Optimizing Hubway Bicycle Docks Allocation in Boston City

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Abstract—**As the number of people living in Boston grows, the traffic environment has become more and more crowded. In recent years, local government has already built up the bicycle system to ameliorate traffic conditions and create a green environment. The idea is to design and implement a bicycle system that is accessible and convenient to the public by planning station locations satisfying the public needs. Residents can rent a bike from one Hubway station and return it at another Hubway station which is closed to their destinations. However, it is important and challenging for the government to arrange number of bicycle docks between stations appropriately so that the system can benefit almost everyone and balance traffic flows in Boston as much as possible. Our approach is to arrange bicycle docks for each station such that maximizes the coverage of the bicycle system and increase penetration of bicycle usage, based on the Hubway shared bike data in Boston Area between 2011 and 2013. Fortunately, the total number of capacity for each Hubway station in Boston area is known, we are going to estimate available bikes from historical Hubway bike trips data, which contains information on stations and every trip. Our goal is to optimize number of docks for each Hubway station to satisfy the demands and supplies, and at the same time to mitigate traffic congestion as well as to create a green environment in Boston Area.**

Index Terms—**Bike-sharing program; Bike-station location; Location Optimize model;**

I. Introduction

Sustainable living and energy conservation have been populous across the globe in recent decades since now people are aware of severe damage on environment inflicted by industrialization. To promote renewable energy, a significant number of developed countries launched a shared bicycle program in the hope that it will facilitate people to switch to green transportation. The Hubway is such program launched by Boston government in 2011 with 61 stations and 600 bicycles initially. By the end of 2013, the system has been expanded to 130 stations and 1200 bicycles. However, the current Hubway system is designed mainly for entertainment purpose. Obviously, the bicycle system has far more benefits than just for fun. It even has high potentials to solve urban problems of oversized and overpopulated cities, for instance traffic congestion, air pollution, etc.

To explore more potentials usage of Hubway Shared Bike, a new bicycle facility plan has to be designed based on trip demands, regardless of trip purposes. As a consequence, the new system will be more efficient and attractive compared to the current one as well as produce more beneficial outcomes. In the first place, reasonable bicycle facility planning will increase the usability of the system and correspondingly reduce usage of private automobiles and emission of carbon dioxide. Plus, the decline in consumption of fossil fuels will help to conserve the non-renewable resources. Secondly, traffic congestion will be mitigated if people switch to bicycles from automobiles. For low-income residents, the Hubway system is able to provide them an alternative and healthy commute travel solution.

For college students, cycling is also a cost-effective and flexible option which better fits their school schedules compared to the subway. Additionally, an efficient bicycle system is likely to ease mass transit pressures for a metropolis.

However, optimizing the entire design, including location planning of stations and re-allocation of docks and bicycles, requires multiple data sources, such as trip records and GIS information, and is way too large for a one-month project. To tailor it to meet workload that we are able to handle in half semester, the problem we are going to address in the paper is simplified to optimize station capacities based on trip demands and current design. In other words, our goal is to modify current design with the least efforts and costs, focusing on re-allocation of docks for stations so that the hubway system can satisfy public demands as much as possible. To tackle the problem, we will use a dataset of the Boston Hubway 2011 Trips And Stations.

According to the ”Wisconsin Bicycle Planning Guidance Handbook (WBPG)” [2], it is necessary to take both supplies and demands of shared bicycles into consideration in the shared bicycle facility planning. In the paper, we proposed our own methodology based on the demands and supplies from the Hubway Bike Trips Data in Boston Area between 2011 and 2013. The rest of paper is organized as follows. Section 2 is the related work in recent year, which talks about what other research projects are doing by using the Hubway Bike Trips Data. Section 3 is going to introduce the Methodology we are proposed, and how can we predict and optimize the docks at each Hubway Stations grouped by Regions. Section 4 Evaluation is going to use the real Hubway Bike Trips data to test our methodology and compare the results with real data. And the last section 5 is the Conclusion for this paper, what we have observed by the Evaluation Experiment results.

II. Related Work

The research paper we have reviewed currently is the one [3] that analyzes the bike rental system using the P-Median (minimize-impedance solution), which is to minimize ”weighted costs between demand points and solution facilities” to maximize coverage. Moreover, in the paper, it uses the ”GIS-based multi-criteria analysis tools.” As we know, this is a popular tool for data visualization on a map creating a heat map rendering with other features. However, the tool is inadequate and flawed in certain aspects considering our problem. So we are going to apply a more advanced method. To estimate the capacity of each bike station, first, aggregate the number of bicycles rented from one station on a daily basis. Then select the maximum over daily total from each station as the estimated capacity. Regarding accessibility and regional population, some stations will have more bicycles that are rented than others. Based on the estimated needs, we can make a right decision to allocate bikes to stations to maximize overall usage of bicycles. Besides, we are reviewing other methodologies, such as multi-criteria decision analysis and exploratory spatial data analysis. We will make comparisons across them to figure out the best one for our problem and evaluate performance by comparing it with baseline algorithms.

III. Methodology

A. Problem Setting

Technically, we intend to solve two specific problems:

- Predict the number of available bicycles at each station, i.e., the number of bicycles allocated to each station in the very beginning.
- Re-Allocate the number of docks number for each station based on the previous prediction of available number of bikes. In the other words, we are doing the optimization of docks for each station in the same region.

Intuitively, the sum of available bicycles at one station and bicycles that has traveled to it should meet the bicycle demands of the station. On the other hand, each station also has to provide sufficient empty docks to accommodate bicycles that has traveled to the station from other stations. Thus, the number of available bicycles and the capacity of each station should be predicted subject to these constraints.

The prediction consists of two steps. In the first step, bicycle demands and dock demands are predicted per station. In the second step, the entire Boston Area is split into 35 regions by zip codes. Numbers of bikes and docks that will be allocated to each station are estimated based on a demand ratio between the stations in every single region. For example, suppose the region with zip code 02101 has two stations A and B. Station A accounts for 20% bicycle demands of the total regional demands and station B accounts for 80%. Then 20% bicycles of the total bicycles in the region will be allocated to the station A and the remaining 80% bicycles will be allocated to the station B.

To make notations in our methods simple and clear, following terms are defined.

$Outbound_s$: the number of bicycles outbound from the station s.

$Inbound_s$: the number of inbound bicycles to the station s.

Avl_s: the number of available bicycles at the station s in the beginning.

$Capacity_s$: the capacity of station s, i.e., the total number of docks at the station s.

To simplify the problems and optimize allocation of bicycles and docks with the lowest costs and the least efforts, we made several assumptions.

- The total numbers of bicycles and docks of the bike-sharing system is fixed and equal to the totals of the current Hubway system throughout the study.
- Given trip data with start time and end time, regional population is assumed to be redundant for trip demand forecasts and will not be considered in the study.

B. Bike Demand Prediction For Stations

Since demands of bicycles are different from station to station, a strategy that distributes bicycles uniformly across all stations as adopted by most of bike-sharing systems is unreasonable. It may create a surplus of bicycles for stations with low demands and a shortage of bicycles for stations with high demands. To balance bicycle supplies and demands across stations, the number of available bicycles in theory should satisfy the equation below,

$$Avl_s + Inbound_s \geq Outbound_s$$

To cope with a special case where a station has no inbound bicycles, the bike allocation strategy has to guarantee sufficient bike allocation to meet the highest bike demands of the station in practice, i.e.,

$$Avl_s \geq max(Outbound_s)$$

C. Capacity Prediction For Stations

The dock demand is predicted subject to two constraints:

- Every inbound bicycle is assigned an empty dock at a station.
- A station has enough docks to park as many bicycles as demanded when the demands reach the highest level.

$$Capacity_s - Avl_s = Inbound_s - Outbound_s$$

The left hand side of the equation is the number of empty docks and the right hand side is the number of bicycles that have to be parked at the station. The rationale behind the equation is that each station must have adequate empty docks so that every bicycle at the station can be parked with a dock. Meanwhile, when a station reaches its full capacity, in other words, no docks are empty, it should satisfy the highest bike demands, i.e.,

$$Capacity_s \geq max(Outbound_s)$$

In a special case when a station has no outbound bicycles, it should be able to accommodate all inbound bicycles and bicycles that are allocated to the station initially, i.e.,

$$Capacity_s \geq max(Inbound_s) + Avl_s$$

D. Estimation Of Bike Allocation And Dock Allocation

Since capacity and quantity of available bicycles at each station of the current Hubway System are known and the totals of docks and bikes are assumed unchanging, the regional total of docks and bicycles can be obtained.

With predicted bike demands and dock demands of individual stations, a demand ratio of bikes and that of docks at a given station s can be calculated respectively as,

$$Ratio_s^{Bike} = \frac{Predicted\ Avl_s}{\sum_{i=1}^{n} Predicted\ Avl_i}$$

$$Ratio_s^{Dock} = \frac{Predicted\ Capacity_s}{\sum_{i=1}^{n} Predicted\ Capacity_i}$$

where n is the number of stations in the region.

For station s, bike allocation and dock allocation should follow

$$Estimated\ Avl_s = Ratio_s^{Bike} * \sum_{i=1}^{n} Avl_i$$

$$Estimated\ Capacity_s = Ratio_s^{Dock} * \sum_{i=1}^{n} Capacity_i$$

where Avl_i and $Capacity_i$ are data of the current system.

E. Time Window

Prediction results may change when different time horizon is chosen, since daily $max(Inbound_s)$, weekly $max(Inbound_s)$ and monthly $max(Inbound_s)$ probably are not identical. In our analysis, data will be aggregated on a daily basis, a weekly basis, a monthly basis and a yearly basis. Also, comparisons of accuracy of results produced with four horizons will be performed.

F. Data

The analysis is conducted with three datasets: hubway_stations.csv, hubway_trips.csv, and the most important and the largest data file, stationstatus.csv. Key attributes are summarized below,

Attribute	Data Type	Description Of Usage
seq_id (sid)	Character (Primary key)	trip index, counting trips
hubway_id	Character (Reference key)	Classification for station count sum
start_station	Integer	Demand-based counter
end_station	Integer	Supply-based counter
start_date	Timestamp	Classification for day, week, month, year
end_date	Timestamp	Classification for day, week, month, year
zip_code	Character	Classification for regions

IV. EVALUATION

A. Data Preparation

First of all, for the data we are using, which is the Hubway bikes shared trip data in Boston. We assume that the user information is not useful in this paper. It is necessary to simplified the data file before doing the data analysis. First, we are going to delete column with attribute 'subs_ctype', 'zip_code', 'birth_data', and 'gender'. Second, load the data into database for further calculation.

Second, the other datafile that we are going to use has the Hubway Station information, which contains the removed bike stations. In this case, we assume those removed Hubway station is no longer available so we use filter to remove the those stations data.

Third, the last datafile that we used has information of docks number. We tract couple of useful columns from this file to do the optimization, which is to group by regions (zipcode) and re-allocate docks for each stations in the same region.

B. Calculation of Available Bikes

First, group by the station number as well as the start_date for one table. Second, group by the station number as well as the start end_date for another table. Third, join the two tables with same station number and subtract the end_date to the start_date. The result tables contain three attributes are shown as Figure[2]. There are three attributes, which are station_ID, Date, and the number of bikes need at the station each date. Next, we find the max number of needs for each stations, which means that gets the biggest number through all dates in one station.

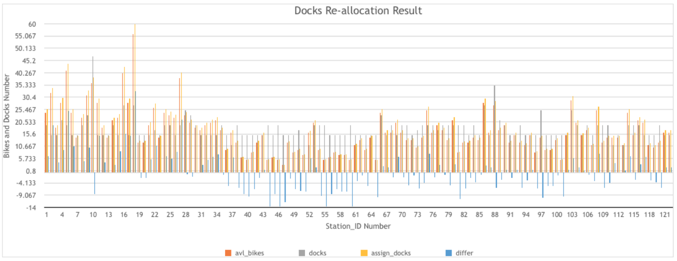

Fig. 1. Docks Re-allocation Result Plot

C. Hubway Bikes Re-allocation

In this section, we are using the predicted needed bikes in previous section to re-allocate the bike dots for each station. We need another data file ”station-status.csv” which contains the docks numbers for 145 stations. Second, we join the previous table results by the same primary key and foreign key, which are station_ID number. First, we are going to do a ratio of each stations in a same group of region, which is group by zip-code. The result table is shown in the figure[3]-[4]. Second, use methodology to re-allocate each station but the sum of total stations in each region is constant. Third, compare the new docks number in each stations. The final re-allocation results are shown in the figure[5]-[6]. From this graph, we can find out some stations have good dock numbers, but some have to re-allocate to satisfied the requirement of minimum of demands. The final result plots in Figure[1].

V. CONCLUSIONS

The goal of this paper is to predict the shared bikes need, and re-allocate the Hubway Docks in each station to satisfied the minimum requirement of the demands for that stations by day. The data we used in the paper is from the Hubway Shared Bikes in Boston from 2011 to 2013. We develop our own Methodology to predict the numbers of bikes in each station needs in order to satisfied the minimum demand for a day. The evaluation results are shown as expected that many Hubway Docks required re-allocation due to different ratio between ”Needs” and ”Docks”. For the future work, it may be a good practice to make the Docks motivative. It means that each individual dock is able to be installed and uninstalled easily in real practice. Use the real Hubway Shared Bike data in Boston, we are able to re-allocate the docks dynamically each Months. And this is also an open challenge to use the real time bike sharing date to re-allocate the docks for each station dynamically in the future.

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id	strt_stati	avl_bikes
0	0	2
1	3	12
2	4	22
3	5	12
4	6	22
5	7	15
6	8	11
7	9	14
8	10	14
9	11	19
10	12	12
11	13	9
12	14	26
13	15	13
14	16	38
15	17	15
16	18	10
17	19	14
18	20	41
19	21	29
20	22	36
21	23	24
22	24	17
23	25	20
24	26	21
25	27	15
26	29	9
27	30	14
28	31	11
29	32	11
30	33	24
31	34	18
32	35	17
33	36	23
34	37	5
35	38	44
36	39	17
37	40	24
38	41	15
39	42	20
40	43	14
41	44	24
42	45	21
43	46	24
44	47	21
45	48	22
46	49	18
47	50	17
48	51	9
49	52	23
50	53	28
51	54	28
52	55	20
53	56	10
54	57	16
55	58	32
56	59	18
57	60	17
58	61	15
59	62	12
60	63	12
61	64	25
62	65	12
63	66	14
64	67	28
65	68	25
66	69	12
67	70	24
68	71	12
69	72	16
70	73	16
71	74	16
72	75	16
73	76	19
74	77	15
75	78	12
76	79	11
77	80	27
78	81	14
79	82	8
80	83	7
81	84	12
82	85	4
83	86	10
84	87	20
85	88	17
86	89	16
87	90	14
88	91	17
89	92	5
90	93	6
91	94	16
92	95	13
93	96	13
94	97	6
95	98	20
96	99	28
97	100	6
98	101	11
99	102	12
100	103	20
101	104	8
102	105	5
103	106	9
104	107	7
105	108	5
106	109	3
107	110	5
108	111	40
109	112	31
110	113	28
111	114	56
112	115	9
113	116	18
114	117	11
115	118	5
116	119	19
117	120	6
118	121	8
119	122	7
120	123	8
121	124	7
122	125	5
123	126	16
124	127	16
125	128	41
126	129	16
127	130	13
128	131	13
129	132	10
130	133	14
131	134	8
132	135	21
133	136	19
134	137	12
135	138	15
136	139	14
137	140	7
138	141	9
139	142	9
140	143	8
141	144	13
142	145	5

Fig. 2. Available Bikes Result Table

2143	77	S32001	Somerville	77	15	15	73	78	16
2143	78	S32002	Somerville	78	12	19	73	78	13
2143	79	S32003	Somerville	79	11	15	73	78	12
2143	138	S32005	Somerville	138	15	15	73	78	16
2143	143	S32010	Somerville	143	8	15	73	78	9
2144	139	S32006	Somerville	139	14	25	50	53	15
2144	141	S32008	Somerville	141	9	15	50	53	10
2144	142	S32009	Somerville	142	9	15	50	53	10
2144	144	S32011	Somerville	144	13	15	50	53	14
2144	145	S32012	Somerville	145	5	15	50	53	5
2163	17	A32006	Boston	17	15	15	15	16	16
2199	21	C32007	Boston	21	29	25	49	52	31
2199	103	C32008	Boston	103	20	19	49	52	21
2210	7	A32000	Boston	7	15	15	80	85	16
2210	24	B32007	Boston	24	17	19	80	85	18
2210	31	B32014	Boston	31	11	15	80	85	12
2210	64	C32010	Boston	64	25	19	80	85	27
2210	65	D32018	Boston	65	12	19	80	85	13
2215	9	A32002	Boston	9	14	19	144	154	15
2215	10	A32003	Boston	10	14	11	144	154	15
2215	19	A32008	Boston	19	14	15	144	154	15
2215	32	B32015	Boston	32	11	11	144	154	12
2215	33	B32010	Boston	33	24	19	144	154	26
2215	41	A32012	Boston	41	15	19	144	154	16
2215	45	B32011	Boston	45	21	19	144	154	22
2215	55	B32018	Boston	55	20	15	144	154	21
2215	101	B32020	Boston	101	11	15	144	154	12
2445	86	K32003	Brookline	86	10	15	10	11	11
2446	69	K32001	Brookline	69	12	19	44	47	13
2446	126	K32002	Brookline	126	16	15	44	47	17
2446	127	K32004	Brookline	127	16	15	44	47	17

Fig. 3. Hubway Join Two Tables (Continue)

zipcode	id	terminal	municipal	strt_statn	avl_bikes	docks	avl_zipcode	assign_zipcode	assign_docks	differ
2108	44	D32009	Boston	44	24	19	74	79	26	7
2108	58	D32017	Boston	58	32	15	74	79	34	19
2108	116	D32024	Boston	116	18	15	74	79	19	4
2109	99	B32008	Boston	99	28	21	28	30	30	9
2110	20	B32004	Boston	20	41	19	132	141	44	25
2110	40	D32006	Boston	40	24	15	132	141	26	11
2110	43	D32008	Boston	43	14	15	132	141	15	-0
2110	48	D32012	Boston	48	22	19	132	141	24	5
2110	112	D32004	Boston	112	31	23	132	141	33	10
2111	22	A32010	Boston	22	36	47	96	102	38	-9
2111	54	D32014	Boston	54	28	15	96	102	30	15
2111	59	D32015	Boston	59	18	15	96	102	19	4
2111	81	D32019	Boston	81	14	15	96	102	15	-0
2113	47	D32010	Boston	47	21	19	21	22	22	3
2114	6	D32000	Boston	6	22	15	146	156	24	9
2114	111	D32003	Boston	111	40	27	146	156	43	16
2114	113	D32016	Boston	113	28	15	146	156	30	15
2114	114	D32022	Boston	114	56	27	146	156	60	33
2115	3	B32006	Boston	3	12	15	130	139	13	-2
2115	5	B32012	Boston	5	12	15	130	139	13	-2
2115	11	A32004	Boston	11	19	15	130	139	20	5
2115	14	B32003	Boston	14	26	17	130	139	28	11
2115	30	B32013	Boston	30	14	15	130	139	15	-0
2115	46	B32005	Boston	46	24	19	130	139	26	7
2115	52	B32000	Boston	52	23	19	130	139	25	6
2116	4	C32000	Boston	4	22	15	157	167	23	8
2116	16	C32003	Boston	16	38	19	157	167	40	21
2116	36	D32005	Boston	36	23	25	157	167	24	-1
2116	42	D32007	Boston	42	20	23	157	167	21	-2
2116	49	D32011	Boston	49	18	19	157	167	19	0
2116	50	D32013	Boston	50	17	15	157	167	18	3
2116	119	D32027	Boston	119	19	15	157	167	20	5
2118	25	A32009	Boston	25	20	15	95	101	21	6
2118	26	D32002	Boston	26	21	15	95	101	22	7
2118	39	C32006	Boston	39	17	19	95	101	18	-1
2118	51	C32005	Boston	51	9	15	95	101	10	-5
2118	57	C32004	Boston	57	16	11	95	101	17	6
2118	102	C32002	Boston	102	12	19	95	101	13	-6
2119	100	B32017	Boston	100	6	15	19	20	6	-9
2119	105	C32015	Boston	105	5	15	19	20	5	-10
2119	123	E32004	Boston	123	8	15	19	20	8	-7
2120	12	B32002	Boston	12	12	15	27	29	13	-2
2120	27	C32001	Boston	27	15	15	27	29	16	1
2125	92	C32014	Boston	92	5	19	19	20	5	-14
2125	93	C32013	Boston	93	6	15	19	20	6	-9
2125	108	C32018	Boston	108	5	19	19	20	5	-14
2125	109	C32019	Boston	109	3	15	19	20	3	-12
2127	63	C32009	Boston	63	12	15	36	38	13	-2
2127	104	C32012	Boston	104	8	15	36	38	8	-7
2127	106	C32016	Boston	106	9	17	36	38	10	-8
2127	107	C32017	Boston	107	7	15	36	38	7	-8
2129	94	D32020	Boston	94	16	11	50	53	17	6
2129	98	D32021	Boston	98	20	19	50	53	21	2
2129	115	D32023	Boston	115	9	19	50	53	10	-9
2129	118	D32026	Boston	118	5	19	50	53	5	-14
2130	120	E32001	Boston	120	6	15	33	35	6	-9
2130	121	E32002	Boston	121	8	15	33	35	8	-7
2130	122	E32003	Boston	122	7	15	33	35	7	-8
2130	124	E32005	Boston	124	7	15	33	35	7	-8
2130	125	E32006	Boston	125	5	19	33	35	5	-14
2134	8	A32001	Boston	8	11	15	47	50	12	-3
2134	15	A32005	Boston	15	13	15	47	50	14	-1
2134	29	A32011	Boston	29	9	15	47	50	10	-5
2134	66	A32017	Boston	66	14	15	47	50	15	-0
2135	110	D32001	Boston	110	5	15	5	5	5	-10
2138	70	M32016	Cambridge	70	24	23	142	151	26	3
2138	73	M32017	Cambridge	73	16	15	142	151	17	2
2138	74	M32018	Cambridge	74	16	19	142	151	17	-2
2138	87	M32014	Cambridge	87	20	15	142	151	21	6

Fig. 4. Hubway Re-allocation Result Tables

2138	89	M32020	Cambridge	89	16	19	142	151	17	-2
2138	96	M32013	Cambridge	96	13	19	142	151	14	-5
2138	130	M32021	Cambridge	130	13	15	142	151	14	-1
2138	132	M32023	Cambridge	132	10	17	142	151	11	-6
2138	133	M32024	Cambridge	133	14	19	142	151	15	-4
2139	68	M32011	Cambridge	68	25	19	111	118	27	8
2139	75	M32009	Cambridge	75	16	19	111	118	17	-2
2139	76	M32012	Cambridge	76	19	17	111	118	20	3
2139	88	M32010	Cambridge	88	17	19	111	118	18	-1
2139	131	M32022	Cambridge	131	13	19	111	118	14	-5
2139	135	M32026	Cambridge	135	21	19	111	118	22	3
2140	134	M32025	Cambridge	134	8	19	20	21	8	-11
2140	137	M32029	Cambridge	137	12	19	20	21	13	-6
2141	84	M32019	Cambridge	84	12	15	39	42	13	-2
2141	90	M32001	Cambridge	90	14	19	39	42	15	-4
2141	95	M32007	Cambridge	95	13	15	39	42	14	-1
2142	67	M32006	Cambridge	67	28	27	107	114	30	3
2142	72	M32003	Cambridge	72	16	15	107	114	17	2
2142	80	M32005	Cambridge	80	27	35	107	114	29	-6
2142	91	M32002	Cambridge	91	17	21	107	114	18	-3
2142	136	M32027	Cambridge	136	19	19	107	114	20	1
2143	71	S32004	Somerville	71	12	15	73	78	13	-2
2143	77	S32001	Somerville	77	15	15	73	78	16	1
2143	78	S32002	Somerville	78	12	19	73	78	13	-6
2143	79	S32003	Somerville	79	11	15	73	78	12	-3
2143	138	S32005	Somerville	138	15	15	73	78	16	1
2143	143	S32010	Somerville	143	8	15	73	78	9	-6
2144	139	S32006	Somerville	139	14	25	50	53	15	-10
2144	141	S32008	Somerville	141	9	15	50	53	10	-5
2144	142	S32009	Somerville	142	9	15	50	53	10	-5
2144	144	S32011	Somerville	144	13	15	50	53	14	-1
2144	145	S32012	Somerville	145	5	15	50	53	5	-10
2163	17	A32006	Boston	17	15	15	15	16	16	1
2199	21	C32007	Boston	21	29	25	49	52	31	6
2199	103	C32008	Boston	103	20	19	49	52	21	2
2210	7	A32000	Boston	7	15	15	80	85	16	1
2210	24	B32007	Boston	24	17	19	80	85	18	-1
2210	31	B32014	Boston	31	11	15	80	85	12	-3
2210	64	C32010	Boston	64	25	19	80	85	27	8
2210	65	D32018	Boston	65	12	19	80	85	13	-6
2215	9	A32002	Boston	9	14	19	144	154	15	-4
2215	10	A32003	Boston	10	14	11	144	154	15	4
2215	19	A32008	Boston	19	14	15	144	154	15	-0
2215	32	B32015	Boston	32	11	11	144	154	12	1
2215	33	B32010	Boston	33	24	19	144	154	26	7
2215	41	A32012	Boston	41	15	19	144	154	16	-3
2215	45	B32011	Boston	45	21	19	144	154	22	3
2215	55	B32018	Boston	55	20	15	144	154	21	6
2215	101	B32020	Boston	101	11	15	144	154	12	-3
2445	86	K32003	Brookline	86	10	15	10	11	11	-4
2446	69	K32001	Brookline	69	12	19	44	47	13	-6
2446	126	K32002	Brookline	126	16	15	44	47	17	2
2446	127	K32004	Brookline	127	16	15	44	47	17	2

Fig. 5. Hubway Re-allocation Result Tables (Continue)