Coding assignment (QSM class)*

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Link to Latest version

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Abstract

This is a coding assignment for the QSM class.

*I acknowledge that I worked with Coni, Yuxuan, and Eni. I also acknowledge that I used OpenAI (2025) and Cursor (2025) to help me with the coding. They were mostly used for debugging and auto-completion. Thus, the main structure of the code was all written by the author. All the codes were later reviwed and finalized by the author.

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1 Use of programming language

For questions 1-7, I used `R` programming language. I also used `R` for most of the data cleaning and manipulation. For other questions that requires more computationally intensive analyses (modeling, etc.), I used `julia` programming language.

2 Main data information

I am using the 2022 LODES data from LEHD for my analysis. I obtained the raw data for Philadelphia county from the LEHD website and aggregated the data into tract-tract level. The process of cleaning the raw data was conducted using the source code: `src/R/01_clean_raw_data.R`.

My primary analysis zone will be bilateral commuting flow within Philadelphia county for the year 2022. This means I will not be considering the flow where either the origin or the destination is outside of Philadelphia county.

Q1

As I mentioned in Section 2, I obtained bilateral commuting flow data from LEHD LODES for the year 2022. I also downloaded supporting data on the locations of the tracts or blocks underlying the data. I downloaded them in the `input` folder. You can also use `make raw` command to automatically download the raw data.[1]

Q2

For distance, I will use the distance between the centroids of the origin and destination tracts. For this, I used `sf` package and `tigris` package in R to calculate the distance between the centroids of the origin and destination tracts. The source code is available in `src/R/02_calculate_distance.R`. I also retained the fixed effects estimates in the Appendix.

Q3

I estimated the following linear model:

$$\log(N_{ij}) = \theta_i + \lambda_j - \epsilon\kappa d_{ij} + e_{ij}$$

The estimation results are reported in the following table:

[1] Note that if you want to re-download the raw data, you must first use `make clean_raw` command to remove the raw data in the `input` folder. Also note that if the original data was updated during the course of the semester, there is a likelihood that the new downloaded data might have different data structure that could affect the analysis.

Table 1: Estimation results

	Log of commuting flow
distance_km	-0.07^{***}
	(0.00)
Num. obs.	73326
Num. groups: w_tract	406
Num. groups: h_tract	408
R^2 (full model)	0.61
R^2 (proj model)	0.19

$^{***}p < 0.001$; $^{**}p < 0.01$; $^{*}p < 0.05$

Note: This table presents estimation result of the equation 2. `distance_km` is the estimate of the $-\epsilon\kappa$. The value in the paranthesis is standard error.

Q4

After including all the ij pairs and adding in zero commuting flows, I estimated the PPML model as follows:

$$\log(\mathbb{E}[N_{ij}]) = \theta_i + \lambda_j - \epsilon\kappa d_{ij} + e_{ij}$$

The estimation results are reported in the following table (I also retained the fixed effects estimates in the `input/q4_ppml_fes.csv`):

Table 2: Estimation results of the PPML model

	PPML
distance_km	-0.12^{***}
	(0.00)
Num. obs.	165648
Num. groups: w_tract	406
Num. groups: h_tract	408
Pseudo R^2	0.64

$^{***}p < 0.001$; $^{**}p < 0.01$; $^{*}p < 0.05$

Note: This table presents estimation result of the equation 2. `distance_km` is the estimate of the $-\epsilon\kappa$. The value in the paranthesis is standard error.

We can clearly see that the estimate of the $-\epsilon\kappa$ differs from the estimate in the previous question. The absolute size of the estimate is larger in the PPML model. Intuitively, I think this occurs because the PPML model incorporates the zero commuting flows that were neglected in the linear model. Since the zero commuting flows were not fully incorporated in the linear model, the estimate in the

linear model was underestimating the effect of the travel-time cost on the commuting flow. The estimate in the PPML model shifts downward to account for the zero commuting flows.

Something to note is that in PPML, FEs are not always identified. In our case, two FEs are not identified because there is no flow for any tract-tract pair. For this assignment, I will be not using the two FEs that drop due to 0 outcomes. However, past literature suggests that there are alternative ways to deal with this issue.

Q5

1. For ii pairs, we could add minimum distance from the centroid to the edge of the polygon geometry as the distance measure. While this is not a perfect measure, it still should work as a proxy for measuring the relative size of certain distance from traveling within the same tract. This also solves the zero distance issue. The only problem might be that this method could be bit ad-hoc and not consistent as we are just adding additional values only onto the ii pairs and not consider the ij pairs.

Using this method, I get the following estimates for linear and PPML models:

Table 3: Estimation results of the linear model for ii pairs

	Log of commuting flow
distance_km	-0.07^{***}
	(0.00)
Num. obs.	73326
Num. groups: w_tract	406
Num. groups: h_tract	408
R^2 (full model)	0.61
R^2 (proj model)	0.19

$^{***}p < 0.001$; $^{**}p < 0.01$; $^{*}p < 0.05$

Table 4: Estimation results of the PPML model for ii pairs

	PPML
distance_km	-0.12^{***}
	(0.00)
Num. obs.	165648
Num. groups: w_tract	406
Num. groups: h_tract	408
Pseudo R^2	0.64

$^{***}p < 0.001$; $^{**}p < 0.01$; $^{*}p < 0.05$

2. Another way would be to change the definition of the distance measure so that ii pairs will not have zero values. We leverage the fact that our data can become more granular. That is,

we have information on the longitude and latitude of the centroid of the census block. After calculating the distance between two centroids of the census blocks, we can use mean of the all the block-level distances within the same tract-tract pair as the distance measure of the tract-tract pairs. This will give us non-zero distance for ii pairs.

Using this method, I get the following estimates for linear and PPML models:

Table 5: Estimation results of the linear model for ii pairs

	Log of commuting flow
distance_km	-0.07^{***}
	(0.00)
Num. obs.	73326
Num. groups: w_tract	406
Num. groups: h_tract	408
R^2 (full model)	0.61
R^2 (proj model)	0.19

$^{***}p < 0.001$; $^{**}p < 0.01$; $^{*}p < 0.05$

Table 6: Estimation results of the PPML model for ii pairs

	PPML
distance_km	-0.12^{***}
	(0.00)
Num. obs.	165648
Num. groups: w_tract	406
Num. groups: h_tract	408
Pseudo R^2	0.64

$^{***}p < 0.001$; $^{**}p < 0.01$; $^{*}p < 0.05$

You can see that the estimates are very similar to the estimates in the previous question. This suggests that perhaps the zero distance issue is not a major issue in the analysis.

Q6

I plotted the boxplot of the fixed effects estimates for the linear and PPML models. The results are reported in the following figure:

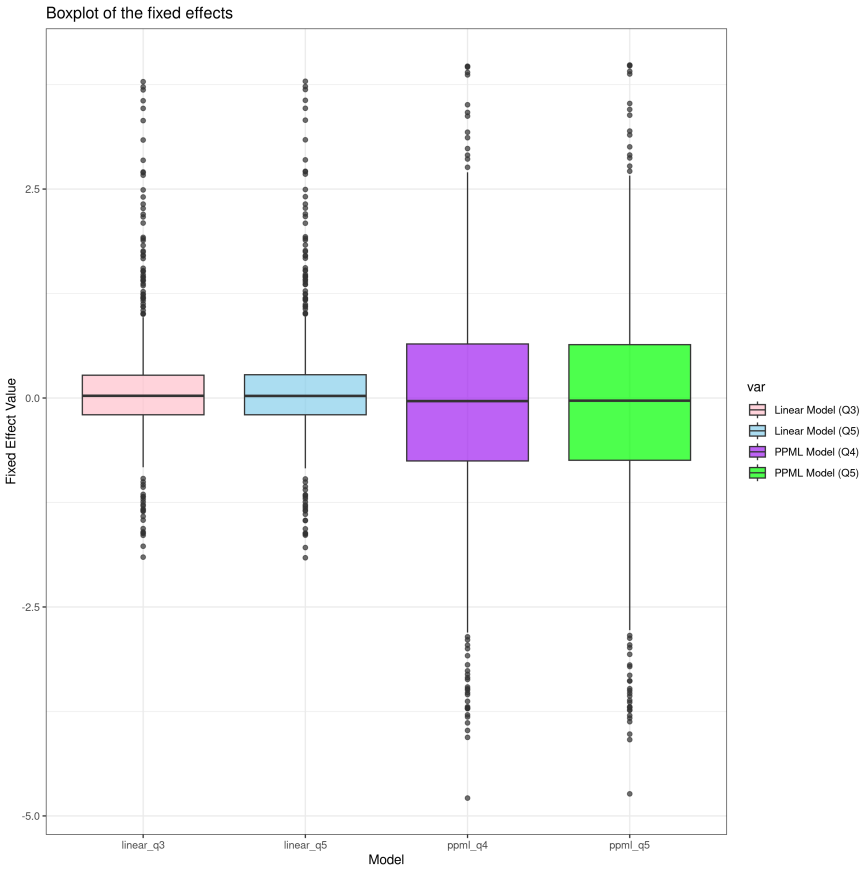

Figure 1: Boxplot of the fixed effects estimates

Note: This is the boxplot of the fixed effects estimates for the linear and PPML models. The values are normalized (z-score). The color represents the model. `linear_q3` and `ppml_q4` are the fixed effects estimates for the linear and PPML models in Q3 and Q4. `linear_q5` and `ppml_q5` are the fixed effects estimates for the linear and PPML models in Q5.

It seems the distribution of the fixed effects estimates are too different from each other. Especially, the distribution is almost identical within the same model (linear and PPML). The only difference is that the PPML model seems to have slightly larger variations.

Q7

My code in `src/R/07_create_market_access.R` creates the market access variable. For each residential and workplace tract, I calculate the market access variable using the definition in the question. I posted the result in the Appendix. In the main document, I will plot the map of the market access variable.

(a) Map of the residential market access

(b) Map of the workplace market access

Note: This is the map (Philadelphia county) of the market access variable. The color represents the market access variable. The lighter the color, the higher the market access. The values are normalized (z-score).

Q8

I use two scripts to accomplish this. For data manipulation stage I use `src/R/08_fixed_point_algorithm.R` to create the sum of bilateral commuting flow and the expotential terms. For implementing fixed point algorithm, I use `src/julia/08_fixed_point_algorithm.jl`.

I plot the map of the market access again below:

(a) Map of the residential market access

(b) Map of the workplace market access

Note: This is the map (Philadelphia county) of the market access variable. The color represents the market access variable. The lighter the color, the higher the market access. The values are normalized (z-score).

Q9

While the level of the market access variable differs, the overall distribution of the market access variable is similar. That is, the ordinality of the market access variable is preserved for both cases. This result is consistent with the derivation of the market access equation we learned in class. To be specific, we discussed in page 21 of the week1-lecture 1 that the equations in Q8 and Q9 are equivalent way to derive market access variable. While the level of the market access variable could differ, the ordinality of the market access variable should be similar.

Q10

Following Apppendix F of Brinkman and Lin (2024), I need to create a fixed point algorithm to solve for the following equation[2]. (We will assume that there are total J workplace tracts and I

[2]I tweaked the equation from the paper to make it more clear for the matrix muliplication process I will be using below.

residential tracts. While the number of tracts is same, we just use separate indices for them to make it more clear in the equation.):

$$\omega_j = \left(\frac{1}{N_{Wj}} \left[\sum_i \left(N_{Ri} \cdot d_{ij}^{-\epsilon} \right) \left[\sum_{j'} \left(w_{j'}^{\epsilon} \cdot d_{ij'}^{-\epsilon} \right) \right]^{-1} \right] \right)^{-\frac{1}{\epsilon}}$$

I use the following matrix multiplication to setup the fixed point algorithm ($\omega = T(\omega)$):

$$\underbrace{\begin{bmatrix} \omega_1 \\ \omega_2 \\ \vdots \\ \omega_J \end{bmatrix}}_{J \times 1} = \overbrace{\begin{bmatrix} \left(\frac{1}{N_{W1}} \cdot N_{R1} \cdot d_{11}^{-\epsilon}\right) & \left(\frac{1}{N_{W1}} \cdot N_{R2} \cdot d_{21}^{-\epsilon}\right) & \dots & \left(\frac{1}{N_{W1}} \cdot N_{RJ} \cdot d_{J1}^{-\epsilon}\right) \\ \left(\frac{1}{N_{W2}} \cdot N_{R1} \cdot d_{12}^{-\epsilon}\right) & \left(\frac{1}{N_{W2}} \cdot N_{R2} \cdot d_{22}^{-\epsilon}\right) & \dots & \\ \vdots & \vdots & \ddots & \\ \left(\frac{1}{N_{WJ}} \cdot N_{R1} \cdot d_{1J}^{-\epsilon}\right) & \left(\frac{1}{N_{WJ}} \cdot N_{R2} \cdot d_{2J}^{-\epsilon}\right) & \dots & \left(\frac{1}{N_{WJ}} \cdot N_{RJ} \cdot d_{JJ}^{-\epsilon}\right) \end{bmatrix}}^{J \times I} \times$$

$$\underbrace{\begin{bmatrix} d_{11}^{-\epsilon} & d_{12}^{-\epsilon} & \dots & d_{1J}^{-\epsilon} \\ d_{21}^{-\epsilon} & d_{22}^{-\epsilon} & \dots & d_{2J}^{-\epsilon} \\ \vdots & \vdots & \ddots & \\ d_{I1}^{-\epsilon} & d_{I2}^{-\epsilon} & \dots & d_{IJ}^{-\epsilon} \end{bmatrix}}_{I \times J} \times \underbrace{\left(\begin{bmatrix} \omega_1 \\ \omega_2 \\ \vdots \\ \omega_J \end{bmatrix} \right)^{\epsilon}}_{J \times 1}$$

For convenience, I did not put the power of the $-\frac{1}{\epsilon}$ in the equation above. Also note that I also did not inverse the rows of the matrix after the multiplication of $I \times J$ and $J \times 1$. I will add them in the fixed point algorithm.

After retrieving the wages for each location, the rest is pretty straightforward. This is because we no longer have the iterative equations. We can just solve for the land rents, neighborhood amenities and productivities using the equations in the Appendix F of Brinkman and Lin (2024). I have implemented this procedure in `src/R/10_recover_fundamentals.R` and saved amenity and productivity data in `output/tables/amenity.csv` and `output/tables/productivity.csv`.

I plot the map of the land rents in the following figure (Note that I z-scored land rents and then used `asinh` transformation to make the map more readable. This is because the land rents are very skewed for certain tracts so raw values for other tracts become indistinguishable in the map):

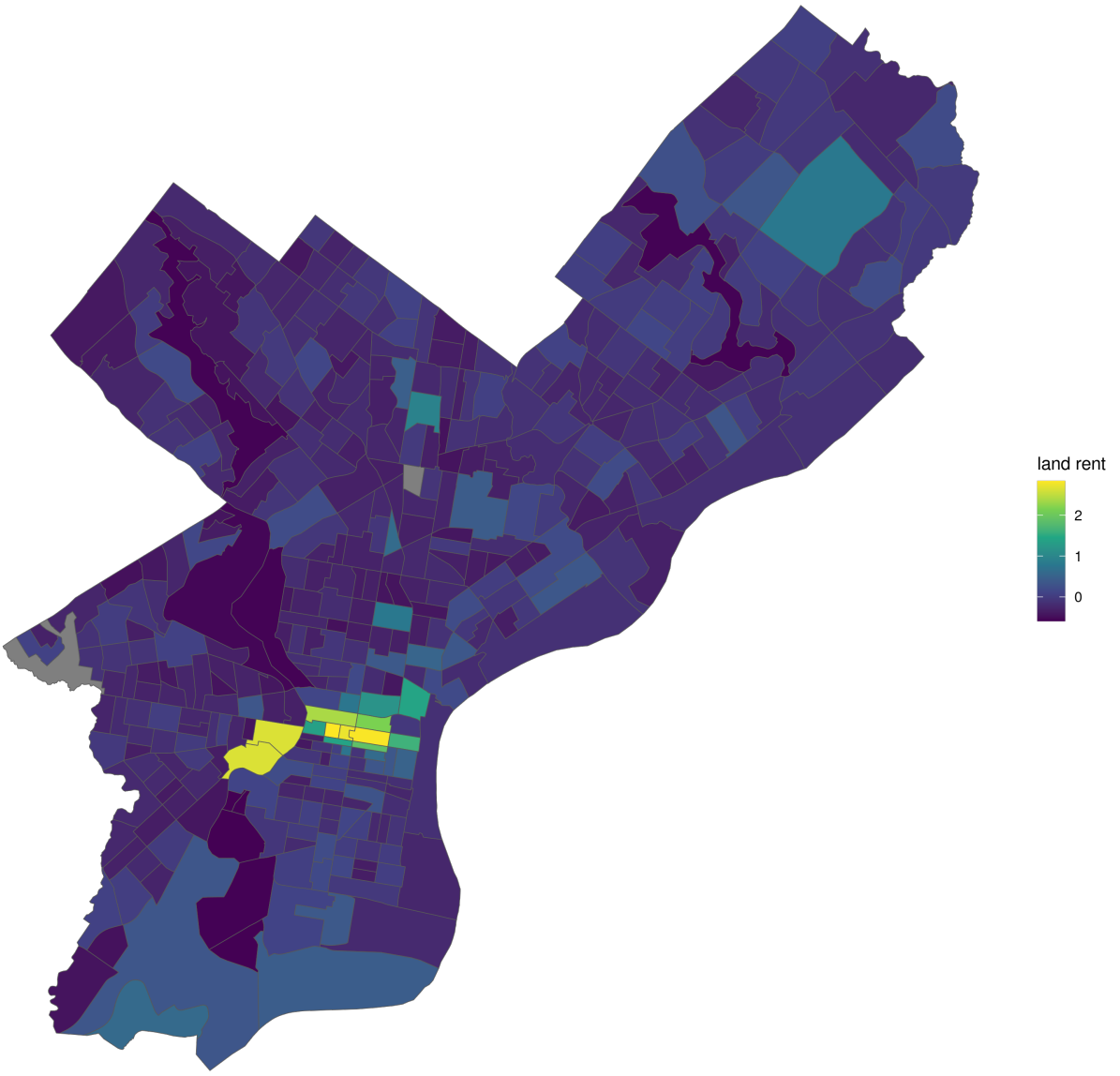

Figure 4: Map of the land rents

Note: This is the map (Philadelphia county) of the land rents. The color represents the land rents. The lighter the color, the higher the land rents. The values are normalized (z-score) and then transformed using `asinh` transformation to make the map more readable. The grey areas are tracts which we cannot recover the land rents as there is no flow for them.

It is hard to say whether the land rents are reasonable or not but my thoughts are that the results are not doing a good job of accurately recovering the actual land rents. While the results seem to correctly hint that regions near the center of the city have higher land rents, this is also not very accurate as tracts that are more close to the center of the city have lower land rents. According

to some anecdotal evidence, the land rents of the center of the city should be the highest and the southern part of Philadelphia also should have relatively higher land rents. These anecdotal evidence do not seem to be well captured by the results.

One of the reasons why the results are not very accurate could be because of the simplifying assumptions we made. For example, we assumed that the land area is the same for all tracts. This is of course not the accurate depiction of the actual land areas of the tracts in Philadelphia county. I am also using tract-tract centroid distance as the measure for the travel time cost. This might not be accurate as perhaps there are certain factors that significantly affect the travel time that the actual travel time differs from the centroid distance. Thus, these simplifying assumptions might be leading to a more less accurate results.

Another possible reason is that maybe the inversion process is not doing a very good job of recovering the actual land rents. In Brinkman and Lin (2024), they use Chicago metropolitan area as their data for the inversion process. It might be that the model is not well-suited for Philadelphia county. For example, the paper mentions that Chicago provides a good setting given that it exhibits relatively centralized employment and has relatively homogeneous topography. While this also seems to be true for Philadelphia county, perhaps there are some differences that make the model not well-suited for Philadelphia county.

References

Brinkman, Jeffrey and Jeffrey Lin (2024) "Freeway Revolts! The Quality of Life Effects of Highways," *The Review of Economics and Statistics*, 106 (5), 1268–1284, 10.1162/rest_a_01244.

Cursor (2025) "Cursor AI," large language model, https://www.cursor.com/.

OpenAI (2025) "ChatGPT," large language model, https://openai.com/api/.

APPENDIX

A. Residential market access

Table 7: Residential market access

Tract	Residential market access
42101000101	639.0000
42101000102	640.6758
42101000200	673.4206
42101000300	678.2559
42101000401	670.2414
42101000403	685.1711
42101000404	682.6896
42101000500	676.5047
42101000600	671.7848
42101000701	680.6982
42101000702	666.4638
42101000801	657.4542
42101000803	669.3243
42101000805	674.9733
42101000806	675.2463
42101000901	671.9652
42101000902	661.2686
42101001001	642.8700
42101001002	624.5171
42101001101	660.9236
42101001102	650.1898
42101001201	650.5192
42101001203	661.9271
42101001204	664.6579
42101001301	625.0713
42101001302	627.2692
42101001400	650.4874
42101001500	643.5468
42101001600	612.0793
42101001700	601.8734
42101001800	634.7687
42101001900	636.9506
42101002000	609.6598

Table 7: Residential market access *(continued)*

Tract	Residential market access
42101002100	618.6535
42101002200	620.8187
42101002300	612.3581
42101002400	619.1416
42101002500	589.4441
42101002701	569.4423
42101002702	559.0235
42101002801	576.3334
42101002802	580.5149
42101002900	592.5586
42101003001	583.5872
42101003002	602.1961
42101003100	594.4223
42101003200	586.7031
42101003300	579.4188
42101003600	549.4329
42101003701	568.7620
42101003702	551.5565
42101003800	522.2531
42101003901	556.9414
42101003902	521.2855
42101004001	557.6791
42101004002	533.2719
42101004101	548.7410
42101004103	531.0104
42101004104	518.7471
42101004201	533.6831
42101004202	509.4160
42101005400	281.8948
42101005500	341.3808
42101005600	330.2170
42101006000	376.1246
42101006100	409.6979
42101006200	407.5095
42101006300	392.0841
42101006400	394.0980
42101006500	431.3316

Table 7: Residential market access *(continued)*

Tract	Residential market access
42101006600	441.2349
42101006700	446.9330
42101007000	482.7128
42101007101	475.7183
42101007102	467.9034
42101007200	453.4342
42101007300	492.1773
42101007400	521.2860
42101007700	555.1971
42101007800	522.3426
42101007900	517.4734
42101008000	482.6838
42101008101	445.4927
42101008102	452.9123
42101008200	411.0564
42101008301	408.0891
42101008302	427.1449
42101008400	449.5292
42101008500	484.6198
42101008601	525.3391
42101008602	524.3084
42101008701	550.8184
42101008702	565.3760
42101008801	600.3704
42101008802	583.1702
42101009000	625.4096
42101009100	598.2004
42101009200	559.2041
42101009300	491.5433
42101009400	459.1726
42101009500	435.9880
42101009600	415.8959
42101009801	330.1410
42101009802	328.7922
42101010000	387.4578
42101010100	413.2522
42101010200	456.7518

Table 7: Residential market access *(continued)*

Tract	Residential market access
42101010300	480.1786
42101010400	507.1256
42101010500	524.1736
42101010600	550.9300
42101010700	546.4358
42101010800	580.3830
42101010900	607.5471
42101011000	538.5288
42101011100	482.1394
42101011200	442.4112
42101011300	428.6951
42101011400	396.7748
42101011500	376.0446
42101011700	388.2408
42101011800	415.4358
42101011900	435.3099
42101012000	411.3600
42101012100	430.2246
42101012201	441.8152
42101012203	430.6568
42101012204	441.6685
42101012501	671.9002
42101012502	659.2144
42101013100	639.0221
42101013200	647.3801
42101013300	650.7982
42101013401	644.9685
42101013402	654.3969
42101013500	638.5013
42101013601	627.7545
42101013602	615.7008
42101013701	578.6255
42101013702	592.3935
42101013800	602.2377
42101013900	615.1503
42101014000	624.4697
42101014100	625.5866

Table 7: Residential market access *(continued)*

Tract	Residential market access
42101014201	613.5777
42101014202	587.2259
42101014300	557.4811
42101014400	594.9821
42101014500	602.1715
42101014600	609.1908
42101014700	604.8572
42101014800	596.0196
42101014900	576.9084
42101015101	547.4438
42101015102	561.1559
42101015200	574.5095
42101015300	584.5237
42101015600	581.1293
42101015700	569.1920
42101015800	561.1395
42101016001	528.8269
42101016002	535.8077
42101016100	534.7923
42101016200	559.9389
42101016300	539.1046
42101016400	550.7822
42101016500	559.4170
42101016600	562.6348
42101016701	556.0416
42101016702	559.0593
42101016800	551.5746
42101016901	539.5065
42101016902	526.0103
42101017000	479.1791
42101017100	503.3389
42101017201	522.3727
42101017202	520.3500
42101017300	529.0001
42101017400	535.8038
42101017500	525.6673
42101017601	525.1571

Table 7: Residential market access *(continued)*

Tract	Residential market access
42101017602	511.3244
42101017701	485.2691
42101017702	501.5694
42101017800	496.4707
42101017900	495.2146
42101018001	499.8963
42101018002	479.3902
42101018300	384.4940
42101018400	358.5857
42101018801	466.0756
42101018802	448.3871
42101019000	424.1777
42101019100	439.1390
42101019200	473.1725
42101019501	502.9275
42101019502	492.2711
42101019700	461.6481
42101019800	482.1233
42101019900	502.3473
42101020000	514.6614
42101020101	511.3105
42101020102	484.5948
42101020200	493.8577
42101020300	479.0565
42101020400	454.4671
42101020500	465.1930
42101020600	438.9276
42101020701	454.4426
42101020702	434.6432
42101020800	415.9339
42101020900	399.1675
42101021000	370.6438
42101021100	379.5433
42101021200	344.6698
42101021300	342.4444
42101021400	341.7439
42101021500	316.4123

Table 7: Residential market access *(continued)*

Tract	Residential market access
42101021600	283.8316
42101021700	298.8882
42101021800	255.9215
42101021900	253.3480
42101022000	226.9578
42101023100	270.0637
42101023500	348.9650
42101023600	347.0276
42101023700	335.5456
42101023800	372.5118
42101023900	383.3058
42101024000	411.5514
42101024100	397.6487
42101024200	418.4115
42101024300	441.0418
42101024400	434.3326
42101024500	406.6449
42101024600	383.2250
42101024700	377.4058
42101024800	359.0840
42101024900	348.4772
42101025200	352.1052
42101025300	324.5738
42101025400	310.1485
42101025500	297.8573
42101025600	280.5762
42101025700	260.1727
42101025800	266.4706
42101025900	253.9764
42101026000	267.7110
42101026100	280.6895
42101026200	295.8520
42101026301	279.6965
42101026302	294.1406
42101026400	311.2792
42101026500	325.8418
42101026600	312.5227

Table 7: Residential market access *(continued)*

Tract	Residential market access
42101026700	340.0431
42101026800	337.9593
42101026900	336.9184
42101027000	356.5222
42101027100	352.5953
42101027200	356.4233
42101027300	381.6673
42101027401	387.9924
42101027402	384.6153
42101027500	385.3481
42101027600	378.2633
42101027700	353.1487
42101027800	380.4554
42101027901	367.6907
42101027902	395.7932
42101028000	433.0786
42101028100	419.4801
42101028200	404.8556
42101028300	433.1487
42101028400	433.8737
42101028500	420.1585
42101028600	416.1862
42101028700	438.8209
42101028800	432.0812
42101028901	435.3682
42101028902	418.0814
42101029000	402.3728
42101029100	379.1325
42101029200	399.8514
42101029300	404.0152
42101029400	397.5810
42101029800	355.4927
42101029900	371.6060
42101030000	372.0573
42101030100	387.2301
42101030200	368.6597
42101030501	355.6924

Table 7: Residential market access *(continued)*

Tract	Residential market access
42101030502	352.6397
42101030600	333.9988
42101030700	314.7596
42101030800	315.8147
42101030900	340.7243
42101031000	319.5549
42101031101	336.7175
42101031102	351.3562
42101031200	346.3529
42101031300	331.4838
42101031401	318.2673
42101031402	314.3150
42101031501	304.9002
42101031502	312.2304
42101031600	325.0097
42101031700	341.0305
42101031800	352.8577
42101031900	343.6274
42101032000	323.1147
42101032100	337.5216
42101032300	321.2726
42101032500	307.4262
42101032600	295.8897
42101032900	269.9287
42101033000	284.2097
42101033101	286.4497
42101033102	267.1389
42101033200	293.5419
42101033300	281.2045
42101033400	292.9157
42101033500	302.9882
42101033600	286.6009
42101033701	268.8173
42101033702	269.4683
42101033800	294.5977
42101033900	288.9652
42101034000	277.0992

Table 7: Residential market access *(continued)*

Tract	Residential market access
42101034100	268.7952
42101034200	249.1374
42101034400	225.7288
42101034501	250.5875
42101034502	240.7516
42101034600	241.9969
42101034701	257.4649
42101034702	259.7915
42101034801	245.2731
42101034802	236.7287
42101034803	223.5891
42101034900	239.8300
42101035100	201.6585
42101035200	210.6546
42101035301	202.7452
42101035302	209.0877
42101035500	220.8810
42101035601	215.8845
42101035602	201.8845
42101035701	190.3363
42101035702	186.2169
42101035800	167.6235
42101035900	180.3865
42101036000	188.4499
42101036100	178.1919
42101036201	189.3246
42101036202	178.3022
42101036203	176.5044
42101036301	157.7371
42101036302	168.9168
42101036303	149.4473
42101036400	157.2073
42101036501	148.7052
42101036502	150.4102
42101036600	589.9003
42101036700	627.5988
42101036901	600.3949

Table 7: Residential market access *(continued)*

Tract	Residential market access
42101036902	634.8801
42101037200	500.0666
42101037300	461.2565
42101037500	359.0122
42101037600	662.1399
42101037700	584.2287
42101037800	447.5264
42101037900	433.6444
42101038000	392.2234
42101038100	300.6101
42101038200	439.9720
42101038301	471.2053
42101038400	224.6463
42101038500	235.5893
42101038600	283.8498
42101038700	217.8781
42101038800	300.2375
42101038900	334.0411
42101039001	356.3713
42101039002	374.6660
42101039100	507.4218
42101980001	549.0917
42101980002	495.2708
42101980003	646.2937
42101980100	311.2988
42101980200	266.3802
42101980300	210.8902
42101980400	309.6947
42101980500	460.6334
42101980600	468.7767
42101980701	436.8104
42101980702	481.4650
42101980800	347.2216
42101980901	372.1682
42101980902	545.8168
42101980903	552.1639
42101980904	514.6799

Table 7: Residential market access *(continued)*

Tract	Residential market access
42101980905	411.5504
42101980906	453.9761
42101989100	237.4495
42101989200	396.5034
42101989300	462.7540

B.Workplace market access

Table 8: Workplace market access

Tract	Workplace market access
42101000101	331.4840
42101000102	337.9878
42101000200	345.4749
42101000300	349.9454
42101000401	345.1504
42101000403	344.8803
42101000404	345.6363
42101000500	341.1504
42101000600	337.4256
42101000701	341.9882
42101000702	341.8906
42101000801	338.6716
42101000803	339.6434
42101000805	339.2713
42101000806	338.4394
42101000901	336.7541
42101000902	333.0399
42101001001	327.1541
42101001002	321.7439
42101001101	332.2224
42101001102	328.2393
42101001201	334.5587
42101001203	335.3536
42101001204	334.6199
42101001301	323.6545
42101001302	326.3937
42101001400	330.1226
42101001500	325.4155
42101001600	314.4142
42101001700	309.6775
42101001800	321.9992
42101001900	325.0010
42101002000	317.7753
42101002100	318.9383

Table 8: Workplace market access *(continued)*

Tract	Workplace market access
42101002200	318.0861
42101002300	313.3564
42101002400	315.8061
42101002500	303.7149
42101002701	294.2042
42101002702	289.4822
42101002801	297.3771
42101002802	299.4857
42101002900	305.3095
42101003001	302.3096
42101003002	310.5162
42101003100	308.7905
42101003200	307.6822
42101003300	310.1388
42101003600	291.8577
42101003701	297.3887
42101003702	289.0535
42101003800	273.2181
42101003901	289.5234
42101003902	270.5515
42101004001	288.8774
42101004002	276.1981
42101004101	283.9717
42101004103	274.6748
42101004104	267.9692
42101004201	276.4885
42101004202	263.3043
42101005400	155.0103
42101005500	196.3160
42101005600	183.9102
42101006000	215.5949
42101006100	232.2290
42101006200	236.1757
42101006300	231.2961
42101006400	236.0594
42101006500	262.5618
42101006600	259.2734

Table 8: Workplace market access *(continued)*

Tract	Workplace market access
42101006700	256.0467
42101007000	280.2222
42101007101	281.2050
42101007102	281.4755
42101007200	279.7674
42101007300	294.0393
42101007400	298.1760
42101007700	312.8857
42101007800	304.9115
42101007900	307.9621
42101008000	296.9673
42101008101	280.1668
42101008102	287.0517
42101008200	264.8283
42101008301	270.9107
42101008302	279.5635
42101008400	290.8921
42101008500	303.7313
42101008601	313.5947
42101008602	316.5447
42101008701	320.0707
42101008702	323.7322
42101008801	331.3929
42101008802	326.6328
42101009000	343.4481
42101009100	337.5854
42101009200	329.2480
42101009300	311.0737
42101009400	299.5737
42101009500	291.5802
42101009600	281.5289
42101009801	239.7282
42101009802	237.0594
42101010000	270.6680
42101010100	285.5205
42101010200	302.5542
42101010300	311.6431

Table 8: Workplace market access *(continued)*

Tract	Workplace market access
42101010400	319.2008
42101010500	325.7130
42101010600	331.7782
42101010700	334.8699
42101010800	341.4367
42101010900	347.2031
42101011000	337.5678
42101011100	318.4473
42101011200	300.6966
42101011300	298.0125
42101011400	282.9075
42101011500	268.6373
42101011700	285.4119
42101011800	296.1489
42101011900	306.9665
42101012000	302.1013
42101012100	313.3525
42101012201	331.3963
42101012203	329.4754
42101012204	326.0789
42101012501	354.0397
42101012502	354.1160
42101013100	355.5792
42101013200	359.2129
42101013300	360.5662
42101013401	357.8656
42101013402	359.0146
42101013500	362.4577
42101013601	358.7500
42101013602	359.8413
42101013701	358.2420
42101013702	361.2490
42101013800	364.4154
42101013900	366.3388
42101014000	366.9819
42101014100	363.1066
42101014201	354.9380

Table 8: Workplace market access *(continued)*

Tract	Workplace market access
42101014202	341.5456
42101014300	340.7437
42101014400	359.1818
42101014500	367.4527
42101014600	369.1783
42101014700	370.9318
42101014800	370.1999
42101014900	364.6529
42101015101	361.4167
42101015102	366.7811
42101015200	372.4741
42101015300	374.6169
42101015600	368.2278
42101015700	363.8911
42101015800	353.3261
42101016001	353.0612
42101016002	359.1246
42101016100	366.6388
42101016200	372.0346
42101016300	374.4820
42101016400	378.4494
42101016500	378.7585
42101016600	378.7310
42101016701	378.1931
42101016702	378.9346
42101016800	375.9816
42101016901	371.0309
42101016902	364.7118
42101017000	364.9689
42101017100	371.0575
42101017201	376.9267
42101017202	372.9059
42101017300	380.8428
42101017400	382.7480
42101017500	383.4446
42101017601	379.3065
42101017602	379.9662

Table 8: Workplace market access *(continued)*

Tract	Workplace market access
42101017701	371.8784
42101017702	374.8398
42101017800	366.9544
42101017900	358.5741
42101018001	348.5587
42101018002	345.8733
42101018300	324.2402
42101018400	314.0260
42101018801	364.4756
42101018802	362.2345
42101019000	369.4511
42101019100	376.1776
42101019200	374.6200
42101019501	382.8406
42101019502	383.9882
42101019700	388.9657
42101019800	388.1308
42101019900	386.5832
42101020000	384.9752
42101020101	384.0579
42101020102	385.0270
42101020200	381.2127
42101020300	386.8284
42101020400	384.9256
42101020500	378.7562
42101020600	360.5432
42101020701	354.8854
42101020702	344.5594
42101020800	345.6461
42101020900	325.0762
42101021000	312.5291
42101021100	324.1490
42101021200	307.6727
42101021300	301.1041
42101021400	294.1455
42101021500	280.9498
42101021600	256.7518

Table 8: Workplace market access *(continued)*

Tract	Workplace market access
42101021700	278.0622
42101021800	247.6980
42101021900	237.0822
42101022000	216.4008
42101023100	277.2647
42101023500	320.8515
42101023600	326.1234
42101023700	326.9854
42101023800	346.3838
42101023900	344.9926
42101024000	359.2402
42101024100	359.3447
42101024200	369.1474
42101024300	371.4863
42101024400	376.1160
42101024500	372.2174
42101024600	358.7281
42101024700	362.3034
42101024800	353.8966
42101024900	353.1951
42101025200	343.7685
42101025300	326.8749
42101025400	322.8253
42101025500	309.6599
42101025600	294.0849
42101025700	274.1429
42101025800	287.0953
42101025900	278.9825
42101026000	293.8889
42101026100	302.2309
42101026200	316.8977
42101026301	306.2551
42101026302	320.0560
42101026400	330.9716
42101026500	343.2765
42101026600	336.5560
42101026700	354.0159

Table 8: Workplace market access *(continued)*

Tract	Workplace market access
42101026800	354.8655
42101026900	355.9496
42101027000	366.7929
42101027100	366.7421
42101027200	370.4162
42101027300	380.5072
42101027401	381.0140
42101027402	380.6708
42101027500	379.2567
42101027600	374.5117
42101027700	359.5898
42101027800	372.3572
42101027901	364.4596
42101027902	373.9277
42101028000	381.7070
42101028100	382.1614
42101028200	382.2993
42101028300	386.4100
42101028400	387.9287
42101028500	387.0439
42101028600	387.2033
42101028700	388.7653
42101028800	387.8926
42101028901	384.4037
42101028902	384.2889
42101029000	384.9835
42101029100	379.8245
42101029200	379.1768
42101029300	367.3678
42101029400	356.9589
42101029800	343.9695
42101029900	349.1712
42101030000	358.8020
42101030100	369.6727
42101030200	367.5814
42101030501	372.9068
42101030502	371.0925

Table 8: Workplace market access *(continued)*

Tract	Workplace market access
42101030600	363.2370
42101030700	352.2753
42101030800	354.2040
42101030900	366.9182
42101031000	356.4141
42101031101	364.2985
42101031102	369.3121
42101031200	365.4537
42101031300	358.9515
42101031401	353.6790
42101031402	348.9031
42101031501	334.3933
42101031502	343.5167
42101031600	347.0483
42101031700	356.5637
42101031800	364.9495
42101031900	347.7157
42101032000	338.3672
42101032100	333.3205
42101032300	327.4681
42101032500	323.7276
42101032600	318.4613
42101032900	301.1715
42101033000	311.6156
42101033101	320.9282
42101033102	305.6180
42101033200	330.7407
42101033300	326.0310
42101033400	336.3907
42101033500	345.4308
42101033600	334.0574
42101033701	318.6734
42101033702	320.2811
42101033800	340.0937
42101033900	332.4779
42101034000	325.7448
42101034100	316.7976

Table 8: Workplace market access *(continued)*

Tract	Workplace market access
42101034200	299.5119
42101034400	277.8562
42101034501	301.6243
42101034502	292.0612
42101034600	290.3197
42101034701	306.5584
42101034702	305.6629
42101034801	288.5876
42101034802	283.3962
42101034803	267.8079
42101034900	275.9948
42101035100	234.6829
42101035200	250.1116
42101035301	245.5095
42101035302	254.1949
42101035500	270.3945
42101035601	266.9312
42101035602	252.1731
42101035701	239.2081
42101035702	234.9803
42101035800	214.3758
42101035900	227.6205
42101036000	234.2275
42101036100	222.5089
42101036201	234.1495
42101036202	222.2368
42101036203	218.3934
42101036301	197.1701
42101036302	212.2746
42101036303	189.3769
42101036400	197.7548
42101036501	191.9882
42101036502	192.7524
42101036600	309.7801
42101036700	345.8318
42101036901	322.3850
42101036902	336.3060

Table 8: Workplace market access *(continued)*

Tract	Workplace market access
42101037200	257.4414
42101037300	238.1645
42101037500	262.6108
42101037600	350.9743
42101037700	373.9169
42101037800	324.3067
42101037900	340.4407
42101038000	346.3047
42101038100	304.1158
42101038200	355.2406
42101038301	388.0286
42101038400	225.3713
42101038500	244.2117
42101038600	280.9694
42101038700	228.8420
42101038800	301.6565
42101038900	341.2597
42101039001	372.7660
42101039002	376.5146
42101039100	285.2360
42101980001	354.3594
42101980002	338.5074
42101980003	347.4473
42101980100	294.4942
42101980200	316.6515
42101980300	254.2309
42101980400	158.7578
42101980500	388.1144
42101980600	239.2324
42101980701	222.7676
42101980702	250.1787
42101980800	246.7172
42101980901	194.9220
42101980902	298.8449
42101980903	299.4402
42101980904	279.3537
42101980905	213.7029

Table 8: Workplace market access *(continued)*

Tract	Workplace market access
42101980906	240.9222
42101989100	262.8361
42101989200	198.4836
42101989300	384.5268