Coupling an urban simulation model with a travel model – A first sensitivity test

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Abstract

Urban simulation models include location choice decisions of residents, firms, and developers. Access to certain activity locations has an influence on these choices. The difficulty to get to locations is clearly not uniformly distributed across space, and travel models of various forms may be used to generate times or generalized costs of travel between locations.

Some efforts towards integrating travel and land use models have been made. One example is the effort to couple UrbanSim with EMME or VISUM. In that approach, UrbanSim moves forward in time from year to year, calling the travel model in regular intervals. The travel model takes the urban structure as input, computes a traffic assignment, and returns a zone-to-zone impedance matrix. UrbanSim then uses that matrix as input to its location choice models. A recent effort integrates UrbanSim with the activity-based travel model SF-CHAMP for San Francisco.

In this situation, it seems quite natural to link micro-simulation land use models like UrbanSim with an agent-based travel model directly at the agent level, directly feeding location and socio-economic characteristic of individual residents and firms from land use model to travel model and then having the travel model return updated accessibility measure back to the land use model. In this study, it is investigated how MATSim ("Multi-Agent Transport Simulation") can be used for this purpose. This integration of MATSim with UrbanSim is analyzed in this paper by creating and simulating a scenario in which the accessibility of an initially poorly connected area is improved compared to the base case. The paper also investigates congestion effects.

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1 Introduction

There is some agreement that access to certain activity locations has an influence on residential and firm location choices, see Hansen (1959), Weisbrod et al. (1980), Levinson (1998), and Moeckel (2006). Hansen (1959) defines accessibility as the potential of opportunities for interaction. He shows that areas which are more accessible to certain activities like work, leisure or shopping have a greater growth potential in residential development. In other words: If locations are equal otherwise, a location with easier access to certain other locations is more attractive than locations with less access. Moeckel (2006) asserts that this approach is also true for businesses.

Accessibility is the result of the interaction of many elements (Geurs and Ritsema van Eck, 2001). The difficulty to travel from an origin to a destination can be described by the amount of travel time and (monetary) travel costs. These are the results of an interaction between road infrastructure and travel demand. The spatial distribution of activities both influences travel demand and thus travel times, and accessibility. Weisbrod et al. (1980) and Levinson (1998) quantify the influence of commuting costs, in terms of travel time, on residential location choices. But both also make clear that accessibility to jobs and housing are not the only element in location decisions.

This paper studies, through simulation runs of multiple scenarios, the impact of a very large accessibility increase, i.e. reduced travel times and travel costs, on land-use and residential location choices in an exisiting real world scenario. The selected urban simulation model is UrbanSim, a microscopic model for urban developmend that includes explicit location choice models for residences, workplaces, and development. In order to update travel time given land use and transport network, another software called "MATSim" (Multi-Agent Transport Simulation) is coupled to UrbanSim. We start with and construct our scenarios from the current UrbanSim application for the Puget Sound Regional Council (PSRC). In order to investigate the accessibility effect, we hypothesize a scenario where a slow ferry connection bewteen Seattle downtown and the so-called Bainbridge Island is replaced by a fast bridge connection. Clearly, this development is highly artificial, and it is selected for research and illustration purposes only. However, it might be worth mentioning that in the early sixties of the last century, there were bridge construction plans that would have had a similar effect: The two bridges marked by "7" in Figure 1 show the plan to connect Bainbridge Island with Seattle via the Cross-Sound Bridge and Rich Passage Bridge.

The paper is organized as follows: In Section 2, the simulation approach is introduced. Details on the data and scenario setups are presented in Section 3. Section 4 illustrates the main results of the simulated scenarios, which are discussed in Section 5. The paper ends with a conclusion (Section 6).

Figure 1: Map of proposed Puget Sound freeway plans from the early 1960s from the Washington State Highway Commission. Image courtesy of Scott Rutherford, University of Washington.

2 Simulation

2.1 Coupling MATSim with UrbanSim

UrbanSim is an agent-based urban simulation model that does not model transport itself. Instead, it relies on interaction with external transport models to update the traffic condition resulting from the land use. It shares this approach with many other urban simulation models (Wegener, 2004).

In the past some integration efforts with external travel models like EMME (Babin et al., 1982) or VISUM (PTV AG, 2009a,b) have been made. Both EMME and VISUM are traditional assignment models using origin-destination matrices (OD-matrices) as inputs (e.g. Ortúzar and Willumsen, 2001). A recent effort (Waddell et al., 2010) integrates UrbanSim with the activity-based travel model SF-CHAMP for San Francisco, but the data exchanged between SF-CHAMP and UrbanSim are still at aggregated zone level.

Disaggregated, "agent-based" traffic simulation models like TRANSIMS (Smith et al., 1995) or MATSim (e.g. Raney and Nagel, 2006; Balmer et al., 2005) simulate each traveler individually. Therefore MATSim takes the synthetic UrbanSim population and directly simulates its travel behavior. The travel demand is, in principle, a result of individual decisions made by each agent trying to organize their day and engage activities at and out of home. Besides, MATSim provides additional advantages such as simulating time-dependent congestion, time-dependent mode choice, or speeding up the computation by running small samples of a scenario.

2.2 UrbanSim and MATSim at a glance

UrbanSim (e.g. Waddell, 2002) aims at simulating interactions between land use, transportation, the economy and the environment at large-scale metropolitan areas and over a long time span. UrbanSim consists of several models reflecting the decisions of households, businesses, developers, and governments (as policy inputs), and their interactions in the real estate market.

Figure 2 provides an overview of the processing sequence of the UrbanSim main models. UrbanSim possesses six main models, which are the Econometric and Demographic Transition Models, the Household and Employment Mobility Models, the Household and Employment Location Models, Real Estate Development Model, and the Real Estate Price Model. The Household and Employment Models are independent models and only illustrated jointly in Figure 2 for simplicity. The bold arrows in the illustration show the sequence of events without necessarily indicating an interaction between the corresponding models.

The input to the UrbanSim models includes the base year data, the access indicators from the external travel model, and control totals derived from external macro-economic forecast models. The base year data store contains the initial state of a scenario. Typically the database includes geographic information, initial household and job information, etc., for a given base year. The primary source of the base year data usually comes from surveys or the census. The UrbanSim models, listed above, maintain the data store and simulate its evolution from one year to the next.

The interaction between UrbanSim and MATSim is a bi-directional relationship. When UrbanSim moves forward in time from year to year, it calls MATSim in regular intervals and passes the traffic network together with the persons and jobs data set table as input (see Figure 3) including a person id as well as the residence and job location of each individual person in UrbanSim.[1] Based on this information MATSim generates the traffic assignment and returns a zone-to-zone impedance matrix; other access and accessibility indicators are planned within the SustainCity project, but not discussed in this paper. UrbanSim then uses this updated matrix as input to its models for its next iteration.

The traffic simulation approach in MATSim consists of the following steps:

1. **Initial demand**: Given the input tables from UrbanSim, MATSim constructs agents. All agents independently generate daily *plans* that encode their activities during a

[1]This implies that a "workplace choice model" is used inside UrbanSim, which assigns every working person to an available job. This model is used in the UrbanSim PSRC scenario by default.

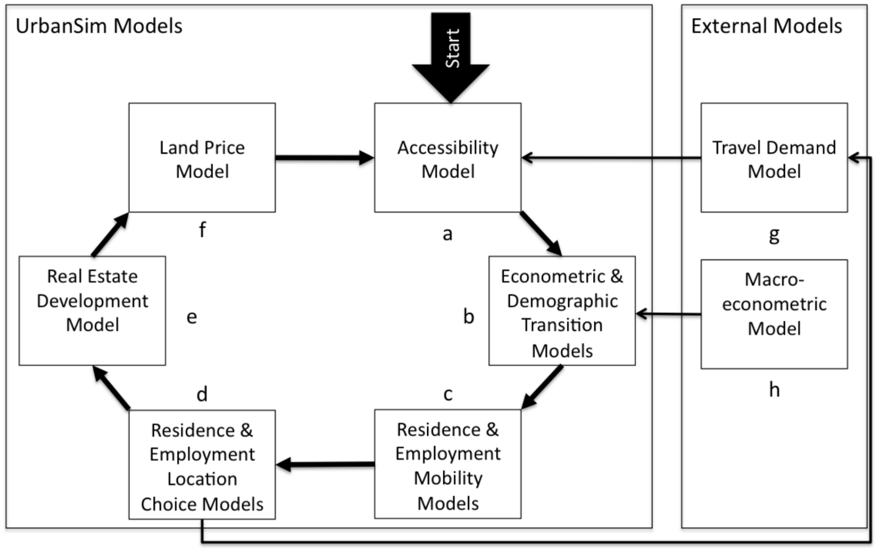

Figure 2: The sequence of UrbanSim main models after Waddell (2002).

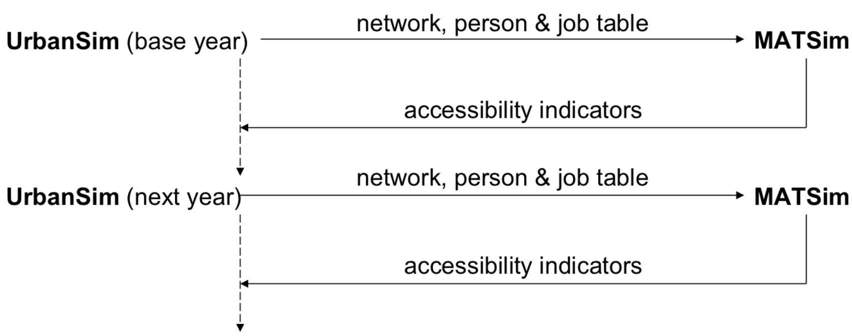

Figure 3: Interaction sequence between UrbanSim and MATSim.

typical day. In order to keep the model as simple as possible, only "home-to-work-to-home" activity chains are generated for the investigations described here, where the home and the work location are both taken from the UrbanSim information. The initial plans are also routed on the traffic network, and set to "selected".

2. **Traffic flow simulation**: The traffic flow simulation executes all selected plans simultaneously.

3. **Scoring**: All executed plans are scored by a *utility function*.

4. **Learning**: Some of the agents obtain new plans for the next iteration by modifying existing plans with respect to the two choice dimensions considered in this paper: route and time choice. Somewhat more technically, 10% of the agents copy one of their plans and obtain new routes computed as best reply to the last iteration, and another 10% of the agents copy one of their plans and obtain new activity starting and ending times based on a random "mutation" of the existing times. All other agents select between existing plans according to a logit model.

The repetition of the iteration cycle coupled with the agent database (i.e. the capability to remember more than one plan per agent) enables the agents to improve their plans over many iterations (Balmer et al., 2005). In the situation described here, MATSim reaches an approximately relaxed state of the traffic system within 60 iteration cycles of the learning-based solution procedure.

As discussed earlier, MATSim generates a zone-to-zone impedance matrix, consisting of times and generalized costs of travel from every zone to every zone. Car travel times are calculated based on the link travel times from the congested network at the end of the MATSim iterations as described above. Zones are connected to the road network by connecting the zone centroid to the closest link in the network. The coordinates of the zone centroid is determined by averaging over the coordinates of all parcels that belong to the zone. In addition, also walk travel times are calulated. This is implemented provisionally in MATSim by taking the car travel times multiplied by 10. The generalized costs at this point consist of car travel time and toll (as time equivalent). Since no toll was assumed for the study here, for the purposes of the present study car travel times and travel costs are identical. Downstream models that use travel model output are listed in Table 1.

3 Scenario

The coupling of UrbanSim with MATSim is now applied to an existing real-world scenario. This is the parcel-based Puget Sound region application, which is one of the most disaggregate metropolitan-scale modeling systems in operation. It contains 938 zones and 1 500 004 parcels. The following subsections provide a simplified description of the simulated scenarios.

3.1 Population and Travel Demand

The metropolitan area of the Puget Sound region counts about 3.2 million inhabitants, "agents", in the UrbanSim base year 2000 and increases to over 4.4 million agents at simulation end in 2030.

MATSim considers a 1% random sample of the entire UrbanSim population to simulate travel. This is done in order to speed up computation time, since MATSim is scheduled in every of the 30 UrbanSim years from 2000 to 2029.

All MATSim agents have complete day plans with "home-to-work-to-home" activities (work activities) based on their residence and job location in UrbanSim as described in Section 2.2.

Work activities can be started between 7 o'clock and 9 o'clock. They have a "typical duration" (in the MATSim sense) of 8 hours. The home activity has a "typical duration" of 12 hours, and no temporal restrictions. Each agent has five plans based with the described activity pattern. Agents try to optimize thier plans with respect to the choice dimensions available: route choice and time choice as described in Section 2.2.

3.2 Traffic Network

The Puget Sound traffic network includes the major roads in this area. It consists of 5024 nodes and 15472 links. Roads are typically described by two links, with one link for each direction. Furthermore, each link is defined by its origin and destination node, length, free speed, average car flow capacity per hour and number of lanes.

In MATSim, ferry connections are also modeled as roads. The ferry between Seattle downtown and Bainbridge Island in particular is modeled as follows: The ferry route consists of several subsections represented by links with a single lane in each direction. The narrowest link of this route has a average car flow capacity of 500 cars per hour with a free speed of 9.94 mph. The free speed of 9.94 mph is due to the conversion from metric system.

The imaginary bridge construction between Seattle downtown and Bainbridge Island is described in detail in Subsection 3.5.

3.3 Preparatory MATSim run

The UrbanSim modelling sequence calls the travel model at the *end* of an update from one year to the next. This means, in particular, that the update from 2000, the first year of the UrbanSim run, to 2001 is based on the travel data that exists already in the travel data cache. In addition, model estimations may use travel data attributes, which also comes from the base year cache.

In consequence, in order to remain consistent it is necessary to replace the original travel data cache from the PSRC scenario by a new travel data cache from a "preparatory" MATSim run. This preparatory run takes a 10% random sample of the overall UrbanSim base year population and performs a traffic simulation with 200 iterations. During the first 100 iterations 10% of the agents perform "time adaptation" while another 10% of the agents adapt routes. In the latter 100 iterations agents neither adapt time nor route, but choose only between existing plans. As a result of this preparatory run, the travel data attributes "am single vehicle to work travel time", "am single vehicle to work travel cost", and "am walk time in minutes" are generated by the MATSim run (see Section 2.2).

3.4 UrbanSim Configuration

We take the scenario (base year cache and configuration) currently being used by Puget Sound Region Council (PSRC) as a starting point to construct scenarios for our simulation runs. The default PSRC base year cache is used together with the default configuration[2] with all UrbanSim models enabled. In the following, a brief summary is provided, focusing on the main changes compared to the default settings.

1. **Replace Household Location Choice Model (HLCM)**: The HLCM from the default configuration is replaced by the HLCM specifiaction from Lee et al. (2010). That

[2]Available on UrbanSim repository *svn.urbansim.org*

model was especially designed to study effects of accessiblity on residential household location choices. Therefore it is useful for the needs for this study.

Instead of the accessibility variables used by Lee, a simpler variable is used, measuring the generalized cost to get to Seattle CBD "lngcdacbd_bldg".

2. **Replace relevant travel data attributes by MATSim**: In the next step it is tested which travel model attributes are actually used in UrbanSim. For this, all model specifications from the base year cache were manually investigated. An overview can be found in Table 1.

   Some of the travel model attributes in Table 1 are already replaced and updated by MATSim, see Section 3.3. This means that the other travel data attributes remain unchanged. Since these other attributes, however, are also related to the congestion computed by the travel model, they are removed from the UrbanSim model by the following steps: (i) Attributes in the base year cache that are not replaced by MATSim are deleted from the base year cache; (ii) UrbanSim model variables based on these attributes are either removed from the model specifications, or replaced by travel model attributes that are actually computed by MATSim (see Table 1).

3. **Model re-estimation**: After adjusting the base year cache and model specifications, the UrbanSim models are re-estimated. The estimation results for the HLCM are presented in Table 2. A comprehensive explanation of each HLCM variable can be found in Section 4.2 in Lee et al. (2010). A complete overview of the used model specifications and estimated coefficients can be found in the appendix (see Section 7.1 and 7.2).

Variables and Description	Estimate	t-values
ln residential units Log of number of residential units in building	-0.314514	-11.5136
same area type (dummy) Building in same area type as previous household (HH) location	5.12435	3.78255
same area (dummy) Building in same area as previous HH location	6.9907	4.48098
Kitsap (dummy) Building in Kitsap County	0.165124	0.084599
population density Log of zonal population density	-0.00423	-0.10306
disposable inc Log of HH annual income (inc) less annual imputed rent/unit	0.012022	0.765195
high inc (dummy) x size High HH inc x log of average dwelling size (sq ft/unit)	0.270331	2.4132
mid inc (dummy) x size Mid HH inc x log of average dwelling size (sq ft/unit)	-0.2346	-2.54169

Continued on next page

Variables and Description	Estimate	t-values
low inc (dummy) x size Low HH inc x log of average dwelling size (sq ft/unit)	-0.19001	-1.54617
inc x condo (dummy) Log of HH inc x condominium	-0.11184	-8.51223
inc x mfr (dummy) Log of HH inc x multifamily residential (MFR) building	-0.24762	-19.4306
one pers (dummy) x not sfr (dummy) one-person HH x not single-family residential (SFR) bld	0.48578	3.99027
renter (dummy) x mfr (dummy) Renting HH x MFR building	2.92714	18.6406
kids (dummy) x SFR (dummy) HH with children x SFR building	1.57228	8.14674
kids (dummy) x kids HH with children x percent HH with children within 600m	0.005661	0.86189
young (dummy) x young HH Young HH (average adult age ≤ 30) x percent young HH within 600m	0.050962	2.52083
lngcdacbd bldg Log of generalized costs to get to CBD	-0.24631	-3.56225

Log-likelihood	-3541.05224792
Null Log-likelihood	-14978.8732688

Table 2: Results of the Household Location Choice Model (HLCM) re-estimation. Explanation of HLCM variables from Lee et al. (2010).

3.5 Simulation Runs

Three scenarios, a base scenario and two alternative scenarios are created to analyze the integration of MATSim into UrbanSim. These scenarios differ only in the network set-up.

- **Base Scenario ("Ferry")**: The base scenario, also called ferry scenario, leaves the traffic network as it is. In particular the ferry connection between Seattle down town and Bainbridge Island remains, i.e. the corresponding links of this connection have a capacity of 500 travelers/hour with a free speed of 9.94 mph.
- **Alternative Scenario 1 ("Bridge")**: In this scenario the ferry connection from the base case is replaced by a bridge, hence this is the bridge scenario. The bridge is simulated by setting the free speed of the ferry connection from 9.94 mph to 70 mph. The free speed is derived from the speed limits on highways in Washington (state) to simulate a fast connection.
- **Alternative Scenario 2 ("Capacity Limited Bridge")**: The ferry connection here is replaced as well by a bridge. Besides a free speed 70 mph the capacity of the links

Travel Data Attribute	Affected UrbanSim Models
am single vehicle to work travel time [in min]	Real Estate Price Model Expected Sales Price Model Household Relocation Model Work at Home Choice Model
single vehicle to work travel cost [in min]	Real Estate Price Model Expected Sales Price Model Employment Location Choice Model Household Location Choice Model
am walk time [in min]	Real Estate Price Model Expected Sales Price Model
am total transit time walk → removed	Real Estate Price Model Expected Sales Price Model
am pk period drive alone vehicle trips → removed	Real Estate Price Model Expected Sales Price Model
logsum hbw am income 1 – 4 → removed	Workplace Choice Model for Residents
single vehicle to work travel distance → replaced by "single vehicle to work travel time"	Workplace Choice Model for Residents

Table 1: Travel data attributes that are used inside the UrbanSim psrc_parcel model. The attributes in boldface are replaced by MATSim output. The other attributes are either removed from the model specifications, or replaced by other attributes as indicated in the table. In all cases, models which use travel data attributes are re-estimated.

are reduced dramatically from 500 to 50 travelers/hour. Hence this bridge can be described as a fast but capacity-limited connection that is susceptible to congestion (capacity limited bridge scenario).

The traffic connection in the first two scenarios provides enough capacity, i.e. 500 travelers/hour, to manage the traffic peaks between 6 and 7 o'clock and between 16 and 18 o'clock for the year 2001 where the bridge is available for the first time. The Capacity Limited Bridge, with a capacity of only 50 traveler/hour, cannot handle these peaks: It takes several hours to process them. Hence this connection is congested, which results in longer travel times.

In UrbanSim, the travel model is run at the end of an UrbanSim update. In consequence, the modified networks are used for the first time after the update from 2000 to 2001. One could say that the bridge construction in these scenarios is finished in 2001 and operational in 2002.

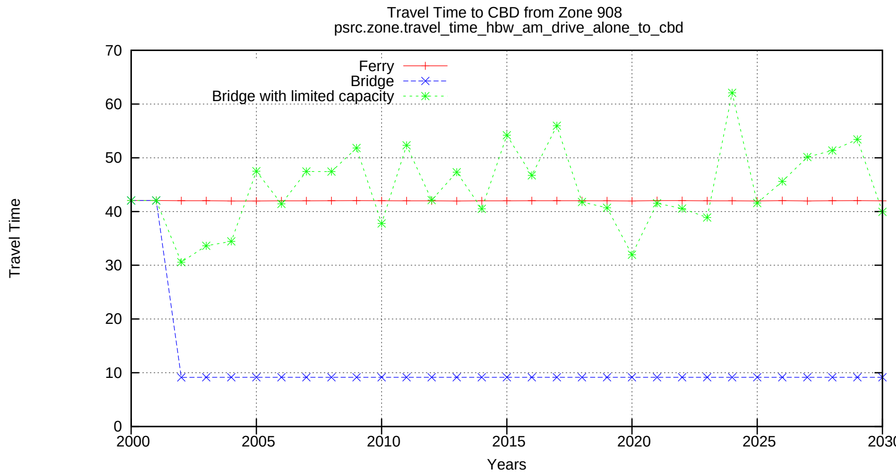

Figure 4: Travel Time from Bainbridge to Seattle CBD.

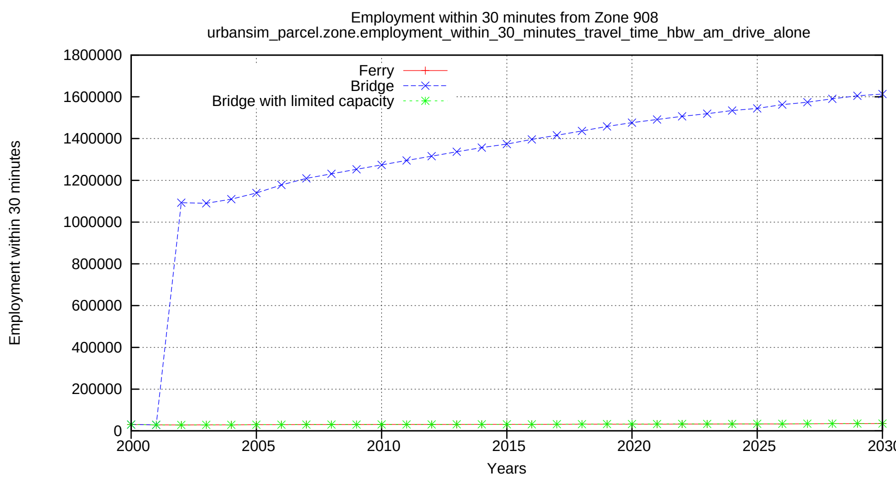

Figure 5: Reachable number of employment within 30 minutes of car travel from Bainbridge.

4 Results

In the following the simulation results for Bainbridge Island, which has the UrbanSim zone number 908, are presented. All plots refer to the three scenarios *Ferry* (red line), *Bridge* (blue line) and *Capacity Limited Bridge* (green line).

4.1 Travel and accessibility consequences

The travel time from Bainbridge Island to Seattle CBD (Figure 4) in the "ferry" scenario remains constant, at about 40 minutes. In the "bridge" scenario it goes to below 10 minutes. In the limited capacity scenario it fluctuates rather strongly. This is presumably a consequence of stochastic effects in the travel model that should be investigated further.

A direct influence of the travel time is visible in the Employment-within-30-minutes plot

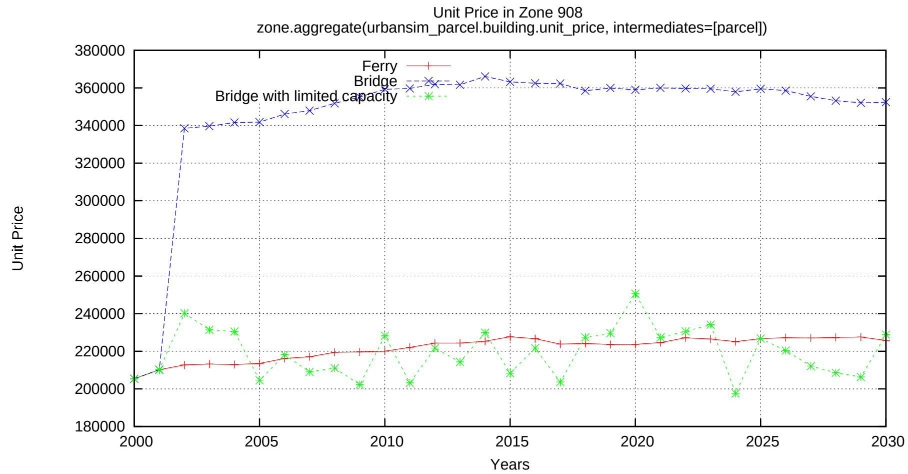

Figure 6: Unit Prices on Bainbridge.

(Figure 5): Clearly, shorter travel time to given destinations lead to a higher number of accessible workplaces. Since the travel times in the “ferry” and “capacity limited bridge” scenario do not fall below 30 minutes, no changes for either scenario can be seen in this plot. The increasing numbers in the “ferry” scenario are due to the increase of the number of workplaces in the Seattle CBD.

4.2 Housing price consequences

In the PSRC implementation of UrbanSim, housing prices react directly to accessibility changes. It therefore makes sense to discuss these aspects directly here, before looking at other consequences.

The unit prices on Bainbridge are almost complementary to the travel times (Figure 6): At the opening of the bridge in 2001 the unit prices go up sharply in the ”bridge” scenario. Also the noise of the ”capacity limited bridge” scenario can be found here again. Any increase of the travel time leads to falling unit prices and vice versa. The prices in the ”ferry” scenario remain almost constant analogously to the travel time.

4.3 Other consequences

Somewhat unexpectedly, there seem to be no population growth consequences of the increased accessibility (Figure 7). Also a closer look on the composition of households reveals no differences, e.g. in the proportion of workers and single-person households (not shown).

The “dent” in population growth in all three scenarios around 2020 can be traced back to the stop of the construction of the single-family residential (SFR) units (Figure 8), which is followed only with some delay by the construction of multi-family residential (MFR) units (Figure 9). Presumably, the UrbanSim developer model prefers SFR over MFR units in the setting here, and MFR construction does not start before all land with SFR zoning is exhausted.

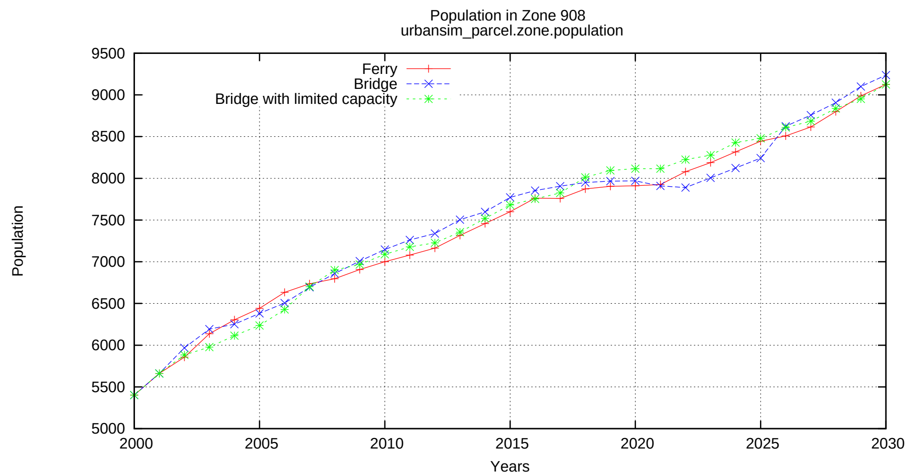

Figure 7: Population growth on Bainbridge.

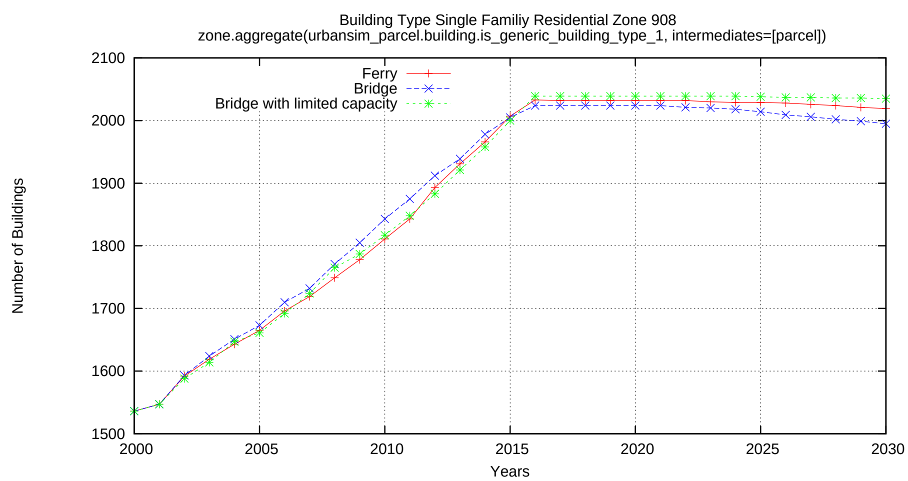

Figure 8: Number of single-family residential on Bainbridge.

This is corroborated by the number of vacant SFR units (Figure 10), which shows that construction of MFR units starts exactly when all vacant SFR units are exhausted. In addition, this plot contains a difference between the scenarios: There are considerably fewer vacant SFR units available in any year after the bridge opening.

The remaining buildings types are commercial, government, industrial, office, and other buildings like parking garages. Compared to the residential buildings, their numbers are small on Bainbridge Island, and there are few if any differences between the scenarios. They are therefore not depicted in this paper.

5 Discussion

The story that seems to emerge is that for the PSRC implementation of UrbanSim, even drastic accessibility changes have little impact on construction activity or population growth.

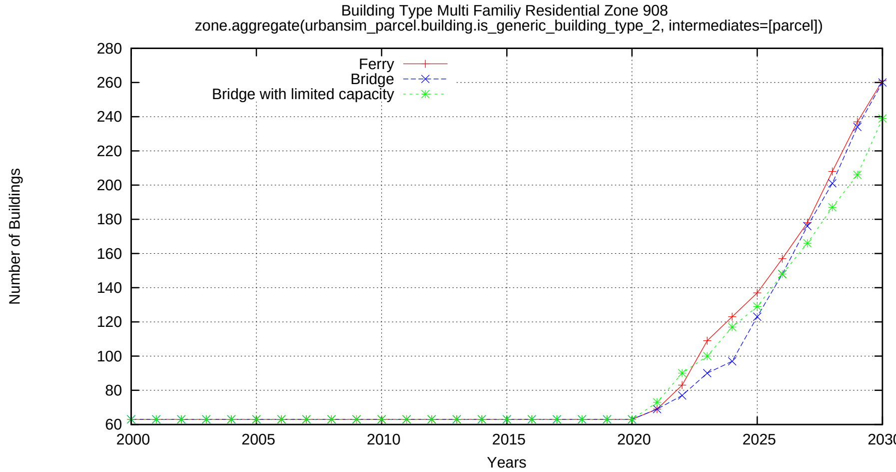

Figure 9: Number of multi-family residential on Bainbridge.

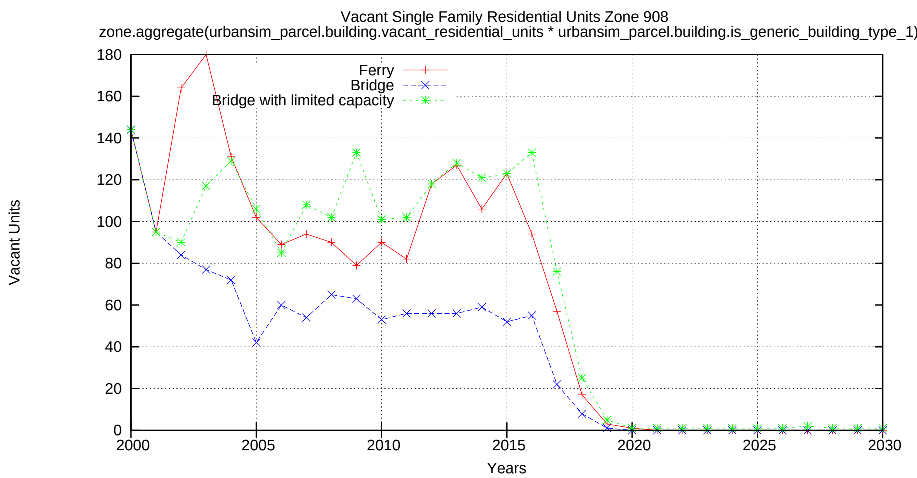

Figure 10: Vacant single-family residential units on Bainbridge.

At least for the location considered here, there seem to be strong zoning and capacity restrictions on construction activity, and those dominate the dynamics. A reduced number of vacant single-family units shows the increased attractiveness of the location in spite of the now much higher prices, but this does not seem to trigger additional construction activities.

Meanwhile, we have evidence that there can also be demographic reactions to accessibility changes: In an earlier version of this paper, the accessibility variable referred to single-person households only, and accordingly the share of single-person households increased significantly after the bridge opening. That model, however, was ultimately rejected since it was not considered realistic in later PSRC work (see, e.g. Lee et al., 2010).

Based on the choice model coefficients, one might speculate that the effects of unit prices and accessibility cancel each other out: improved accessibility makes an area more attractive, but triggers higher prices which cancel out the accessibility improvement. While this would be a credible story, it is not borne out by the model: We re-estimated the household location choice model without the "income minus price" variable and re-ran the simulations, but obtained no discernible difference in the resulting dynamics.

6 Conclusion

This paper investigates how the land use in a single zone within the modeling system UrbanSim reacts to a very large accessibility increase in that particular zone. Rather than a synthetic scenario, a real world scenario together with an existing real world UrbanSim implementation is used; this is done to ensure that the configuration of Urbansim is close to a real-world implementation. The selected scenario itself, however, is highly artificial and selected for research and illustration purposes only: The replacement of a slow ferry with a fast bridge connection between a central business district (CBD) and a tranquil residential area ("zone 908").

All accessibility indicators, including "reachable number of employment within30 minutes", react strongly to the accessibility change. The accessibility change implicates dramatically lower travel times to get to the CBD together with a very high increase of accessible workplaces within 30 minutes of car travel.

Also the price of a housing unit in the model reacts directly: It increases from $200,000 to a little more than $350,000. Despite higher unit prices, the demand for single family residential units is considerably higher after the bridge opening. This shows an increased attractiveness of the location. But from now on, the influence of the accessibility improvement is weakening. The growth of the number of residential units is quite similar in all scenarios. No additional construction activities are triggered by the accessibility increase. Presumably as a consequence of the limited construction activity, also demographic indicators, meaning population growth and the composition of households, are close together in all scenarios. Again, no impact of the changed accessibility can be observed.

In addition, a "capacity-limited bridge" scenario was run. With this scenario, the free speed travel time from the island to the CBD is significantly reduced in principle, but because of congestion effects, the effect is dampened. In general it fluctuates around the level of the "ferry" scenario. Overall, this scenario lies between the other two.

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7 Appendix

7.1 Model Specifications

Model: real_estate_price_model_specification

coefficient_name	submodel_id	variable_name
constant	2	constant
is_pre_1940	2	is_pre_1940 = parcel.aggregate(numpy.ma.masked_where(urbansim_parcel.building.has_valid_year_built == 0, building.year_built),function=mean) < 1940
ln_invfar	2	ln_invfar = (ln(parcel.parcel_sqft/(urbansim_parcel.parcel.building_sqft).astype(float32))).astype(float32)
lnemp10da	2	lnemp10da = (ln(parcel.disaggregate(urbansim_parcel.zone.employment_within_10_minutes_travel_time_hbw_am_drive_alone))).astype(float32)
lnempden	2	lnempden = (ln(parcel.disaggregate(urbansim_parcel.zone.number_of_jobs_per_acre))).astype(float32)
lngcdacbd	3	lngcdacbd = (ln(parcel.disaggregate(psrc.zone.generalized_cost_hbw_am_drive_alone_to_cbd))).astype(float32)
lnempden	3	lnempden = (ln(parcel.disaggregate(urbansim_parcel.zone.number_of_jobs_per_acre))).astype(float32)
ln_invfar	3	ln_invfar = (ln(parcel.parcel_sqft/(urbansim_parcel.parcel.building_sqft).astype(float32))).astype(float32)
lnunits	3	lnunits = (ln(urbansim_parcel.parcel.residential_units)).astype(float32)
lnsqft	3	lnsqft = (ln(urbansim_parcel.parcel.building_sqft)).astype(float32)
ln_bldgage	3	ln_bldgage = (ln(parcel.aggregate(urbansim_parcel.building.age_masked, function=mean))).astype(float32)
art600	3	art600 = psrc.parcel.distance_to_arterial_in_gridcell<600
constant	3	constant
constant	7	constant
lngcdacbd	7	lngcdacbd = (ln(parcel.disaggregate(psrc.zone.generalized_cost_hbw_am_drive_alone_to_cbd))).astype(float32)
lnlotsqft	7	lnlotsqft = (ln(parcel.parcel_sqft)).astype(float32)
lnsqft	7	lnsqft = (ln(urbansim_parcel.parcel.building_sqft)).astype(float32)
lnsqft	9	lnsqft = (ln(urbansim_parcel.parcel.building_sqft)).astype(float32)
lnlotsqft	9	lnlotsqft = (ln(parcel.parcel_sqft)).astype(float32)
lngcdacbd	9	lngcdacbd = (ln(parcel.disaggregate(psrc.zone.generalized_cost_hbw_am_drive_alone_to_cbd))).astype(float32)
ln_bldgage	9	ln_bldgage = (ln(parcel.aggregate(urbansim_parcel.building.age_masked, function=mean))).astype(float32)
constant	9	constant
constant	10	constant
ln_bldgage	10	ln_bldgage = (ln(parcel.aggregate(urbansim_parcel.building.age_masked, function=mean))).astype(float32)
ln_invfar	10	ln_invfar = (ln(parcel.parcel_sqft/(urbansim_parcel.parcel.building_sqft).astype(float32))).astype(float32)
lnempden	10	lnempden = (ln(parcel.disaggregate(urbansim_parcel.zone.number_of_jobs_per_acre))).astype(float32)
lngcdacbd	10	lngcdacbd = (ln(parcel.disaggregate(psrc.zone.generalized_cost_hbw_am_drive_alone_to_cbd))).astype(float32)
lnsqft	10	lnsqft = (ln(urbansim_parcel.parcel.building_sqft)).astype(float32)
art300	14	art300 = psrc.parcel.distance_to_arterial_in_gridcell<300
constant	14	constant
is_pre_1940	14	is_pre_1940 = parcel.aggregate(numpy.ma.masked_where(urbansim_parcel.building.has_valid_year_built == 0, building.year_built),function=mean) < 1940
ln_bldgage	14	ln_bldgage = (ln(parcel.aggregate(urbansim_parcel.building.age_masked, function=mean))).astype(float32)
ln_invfar	14	ln_invfar = (ln(parcel.parcel_sqft/(urbansim_parcel.parcel.building_sqft).astype(float32))).astype(float32)
lnavginc	14	lnavginc = (ln(parcel.disaggregate(urbansim_parcel.zone.average_income))).astype(float32)
lnemp10da	14	lnemp10da = (ln(parcel.disaggregate(urbansim_parcel.zone.employment_within_10_minutes_travel_time_hbw_am_drive_alone))).astype(float32)
lnemp20da	14	lnemp20da = (ln(parcel.disaggregate(urbansim_parcel.zone.employment_within_20_minutes_travel_time_hbw_am_drive_alone))).astype(float32)
lnempden	14	lnempden = (ln(parcel.disaggregate(urbansim_parcel.zone.number_of_jobs_per_acre))).astype(float32)
lngcdacbd	14	lngcdacbd = (ln(parcel.disaggregate(psrc.zone.generalized_cost_hbw_am_drive_alone_to_cbd))).astype(float32)
lnpopden	14	lnpopden = (ln(parcel.disaggregate(urbansim_parcel.zone.population_per_acre))).astype(float32)
lnsqft	14	lnsqft = (ln(urbansim_parcel.parcel.building_sqft)).astype(float32)
lnavginc	15	lnavginc = (ln(parcel.disaggregate(urbansim_parcel.zone.average_income))).astype(float32)
lnemp10da	15	lnemp10da = (ln(parcel.disaggregate(urbansim_parcel.zone.employment_within_10_minutes_travel_time_hbw_am_drive_alone))).astype(float32)
lngcdacbd	15	lngcdacbd = (ln(parcel.disaggregate(psrc.zone.generalized_cost_hbw_am_drive_alone_to_cbd))).astype(float32)
lnunits	15	lnunits = (ln(urbansim_parcel.parcel.residential_units)).astype(float32)
art600	15	art600 = psrc.parcel.distance_to_arterial_in_gridcell<600
constant	15	constant
constant	18	constant
ln_bldgage	18	ln_bldgage = (ln(parcel.aggregate(urbansim_parcel.building.age_masked, function=mean))).astype(float32)
ln_invfar	18	ln_invfar = (ln(parcel.parcel_sqft/(urbansim_parcel.parcel.building_sqft).astype(float32))).astype(float32)
lnemp10da	18	lnemp10da = (ln(parcel.disaggregate(urbansim_parcel.zone.employment_within_10_minutes_travel_time_hbw_am_drive_alone))).astype(float32)
lnempden	18	lnempden = (ln(parcel.disaggregate(urbansim_parcel.zone.number_of_jobs_per_acre))).astype(float32)
lngcdacbd	18	lngcdacbd = (ln(parcel.disaggregate(psrc.zone.generalized_cost_hbw_am_drive_alone_to_cbd))).astype(float32)
lnlotsqft	18	lnlotsqft = (ln(parcel.parcel_sqft)).astype(float32)
lnunits	18	lnunits = (ln(urbansim_parcel.parcel.residential_units)).astype(float32)
ln_invfar	19	ln_invfar = (ln(parcel.parcel_sqft/(urbansim_parcel.parcel.building_sqft).astype(float32))).astype(float32)
art300	19	art300 = psrc.parcel.distance_to_arterial_in_gridcell<300
constant	19	constant
lnempden	20	lnempden = (ln(parcel.disaggregate(urbansim_parcel.zone.number_of_jobs_per_acre))).astype(float32)
ln_invfar	20	ln_invfar = (ln(parcel.parcel_sqft/(urbansim_parcel.parcel.building_sqft).astype(float32))).astype(float32)
hwy200	20	hwy200 = psrc.parcel.distance_to_highway_in_gridcell<200
constant	20	constant
art600	24	art600 = psrc.parcel.distance_to_arterial_in_gridcell<600
constant	24	constant
is_pre_1940	24	is_pre_1940 = parcel.aggregate(numpy.ma.masked_where(urbansim_parcel.building.has_valid_year_built == 0, building.year_built),function=mean) < 1940
ln_bldgage	24	ln_bldgage = (ln(parcel.aggregate(urbansim_parcel.building.age_masked, function=mean))).astype(float32)
ln_invfar	24	ln_invfar = (ln(parcel.parcel_sqft/(urbansim_parcel.parcel.building_sqft).astype(float32))).astype(float32)
lnavginc	24	lnavginc = (ln(parcel.disaggregate(urbansim_parcel.zone.average_income))).astype(float32)
lnemp10da	24	lnemp10da = (ln(parcel.disaggregate(urbansim_parcel.zone.employment_within_10_minutes_travel_time_hbw_am_drive_alone))).astype(float32)
lnemp20da	24	lnemp20da = (ln(parcel.disaggregate(urbansim_parcel.zone.employment_within_20_minutes_travel_time_hbw_am_drive_alone))).astype(float32)
lnemp30da	24	lnemp30da = (ln(parcel.disaggregate(urbansim_parcel.zone.employment_within_30_minutes_travel_time_hbw_am_drive_alone))).astype(float32)
lngcdacbd	24	lngcdacbd = (ln(parcel.disaggregate(psrc.zone.generalized_cost_hbw_am_drive_alone_to_cbd))).astype(float32)
lnsqft	24	lnsqft = (ln(urbansim_parcel.parcel.building_sqft)).astype(float32)
lnunits	24	lnunits = (ln(urbansim_parcel.parcel.residential_units)).astype(float32)
ln_invfar	25	ln_invfar = (ln(parcel.parcel_sqft/(urbansim_parcel.parcel.building_sqft).astype(float32))).astype(float32)
constant	25	constant
lngcdacbd	26	lngcdacbd = (ln(parcel.disaggregate(psrc.zone.generalized_cost_hbw_am_drive_alone_to_cbd))).astype(float32)
lnemp10da	26	lnemp10da = (ln(parcel.disaggregate(urbansim_parcel.zone.employment_within_10_minutes_travel_time_hbw_am_drive_alone))).astype(float32)
lnavginc	26	lnavginc = (ln(parcel.disaggregate(urbansim_parcel.zone.average_income))).astype(float32)
hwy2000	26	hwy2000 = psrc.parcel.distance_to_highway_in_gridcell<2000
constant	26	constant
lngcdacbd	28	lngcdacbd = (ln(parcel.disaggregate(psrc.zone.generalized_cost_hbw_am_drive_alone_to_cbd))).astype(float32)
lnempden	28	lnempden = (ln(parcel.disaggregate(urbansim_parcel.zone.number_of_jobs_per_acre))).astype(float32)
constant	28	constant
constant	30	constant
ln_bldgage	30	ln_bldgage = (ln(parcel.aggregate(urbansim_parcel.building.age_masked, function=mean))).astype(float32)
lnunits	30	lnunits = (ln(urbansim_parcel.parcel.residential_units)).astype(float32)

Model: household_location_choice_model_specification

coefficient_name	submodel_id	variable_name
Kitsap	-2	Kitsap = building.disaggregate(faz.fazdistrict_id) == 6
disposable_inc	-2	disposable_inc
high_inc_x_size	-2	high_inc_x_size
inc_x_condo	-2	inc_x_condo
inc_x_mfr	-2	inc_x_mfr
kids_x_SFR	-2	kids_x_SFR
kids_x_kids	-2	kids_x_kids
ln_residential_units	-2	ln_residential_units = ln(psrc_parcel.building.residential_units)
lngcdacbd_bldg	-2	lngcdacbd_bldg = ln(building.disaggregate(psrc.zone.generalized_cost_hbw_am_drive_alone_to_seattle_cbd))
low_inc_x_size	-2	low_inc_x_size
mid_inc_x_size	-2	mid_inc_x_size
one_pers_x_not_sfr	-2	one_pers_x_not_sfr
population_density	-2	population_density = (ln(building.disaggregate(urbansim_parcel.zone.population_per_acre))).astype(float32)
renter_x_mfr	-2	renter_x_mfr
same_area	-2	same_area
same_area_type	-2	same_area_type
young_x_young_HH	-2	young_x_young_HH

Model: non_home_based_employment_location_choice_model_specification

coefficient_name	submodel_id	variable_name
sector_density_in_zone	1	sector_density_in_zone
lnavginc_bldg	1	lnavginc_bldg = (ln(building.disaggregate(urbansim_parcel.zone.average_income))).astype(float32)
lnpopden_bldg	1	lnpopden_bldg = (ln(building.disaggregate(urbansim_parcel.zone.population_per_acre))).astype(float32)
lnempden_bldg	1	lnempden_bldg = (ln(building.disaggregate(urbansim_parcel.zone.number_of_jobs_per_acre))).astype(float32)
lnemp30da_bldg	1	lnemp30da_bldg = (ln(building.disaggregate(urbansim_parcel.zone.employment_within_30_minutes_travel_time_hbw_am_drive_alone))).astype(float32)
is_near_art	1	is_near_art = building.disaggregate(psrc.parcel.is_near_arterial_in_gridcell)
ln_unit_price_trunc	1	ln_unit_price_trunc = ln(where(building.disaggregate(urbansim_parcel.parcel.unit_price<1500),where(building.disaggregate(urbansim_parcel.parcel.unit_price<1),1,building.disaggregate(urbansim_parcel.parcel.unit_price)),1500))
sector_density_in_zone	2	sector_density_in_zone
lnpopden_bldg	2	lnpopden_bldg = (ln(building.disaggregate(urbansim_parcel.zone.population_per_acre))).astype(float32)
lnempden_bldg	2	lnempden_bldg = (ln(building.disaggregate(urbansim_parcel.zone.number_of_jobs_per_acre))).astype(float32)
lnemp30da_bldg	2	lnemp30da_bldg = (ln(building.disaggregate(urbansim_parcel.zone.employment_within_30_minutes_travel_time_hbw_am_drive_alone))).astype(float32)
is_near_highway	2	is_near_highway = building.disaggregate(psrc.parcel.is_near_highway_in_gridcell)
is_near_art	2	is_near_art = building.disaggregate(psrc.parcel.is_near_arterial_in_gridcell)
is_warehousing_building	2	is_warehousing_building = urbansim.building.is_warehousing

is_industrial_building	2	is_industrial_building = urbansim.building.is_industrial
inugb_bldg	2	inugb_bldg = building.disaggregate(parcel.is_inside_urban_growth_boundary==True)
ln_unit_price_trunc	2	ln_unit_price_trunc = ln(where(building.disaggregate(urbansim_parcel.parcel.unit_price<1500),where(building.disaggregate(urbansim_parcel.parcel.unit_price<1),1,building.disaggregate(urbansim_parcel.parcel.unit_price)),1500))
sector_density_in_zone	3	sector_density_in_zone
lnavginc_bldg	3	lnavginc_bldg = (ln(building.disaggregate(urbansim_parcel.zone.average_income))).astype(float32)
lnpopden_bldg	3	lnpopden_bldg = (ln(building.disaggregate(urbansim_parcel.zone.population_per_acre))).astype(float32)
lnemp30da_bldg	3	lnemp30da_bldg = (ln(building.disaggregate(urbansim_parcel.zone.employment_within_30_minutes_travel_time_hbw_am_drive_alone))).astype(float32)
is_near_highway	3	is_near_highway = building.disaggregate(psrc.parcel.is_near_highway_in_gridcell)
is_near_art	3	is_near_art = building.disaggregate(psrc.parcel.is_near_arterial_in_gridcell)
ln_nonresidential_sqft	3	ln_nonresidential_sqft = (ln(building.non_residential_sqft)).astype(float32)
is_warehousing_building	3	is_warehousing_building = urbansim.building.is_warehousing
is_industrial_building	3	is_industrial_building = urbansim.building.is_industrial
ln_unit_price_trunc	3	ln_unit_price_trunc = ln(where(building.disaggregate(urbansim_parcel.parcel.unit_price<1500),where(building.disaggregate(urbansim_parcel.parcel.unit_price<1),1,building.disaggregate(urbansim_parcel.parcel.unit_price)),1500))
sector_density_in_zone	4	sector_density_in_zone
lnavginc_bldg	4	lnavginc_bldg = (ln(building.disaggregate(urbansim_parcel.zone.average_income))).astype(float32)
lnpopden_bldg	4	lnpopden_bldg = (ln(building.disaggregate(urbansim_parcel.zone.population_per_acre))).astype(float32)
lnempden_bldg	4	lnempden_bldg = (ln(building.disaggregate(urbansim_parcel.zone.number_of_jobs_per_acre))).astype(float32)
lnemp30da_bldg	4	lnemp30da_bldg = (ln(building.disaggregate(urbansim_parcel.zone.employment_within_30_minutes_travel_time_hbw_am_drive_alone))).astype(float32)
is_near_highway	4	is_near_highway = building.disaggregate(psrc.parcel.is_near_highway_in_gridcell)
is_near_art	4	is_near_art = building.disaggregate(psrc.parcel.is_near_arterial_in_gridcell)
ln_nonresidential_sqft	4	ln_nonresidential_sqft = (ln(building.non_residential_sqft)).astype(float32)
is_warehousing_building	4	is_warehousing_building = urbansim.building.is_warehousing
is_office_building	4	is_office_building = urbansim.building.is_office
is_mixed_use_building	4	is_mixed_use_building = urbansim.building.is_mixed_use
is_industrial_building	4	is_industrial_building = urbansim.building.is_industrial
is_commercial_building	4	is_commercial_building = urbansim.building.is_commercial
inugb_bldg	4	inugb_bldg = building.disaggregate(parcel.is_inside_urban_growth_boundary==True)
ln_unit_price_trunc	4	ln_unit_price_trunc = ln(where(building.disaggregate(urbansim_parcel.parcel.unit_price<1500),where(building.disaggregate(urbansim_parcel.parcel.unit_price<1),1,building.disaggregate(urbansim_parcel.parcel.unit_price)),1500))
sector_density_in_zone	5	sector_density_in_zone
lnavginc_bldg	5	lnavginc_bldg = (ln(building.disaggregate(urbansim_parcel.zone.average_income))).astype(float32)
lnpopden_bldg	5	lnpopden_bldg = (ln(building.disaggregate(urbansim_parcel.zone.population_per_acre))).astype(float32)
lnempden_bldg	5	lnempden_bldg = (ln(building.disaggregate(urbansim_parcel.zone.number_of_jobs_per_acre))).astype(float32)
lnemp30da_bldg	5	lnemp30da_bldg = (ln(building.disaggregate(urbansim_parcel.zone.employment_within_30_minutes_travel_time_hbw_am_drive_alone))).astype(float32)
is_near_highway	5	is_near_highway = building.disaggregate(psrc.parcel.is_near_highway_in_gridcell)
is_near_art	5	is_near_art = building.disaggregate(psrc.parcel.is_near_arterial_in_gridcell)
is_warehousing_building	5	is_warehousing_building = urbansim.building.is_warehousing
is_office_building	5	is_office_building = urbansim.building.is_office
is_mixed_use_building	5	is_mixed_use_building = urbansim.building.is_mixed_use
is_industrial_building	5	is_industrial_building = urbansim.building.is_industrial
is_commercial_building	5	is_commercial_building = urbansim.building.is_commercial
inugb_bldg	5	inugb_bldg = building.disaggregate(parcel.is_inside_urban_growth_boundary==True)
ln_unit_price_trunc	5	ln_unit_price_trunc = ln(where(building.disaggregate(urbansim_parcel.parcel.unit_price<1500),where(building.disaggregate(urbansim_parcel.parcel.unit_price<1),1,building.disaggregate(urbansim_parcel.parcel.unit_price)),1500))
sector_density_in_zone	6	sector_density_in_zone
lnavginc_bldg	6	lnavginc_bldg = (ln(building.disaggregate(urbansim_parcel.zone.average_income))).astype(float32)
lnpopden_bldg	6	lnpopden_bldg = (ln(building.disaggregate(urbansim_parcel.zone.population_per_acre))).astype(float32)
lnempden_bldg	6	lnempden_bldg = (ln(building.disaggregate(urbansim_parcel.zone.number_of_jobs_per_acre))).astype(float32)
lnemp30da_bldg	6	lnemp30da_bldg = (ln(building.disaggregate(urbansim_parcel.zone.employment_within_30_minutes_travel_time_hbw_am_drive_alone))).astype(float32)
is_near_highway	6	is_near_highway = building.disaggregate(psrc.parcel.is_near_highway_in_gridcell)
is_near_art	6	is_near_art = building.disaggregate(psrc.parcel.is_near_arterial_in_gridcell)
ln_nonresidential_sqft	6	ln_nonresidential_sqft = (ln(building.non_residential_sqft)).astype(float32)
is_warehousing_building	6	is_warehousing_building = urbansim.building.is_warehousing
is_office_building	6	is_office_building = urbansim.building.is_office
is_mixed_use_building	6	is_mixed_use_building = urbansim.building.is_mixed_use
is_industrial_building	6	is_industrial_building = urbansim.building.is_industrial
is_commercial_building	6	is_commercial_building = urbansim.building.is_commercial
inugb_bldg	6	inugb_bldg = building.disaggregate(parcel.is_inside_urban_growth_boundary==True)
ln_unit_price_trunc	6	ln_unit_price_trunc = ln(where(building.disaggregate(urbansim_parcel.parcel.unit_price<1500),where(building.disaggregate(urbansim_parcel.parcel.unit_price<1),1,building.disaggregate(urbansim_parcel.parcel.unit_price)),1500))
sector_density_in_zone	7	sector_density_in_zone
lnavginc_bldg	7	lnavginc_bldg = (ln(building.disaggregate(urbansim_parcel.zone.average_income))).astype(float32)
lnpopden_bldg	7	lnpopden_bldg = (ln(building.disaggregate(urbansim_parcel.zone.population_per_acre))).astype(float32)
lnempden_bldg	7	lnempden_bldg = (ln(building.disaggregate(urbansim_parcel.zone.number_of_jobs_per_acre))).astype(float32)
lnemp30da_bldg	7	lnemp30da_bldg = (ln(building.disaggregate(urbansim_parcel.zone.employment_within_30_minutes_travel_time_hbw_am_drive_alone))).astype(float32)
is_near_highway	7	is_near_highway = building.disaggregate(psrc.parcel.is_near_highway_in_gridcell)
is_near_art	7	is_near_art = building.disaggregate(psrc.parcel.is_near_arterial_in_gridcell)
is_warehousing_building	7	is_warehousing_building = urbansim.building.is_warehousing
is_mixed_use_building	7	is_mixed_use_building = urbansim.building.is_mixed_use
is_commercial_building	7	is_commercial_building = urbansim.building.is_commercial
inugb_bldg	7	inugb_bldg = building.disaggregate(parcel.is_inside_urban_growth_boundary==True)
ln_unit_price_trunc	7	ln_unit_price_trunc = ln(where(building.disaggregate(urbansim_parcel.parcel.unit_price<1500),where(building.disaggregate(urbansim_parcel.parcel.unit_price<1),1,building.disaggregate(urbansim_parcel.parcel.unit_price)),1500))
sector_density_in_zone	8	sector_density_in_zone
lnavginc_bldg	8	lnavginc_bldg = (ln(building.disaggregate(urbansim_parcel.zone.average_income))).astype(float32)
lnpopden_bldg	8	lnpopden_bldg = (ln(building.disaggregate(urbansim_parcel.zone.population_per_acre))).astype(float32)
lnempden_bldg	8	lnempden_bldg = (ln(building.disaggregate(urbansim_parcel.zone.number_of_jobs_per_acre))).astype(float32)
lnemp30da_bldg	8	lnemp30da_bldg = (ln(building.disaggregate(urbansim_parcel.zone.employment_within_30_minutes_travel_time_hbw_am_drive_alone))).astype(float32)
is_near_highway	8	is_near_highway = building.disaggregate(psrc.parcel.is_near_highway_in_gridcell)
is_near_art	8	is_near_art = building.disaggregate(psrc.parcel.is_near_arterial_in_gridcell)
ln_nonresidential_sqft	8	ln_nonresidential_sqft = (ln(building.non_residential_sqft)).astype(float32)
is_warehousing_building	8	is_warehousing_building = urbansim.building.is_warehousing
is_industrial_building	8	is_industrial_building = urbansim.building.is_industrial
inugb_bldg	8	inugb_bldg = building.disaggregate(parcel.is_inside_urban_growth_boundary==True)
ln_unit_price_trunc	8	ln_unit_price_trunc = ln(where(building.disaggregate(urbansim_parcel.parcel.unit_price<1500),where(building.disaggregate(urbansim_parcel.parcel.unit_price<1),1,building.disaggregate(urbansim_parcel.parcel.unit_price)),1500))
sector_density_in_zone	9	sector_density_in_zone
lnavginc_bldg	9	lnavginc_bldg = (ln(building.disaggregate(urbansim_parcel.zone.average_income))).astype(float32)
lnpopden_bldg	9	lnpopden_bldg = (ln(building.disaggregate(urbansim_parcel.zone.population_per_acre))).astype(float32)
lnempden_bldg	9	lnempden_bldg = (ln(building.disaggregate(urbansim_parcel.zone.number_of_jobs_per_acre))).astype(float32)
lnemp30da_bldg	9	lnemp30da_bldg = (ln(building.disaggregate(urbansim_parcel.zone.employment_within_30_minutes_travel_time_hbw_am_drive_alone))).astype(float32)
is_near_art	9	is_near_art = building.disaggregate(psrc.parcel.is_near_arterial_in_gridcell)
ln_nonresidential_sqft	9	ln_nonresidential_sqft = (ln(building.non_residential_sqft)).astype(float32)
ln_unit_price_trunc	9	ln_unit_price_trunc = ln(where(building.disaggregate(urbansim_parcel.parcel.unit_price<1500),where(building.disaggregate(urbansim_parcel.parcel.unit_price<1),1,building.disaggregate(urbansim_parcel.parcel.unit_price)),1500))
is_commercial_building	10	is_commercial_building = urbansim.building.is_commercial
is_industrial_building	10	is_industrial_building = urbansim.building.is_industrial
is_near_art	10	is_near_art = building.disaggregate(psrc.parcel.is_near_arterial_in_gridcell)
is_near_highway	10	is_near_highway = building.disaggregate(psrc.parcel.is_near_highway_in_gridcell)
is_office_building	10	is_office_building = urbansim.building.is_office
is_tcu_building	10	is_tcu_building = urbansim.building.is_tcu
lnemp30da_bldg	10	lnemp30da_bldg = (ln(building.disaggregate(urbansim_parcel.zone.employment_within_30_minutes_travel_time_hbw_am_drive_alone))).astype(float32)
lnempden_bldg	10	lnempden_bldg = (ln(building.disaggregate(urbansim_parcel.zone.number_of_jobs_per_acre))).astype(float32)
is_commercial_building	11	is_commercial_building = urbansim.building.is_commercial
is_industrial_building	11	is_industrial_building = urbansim.building.is_industrial
is_mixed_use_building	11	is_mixed_use_building = urbansim.building.is_mixed_use
is_near_art	11	is_near_art = building.disaggregate(psrc.parcel.is_near_arterial_in_gridcell)
is_near_highway	11	is_near_highway = building.disaggregate(psrc.parcel.is_near_highway_in_gridcell)
is_office_building	11	is_office_building = urbansim.building.is_office
lnavginc_bldg	11	lnavginc_bldg = (ln(building.disaggregate(urbansim_parcel.zone.average_income))).astype(float32)
lnemp30da_bldg	11	lnemp30da_bldg = (ln(building.disaggregate(urbansim_parcel.zone.employment_within_30_minutes_travel_time_hbw_am_drive_alone))).astype(float32)
lnempden_bldg	11	lnempden_bldg = (ln(building.disaggregate(urbansim_parcel.zone.number_of_jobs_per_acre))).astype(float32)
lnpopden_bldg	11	lnpopden_bldg = (ln(building.disaggregate(urbansim_parcel.zone.population_per_acre))).astype(float32)
sector_density_in_zone	12	sector_density_in_zone
lnavginc_bldg	12	lnavginc_bldg = (ln(building.disaggregate(urbansim_parcel.zone.average_income))).astype(float32)
lnpopden_bldg	12	lnpopden_bldg = (ln(building.disaggregate(urbansim_parcel.zone.population_per_acre))).astype(float32)
lnempden_bldg	12	lnempden_bldg = (ln(building.disaggregate(urbansim_parcel.zone.number_of_jobs_per_acre))).astype(float32)
lnemp30da_bldg	12	lnemp30da_bldg = (ln(building.disaggregate(urbansim_parcel.zone.employment_within_30_minutes_travel_time_hbw_am_drive_alone))).astype(float32)
is_near_highway	12	is_near_highway = building.disaggregate(psrc.parcel.is_near_highway_in_gridcell)
is_office_building	12	is_office_building = urbansim.building.is_office
is_mixed_use_building	12	is_mixed_use_building = urbansim.building.is_mixed_use
is_industrial_building	12	is_industrial_building = urbansim.building.is_industrial
is_commercial_building	12	is_commercial_building = urbansim.building.is_commercial
inugb_bldg	12	inugb_bldg = building.disaggregate(parcel.is_inside_urban_growth_boundary==True)
ln_unit_price_trunc	12	ln_unit_price_trunc = ln(where(building.disaggregate(urbansim_parcel.parcel.unit_price<1500),where(building.disaggregate(urbansim_parcel.parcel.unit_price<1),1,building.disaggregate(urbansim_parcel.parcel.unit_price)),1500))
sector_density_in_zone	13	sector_density_in_zone
lnavginc_bldg	13	lnavginc_bldg = (ln(building.disaggregate(urbansim_parcel.zone.average_income))).astype(float32)
lnpopden_bldg	13	lnpopden_bldg = (ln(building.disaggregate(urbansim_parcel.zone.population_per_acre))).astype(float32)
lnempden_bldg	13	lnempden_bldg = (ln(building.disaggregate(urbansim_parcel.zone.number_of_jobs_per_acre))).astype(float32)
lnemp30da_bldg	13	lnemp30da_bldg = (ln(building.disaggregate(urbansim_parcel.zone.employment_within_30_minutes_travel_time_hbw_am_drive_alone))).astype(float32)
is_near_highway	13	is_near_highway = building.disaggregate(psrc.parcel.is_near_highway_in_gridcell)
is_near_art	13	is_near_art = building.disaggregate(psrc.parcel.is_near_arterial_in_gridcell)
is_office_building	13	is_office_building = urbansim.building.is_office
is_mixed_use_building	13	is_mixed_use_building = urbansim.building.is_mixed_use
is_industrial_building	13	is_industrial_building = urbansim.building.is_industrial

is_commercial_building	13	is_commercial_building = urbansim.building.is_commercial
inugb_bldg	13	inugb_bldg = building.disaggregate(parcel.is_inside_urban_growth_boundary==True)
ln_unit_price_trunc	13	ln_unit_price_trunc = ln(where(building.disaggregate(urbansim_parcel.parcel.unit_price<1500),where(building.disaggregate(urbansim_parcel.parcel.unit_price<1),1,building.disaggregate(urbansim_parcel.parcel.unit_price)),1500))
sector_density_in_zone	14	sector_density_in_zone
lnavginc_bldg	14	lnavginc_bldg = (ln(building.disaggregate(urbansim_parcel.zone.average_income))).astype(float32)
lnpopden_bldg	14	lnpopden_bldg = (ln(building.disaggregate(urbansim_parcel.zone.population_per_acre))).astype(float32)
lnempden_bldg	14	lnempden_bldg = (ln(building.disaggregate(urbansim_parcel.zone.number_of_jobs_per_acre))).astype(float32)
lnemp30da_bldg	14	lnemp30da_bldg = (ln(building.disaggregate(urbansim_parcel.zone.employment_within_30_minutes_travel_time_hbw_am_drive_alone))).astype(float32)
is_near_highway	14	is_near_highway = building.disaggregate(psrc.parcel.is_near_highway_in_gridcell)
is_near_art	14	is_near_art = building.disaggregate(psrc.parcel.is_near_arterial_in_gridcell)
is_office_building	14	is_office_building = urbansim.building.is_office
is_mixed_use_building	14	is_mixed_use_building = urbansim.building.is_mixed_use
is_commercial_building	14	is_commercial_building = urbansim.building.is_commercial
inugb_bldg	14	inugb_bldg = building.disaggregate(parcel.is_inside_urban_growth_boundary==True)
ln_unit_price_trunc	14	ln_unit_price_trunc = ln(where(building.disaggregate(urbansim_parcel.parcel.unit_price<1500),where(building.disaggregate(urbansim_parcel.parcel.unit_price<1),1,building.disaggregate(urbansim_parcel.parcel.unit_price)),1500))
sector_density_in_zone	15	sector_density_in_zone
lnavginc_bldg	15	lnavginc_bldg = (ln(building.disaggregate(urbansim_parcel.zone.average_income))).astype(float32)
lnpopden_bldg	15	lnpopden_bldg = (ln(building.disaggregate(urbansim_parcel.zone.population_per_acre))).astype(float32)
lnempden_bldg	15	lnempden_bldg = (ln(building.disaggregate(urbansim_parcel.zone.number_of_jobs_per_acre))).astype(float32)
lnemp30da_bldg	15	lnemp30da_bldg = (ln(building.disaggregate(urbansim_parcel.zone.employment_within_30_minutes_travel_time_hbw_am_drive_alone))).astype(float32)
is_near_highway	15	is_near_highway = building.disaggregate(psrc.parcel.is_near_highway_in_gridcell)
is_near_art	15	is_near_art = building.disaggregate(psrc.parcel.is_near_arterial_in_gridcell)
is_office_building	15	is_office_building = urbansim.building.is_office
is_mixed_use_building	15	is_mixed_use_building = urbansim.building.is_mixed_use
is_industrial_building	15	is_industrial_building = urbansim.building.is_industrial
is_commercial_building	15	is_commercial_building = urbansim.building.is_commercial
inugb_bldg	15	inugb_bldg = building.disaggregate(parcel.is_inside_urban_growth_boundary==True)
ln_unit_price_trunc	15	ln_unit_price_trunc = ln(where(building.disaggregate(urbansim_parcel.parcel.unit_price<1500),where(building.disaggregate(urbansim_parcel.parcel.unit_price<1),1,building.disaggregate(urbansim_parcel.parcel.unit_price)),1500))
sector_density_in_zone	16	sector_density_in_zone
lnavginc_bldg	16	lnavginc_bldg = (ln(building.disaggregate(urbansim_parcel.zone.average_income))).astype(float32)
lnpopden_bldg	16	lnpopden_bldg = (ln(building.disaggregate(urbansim_parcel.zone.population_per_acre))).astype(float32)
lnempden_bldg	16	lnempden_bldg = (ln(building.disaggregate(urbansim_parcel.zone.number_of_jobs_per_acre))).astype(float32)
lnemp30da_bldg	16	lnemp30da_bldg = (ln(building.disaggregate(urbansim_parcel.zone.employment_within_30_minutes_travel_time_hbw_am_drive_alone))).astype(float32)
is_near_highway	16	is_near_highway = building.disaggregate(psrc.parcel.is_near_highway_in_gridcell)
is_near_art	16	is_near_art = building.disaggregate(psrc.parcel.is_near_arterial_in_gridcell)
is_office_building	16	is_office_building = urbansim.building.is_office
is_mixed_use_building	16	is_mixed_use_building = urbansim.building.is_mixed_use
is_industrial_building	16	is_industrial_building = urbansim.building.is_industrial
is_commercial_building	16	is_commercial_building = urbansim.building.is_commercial
inugb_bldg	16	inugb_bldg = building.disaggregate(parcel.is_inside_urban_growth_boundary==True)
ln_unit_price_trunc	16	ln_unit_price_trunc = ln(where(building.disaggregate(urbansim_parcel.parcel.unit_price<1500),where(building.disaggregate(urbansim_parcel.parcel.unit_price<1),1,building.disaggregate(urbansim_parcel.parcel.unit_price)),1500))
sector_density_in_zone	17	sector_density_in_zone
lnavginc_bldg	17	lnavginc_bldg = (ln(building.disaggregate(urbansim_parcel.zone.average_income))).astype(float32)
lnpopden_bldg	17	lnpopden_bldg = (ln(building.disaggregate(urbansim_parcel.zone.population_per_acre))).astype(float32)
lnempden_bldg	17	lnempden_bldg = (ln(building.disaggregate(urbansim_parcel.zone.number_of_jobs_per_acre))).astype(float32)
lnemp30da_bldg	17	lnemp30da_bldg = (ln(building.disaggregate(urbansim_parcel.zone.employment_within_30_minutes_travel_time_hbw_am_drive_alone))).astype(float32)
is_near_highway	17	is_near_highway = building.disaggregate(psrc.parcel.is_near_highway_in_gridcell)
is_near_art	17	is_near_art = building.disaggregate(psrc.parcel.is_near_arterial_in_gridcell)
is_office_building	17	is_office_building = urbansim.building.is_office
is_mixed_use_building	17	is_mixed_use_building = urbansim.building.is_mixed_use
is_industrial_building	17	is_industrial_building = urbansim.building.is_industrial
is_commercial_building	17	is_commercial_building = urbansim.building.is_commercial
inugb_bldg	17	inugb_bldg = building.disaggregate(parcel.is_inside_urban_growth_boundary==True)
ln_unit_price_trunc	17	ln_unit_price_trunc = ln(where(building.disaggregate(urbansim_parcel.parcel.unit_price<1500),where(building.disaggregate(urbansim_parcel.parcel.unit_price<1),1,building.disaggregate(urbansim_parcel.parcel.unit_price)),1500))

Model: home_based_employment_location_choice_model_specification

coefficient_name	submodel_id	variable_name
blngcdacbd	-2	blngcdacbd = (ln(building.disaggregate(psrc.zone.generalized_cost_hbw_am_drive_alone_to_cbd))).astype(float32)

Model: work_at_home_choice_model_specification

coefficient_name	submodel_id	variable_name
age	-2	person.age
age13	-2	age13 = person.disaggregate(urbansim_parcel.household.persons_with_age_le_13>0)
edu	-2	person.edu
kemp30m	-2	kemp30m = person.disaggregate(urbansim_parcel.zone.employment_within_30_minutes_travel_time_hbw_am_drive_alone, intermediates=[household])/1000
parttime	-2	parttime = person.employment_status==2
constant	-2	constant

Model: workplace_choice_model_for_resident_specification

coefficient_name	submodel_id	variable_name
edu_x_job_is_in_employment_sector_group_basic	-2	edu_x_job_is_in_employment_sector_group_basic
edu_x_job_is_in_employment_sector_group_edu	-2	edu_x_job_is_in_employment_sector_group_edu
edu_x_job_is_in_employment_sector_group_fires	-2	edu_x_job_is_in_employment_sector_group_fires
edu_x_job_is_in_employment_sector_group_retail	-2	edu_x_job_is_in_employment_sector_group_retail
home_area_type_3_workplace_area_type_1	-2	psrc_parcel.person_x_job.home_area_type_3_workplace_area_type_1
home_dist_1_workplace_dist_1	-2	home_dist_1_workplace_dist_1
home_dist_6_workplace_dist_6	-2	home_dist_6_workplace_dist_6
home_district_is_same_as_workplace_district	-2	psrc_parcel.person_x_job.home_district_is_same_as_workplace_district
travel_time_hbw_am_drive_alone_from_home_to_work	-2	psrc_parcel.person_x_job.travel_time_hbw_am_drive_alone_from_home_to_work

7.2 Model Coefficients

Model: real_estate_price_model_coefficients

coefficient_name	estimate	error	submodel_id	t_statistic
constant	2.456344	0.092680	2	26.503622
is_pre_1940	-0.100422	0.025825	2	-3.888608
ln_invfar	0.279860	0.009535	2	29.349848
lnemp10da	0.098804	0.007952	2	12.425369
lnempden	0.115753	0.010050	2	11.517746
art600	0.189906	0.013294	3	14.285398
constant	6.190252	0.052564	3	117.765900
ln_bldgage	-0.172448	0.004155	3	-41.502029
ln_invfar	0.320258	0.004522	3	70.830086
lnempden	0.073433	0.003759	3	19.533459
lngcdacbd	-0.303858	0.006390	3	-47.551483
lnsqft	-0.114646	0.004103	3	-27.942001
lnunits	-0.284653	0.013103	3	-21.724806
constant	5.007825	0.193020	7	25.944550
lngcdacbd	-0.274207	0.027565	7	-9.947601
lnlotsqft	0.213021	0.019508	7	10.919862
lnsqft	-0.224874	0.021496	7	-10.461335
constant	5.085237	0.491260	9	10.351415
ln_bldgage	-0.070589	0.036318	9	-1.943642
lngcdacbd	-0.162680	0.053129	9	-3.061969
lnlotsqft	0.182278	0.057539	9	3.167920
lnsqft	-0.206792	0.057986	9	-3.566225
constant	5.160256	0.111438	10	46.305969
ln_bldgage	-0.115222	0.009855	10	-11.691659
ln_invfar	0.338644	0.010960	10	30.897448
lnempden	0.090896	0.010575	10	8.595695
lngcdacbd	-0.232403	0.018585	10	-12.504976
lnsqft	-0.075995	0.007998	10	-9.502139
art300	-0.013163	0.004230	14	-3.111495
constant	1.852417	0.108187	14	17.122364
is_pre_1940	0.047714	0.006036	14	7.905516
ln_bldgage	-0.023176	0.002858	14	-8.109178
ln_invfar	0.180240	0.003572	14	50.461044
lnavginc	0.401905	0.007755	14	51.826221
lnemp10da	-0.060846	0.004598	14	-13.234377
lnemp20da	0.042889	0.004813	14	8.910419
lnempden	0.041125	0.002264	14	18.160696
lngcdacbd	-0.279397	0.005481	14	-50.974266
lnpopden	0.054975	0.003029	14	18.149071
lnsqft	-0.153623	0.002613	14	-58.799877
art600	0.112780	0.019476	15	5.790721
constant	3.654817	0.295049	15	12.387145
lnavginc	0.225262	0.020847	15	10.805618
lnemp10da	-0.047448	0.012565	15	-3.776371
lngcdacbd	-0.325476	0.019799	15	-16.439060
lnunits	-0.028035	0.006260	15	-4.478032
constant	5.488019	0.108847	18	50.419579
ln_bldgage	-0.113861	0.005583	18	-20.393124
ln_invfar	0.348094	0.006259	18	55.613163
lnemp10da	-0.004553	0.006485	18	-0.702037
lnempden	0.077436	0.004670	18	16.583031
lngcdacbd	-0.196446	0.009453	18	-20.781464
lnlotsqft	-0.049904	0.004893	18	-10.198849
lnunits	-0.269536	0.015748	18	-17.115305
art300	0.452412	0.150082	19	3.014421
constant	4.046621	0.081757	19	49.495468
ln_invfar	-0.178334	0.035281	19	-5.054729
constant	3.292528	0.072855	20	45.192669
hwy200	0.256473	0.088260	20	2.905879
ln_invfar	0.355288	0.022264	20	15.957749
lnempden	0.239174	0.018702	20	12.788549
art600	-0.020328	0.001921	24	-10.580562
constant	2.389466	0.049466	24	48.305439
is_pre_1940	0.037102	0.002837	24	13.079166
ln_bldgage	-0.016522	0.001063	24	-15.538515
ln_invfar	0.082575	0.001149	24	71.891388
lnavginc	0.533813	0.003788	24	140.908630
lnemp10da	-0.020939	0.001564	24	-13.387031
lnemp20da	-0.009239	0.002972	24	-3.108479
lnemp30da	-0.009238	0.002594	24	-3.560902
lngcdacbd	-0.398986	0.002502	24	-159.446960
lnsqft	-0.270870	0.002461	24	-110.081230
lnunits	-0.362857	0.006775	24	-53.561962
constant	3.843303	0.046805	25	82.113106
ln_invfar	0.259180	0.012564	25	20.628309
constant	3.104441	0.209538	26	14.815682
hwy2000	0.238623	0.017374	26	13.734358
lnavginc	0.009648	0.011907	26	0.810283
lnemp10da	0.056152	0.010037	26	5.594724
lngcdacbd	-0.068944	0.017026	26	-4.049340
constant	4.121785	0.057770	28	71.347649
lnempden	0.005024	0.009577	28	0.524589
lngcdacbd	-0.093830	0.015637	28	-6.000632
constant	4.266751	0.042584	30	100.197205
ln_bldgage	-0.038925	0.012618	30	-3.084891
lnunits	0.067960	0.013743	30	4.945158

Model: household_location_choice_model_coefficients

coefficient_name	estimate	error	submodel_id	t_statistic
Kitsap	0.165124	1.951837	-	0.084599
disposable_inc	0.012022	0.015711	-	0.765195
high_inc_x_size	0.270331	0.112022	-	2.413200
inc_x_condo	-0.111839	0.013139	-	-8.512225
inc_x_mfr	-0.247619	0.012744	-	-19.430611
kids_x_SFR	1.572276	0.192995	-	8.146736
kids_x_kids	0.005661	0.006568	-	0.861890
ln_residential_units	-0.314514	0.027317	-	-11.513589
lngcdacbd_bldg	-0.246310	0.069144	-	-3.562251
low_inc_x_size	-0.190010	0.122891	-	-1.546167
mid_inc_x_size	-0.234603	0.092302	-	-2.541692
one_pers_x_not_sfr	0.485775	0.121740	-	3.990271
population_density	-0.004229	0.041030	-	-0.103059
renter_x_mfr	2.927140	0.157031	-	18.640572
same_area	6.990695	1.560083	-	4.480976
same_area_type	5.124347	1.354734	-	3.782550
young_x_young_HH	0.050962	0.020217	-	2.520828

Model: non_home_based_employment_location_choice_model_coefficients

coefficient_name	estimate	error	submodel_id	t_statistic
is_near_art	0.004757	0.052688	1	0.090287
ln_unit_price_trunc	0.714837	0.016560	1	43.167080
lnavginc_bldg	0.803152	0.065953	1	12.177661
lnemp30da_bldg	-0.186191	0.021857	1	-8.518666
lnempden_bldg	-0.289915	0.019591	1	-14.798614
lnpopden_bldg	-0.118746	0.018673	1	-6.359346
sector_density_in_zone	12.256066	0.154271	1	79.444794
inugb_bldg	-0.578999	0.061602	2	-9.399026
is_industrial_building	-0.137970	0.075886	2	-1.818114
is_near_art	0.086001	0.034266	2	2.509826
is_near_highway	0.153520	0.071402	2	2.150088
is_warehousing_building	0.459456	0.041482	2	11.076130
ln_unit_price_trunc	1.025313	0.020314	2	50.472607
lnemp30da_bldg	0.152048	0.022833	2	6.659063
lnempden_bldg	-0.051544	0.011893	2	-4.333853

lnpopden_bldg	-0.037809	0.010597	2	-3.567719
sector_density_in_zone	5.088881	0.140526	2	36.213062
is_industrial_building	0.247718	0.064670	3	3.830523
is_near_art	-0.698107	0.063116	3	-11.060764
is_near_highway	1.033688	0.097592	3	10.591888
is_warehousing_building	-1.124602	0.077080	3	-14.590088
ln_nonresidential_sqft	-0.458949	0.018158	3	-25.275534
ln_unit_price_trunc	-0.135157	0.029831	3	-4.530755
lnavginc_bldg	0.001401	0.005582	3	0.251055
lnemp30da_bldg	2.503329	0.116791	3	21.434191
lnpopden_bldg	-0.224063	0.010344	3	-21.661610
sector_density_in_zone	4.998341	0.099421	3	50.274563
inugb_bldg	0.397624	0.122262	4	3.252234
is_commercial_building	1.738195	0.097507	4	17.826376
is_industrial_building	3.911438	0.089936	4	43.491451
is_mixed_use_building	2.347082	0.470076	4	4.992979
is_near_art	-0.562611	0.043627	4	-12.896027
is_near_highway	-0.458085	0.092319	4	-4.961966
is_office_building	2.586942	0.091625	4	28.234066
is_warehousing_building	3.147016	0.088830	4	35.427265
ln_nonresidential_sqft	-0.632342	0.010875	4	-58.145882
ln_unit_price_trunc	0.428133	0.024332	4	17.595528
lnavginc_bldg	0.024027	0.005281	4	4.549863
lnemp30da_bldg	0.398586	0.023380	4	17.048424
lnempden_bldg	0.167173	0.016482	4	10.142845
lnpopden_bldg	-0.092916	0.010866	4	-8.550928
sector_density_in_zone	5.913684	0.110226	4	53.650410
inugb_bldg	0.062652	0.121167	5	0.517075
is_commercial_building	0.732830	0.068567	5	10.687794
is_industrial_building	3.142480	0.067243	5	46.733109
is_mixed_use_building	2.628788	0.228866	5	11.486164
is_near_art	0.235528	0.035587	5	6.618402
is_near_highway	0.275314	0.065215	5	4.221614
is_office_building	0.854082	0.068269	5	12.510474
is_warehousing_building	2.177935	0.065838	5	33.080383
ln_unit_price_trunc	0.492294	0.022297	5	22.078648
lnavginc_bldg	0.064624	0.006585	5	9.813656
lnemp30da_bldg	-0.038885	0.028201	5	-1.378853
lnempden_bldg	0.299562	0.014767	5	20.285358
lnpopden_bldg	-0.006240	0.010376	5	-0.601421
sector_density_in_zone	14.910714	0.225675	5	66.071487
inugb_bldg	0.095489	0.142874	6	0.668349
is_commercial_building	1.445230	0.089173	6	16.207005
is_industrial_building	2.306227	0.099622	6	23.149757
is_mixed_use_building	1.290189	0.374825	6	3.442111
is_near_art	-0.029225	0.037493	6	-0.779463
is_near_highway	0.188139	0.068768	6	2.735835
is_office_building	2.301944	0.084585	6	27.214632
is_warehousing_building	3.330888	0.081776	6	40.731956
ln_nonresidential_sqft	-0.748844	0.011963	6	-62.597790
ln_unit_price_trunc	0.280949	0.025707	6	10.929015
lnavginc_bldg	-0.051250	0.004574	6	-11.204590
lnemp30da_bldg	0.714725	0.048819	6	14.640269
lnempden_bldg	0.330523	0.014891	6	22.196552
lnpopden_bldg	-0.020690	0.010467	6	-1.976659
sector_density_in_zone	6.714878	0.154941	6	43.338188
inugb_bldg	-0.135384	0.117614	7	-1.151087
is_commercial_building	1.781531	0.038149	7	46.699066
is_mixed_use_building	2.063761	0.217168	7	9.503060
is_near_art	0.579782	0.033000	7	17.569059
is_near_highway	0.171280	0.071286	7	2.402728
is_warehousing_building	0.867257	0.060803	7	14.263309
ln_unit_price_trunc	0.664678	0.018884	7	35.197620
lnavginc_bldg	0.006129	0.005579	7	1.098575
lnemp30da_bldg	-0.146458	0.023036	7	-6.357737
lnempden_bldg	0.117806	0.010844	7	10.863416
lnpopden_bldg	-0.024170	0.012896	7	-1.874231
sector_density_in_zone	4.472168	0.126087	7	35.469021
inugb_bldg	0.662909	0.201783	8	3.285265
is_industrial_building	0.337100	0.074478	8	4.526150
is_near_art	-0.101623	0.042620	8	-2.384385
is_near_highway	-0.732121	0.113101	8	-6.473160
is_warehousing_building	1.017449	0.043396	8	23.445604
ln_nonresidential_sqft	-0.588783	0.010869	8	-54.169140
ln_unit_price_trunc	0.012909	0.023244	8	0.555342
lnavginc_bldg	0.019234	0.006688	8	2.876024
lnemp30da_bldg	0.438675	0.047826	8	9.172340
lnempden_bldg	0.529556	0.014370	8	36.852566
lnpopden_bldg	-0.085076	0.010624	8	-8.007920
sector_density_in_zone	6.480068	0.081664	8	79.350815
is_near_art	-0.124869	0.124616	9	-1.002029
ln_nonresidential_sqft	-0.703194	0.040229	9	-17.479771
ln_unit_price_trunc	0.206815	0.072811	9	2.840443
lnavginc_bldg	1.072793	0.098324	9	10.910773
lnemp30da_bldg	1.207466	0.086941	9	13.888398
lnempden_bldg	0.054433	0.070793	9	0.768894
lnpopden_bldg	-0.048237	0.067994	9	-0.709433
sector_density_in_zone	42.677662	2.024558	9	21.079992
is_commercial_building	0.451077	0.065018	10	6.937773
is_industrial_building	0.909446	0.088708	10	10.252085
is_near_art	0.641827	0.041231	10	15.566754
is_near_highway	-0.628128	0.080989	10	-7.755717
is_office_building	2.015270	0.048690	10	41.389698
is_tcu_building	1.010292	0.251169	10	4.022360
lnemp30da_bldg	0.175494	0.037330	10	4.701192
lnempden_bldg	0.170005	0.011245	10	15.117980
is_commercial_building	0.361676	0.058064	11	6.228895
is_industrial_building	0.357688	0.107113	11	3.339353
is_mixed_use_building	2.028167	0.271514	11	7.469846
is_near_art	0.286697	0.037248	11	7.697014
is_near_highway	0.348018	0.055929	11	6.222456
is_office_building	1.896182	0.041533	11	45.654476
lnavginc_bldg	0.013073	0.005942	11	2.200086
lnemp30da_bldg	0.373467	0.029949	11	12.469987
lnempden_bldg	0.166481	0.010415	11	15.984391
lnpopden_bldg	0.082930	0.012937	11	6.410324
inugb_bldg	0.153895	0.179685	12	0.856471
is_commercial_building	0.259011	0.058411	12	4.434304
is_industrial_building	-1.979239	0.336704	12	-5.878282
is_mixed_use_building	1.780500	0.241881	12	7.361045
is_near_highway	-0.495334	0.064808	12	-7.643075
is_office_building	1.831128	0.041690	12	43.922981
ln_unit_price_trunc	0.279546	0.016225	12	17.229403
lnavginc_bldg	-0.010987	0.006427	12	-1.709385
lnemp30da_bldg	-0.228988	0.029954	12	-7.644569
lnempden_bldg	0.221793	0.010033	12	22.105459
lnpopden_bldg	0.099540	0.014346	12	6.938344
sector_density_in_zone	4.635916	0.122270	12	37.915539
inugb_bldg	-0.820254	0.103016	13	-7.962380
is_commercial_building	-0.395145	0.058997	13	-6.697712
is_industrial_building	-0.012843	0.105317	13	-0.121944
is_mixed_use_building	1.703133	0.232841	13	7.314589
is_near_art	0.470034	0.038964	13	12.063220
is_near_highway	-0.206910	0.057684	13	-3.586965
is_office_building	1.118119	0.040754	13	27.435875
ln_unit_price_trunc	0.549924	0.017012	13	32.326298
lnavginc_bldg	0.003756	0.005255	13	0.714697
lnemp30da_bldg	-0.081909	0.029553	13	-2.771558
lnempden_bldg	0.136589	0.010991	13	12.427895
lnpopden_bldg	-0.014893	0.012793	13	-1.164176
sector_density_in_zone	5.211517	0.119458	13	43.626457
inugb_bldg	-0.034960	0.129581	14	-0.269795
is_commercial_building	1.935736	0.044561	14	43.440468
is_mixed_use_building	3.016352	0.178180	14	16.928703
is_near_art	1.118338	0.034877	14	32.065327
is_near_highway	0.122436	0.069336	14	1.765826
is_office_building	0.113179	0.061243	14	1.848028
ln_unit_price_trunc	1.173024	0.020329	14	57.702641

lnavginc_bldg	0.073923	0.008285	14	8.922059
lnemp30da_bldg	-0.242664	0.024822	14	-9.776085
lnempden_bldg	0.164055	0.012159	14	13.492184
lnpopden_bldg	-0.036777	0.014258	14	-2.579497
sector_density_in_zone	5.458154	0.173313	14	31.493061
inugb_bldg	-1.299951	0.098259	15	-13.229889
is_commercial_building	-0.353241	0.051554	15	-6.851884
is_industrial_building	1.088603	0.097147	15	11.205766
is_mixed_use_building	1.473522	0.227333	15	6.481789
is_near_art	0.776902	0.035269	15	22.027582
is_near_highway	-0.762770	0.091324	15	-8.352324
is_office_building	0.850858	0.037772	15	22.526188
ln_unit_price_trunc	0.389757	0.017869	15	21.812412
lnavginc_bldg	-0.058583	0.007550	15	-7.759671
lnemp30da_bldg	0.697098	0.027759	15	25.112747
lnempden_bldg	-0.058068	0.011527	15	-5.037555
lnpopden_bldg	0.107133	0.011613	15	9.225023
sector_density_in_zone	5.276817	0.117467	15	44.921719
inugb_bldg	0.138429	0.140156	16	0.987683
is_commercial_building	-0.601001	0.058751	16	-10.229675
is_industrial_building	-0.716292	0.153478	16	-4.667080
is_mixed_use_building	1.321425	0.248122	16	5.325707
is_near_art	0.476850	0.033180	16	14.371585
is_near_highway	-0.100925	0.070822	16	-1.425059
is_office_building	1.084561	0.035890	16	30.219423
ln_unit_price_trunc	0.632697	0.012986	16	48.723167
lnavginc_bldg	0.124319	0.013011	16	9.554713
lnemp30da_bldg	-0.107348	0.024163	16	-4.442718
lnempden_bldg	-0.049218	0.010600	16	-4.643172
lnpopden_bldg	0.191550	0.015113	16	12.674654
sector_density_in_zone	2.805728	0.067112	16	41.806427
inugb_bldg	-0.367307	0.087065	17	-4.218763
is_commercial_building	0.355707	0.037578	17	9.465826
is_industrial_building	-0.244183	0.087324	17	-2.796279
is_mixed_use_building	1.897547	0.172546	17	10.997350
is_near_art	0.440640	0.033953	17	12.977818
is_near_highway	0.032870	0.069185	17	0.475098
is_office_building	-0.027284	0.042444	17	-0.642805
ln_unit_price_trunc	0.798957	0.017242	17	46.337627
lnavginc_bldg	0.028741	0.006503	17	4.419967
lnemp30da_bldg	-0.112915	0.024641	17	-4.582400
lnempden_bldg	0.115109	0.010456	17	11.008572
lnpopden_bldg	0.078696	0.012587	17	6.252241
sector_density_in_zone	5.130723	0.111668	17	45.946419

Model: home_based_employment_location_choice_model_coefficients

coefficient_name	estimate	error	submodel_id	t_statistic
blngcdacbd	-0.334675	0.009182	-	-36.449081

Model: work_at_home_choice_model_coefficients

coefficient_name	estimate	error	submodel_id	t_statistic
age	-0.019149	0.004622	-	-4.143268
age13	-0.221413	0.127492	-	-1.736686
constant	-4.188630	0.293984	-	-14.247802
edu	-0.086874	0.029333	-	-2.961648
kemp30m	-0.000183	0.000115	-	-1.583941
parttime	-0.892045	0.115999	-	-7.690083

Model: workplace_choice_model_for_resident_coefficients

coefficient_name	estimate	error	submodel_id	t_statistic
edu_x_job_is_in_employment_sector_group_basic	-0.162745	0.012583	-	-12.933875
edu_x_job_is_in_employment_sector_group_edu	0.246912	0.015558	-	15.870398
edu_x_job_is_in_employment_sector_group_fires	0.149520	0.010711	-	13.959301
edu_x_job_is_in_employment_sector_group_retail	-0.171062	0.013979	-	-12.236832
home_area_type_3_workplace_area_type_1	0.010396	0.086524	-	0.120153
home_dist_1_workplace_dist_1	0.030905	0.320714	-	0.096363
home_dist_6_workplace_dist_6	-0.348714	0.214331	-	-1.626986
home_district_is_same_as_workplace_district	0.647720	0.049556	-	13.070412
travel_time_hbw_am_drive_alone_from_home_to_work	-0.111776	0.001959	-	-57.050407