAZ). Using these data, and running on a Pentium III 333Mhz with 128 MB RAM, UrbanSim

executes in approximately 5 minutes per year. (This is probably the minimum reasonable system size and speed for a computer system that will be used to run UrbanSim. Larger regions will require more main memory to run.)

### 3.2.2 Installing Java

The UrbanSim modeling software requires Java 2 version 1.3 for operation. Java 2 can be obtained free of charge from the Sun Microsystems homepage, [www.sun.com](http://www.sun.com). From the Sun homepage navigate through the “download center” links for downloading Java 2 Standard Edition Version 1.3.

To install the software, double-click on the downloaded file (j2sdk1\_3\_0-win.exe or similar) and follow the instructions provided by the installation wizard. The final step you must take is setting the Path and Class Path to include the directory where Java was installed. Once Java is installed properly, typing ‘java -version’ in a command window should produce the following response:

```
F:\urbansim>java -version
java version "1.3.0rc1"
Java(TM) 2 Runtime Environment, Standard Edition (build 1.3.0rc1-T)
Java HotSpot(TM) Client VM (build 1.3.0rc1-S, mixed mode)
```

### 3.2.3 Installing UrbanSim

At the UrbanSim homepage, <http://www.urbansim.org>, select the “download” link and follow the links for downloading the model software. You will be asked to register and agree to the GNU licensing agreement before completing the download.

The UrbanSim software is downloaded in a ZIP file. To install UrbanSim, extract the files contained in UrbanSim.zip to the root directory on your hard drive. When extracted, all software components will be placed in a newly created “UrbanSim” directory.

### 3.2.4 Installing the Sample Project

The UrbanSim web site provides a sample project with which the model can be tested. The sample data is from Eugene-Springfield, containing the 1980 base year data used in a historical validation of the model. It can be downloaded from the UrbanSim web site in a ZIP file format. Download the sample project (SamplePR.zip) and extract its contents to the root directory of your hard drive.

### 3.2.5 The Project Directory

The sample project will be installed in a subdirectory of the UrbanSim directory, named “Eugene1980”. All project directories should have the following subdirectories:

```
+---InputData
|   +---BinaryDB
|   +---Coefficients
|   \---CommonData
\---Scenarios
    \---Default
        +---Input
        +---Output
```

The input data for the operation of the model is organized into four subdirectories. The first three of these directories are stored within the InputData directory. The BinaryDB directory contains the binary base year database that has been preprocessed by the data preparation tools into the form necessary for the operation of the model. In the Eugene1980 project, the name of the binary database

file is *test.db*. The Coefficients directory contains all of the files containing coefficients or model parameters that influence the operation of the model, and are not likely to vary between different scenarios. CommonData contains data common to the model system, including the input files from which the binary database is constructed. These files also would not be generally expected to vary between scenarios.

The second directory under the project parent directory is the Scenarios directory. This is where a user is expected to store all the inputs and results from running the model on different scenarios related to the project. The Input directory under scenarios contains the files that are likely to change between alternative scenarios, including control totals, travel model outputs, user-defined events, and other policy assumptions. Much of the activity of running the model will be to revise or replace these files between alternative scenarios and executing the model to produce new output based on the new assumptions. All outputs from a run of the model are stored in the Scenario Output directory.

### 3.3 Creating Scenarios and Running the Model

The process of running UrbanSim, once a binary database has been created, involves editing input files that define the assumptions on which a particular model run, or scenario, will be executed. Once these scenario input files are ready, the model is invoked using a batch file that contains arguments for identifying input and output directories, and controlling the length of the model run. All input and output of the model is in ASCII format, and files are delimited with the tab character unless noted otherwise. This allows ease of editing or loading into other software such as Excel, and simplifies the file formatting.

#### 3.3.1 Running the Model

Once Java is installed and running, and the user has downloaded and extracted the UrbanSim software and sample project, the model can be run by executing the batch file “Run\_UrbanSim.bat” in the UrbanSim directory. This can be done either by opening a command window, changing to the UrbanSim directory, and typing “Run\_Urbansim”, or alternatively, by double-clicking on this file from a Windows file manager. The model should run on the sample project from 1980 to 1994, issuing messages to the command window as it proceeds, and writing its output to the Scenarios\Default\Output directory. The balance of this section describes the input files that may be edited to change the assumptions in the default scenario. In normal use on an actual project, users would copy the contents of the Scenarios\Default to a new scenario directory, such as Scenarios\Alternative1, for example, before proceeding to edit these files. This facilitates comparison of the results of alternative scenarios.

#### 3.3.2 Input Files

The specific files to be edited for a particular scenario are:

TimeConfiguration.tab	Start and end dates, reporting years, travel model years
LDRM_Input.tab	Run parameters to use development constraints
EmploymentControlTotals.tab	Employment control totals for at least first and last year
PopulationControlTotals.tab	Population control totals for at least first and last year
PLUDevConversion.tab	Development constraints imposed by Land Use Plan or Zoning
SqftPerEmployeebyYear.tab	Space utilization rates by devtype, potential trend
UnitsPerEmployeebyYear.tab	Maximum employment in housing by devtype, potential trend
DevelopmentEvents.tab	Anticipated development events ‘in the pipeline’
BusinessEvents.tab	Anticipated business events
GridUpdateEvents.tab	Anticipated policy events

Files generated from the Travel Models:

CarOwnershipProbabilities.tab  
AccessLogsum.tab  
HighwayTimes.tab

Database Components that may be changed to reflect policy changes:

SavedGridCells.tab                      Contains land use plan, and policy and environmental overlays

### 3.3.3 Time Configuration

The basic time management of a simulation run is controlled by the data in TimeConfiguration.tab, as shown below:

```
# UrbanSim Scenario File ver. 1001
# Start Year
1980
# Stop Year
1994
# Number of reporting years
15
# Reporting years (if any) separated by commas
1980,1981,1982,1983,1984,1985,1986,1987,1988,1989,1990,1991,
1992,1993,1994
# Number of years to run the travel model
0
# Travel model years (if any) separated by commas
```

The start year is the same as the base year, with only the developer model running in this year to generate initial conditions for the first full simulation year. The start year must be greater than or equal to the base year for the database. The stop year is the ending year for the simulation. Any individual years between the start and end years may be listed as reporting years, which means that all ASCII files exported by the model will be written for these years. If only certain years are of interest, then only these years are included in the list of reporting years, thus speeding up the operation of the model, since writing the ASCII export files is one of the more time consuming aspects of the model operation.

Travel model years are those years in which the travel model system is to be run. When the model system reaches a travel model year, it terminates, automatically writing all output files so they can be used in the travel models. Once the appropriate travel model outputs are placed in the scenario input directory as described later, the start year is edited in the time configuration file to begin with the first year after the travel model execution, and the model is run again to simulate the next period until the subsequent travel model year. Note that this interaction requires manual intervention, since UrbanSim is intended to interface with existing travel modeling systems in a variety of platforms. All file exchange with the travel models is through standard formatted ASCII files.

### 3.3.4 Control Totals

Scenarios are constrained to match external control totals for employment and population for the study area, as input by the user into two files. The totals are typically obtained from macroeconomic forecasting models such as Input-Output or structural econometric models. The totals must be entered for the first and last years of the simulation run, at a minimum, and may be put in for each year of the simulation period if available. Similarly, totals may be put in by employment sector and by household type, if available, but only total population and total employment are required.

The population control totals are stored in PopulationControlTotals.tab. The data for the sample project from Eugene-Springfield are shown below:

```
#Year,Population
Year: 1980
Total: 217002
Size: 14675 52214 39096 57932 53085

Year: 1994
Total: 249409
Size: 17291 59928 46746 66144 59300
```

The first line of the file contains a comment, as indicated by the initial '#' character. Note that the control totals for population must include the beginning simulation year and the end simulation year, and may optionally include intermediate years. In addition to total population, the population by household category may also be included. The sample project includes household categories for income, household size, age of head, presence of children, and number of workers. The example above includes subtotals for population by household size. In the absence of subtotals such as this, the base year household distribution will be scaled to end year population control totals.

The employment control totals are stored in EmploymentControlTotals.tab. The sample project file contains the following data:

The employment totals are used in a similar way to population totals, with the difference that employment only contains one dimension of classification, the industrial sector. Sectors are defined by the user as aggregations of detailed Standard Industrial Classification codes during the data preparation process. Note here that the employment control totals are specified by sector.

### 3.3.5 Land Use Plan Policies

The land use plan may be used to impose constraints on the development of urban real estate by location, using the data in PLUDeConversion.tab file. Each grid cell is coded with a predominant land use plan designation, and the constraints on development that apply to each plan designation may specify any of the 24 development types as being excluded from occurring. In addition, these policies may be generic to the entire metropolitan region, or may be tailored to specific counties, cities, or overlays such as environmentally sensitive areas or urban growth boundaries. In the example below, the only constraint on development is the exclusion of all forms of development outside the urban growth boundary.

Even if the land use plan is not used as a 'hard' constraint, the developer model may be calibrated to include variables reflecting the historical influence of land use plan designations on patterns of development. This may reflect a more market-realistic use of land use plan policies than the hard constraints imposed in the PLUDevConversion file, but both may be useful for testing policy effects.

#County	City	Overlay	PLU	Devtype
-1	-1	UGB	-1	1
-1	-1	UGB	-1	2
-1	-1	UGB	-1	3
-1	-1	UGB	-1	4
-1	-1	UGB	-1	5
-1	-1	UGB	-1	6
-1	-1	UGB	-1	7
-1	-1	UGB	-1	8
-1	-1	UGB	-1	9
-1	-1	UGB	-1	10
-1	-1	UGB	-1	11
-1	-1	UGB	-1	12
-1	-1	UGB	-1	13
-1	-1	UGB	-1	14
-1	-1	UGB	-1	15
-1	-1	UGB	-1	16
-1	-1	UGB	-1	17
-1	-1	UGB	-1	18
-1	-1	UGB	-1	19
-1	-1	UGB	-1	20
-1	-1	UGB	-1	21
-1	-1	UGB	-1	22
-1	-1	UGB	-1	23

Note that the value of -1 in the file, indicating a null value. Null values are used to indicate that the field value is to be ignored. In this case the implication is that the policy constraint applies to all counties, cities, and planned land use values, leaving the constraint applied only to the cells outside the urban growth boundary.

#Year, Emp										
Year: 1980										
Total: 76026										
Sector:	810	7058	2690	1017	1810	3426	102	4627	5152	16418
	3442	15561	0	0	9856	4057				
Year: 1994										
Total: 98704										
Sector:	994	5494	4746	1206	2873	3968	115	5107	5173	21080
	4943	29312	0	0	8883	4810				

### 3.3.6 LDRM Input

A small control file, LDRM\_Input.tab, is used to store a Boolean value for a flag that determines whether to impose the constraints included in the PLUDevConversion.tab file or not. The file may be used for other values not documented here, but this is the most important function of this file. This allows the user to easily test the effects of imposing binding land use plan constraints on the simulation results. The contents of the file are as follows, with the value true or false set by the user.

```
use PLUDevConversion table:true
```

### 3.3.7 Space Utilization per Employee

Since the UrbanSim model is explicit about the accounting of the use of real estate by households and firms, we allow the user to define the utilization rate for nonresidential space for each development type, and to specify whether there is any trend over time in the utilization of any type of space due to changing market or technological conditions. The base year and end year of the simulation must have values, though they may be the same. An example of this data, as stored in the file 'SqftPerEmployeeByYear.tab' are shown below.

```
# Year, Devtype, Sqft/Emp
1980 1 750
1980 2 750
1980 3 750
1980 4 750
1980 5 750
1980 6 750
1980 7 750
1980 8 750
1980 9 500
1980 10 500
1980 11 500
1980 12 500
1980 13 500
1980 14 500
```

In addition to space used in nonresidential buildings, employment is frequently located in residential housing. Employment that is found in residential units during the data preparation process is left there, up to a maximum ratio of units per employee per grid cell, defined by the user. These same ratios are used when locating jobs in grid cells during a simulation, and serve as a maximum number of jobs that can be placed within housing units in a grid cell. The data are stored in a file named 'UnitsPerEmployeeByYear.tab', as shown below. A trend may be included to reflect assumptions regarding telecommunications and other factors contributing to residential-based employment.

```
# Year, Devtype, Units/Emp
1980 1 5
1980 2 5
1980 3 5
1980 4 5
1980 5 5
1980 6 5
1980 7 5
1980 8 5
1980 9 5
1980 10 5
```

### 3.3.8 Development Events

Development events are user-specified events that are added to an input file and processed by the model as though they were generated by the simulation. The user must specify the details of the development project within the form of the model database, which is based on grid cells. Therefore the cells affected by the development must be identified, and the nature of the changes to the model

database to reflect the incorporation of the event must be explicitly defined. Changes can include addition, demolition, or modification of current real estate development within a cell.

The degree of certainty of information about a project may be specified by indicating whether a project is committed or proposed. Committed projects are treated as having complete certainty, while potential projects must compete with other outcomes simulated by the developer model. An incremental probability may be assigned to potential projects to reflect user expectations of the likelihood of the project occurring. In such a case, the specified project adds the user-defined probability, and the probabilities predicted by the model for the remaining outcomes for the cell are scaled down in proportion.

The elements of a development event, stored in the DevelopmentEvents.tab file, are:

GridCell	The Id number of the grid cell in which the event takes place
DevelopmentID	Unique identification number for a development event, shared by affected cells
StartYear	The year to initiate the development event
EventType	The type of development event: A (add new development), D (demolish existing development), C (change existing development)
NumYears	The number of years over which to phase the development
Phased	0 (build in start year), 1 (prorate across NumYears), 2 (hold development until it is complete)
Commitment	C=committed, P=potential
Probability	Probability to add to the development event (-1 indicates no user assignment)
Units	Housing units
Sqft	Nonresidential building square footage
ResImpval	Residential building value (in current dollars)
NresImpval	Nonresidential building value (in current dollars)
PrimaryUse	Primary use of cell after event, used to assign Devtype (C=commercial, I=industrial, G=government, R=residential, M=mixed use, V=vacant)

Committed projects are processed at the beginning of a simulation year, preceding the developer model application. Potential projects are flagged for special consideration during the developer model.

A special consideration for user-defined development events is that these will inflate the quantity of real estate development simulated by the size of the specified events. While this may seem obvious, the implications may not be. If a very substantial quantity of development is specified by the user over the first several years of a simulation run, then the model is likely to over-predict real estate development in the near term, and would need to compensate by reacting to increasing vacancy rates as the development outpaces demand. If the development event feature is to be used heavily by the user, it would perhaps be appropriate to exclude the developer model from running for these years, in order to avoid such artificial over-production of real estate development. This can be done by separating the simulation period into a short-term period in which all development is specified through events, and a long-term model run that begins at the end of the first run, and which contains at most a limited number of potential projects, and relies on the simulated results of the developer model.

### 3.3.9 Employment Events

Like development events, local planners may have information about anticipated events that would affect local concentrations of employment, such as a corporate relocation or closure. It is useful to accommodate information about these events, including an assessment of the potential impacts of a

major corporate location decision, for the same reasons as for development events. Just as there are complications in considering development events, the introduction of user-specified employment events raises issues regarding interaction with real estate development and with the operation of the macro-economy. In the first case, the addition of employment to a cell through a user-specified event might be accommodated within existing real estate, might involve displacing existing jobs, or might be accompanied by the construction of space specific to the firm being located. In the second instance, the addition or subtraction of jobs from a cell might be considered as raising or lowering the regional quantity of employment, thereby creating an offset from the specified regional control totals, or might be considered as being accommodated within the control totals. In order to manage the complexity of the potential interactions, we make two simplifying assumptions in the current implementation of employment events:

1. If there are interactions between employment events and development events, the user is responsible for creating the appropriate development and employment events to ensure their consistency. The model will generate error messages if this is not done.
2. The current implementation assumes that any net additions or subtractions of employment from the set of employment events encountered for a specific year will offset the regional employment control totals by the same amount, and that this offset will carry forward into future years unless subsequently modified by another employment event.

If a business event covers multiple cells, then these would need to be treated as separate events. The components of an employment event, stored in the EmploymentEvents.tab file, are:

GridCell	The Id number of the grid cell in which the event takes place
EventYear	The year to initiate the employment event
EventType	The type of event: A (add new jobs), D (delete jobs), C (change existing jobs), M (move existing jobs)
Sector	Employment sector
Jobs	Number of jobs

Where the event type is interpreted as follows:

- A Addition of new jobs in given sector to gridcell. Event is constrained by the available square feet. Thus, if 10 jobs are requested but there is only enough square feet for five jobs then only 5 will be built.
- D Deletion of jobs in given sector from gridcell. Jobs are removed entirely, not placed in limbo. Event is constrained by the number of jobs within the given sector on the gridcell.
- C Change total job count in given sector. Event deletes all jobs in sector currently located on cell freeing the square footage. After complete removal, event adds given jobs to gridcell in sector constrained by the amount of available square feet.
- M Move given number of jobs in sector from gridcell into limbo (i.e., jobs will be placed elsewhere). Event is constrained by the existing number of jobs in sector on gridcell.

### 3.3.10 Policy Events

A third type of user-specified event is a policy event. This includes user-specified changes at the grid cell level for an urban growth boundary, land use plan designation, or environmental or special policy overlay. Data regarding such user-specified policy events is stored in the file GridUpdateEvents.tab, as shown below.

```
#YEAR FIELD FILENAME FILETYPE DATATYPE/FIELDNAME
# YEAR - when the update should take place
# FIELD - what field should be updated
# FILENAME - the filename containing the gridIDs and values to update
# FILETYPE - what type of file is "filename", either FCOEFF or OVERLAY
# DATATYPE/FIELDNAME - if filetype is OVERLAY, then the data type stored
# in the file. if filetype is FCOEFF, then the fcoeff field name of
# the new values.
# when using fcoeffs the gridIDs are assumed to be in a fcoeff field
# with the same name as the DB's gridID field name
#
#1981.0 UGB ugb.fcoeff FCOEFF ugb
#1990.0 PLANTYPE plantype.fcoeff FCOEFF plan
#1981 STREAM stream.asc OVERLAY int
```

### 3.3.11 Inputs From Travel Models

UrbanSim currently uses three sets of outputs from a travel model to capture the effects of transportation policy changes on real estate and household and employment location. These three outputs are the composite utilities of travel from zone to zone by auto ownership class from the mode choice model, the auto ownership probabilities from the vehicle ownership model, and the am peak auto travel times for home based work trips.

#### 3.3.11.1 Car Ownership Probabilities

The car (or vehicle) ownership probabilities predicted by a vehicle ownership component of an external travel model system are typically a function of household size and income distributions, at a minimum, and increasingly also consider local land use characteristics such as density and parking costs, as well as availability of transit alternatives. UrbanSim uses these predicted probabilities to assign an auto ownership to each household, in a manner consistent with that generated by the travel model system, since auto ownership and residential location choices are likely to be interdependent. This linkage of auto ownership and residential location represents a small but important step toward a more complete model integration in the long-run, since it would be preferable to consider in a more integrated way several key household choices related to housing, labor supply, auto ownership and travel. However, this is beyond the scope of a more loosely coupled land use and travel model system.

The auto ownership probabilities may be indexed by zone, if zonal information is considered in the auto ownership model. If not, the generic nodata value of -1 is used for the zone value and only income and household size are included in the data with the auto ownership probabilities. The data are stored in YYYY\_CarOwnershipProbabilities.tab (where YYYY is the year of the travel model run), as shown in the partial sample below.

#Zone	LoInc	Hiinc	Size	Prob0	Prob1	Prob2+
1	0	19999	1	0.55	0.42	0.03
1	20000	39999	1	0.23	0.7	0.08
1	40000	74999	1	0.12	0.64	0.23
1	75000	999999	1	0.12	0.57	0.31
1	0	19999	2	0.5	0.39	0.11
1	20000	39999	2	0.18	0.56	0.25
1	40000	74999	2	0.07	0.37	0.56
1	75000	999999	2	0.06	0.28	0.66
1	0	19999	3	0.49	0.38	0.13
1	20000	39999	3	0.17	0.51	0.32
1	40000	74999	3	0.05	0.26	0.69
1	75000	999999	3	0.04	0.17	0.8

Note that auto ownership probabilities up to 3 or more can be entered in the file. The classification of car ownership is entered in the CarOwnershipCategories.tab file.

### 3.3.11.2 Composite Utilities

The primary influence of transportation access on real estate development, household and employment location is captured through access indicators generated by interacting the spatial distribution of activities with the composite utility of travel to those activities. The composite utility measure, or logsum, is generated by the mode choice model, and incorporates all the attributes of travel utility that are included in the mode choice model. Most mode choice models are stratified by auto ownership class, reflecting the differing travel constraints and weights placed on transit modes by different auto ownership groups. UrbanSim uses these composite utilities by auto ownership to associate the appropriate access measures to households by auto ownership group. The data for the composite utility are extracted from the results of the mode choice model and formatted in the AccessLogsum.tab file as shown in the partial sample below, in this case with a stratification of the mode choice model into four auto ownership categories.

#Fzone	Tzone	Logsum0	Logsum1	Logsum2	Logsum3+
25	25	-5.8313	-3.2937	-1.9503	-2.0275
25	26	-3.827	-1.9055	-0.6032	-0.675
25	27	-6.0462	-2.2871	-0.9097	-0.9891
25	28	-5.3814	-2.0754	-0.7022	-0.781
25	29	-2.7706	-1.7427	-0.603	-0.6589
25	30	-2.0733	-1.4651	-0.5203	-0.5614
25	31	-4.1398	-2.1247	-0.7737	-0.852
25	32	-3.7248	-2.0408	-0.7104	-0.7871
25	33	-3.7552	-2.0466	-0.7143	-0.7912
25	34	-5.8174	-2.146	-0.7669	-0.8463
25	35	-5.9098	-2.6864	-1.3207	-1.3992
25	36	-6.0177	-2.7622	-1.3966	-1.4752

The logsum values in their original form from the mode choice model vary in scale and range from negative to positive values. In their use as exponential weights for the activities available at alternative destinations using an entropy formulation, positive values of the logsum distort the influence of these zones, so users are expected to shift the values of each logsum variable so that the maximum value of each is zero. This assures that the exponential weight will always produce a contributing value that is between zero and the original value of the activity in the zone.

### 3.3.11.3 Highway Travel Times

Highway travel times are used to measure travel times to key regional destinations such as a primary central business district and regional airport. These variables may be used as independent variables in the employment or residential location choice models. The data are stored in the file YYYY\_procHighwayTimes.tab, as shown in the sample below:

#Fzone	Tzone	Time
25	25	2.707
25	26	5.806
25	27	10.595
25	28	7.776
25	29	6.007
25	30	4.957
25	31	8.371
25	32	6.885
25	33	6.976
25	34	8.992
25	35	19.621
25	36	20.251

Note that if travel times are stored internally in the travel model system in some transformation such as minutes\*100, they need to be returned to their untransformed values as minutes before formatting as above.

## 3.4 Outputs from UrbanSim

UrbanSim writes a series of ASCII files for any year in which the user specifies that data should be exported in the TimeConfiguration.tab file. The model exports a series of files for the requested reporting years, summarizing the simulation results by grid cell, traffic analysis zone, and for the region as a whole. All of these results are placed in the Scenarios\ScenarioName\Output directory, where ScenarioName is the user-defined name of the scenario. Section 4 contains the detailed contents of each of the output files.

## 3.5 Runtime Options

The following sections provide detailed information regarding run-time options that may be used to manage the operation of a simulation.

### 3.5.1 ModelCoordinator Command Line Arguments

The model is run by invoking the model coordinator in Java, with appropriate arguments. This may be stored in a batch file for efficiency. The model coordinator is invoked in a command window by typing:

```
java urbansim.ProjectCode.ModelCoordinator
```

The possible arguments are given below. If there is a second argument in parentheses, it is a shorter and equivalent abbreviation for the first. (See the batch file "Run\_UrbanSim.bat", mentioned in section 3.3.1, for an example of a plausible set of command arguments.)

-scenariodir (-sd) <pathname>

Required. Sets location of scenario directory. Assumes the given scenario directory contains 'Input' and 'Output' directories.

-output (-out) <pathname>

Optional. Used to override default output location of {scenariodir}/Output.

-dependencies (-dep(s)) <pathname>

Optional. Overrides default data dependency file location of {scenariodir}/Input/datadeps.txt.

-debugflags (-debug) <pathname>

Optional. Sets the optional debug flags file location which defines the level of debugging output. Defaults to no debugging output.

-input (-in) <pathname>

Required. Defines location of directory containing Coefficients and CommonData subdirectories.

-db <pathname>

Required. Sets path to binary database to be used as the simulation base data.

-common <pathname>

Optional. Overrides default location of the common data dir at {inputdir}/CommonData.

-scenarioname (-sc) <pathname>

Optional. Sets path to optional scenario name file for tracking exported data per scenario. Functionality still in alpha stages.

-swapdir (-swap) <pathname>

Optional. Overrides default location of memory swap directory of current runtime directory.

-calibrator (-cal) <pathname>

Not intended for use by a modeller. This is used by a Calibrator package, which uses simulated annealing or other search techniques to fit coefficients across the entire system to fit the observed data. The Calibrator is not included in the current release, but will be in a future one.

-earlyendyear (-end) <year>

Optional. Defines an end year that is earlier than the given end year located in the TimeConfiguration.tab file within {scenariodir}/Input.

-startyear (-start) <year>

Optional. Defines a start year that is later than the given start year located in the TimeConfiguration.tab file within {scenariodir}/Input.

-nowrite (-nosave)

Optional. This flag as a command line argument overrides the default action of saving the database at the end of the simulation.

### 3.5.2 Debugging Flags

Configuration options are stored in a file named DebugFlags.txt. These options are given to the ModelCoordinator and the various model components, and define what debugging information should be generated while the model runs. The output will be written primarily to MC.log with some limited output to DBImport.log. These debug flags provide valuable tools to diagnose aspects of the model behavior the user wishes to investigate. They are organized below according to the model component in which they are generated.

#### ModelCoordinator

DevelopmentEvents	Log characteristics of each development event as it gets implemented
ModelOrdering	Log detailed information on model ordering, creation, and scheduling
DataDeps	Dump detailed information on data dependencies
BusinessEvents	Dump business events as they occur and are processed
DevelopmentDisplacement	Display information on households/businesses displaced by a development event
BaseYearData	Display base year data totals
Updates	Display information on every single database update - be warned that this will print a very large amount of data causing a much longer model run time
ObjectMemoryUsage	Display object memory usage figures for each timestamp

#### Database

Filters	Log debugging info on filters
SpatialQueries	Log debugging info on spatial queries
ExtractResults	Display information on the object result-extraction process
IDOptimization	Log info on the use of ID-equality optimizations
SizeOptimization	Dump info on the use of field counts to preinitialize sizes of return structs
Query	Display information on every query made to the database
QueryResults	Display information on results of every query made to the database
ModifyUpdate	Log the contents of every MODIFY update
CreateUpdate	Log the contents of every CREATE update
RemoveUpdate	Log the contents of every REMOVE update
IterationStart	Log a message whenever object iteration is started (vs an optimization)
MonitorMemoryThread	Start a thread that monitors and logs memory usage
QueryResultSize	Display diagnostics on size of returning QueryResult objects
AllowSwapping	Allow for swapping of data to disk to try to reduce memory requirements
GridLists	Display diagnostics on the per-gridcell object lists

---

GridOptimizations	Display diagnostics on grid-related optimizations
TypeTupleOptimization	Display type tuple set-based optimizations
<b>Scenario</b>	
Interpolation	Dump information on the interpolation process for all control totals
DemoControlTotals	Display the demographic control totals
EconControlTotals	Display the economic control totals
HomeBasedBusinessProportions	Display the initial home-based business proportions
<b>Accessibility Model</b>	
WarnZones	Display warnings about zone IDs not found during accessibility data loading
JobSums	Display per-job employment summation diagnostics
HouseholdSums	Display per-household population summation diagnostics
ZoneSums	Display per-zone summation terms
<b>BasicObject Model</b>	
OnChangeBehavior	Display parcel<->bldg sqft/units invariant maintenance info
<b>Job Mobility Model</b>	
MovingJobs	Display a list of every moving job
<b>Demographic Transition Model</b>	
HHCreate	Debug the household creation process
HHDelete	Debug the household deletion process
PopTotals	Log population totals and marginals
DisaggregatePopTotals	Log disaggregate (detailed) population totals and marginals
<b>Economic Transition Model</b>	
JobCreate	Debug the job creation processes
JobDelete	Debug the job deletion processes
EmpTotals	Log employment totals and marginals
DisaggregateEmpTotals	Log disaggregate (detailed) employment totals and marginals
NonModeledIndustry	Display information on proportional growth of non-modeled industries
<b>Employment Location Choice model</b>	
LogitTerms	Log all the terms in the per-alternative logit equation (long!)
JobsToPlace	Log the list of jobs to be placed
ConsideredGCs	Display each gridcell being considered, per job
AccessibilityTerms	Display accessibility term data
LandValTerms	Display land value term data
ProbRanking	Display information on probability ranking
SelectionProcess	Display location selection process and progress
LogUpdates	Display updates before being sent back to database
WarnUnplaced	Display warnings for each job that cannot be placed
<b>Residential Location Choice model</b>	
LogitTerms	Log all the terms in the per-alternative logit equation (long!)
ProbRanking	Display information on probability ranking

---

---

SelectionProcess	Display location selection process and progress
LogUpdates	Display updates before being sent back to database
VacantSpace	Display cell counts with any empty space
VacantSpaceAlternatives	Display cell counts with any empty space, per alternative set
WarnUnplaced	Display warnings for each household that cannot be placed
<b>Developer Model</b>	
ChoiceModel	Misc debugging output
<b>Price Adjustment model</b>	
PriceAdjustments	Display adjusted price for every gridcell
AreaQueries	Display diagnostics relating to every area-based query
PriceTerms	Display terms of price adjustment equation (long)
<b>Sqft/Employee Adjustment Model</b>	
JobDisplacement	Display diagnostics on jobs displaced due to changing space requirements
<b>Export model</b>	
WriteHeaders	Write headers to tops of tab-delimited files
WarnZones	Display warnings about Zone/TAZ values being skipped
WriteGridHouseholdJoint	Write the joint household distribution per gridcell (GridHouseholdJoint.tab) NOTE: File can be over 1 GB in size per year!
WriteZoneHouseholdJoint	Write the joint household distribution per zone
WriteGridHousehold	Write the GridHousehold file (households by gridcell)
ZoneFracShortfall	Display diagnostics about fixed roundoff errors for zone hh/job aggregates

## 4.0 Appendix: File Contents and Formats

### 4.1 File Formats

The format of each ASCII, tab-delimited file used as input to UrbanSim is documented in a separate file with the suffix 'coeff' or 'fcoeff'. From the user perspective coeff and fcoeff files perform the same function of describing the format of a particular input file, though they have different implications for how the model will read the data they refer to. Henceforth they will both be referred to as fcoeff files. Fcoeff files are simple tab-delimited ASCII text files that describe an accompanying tab-delimited ASCII data file (heretofore referred to as 'tabfile'). The purpose of fcoeff files is to classify via column name and data type the contents of the tabfile. Ordering of variables within the fcoeff file is critical to proper operation. The file contains the following line types: header line, file line, column description. Below is a line-by-line description of these elements within the fcoeff file:

Notes:

<t> indicates imbedded tab character

tabfile and fcoeff must be located in same directory

Name	Syntax	Notes
header line	header	optional, if present denotes existence of human readable header line in tabfile
file line	FILE<t>filename	if 'header' does not exist, the file line should be the first line in the file
column description	name<t>data type<t>comment	column descriptions must be listed in order as they appear left to right in tabfile

The following is an example of an fcoeff file:

```
header
FILE  fakefile.tab
Col1  Integer This is a comment
Col2  Float   This is another comment
Col3  Short   We could do this all day
```

The following are acceptable type identifiers for data types (all are case insensitive):

int/integer, float, double, string, short, byte, long, boolean

Ranges for accepted values:

For byte, from -128 to 127, inclusive

For short, from - 32,768 to 32,767, inclusive

For integer, from - 2,147,483,648 to 2,147,483,647, inclusive

For long, from - 9,223,372,036,854,775,808 to 9,223,372,036,854,775,807, inclusive

For float and double, see the single-precision 32-bit and double-precision 64-bit format IEEE 754 values and operations as specified in IEEE Standard for Binary Floating-Point Arithmetic, ANSI/IEEE Standard 754-1985 (IEEE, New York).

The following is a reference list of files, organized according to the directory in which they reside. Each reference contains the location of the file, a brief description of its application and the files contents. Please note that this list is a temporary placeholder for information about specific model configuration files. The next release of UrbanSim will transition to a XML-based file format, and include a user interface that manages these files.

## 4.2 CommonData

The files listed below are located in the CommonData directory within the project InputData directory. These files are generally not intended for change within a project. In general, each of these files contains common project characteristics that are used by the entire Urbansim modeling system.

### Base Data Year

Defines the base year for which the database has been constructed.

**FILE: BaseDataYear.tab**

Year	Integer	Year associated with database
------	---------	-------------------------------

### Car Ownership Categories

Defines the existence of given car ownership categories for the base data set.

**FILE: BaseDataYear.tab**

Category	Integer	Ownership category
Description	String	Description

### Development Type Names

Describes the development types and their constraining characteristics.

**FILE: DevtypeNames.tab**

Devtype	Integer	Development type
Name	String	Name
UnitsLow	Integer	Min. units for type
UnitsHigh	Integer	Max. units for type
SqftLow	Integer	Min. sqft for type
SqftHigh	Integer	Max. sqft for type
PrimaryUse	String	Primary use description
PrimaryUseCode	Integer	Primary use code
VacancyType	Integer	1 = SQFT, 0 = UNITS
LocalVacancyWeight	Float	Value associated with local vs regional vacancy relationship
StructuralVacancy	Float	Structural vacancy rate associated with the above local vacancy weight

### Income Categories

File defines the income categories and their constraining characteristics.

**FILE: incomeDollarValues.tab**

Income	INTEGER	Income category
Median	INTEGER	Median income (\$)
Min	INTEGER	Min. income (\$) for category
Max	INTEGER	Max. income (\$) for category
Description	STRING	Description of category

### Land Use Plan Conversions

Describes conversion rules between the ALU and PLU types.

#### FILE: LandUsePlanConversion.tab

County	Integer	County Code
City	Integer	City Code
Overlay	Integer	Overlay Number
PLU	Integer	Planned Land Use
ALU	Integer	Actual Land Use

### Travel Model Categories

The following files describe travel model categories and characteristics.

#### FILE: TravelModelHHSizeCategories.tab

Category	Integer	Travel model household size category #
Min	Integer	Min # of persons
Max	Integer	Max # of persons

#### FILE: TravelModelIncomeCategories.tab

Category	Integer	Income category #
Min	Integer	Min dollar amount of category
Max	Integer	Max dollar amount of category

#### FILE: TravelModelWorkerCategories.tab

Category	Integer	Travel model worker category
Min	Integer	Min. # of workers in category
Max	Integer	Max. # of workers in category

### Zone Fractionation

The procFracZoneData.bin file is the processed, binary version of this file. This file is not intended to be changed.

#### FILE: zoneFractions.tab

area	float	Total area of zone
count	int	Total number of gridcells in zone
frac	float	Generic Comment
gridid	int	Generic Comment
taz	int	Generic Comment

### Zone Mapping

The following files are used internally as tools for mapping zone external identifiers to internal ones. The zoneIDtoIntMapping maps external IDs to an internally consistent set (ie, 1,2,3...). The ZoneMap file represents translation rules for zone maps and is not at this time supported.

**FILE: zoneIDtoIntMapping.tab**

ExternalID	Integer	External ID
InternalID	Integer	Internal ID

**FILE: ZoneMap.tab**

LowValue	Integer	The lower end of this zone-translation's range inclusive
HighValue	Integer	The upper end of the range inclusive
AddedValue	Integer	The translation to make

**Household Birth and Death Rates**

The user defines the household birth and death rates in, **HouseholdBirthDeathRates.tab** using the following format:

**FILE: HouseholdBirthDeathRates.tab**

Income	Integer	Income category
Age	Integer	Age category
Persons	Integer	Size of household
Workers	Integer	Workers in household
Child	Integer	Number of children
BirthRate	Float	Birth rate
DeathRate	Float	Death rate

**Household Mobility Rates**

The user provides the Household Mobility Rates using the following format:

**FILE: HouseholdMobilityRates.tab**

Age	Integer	Age
Income	Integer	Income Category
Persons	Integer	Number of persons
Workers	Integer	Number of workers
Child	Integer	Count of children
Rate	Float	Movement rate

**Job Mobility Rates**

The user provides job mobility rates per sector in **JobMobilityRates.tab** using the following format:

**FILE: JobMobilityRates.tab**

Sector	Integer	Job sector
Rate	Float	Move rate

**Price Adjustment Beta Values**

The user provides beta values for the Price Adjustment model here.

**FILE: PriceAdjustBeta.tab**

RegionBeta    Float    Beta adjustment coefficient for the region  
 AreaRadius    Float    Radius (meters) around center of gridcell for neighborhood  
 AreaBeta      Float    Beta adjustment coefficient for the area around a gridcell  
 # Price adjustment equation parameters, broken down by Devtype  
 # If that degree of control is not needed, just set all the values to be  
 # equal.

**Price Adjustment by Development Type**

User may define Price Adjustment Model parameters here for scaling factors by development type.

**FILE: PriceAdjustParam.tab**

Devtype	Integer	Development type
IncreaseBeta	Float	Scaling factor for increasing ( $\geq 1$ ) values
DecreaseBeta	Float	Scaling factor for decreasing ( $< 1$ ) values
# Regional/zonal scaling factor		
Delta	Float	Scaling factor for regional/zonal influence
# Increase, decrease caps expressed as proportions of the regional avg		
# To remove caps, set IncreaseCap to be very large, and DecreaseCap to be 0.		
IncreaseCap	Float	Max allowable fractional increase as compared to regional avg
DecreaseCap	Float	Max allowable fractional decrease as compared to regional avg

**4.3 Coefficients**

The files listed below are located in the Coefficients directory within the project InputData directory. These files are generally not intended for change within a project. In general, each of these files contains model dependent coefficient values.

**Probability of Car Ownership by Income and Household Size**

The user provides the probability of car ownership by household size and income using the following format:

**FILE: CarOwnershipProbs.tab**

MinInc	Integer	Min (dollar) income level
MaxInc	Integer	Max (dollar) income level
Size	Integer	Household size (# of persons)
Zero	Float	Prob. of zero cars
One	Float	Prob. of one car
Two	Float	Prob. of two cars
ThreePlus	Float	Prob. of 3+ cars

**Land Price Coefficients**

The user may define specific model coefficients.

**FILE: LandPriceCoeffs.tab**

Constant	Float	Intercept
R1	Float	0/1 dummy for particular devtype
R2	Float	0/1 dummy for particular devtype
R3	Float	0/1 dummy for particular devtype
R4	Float	0/1 dummy for particular devtype
R5	Float	0/1 dummy for particular devtype
R6	Float	0/1 dummy for particular devtype
R7	Float	0/1 dummy for particular devtype
R8	Float	0/1 dummy for particular devtype
M1	Float	0/1 dummy for particular devtype
M2	Float	0/1 dummy for particular devtype
M3	Float	0/1 dummy for particular devtype
M4	Float	0/1 dummy for particular devtype
M5	Float	0/1 dummy for particular devtype
M6	Float	0/1 dummy for particular devtype
M7	Float	0/1 dummy for particular devtype
M8	Float	0/1 dummy for particular devtype
C1	Float	0/1 dummy for particular devtype
C2	Float	0/1 dummy for particular devtype
C3	Float	0/1 dummy for particular devtype
I1	Float	0/1 dummy for particular devtype
I2	Float	0/1 dummy for particular devtype
I3	Float	0/1 dummy for particular devtype
GV	Float	0/1 dummy for particular devtype
P1	Float	0/1 dummy for particular plantype
P2	Float	0/1 dummy for particular plantype
P3	Float	0/1 dummy for particular plantype
P4	Float	0/1 dummy for particular plantype
P5	Float	0/1 dummy for particular plantype
P6	Float	0/1 dummy for particular plantype
P7	Float	0/1 dummy for particular plantype
P8	Float	0/1 dummy for particular plantype
P9	Float	0/1 dummy for particular plantype
P10	Float	0/1 dummy for particular plantype
P11	Float	0/1 dummy for particular plantype
P12	Float	0/1 dummy for particular plantype
P13	Float	0/1 dummy for particular plantype
P14	Float	0/1 dummy for particular plantype
P15	Float	0/1 dummy for particular plantype
P16	Float	0/1 dummy for particular plantype
P17	Float	0/1 dummy for particular plantype
P18	Float	0/1 dummy for particular plantype
P19	Float	0/1 dummy for particular plantype

P20	Float	0/1 dummy for particular plantype
P21	Float	0/1 dummy for particular plantype
P22	Float	0/1 dummy for particular plantype
P23	Float	0/1 dummy for particular plantype
P24	Float	0/1 dummy for particular plantype
P25	Float	0/1 dummy for particular plantype
P26	Float	0/1 dummy for particular plantype
P27	Float	0/1 dummy for particular plantype
LGLVAL	Float	Ln(landval)
IMPVAL	Float	Improvement value = resival + nrsival
LGIVAL	Float	Ln(impval+1) : log of improvement value
LGUNIT	Float	Ln(units+1) : log of units in cell
LGSQFT	Float	Ln(sqft+1) : log of sqft in cell
LGUNIT6	Float	Ln(units6+1) : log of units within 600 m
LGSQFT6	Float	Ln(sqft6+1) : log of sqft within 600 m
LGEMP6	Float	Ln(totemp6+1) : log of total employment within 600 m
LGAVU6	Float	Ln(avgvalu6+1) : log of average value (per unit?) within 600 m
LGAVL6	Float	Ln(avglval6+1) : log of average land value within 600 m
LGACCP	Float	Ln(accpop) : log of access to population logsum
LGACCE	Float	Ln(accemp) : log of access to employment logsum
LGPCTD	Float	Ln(PctDev+1) : log of percent developed within 600 m
LGPCTR	Float	Ln(PctRes+1) : log of percent residential within 600 m
LGPCTM	Float	Ln(PctMix+1) : log of percent mixed within 600 m
LGPCTC	Float	Ln(PctCom+1) : log of percent commercial within 600 m
LGPCTI	Float	Ln(PctInd+1) : log of percent industrial within 600 m
LGPCTG	Float	Ln(PctGov+1) : log of percent governmental within 600 m
HWY1	Float	0/1 dummy if disthwy <= 300 m
LGHWY	Float	Ln(disthwy) : log of distance to highway
WETLAND	Float	0/1 dummy for presence of wetland within ...
UGB	Float	0/1 dummy for cell being outside of urban growth boundary
STREAM	Float	0/1 dummy for presence of stream within ...
SLOPE	Float	0/1 dummy for presence of slope within ...
FLOOD	Float	0/1 dummy for location in flood plane
LRVACAN	Float	Local and regional vacancy measure

### Employment Location Coefficients

The user may define coefficient values for the Employment Location Choice Model.

#### FILE: EmploymentLocationCoeffs.tab

SECTOR	INTEGER	Sector
DEVM2	FLOAT	DevM2 dummy variable
DEVM3	FLOAT	DevM3 dummy variable
DEVM4	FLOAT	DevM4 dummy variable
DEVI1	FLOAT	DevI1 dummy variable
DEVI2	FLOAT	DevI2 dummy variable
DEVI3	FLOAT	DevI3 dummy variable
DEVG	FLOAT	DevG dummy variable

ACCPop	FLOAT	Accessibility to population
SAME600	FLOAT	Same sector employment w/in 600m
BAS600	FLOAT	Basic sector employment w/in 600m
RET600	FLOAT	Retail sector employment w/in 600m
SER600	FLOAT	Service sector employment w/in 600m
UNIT600	FLOAT	Housing units w/in 600m
LVAC600	FLOAT	Average land value/acre w/in 600m
HWY	FLOAT	Highway dummy variable
DISTHWY	FLOAT	Distance to highway
LogSqft	Float	Comment
LogTotUnit	Float	Comment
LogTotVal	Float	Comment
LogAccPop	Float	Comment
LogAccEmp	Float	Comment
LogDistHwy	Float	Comment
cbdTime	Float	Comment
airTime	Float	Comment
LogUnit600	Float	Comment
LogLVAC600	Float	Comment
LogValUnit600	Float	Comment
devRes	Float	Residential devtypes 1-8
devMix	Float	Mixed devtypes 9-16
dev17	Float	Commercial 17
dev18	Float	Commercial 18
dev19	Float	Commercial 19
devIndGov	Float	Industrial, Government 20-23
s00	Float	Sector 00 # of jobs within 600 meters
s01	Float	01
s02	Float	02
s03	Float	03
s04	Float	04
s05	Float	05
s06	Float	06
s07	Float	07
s08	Float	08
s09	Float	09
s10	Float	10
s11	Float	11
s12	Float	12
s13	Float	13
s14	Float	14
s15	Float	15

### Employment Location Choice Model Sample Size

The user provides the sample size to be used in the EmpLocChoice model.

**FILE: EmploymentLocationSampleSize.tab**

---

SampleSize	Integer	Number of samples to use for EmpLocChoice model
------------	---------	---

### Developer Model Coefficients

Definition file for the coefficients applied in the multinomial logit choice model of the Developer Model.

#### FILE: DevelopmentCoeffs.tab

OldDev	Integer	Starting development type
NewDev	Integer	End development type
Constant	Float	Constant factor
Develop	Float	Developed factor
LogSqft	Float	The log of the cells sqft
LogUnits	Float	Log of cells units
Prx_dev	Float	Proximity to development
LagSame	Float	Historical development of same devtype within 600m
LagRes	Float	Historical development of res devtype within 600m
LagMix	Float	Historical development of mixed devtype within 600m
LagCom	Float	Historical development of com devtype within 600m
LagInd	Float	Historical development of ind devtype within 600m
LagGov	Float	Historical development of gov devtype within 600m
LagDev	Float	Historical development within 600m
LagUnits	Float	Historical unit value
LagSqft	Float	Historical sqft value
PctSame	Float	Percentage of same development with 600m
PctRes	Float	Residential
PctMix	Float	Mixed Use
PctCom	Float	Commercial
PctInd	Float	Industrial
PctGov	Float	Government
PctDev	Float	Development
LogLandval	Float	Log of land value
Hwy	Float	Distance to highway
Art	Float	Distance to arterial
Flood	Float	Dummy for flood overlay
Slope	Float	Dummy for slope overlay
Stream	Float	Dummy for stream overlay
UGB	Float	Dummy for ugb overlay
Wetland	Float	Dummy for wetland overlay
Commit	Float	Dummy for commit overlay
Cost	Float	Development cost
Revenue	Float	Development revenue
Vacancy	Float	Regional/local vacancy value

### Residential Location Coefficients

Coefficients values defined for use in the Residential Location Choice Model.

#### FILE: ResidentialLocationCoeffs.tab

---

lowIncome	Integer	High range for low income strata, 0-(this value)
highIncome	Integer	High range for high income strata (lowincome-this value)
DEV1	Float	Dummy for devtype 1
DEV2	Float	Dummy for devtype 2
DEV3	Float	Dummy for devtype 3
DEV4	Float	Dummy for devtype 4
DEV5	Float	Dummy for devtype 5
DEV6	Float	Dummy for devtype 6
DEV7	Float	Dummy for devtype 7
DEV8	Float	Dummy for devtype 8
DEV9	Float	Dummy for devtype 9
DEV10	Float	Dummy for devtype 10
DEV11	Float	Dummy for devtype 11
DEV12	Float	Dummy for devtype 12
DEV13	Float	Dummy for devtype 13
DEV14	Float	Dummy for devtype 14
DEV15	Float	Dummy for devtype 15
DEV16	Float	Dummy for devtype 16
DevResLow	Float	"0/1 dummy for residential low devtype (1,2,3)"
DevResMid	Float	"0/1 dummy for residential middle (devtype 4,5,6)"
DevResHigh	Float	"0/1 dummy for residential high (devtype 7,8)"
DevMixLow	Float	"0/1 dummy for mixed low (devtype 9,10,11,12,13)"
DevMixHigh	Float	"0/1 dummy for mixed high (devtype 14,15,16)"
DevCIG	Float	"0/1 dummy for commercial,industrial,government (devtype 17-23)"
LogTotUnit	Float	Ln(TotUnits)
LogTotResVal	Float	Ln(TotResVal)
LogTotImpVal	Float	Ln(TotImpVal)
UnitAge	Float	"1994-yearbuilt, if yearbuilt>1994 then UnitAge=0"
LogAccEmp0	Float	Ln(accemp0) access to employment for 0 car households
LogAccEmp1	Float	Ln(accemp1) access to employment for 1 car households
LogAccEmp2	Float	Ln(accemp2) access to employment for 2 car households
LogAccEmp3	Float	Ln(accemp3) access to employment for 3 car households
LogAccPop	Float	Ln(accpop) access to population
LogUnit600	Float	Ln(unit600) number of units within 600 m
LogValUnit600	Float	Ln(valunit600) value/unit within 600 m
LogSqftInd600	Float	Ln(sqftind600) industrial sqft within 600 m
LogSqftCom600	Float	Ln(sqftcom600) commercial sqft within 600 m
LogSqftTot600	Float	Ln(sqftTot600) total sqft within 600 m
PctRes600	Float	Residential % within 600 m (0-100)
PctMix600	Float	Mixed % --
PctCom600	Float	Commercial % --

---

---

PctInd600	Float	Industrial %
PctGov600	Float	Governmental %
Emp0_600	Float	Employment in sector 0 within 600 m
Emp1_600	Float	-- sector 1
Emp2_600	Float	-- sector 2
Emp3_600	Float	-- sector 3
Emp4_600	Float	-- sector 4
Emp5_600	Float	-- sector 5
Emp6_600	Float	-- sector 6
Emp7_600	Float	-- sector 7
Emp8_600	Float	-- sector 8
Emp9_600	Float	-- sector 9
Emp10_600	Float	-- sector 10
Emp11_600	Float	-- sector 11
Emp12_600	Float	-- sector 12
Emp13_600	Float	-- sector 13
Emp14_600	Float	-- sector 14
Emp15_600	Float	-- sector 15
LogDistHwy	Float	Ln(disthwy)
CbdTime	Float	Travel time in minutes to CBD
AirTime	Float	Time to airport
LogLVAC600	Float	Ln(lvac600) land value/acre within 600 m
C0LogAccEmp0	Float	"LogAccEmp0 if AUTOS==0, 0 otherwise"
C1LogAccEmp1	Float	"LogAccEmp1 if AUTOS==1, 0 otherwise"
C2LogAccEmp2	Float	"LogAccEmp2 if AUTOS==2, 0 otherwise"
C3LogAccEmp3	Float	"LogAccEmp3 if AUTOS==3, 0 otherwise"
C0LogUnit600	Float	"LogUnit600 if AUTOS==0, 0 otherwise"
C1LogUnit600	Float	"LogUnit600 if AUTOS==1, 0 otherwise"
C2LogUnit600	Float	"LogUnit600 if AUTOS==2, 0 otherwise"
C3LogUnit600	Float	"LogUnit600 if AUTOS==3, 0 otherwise"
IncLogSqftInd600	Float	Income(\$)*LogSqftInd600
IncLogSqftCom600	Float	Income(\$)*LogSqftCom600
IncLogValUnit600	Float	Income(\$)*LogValUnit600
IncLogTotUnit	Float	Income(\$)*LogTotUnit
IncCost	Float	$hc = ( \text{Income}(\$) - \text{totresval} / (10 * \text{totunits}) ) / 1000$
IncCost2	Float	HCT = Ln(IncCost + 1) if IncCost>0, else hct =IncCost
SizeLogTotUnit	Float	Household size * LogTotUnit
SizeLogUnit600	Float	Household size * LogUnit600
R678NC	Float	Dummy for households w/no children, in Devtype 6-8
DEVMNC	Float	Dummy for households w/no children, in Devtype 9-16
CHILDN	Float	# of children (0, 1, 2+) * units in cell
R678A40	Float	Dummy for age under 40, in Devtype 6-8
DEVMA40	Float	Dummy for age under 40, in Devtype 9-16
IYB	Float	Income * year built
LOGRET	Float	Log of retail employment in 600m
CARLRET	Float	Dummy for household cars < workers, * logRet
CARLMDN	Float	Dummy for household cars < workers, * units w/in

---

		600m
ACCEW0H	Float	Dummy for no workers * auto logsum acc. to emp
ACCEW1H	Float	Dummy for 1+ workers * auto logsum acc. to emp
ACCEC0	Float	Dummy for 0 cars * transit logsum acc. to emp

### Residential Location Sample Size for ResLocChoice model

The user provides the sample size for the ResLocChoice Model

#### FILE: ResidentialLocationSampleSize.tab

SampleSize	Integer	Number of samples to use for ResLocChoice model
------------	---------	---

### Development Plan Coefficients

File defines coefficients per plan type for the Developer Model

#### FILE: planCoeffs.tab

PlanNum	String	Identifiable plan name
Coeff	Float	Coefficient

### Economic Status for Developer

This file is not currently in active use.

#### FILE: econStatus.tab

Year	Integer	Year of data sample
PersIncome	Integer	Personal income
Basic	Integer	Used by Bas_ind variable
Retail	Integer	Retail value
Service	Integer	Service oriented
Intrate	Float	Interest rate

### Development Type (Devtype) Templates

User defined list of development type transition templates for use in describing and constructing development transitions within the Urbansim modeling system.

#### FILE: template.tab

ID	Integer	Must be a unique ID enumerating the templates, start at 1
OldDevType	Integer	Starting development type
NewDevType	Integer	Resulting development type
ImpvalUnit	Float	Mean improvement value per unit
ImpvalSqft	Float	Mean improvement value per sqft
UnitsAdded	Float	Mean units added by transition
SqftAdded	Float	Mean sqft added by transition
ImpvalUnit_S	Float	Standard deviation of ImpvalUnit
ImpvalSqft_S	Float	Standard deviation of ImpvalSqft
UnitsAdded_S	Float	Standard deviation of UnitsAdded
SqftAdded_S	Float	Standard deviation of SqftAdded
ImpvalUnit_M	Float	Minimum value for ImpvalUnit
ImpvalSqft_M	Float	Minimum value for ImpvalSqft
UnitsAdded_M	Float	Minimum value for UnitsAdded

---

SqftAdded_M	Float	Minimum value for SqftAdded
ImpvalUnit_X	Float	Maximum value for ImpvalUnit
ImpvalSqft_X	Float	Maximum value for ImpvalSqft
UnitsAdded_X	Float	Maximum value for UnitsAdded
SqftAdded_X	Float	Maximum value for SqftAdded
YEARS	Integer	Number of years to develop
PHASING	Integer	Phasing flag for development

#### 4.4 Scenario Files

The files listed below are located in the Scenarios/Default/Input directory within the project InputData directory. These files are intended to be changed on a per scenario basis. In general, each of these files contains scenario dependent configuration data used across the Urbansim modeling platform. If a user intends to edit these files, it is recommended that a new scenario directory be created next to Default and the files copied to the new directory. The command line parameters will need to be changed accordingly.

##### Highway Times

Definition file for highway travel times from TAZ to TAZ. The **XXXX** represents the year to which the data is attributed (i.e., 1980).

**FILE: XXXXHighwayTimes.tab**

FromZone	Integer	The starting zone for which the travel time corresponds.
ToZone	Integer	The end zone
TravelTime	Float	The average highway travel time

##### Development Events

**FILE: DevelopmentEvents.tab**  
(see section 3)

##### Employment Events

**FILE: EmploymentEvents.tab**  
(see section 3)

##### Policy Events

**FILE: GridUpdateEvents.tab**  
(see section 3)

##### Time Configuration

**FILE: TimeConfiguration.tab**  
(see section 3)

**Primary Land Use Conversion**

User defined constraints on the primary land use conversion used by Developer Model.

**FILE: PLUDevConversion.tab**

County	integer	County code
City	integer	City code
Overlay	String	Overlay name
PLU	String	Primary land use type
DevType	integer	Devtype

**Developer Configuration**

Small file that sets a boolean value in the Developer for using the PLUDevConversion constraints.

**FILE: LDRM\_Input.tab (unique format)**

use PLUDevConversion table:true

**Accessibility Model Configuration**

Defines the central business district and airport zones.

**FILE: AccessibilityConfig.tab (unique format)**

AIR 249  
CBD 95

**Data Dependencies**

Automatically generated from the Autogen class, this file defines internal data structures and their data dependencies for the Urbansim modeling system. This file is not intended to be changed by the user. However, if the Autogen process is run by the user, this file should be replaced by the datadeps.txt file that is produced.

**FILE: datadeps.txt**

(content is automatically generated – DO NOT EDIT BY HAND)

**Debug Flags**

Refer to section 3 of the Reference Guide for a description of the internal structure of this file.

**FILE: DebugFlags.txt**

(refer to Reference Guide Section 3)

**Control Totals**

Designed to be edited by user to define control totals for model. Refer to section 3 for in depth coverage of use.

**FILE: EmploymentControlTotals.tab**

(refer to section 3)

**FILE: PopulationControlTotals.tab**  
(refer to section 3)

### Model Run Control

The following files are to be used to define the actual models to run and their sequence.

**FILE: modelList.txt (unique format)**

# List of models to create

Create:

#BasicObj

Accessibility

PriceAdj

Developer

DemoTrans

EconTrans

SqftEmpAdj

LatentDmd

JobMobility

HouseholdMobility

EmpLocChoice

ResLocChoice

Export

#EmpLocEstimation

#PriceAdjEstimation

Run:

PriceAdj 1

DemoTrans 1

EconTrans 1

SqftEmpAdj 1

LatentDmd 1

Developer 0

JobMobility 1

HouseholdMobility 1

EmpLocChoice 1

ResLocChoice 1

Accessibility 1

Export 0

#EmpLocEstimation 0

#PriceAdjEstimation 0

**FILE: modelorder.txt (unique format)**

(each unique line contains model ordering rules)

### Per Employee Constraints

Defines sqft and units per employee constraints by year and development type.

**FILE: SqftPerEmployeeByYear.tab**

Year	INTEGER	Year
Devtype	INTEGER	Development type
Sqft	INTEGER	Sqft/emp

**FILE: UnitsPerEmployeeByYear.tab**

Year	INTEGER	Year
Devtype	INTEGER	Development type
Units	INTEGER	Units/emp

**4.5 Exported Files**

Below we describe all of the data that is potentially exported from the Export Model of the UrbanSim Modeling System.

**Grid-Based Exported Files****FILE: YEAR\_GridEmp.tab**

GRID_ID	INTEGER	Grid_ID value
SecX	INTEGER	Employee count for sector X
Total	Integer	Total employment

**FILE: YEAR\_GridHousehold.tab**

GRID_ID	Integer	Grid_ID value
hhIncomeX	Integer	Number of households in income category X
hhAgeX	Integer	Number of households in age category X
hhPersonsX	Integer	Number of households in persons category X
hhChildX	Integer	Number of households in child category X
hhTotal	Integer	Number of households in gridcell
IncomeX	Integer	Number of people in income category X
AgeX	Integer	Number of people in age category X
PersonsX	Integer	Number of people in persons category X
WorkersX	Integer	Number of people in workers category X
ChildX	Integer	Number of people in child category X
Total	Integer	Number of persons in gridcell

**FILE: YEAR\_GridHouseholdJoint.tab**

GRID_ID	Integer	Grid ID
IWAXSYWZ	Integer	Number of households in Income cat. W, age cat. X, size cat. Y and worker cat. Z

**FILE: YEAR\_GridHomebasedEmp.tab**

GRID_ID	Integer	Grid_ID value
SecX	Integer	Count of home-based employees in sector X
Total	Integer	Total home-based employment

**FILE: YEAR\_GridDevStatus.tab**

GRID_ID	Integer	Grid_ID value
Devtype	Integer	Development type
TotalUnits	Integer	Total units
UsedUnits	Integer	Used units
TotalSqft	Integer	Total sqft
UsedSqft	Integer	Used sqft
YrBuilt	Integer	Year built
LandVal	Float	Land value
ResImpVal	Float	Residential Improvement value
NonResImpVal	Float	Nonresidential Improvement value
OVERLAYX	boolean	Value of this overlay

**Regional Exported Files****FILE: RegionalHouseholdCount.tab**

YEAR	Integer	Year
HHINCX	Integer	HH count for income X
HHAGEX	Integer	HH count for age X
HHPERX	Integer	HH count for persons X
HHWORKX	Integer	HH count for workers X
HHCHILDX	Integer	HH count for child X
HHTOTAL	Integer	total count of HH
PINCX	Integer	Person count for income X
PAGEX	Integer	Person count for age X
PPERX	Integer	Person count for persons X
PWORKX	Integer	Person count for workers X
PCHILDX	Integer	Person count for child X
PTOTAL	Integer	total count of persons

**FILE: RegionalJobCount.tab**

Year	INTEGER	Year
SecX	INTEGER	Employee count for sector X

**FILE: RegionalHBJobCount.tab**

Year	INTEGER	Year
SecX	INTEGER	Home-based employee count for sector X

**FILE: RegionalDevelopment.tab**

Year	Integer	Year
TOTUNX	Integer	Total units in devtype X
USEDUNX	Integer	Total used units in devtype X
TOTSQX	Integer	Total sqft in devtype X
USEDSEQX	Integer	Total used sqft in devtype X
LANDVX	Integer	Total land value in devtype X
IMPVX	Integer	Total improvement value in devtype X

## Zonal Exported Files

### FILE: *YEAR\_ZoneDevStatus.tab*

Zone	Integer	TAZ Zone
Zone1	Integer	TAZ1 Zone
Devtype	Integer	Development type
TotalUnits	Integer	Total units
UsedUnits	Integer	Used units
TotalSqft	Integer	Total sqft
UsedSqft	Integer	Used sqft
YrBuilt	Integer	Year built
LandVal	Float	Land value
ResImpVal	Float	Residential Improvement value
NonResImpVal	Float	Nonresidential Improvement value

### FILE: *YEAR\_ZoneHousehold.tab*

Zone	Integer	TAZ Zone ID
Zone1	Integer	TAZ Zone1 ID
INCX	Integer	Number of households in income category <b>X</b>
AGEX	Integer	Number of households in age category <b>X</b>
SIZEX	Integer	Number of households in size category <b>X</b>
WORKX	Integer	Number of households in worker category <b>X</b>
CHILDX	Integer	Number of households in child category <b>X</b>

### FILE: *YEAR\_ZoneHouseholdJoint.tab*

Zone	Integer	TAZ Zone ID
Zone1	Integer	TAZ Zone1 ID
IWAXSYWZ	Integer	Number of households in Income cat. <b>W</b> , Age cat. <b>X</b> , Size cat. <b>Y</b> and Worker cat. <b>Z</b>

### FILE: *YEAR\_ZoneEmp.tab*

TAZ	Integer	Travel zone
TAZ1	Integer	Travel zone1
SecX	Integer	Number of jobs in sector <b>X</b>
TotalJobs	Integer	Total jobs in zone

### FILE: *YEAR\_ZoneHomebasedEmp.tab*

TAZ	Integer	Travel zone
TAZ1	Integer	Travel zone1
SecX	Integer	Number of jobs in sector <b>X</b>
TotalJobs	Integer	Total jobs in zone

## Miscellaneous Exported Files

### FILE: *YEAR\_DevHistory.tab*

---

GridID	Integer	Grid ID
Timestamp	Integer	Timestamp
OldDT	Integer	Old devtype
NewDT	Integer	New devtype
OldUnits	Integer	Old housing units
OldSqft	Integer	Old sqft
OldResImpVal	Integer	Old residential improvement value
OldNonResImpVal	Integer	Old nonresidential improvement value
NewUnits	Integer	Old housing units
NewSqft	Integer	Old sqft
NewResImpVal	Integer	New residential improvement value
NewNonResImpVal	Integer	New nonresidential improvement value
DeltaUnits	Integer	Old housing units
DeltaSqft	Integer	Old sqft
DeltaResImpVal	Integer	Change in residential improvement value
DeltaNonResImpVal	Integer	Change in nonresidential improvement value

**FILE: YEAR\_FullHHDData.tab**

HH ID	Integer	Household ID
GridID	Integer	External Grid ID
Inc	Integer	Income category
Age	Integer	Age category
Persons	Integer	Number of persons
Workers	Integer	Number of workers
Children	Integer	Number of children