

Computing Auto Accessibility to Other Destinations

Final Report

Prepared by:

Chen-Fu Liao
Sr. Systems Engineer
Minnesota Traffic Observatory Laboratory
Department of Civil Engineering

David Levinson
Associate Professor
Department of Civil Engineering

March 22, 2011

Submitted to:

Center for Transportation Studies
200 Transportation and Safety Building
511 Washington Avenue S.E.
Minneapolis, Minnesota 55455

This report represents the results of research conducted by the authors and does not necessarily represent the views or policies of the Center for Transportation Studies or the University of Minnesota.

Abstract

Highway-based accessibility measures to jobs and labor for the Twin Cities region were previously computed. The objective of the proposed work is to compute the auto accessibility measures (TAZ level) to other destination types such as retail, entertainment, food/restaurant and recreation for the period of 1995, 2000 and 2005. The resulting access measures to different destinations will provide a comprehensive evaluation of accessibility in the Twin Cities region, which can help in operational planning and in public involvement activities of transportation agencies to ascertain how investments, transportation strategies, market conditions, and land use policies affect the performance of the transportation-land use system.

Introduction

Accessibility measures for walking, biking, and transit to different types of destinations for the entire seven counties of the Twin Cities were computed by Krizek et al. (2009). Highway-based accessibility measures to jobs and labor for the Twin Cities region were also computed by Levinson et al. (2010). A set of cumulative opportunity measures are computed with transportation analysis zones (TAZs) as the unit of analysis for the years 1995, 2000, and 2005. Proposed effort will compute the highway accessibility to other destination types at TAZ level. Reclassified destination categories and specific destinations are listed in Appendix B.

Data Process Methodology

The data processing is divided into 2 stages. The first step is to aggregate the land use data from block level to TAZ level. The land use data was obtained from the previous non-auto mode accessibility measures project (Krizek et al., 2009). Seven destination types (big box, food, clothing, capital, restaurant, entertainment, and recreation) are processed for AM, PM, and off-peak hours in 1995, 2000, and 2005. Land use data for seven destination types of each year are loaded into a SQL database as inputs. The aggregated results will be created in a separate table in the database after executing the *taz_opportunity_xxxx.sql* script as illustrated in Figure 1. Sample source code of the *taz_opportunity_xxxx.sql* script is listed in Appendix.

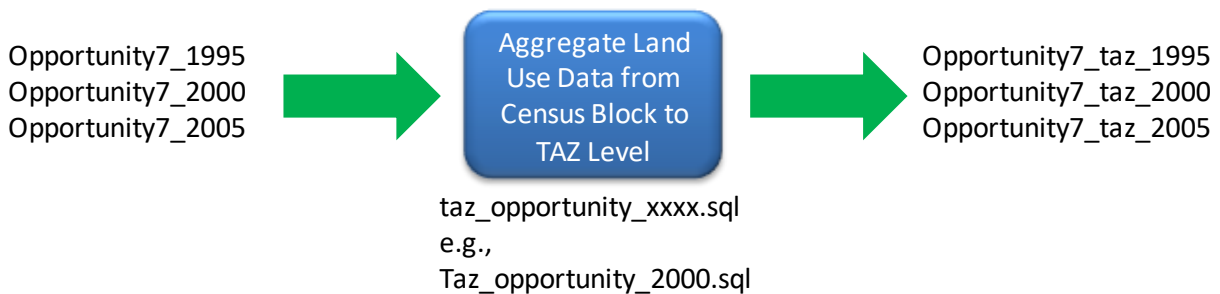


Figure 1 Aggregate Land Use Data to TAZ Level

Highway travel time between TAZ zones for all 3 years were obtained from Levinson et al. (2010). The accessibility computation script (*access_year_period_type.sql*) was created to process 63 resulting access tables (3 years [95, 00, 05] x 3 periods [AM, PM, OFF peak] x 7 destination types [big box, food, clothing, capital, restaurant, entertainment, recreation] = 63). The processing flowchart is illustrated in Figure 2.

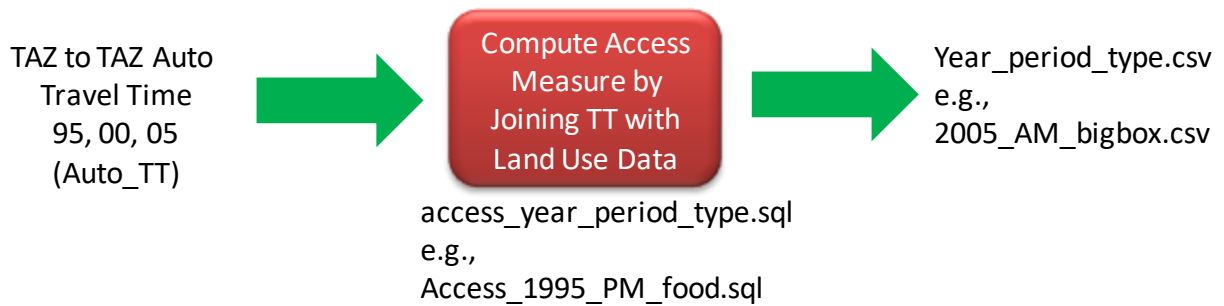


Figure 2 Compute Access Measures

Results

First 20 records of the 2005 PM peak hour access measures to restaurants were listed in Table 1 as an example. Each record indicates number of restaurants a person from a TAZ zone can reach within 10, 20, 30, 40, 50, 60, 90, or 120 minute of travel via auto mode through highway network. For example, a person in TAZ #1 can access 8 restaurants with 10-minute of auto travel while another person in TAZ #10 can reach 15 restaurants within 10-minute of travel. Map of auto accessibility up to 60-min through highway network to restaurants in 2005 PM peak hours is shown in Figure 3. Figure 4 illustrates the map of auto accessibility up to 30-min through highway network to foods in 2005 off-peak hours. Processed results are compressed in a zip file (auto_access_to7_dests.zip) which will be sent to CTS electronically.

Table 1 Sample 2005 Access Measures PM Peak to Restaurants

TAZ ID	Period	Destination Type	10 min	20 min	30 min	40 min	50 min	60 min	90 min	120 min
1	PM	Restaurant	8	14	92	288	627	1907	3630	3740
2	PM	Restaurant	5	26	176	376	973	2392	3679	3740
3	PM	Restaurant	9	22	134	355	824	2292	3666	3740
4	PM	Restaurant	2	46	242	625	1943	3005	3707	3740
5	PM	Restaurant	3	106	291	696	2032	3031	3701	3740
6	PM	Restaurant	5	78	276	629	1915	2995	3707	3740
7	PM	Restaurant	6	79	291	668	2026	3025	3700	3740
8	PM	Restaurant	13	179	401	1261	2495	3257	3715	3740
9	PM	Restaurant	5	50	240	515	1647	2859	3682	3740
10	PM	Restaurant	15	79	328	797	2262	3141	3692	3740
11	PM	Restaurant	7	53	204	492	1675	2806	3666	3740
12	PM	Restaurant	4	26	141	408	1336	2572	3664	3740
13	PM	Restaurant	11	45	204	526	1760	2890	3667	3740
14	PM	Restaurant	9	90	338	1157	2505	3237	3696	3740
15	PM	Restaurant	1	17	98	404	1565	2786	3666	3740
16	PM	Restaurant	22	60	247	1452	2646	3299	3704	3740
17	PM	Restaurant	23	77	631	2289	3085	3442	3729	3740
18	PM	Restaurant	1	51	448	1984	3011	3388	3714	3740
19	PM	Restaurant	10	165	1002	2357	3225	3492	3739	3740
20	PM	Restaurant	34	255	743	2185	3101	3435	3739	3740

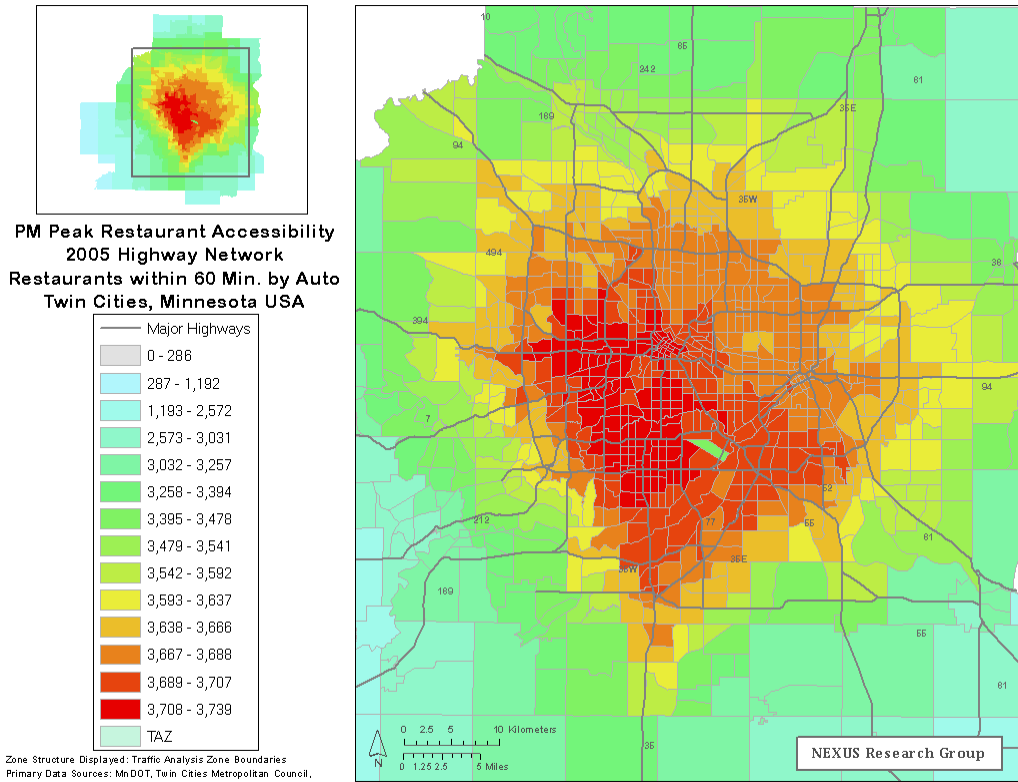


Figure 3 Access to Restaurants 2005 PM Peak (60-min)

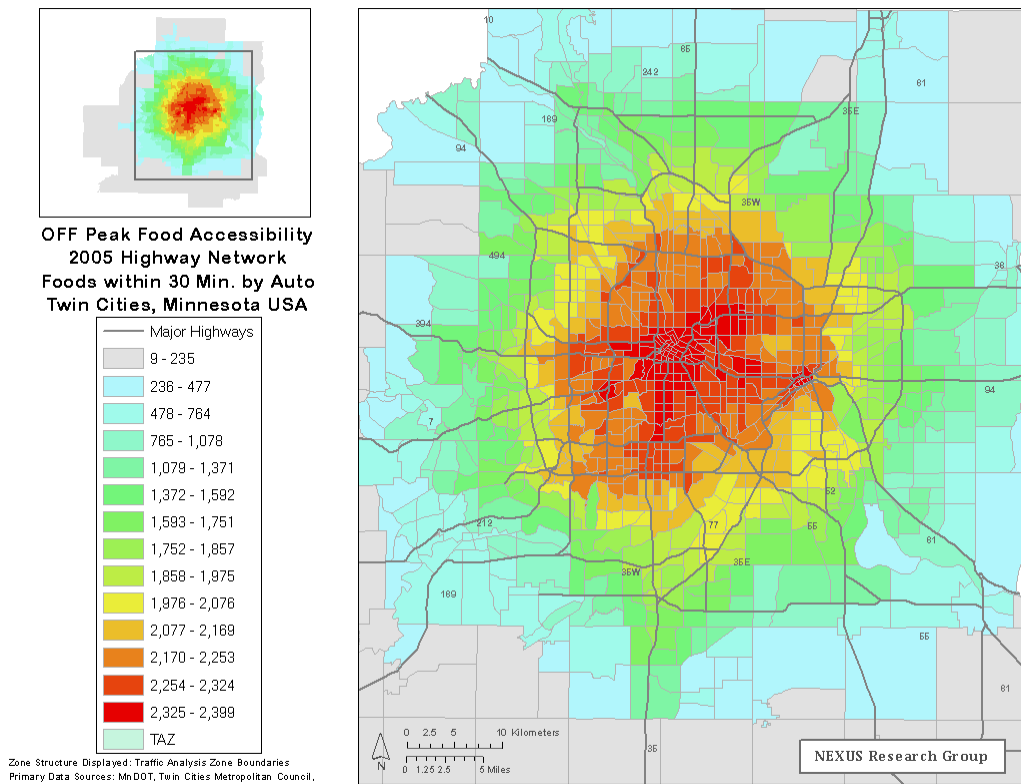


Figure 4 Access to Foods 2005 Off Peak (30-min)

References

- Krizek, K., Iacono, M., El-Geneidy, A.M., Liao, C.-F. and Johns, R., (2009) Access to Destinations: Application of Accessibility Measures for Non-Auto Travel Modes. Report no. Mn/DOT 2009-24, Series: Access to Destinations Study, CTS, UMN
- Levinson, D.M., Marion, B., and Iacono, M., (2010) Access to Destinations, Phase 3: Measuring Accessibility by Automobile. Report no. Mn/DOT 2010-09, Series: Access to Destinations Study, CTS, UMN

Appendix A: Sample SQL Scripts to Process Access Measures

A.1 taz_opportunity_1995.sql

```
create table opportunity7_taz_1995 (  
taz_ID int,  
dest_cat varchar(32),  
taz_activity int)  
go  
insert into opportunity7_taz_1995  
select a.taz_2000, b.dest_cat, sum(b.activity) as taz_activity from taz_2000_intersect a  
inner join opportunity7_1995 b  
on a.accessid=b.destID  
group by a.taz_2000, b.dest_cat  
go
```

A.2 access_2005_am_bigbox.sql

```
create view tmp10 as  
select a.taz_origin, sum(b.taz_activity) as total  
from auto_TT a  
inner join opportunity7_taz_2005 b  
on a.taz_dest=b.taz_id  
where b.dest_cat='BIGBOX'  
and a.spfin05AMT<=10  
group by a.taz_origin  
go
```

```
create view tmp20 as  
select a.taz_origin, sum(b.taz_activity) as total  
from auto_TT a  
inner join opportunity7_taz_2005 b  
on a.taz_dest=b.taz_id  
where b.dest_cat='BIGBOX'  
and a.spfin05AMT<=20  
group by a.taz_origin  
go
```

```
create view tmp30 as  
select a.taz_origin, sum(b.taz_activity) as total  
from auto_TT a  
inner join opportunity7_taz_2005 b  
on a.taz_dest=b.taz_id  
where b.dest_cat='BIGBOX'  
and a.spfin05AMT<=30  
group by a.taz_origin  
go
```

```
create view tmp40 as  
select a.taz_origin, sum(b.taz_activity) as total  
from auto_TT a  
inner join opportunity7_taz_2005 b  
on a.taz_dest=b.taz_id  
where b.dest_cat='BIGBOX'  
and a.spfin05AMT<=40  
group by a.taz_origin  
go
```

```
create view tmp50 as  
select a.taz_origin, sum(b.taz_activity) as total
```

```
from auto_TT a  
inner join opportunity7_taz_2005 b  
on a.taz_dest=b.taz_id  
where b.dest_cat='BIGBOX'  
and a.spfin05AMT<=50  
group by a.taz_origin  
go
```

```
create view tmp60 as  
select a.taz_origin, sum(b.taz_activity) as total  
from auto_TT a  
inner join opportunity7_taz_2005 b  
on a.taz_dest=b.taz_id  
where b.dest_cat='BIGBOX'  
and a.spfin05AMT<=60  
group by a.taz_origin  
go
```

```
create view tmp90 as  
select a.taz_origin, sum(b.taz_activity) as total  
from auto_TT a  
inner join opportunity7_taz_2005 b  
on a.taz_dest=b.taz_id  
where b.dest_cat='BIGBOX'  
and a.spfin05AMT<=90  
group by a.taz_origin  
go
```

```
create view tmp120 as  
select a.taz_origin, sum(b.taz_activity) as total  
from auto_TT a  
inner join opportunity7_taz_2005 b  
on a.taz_dest=b.taz_id  
where b.dest_cat='BIGBOX'  
and a.spfin05AMT<=120  
group by a.taz_origin  
go
```

```
select h.taz_origin,  
a.total as cutoff10,  
b.total as cutoff20,  
c.total as cutoff30,
```

```
d.total as cutoff40,
e.total as cutoff50,
f.total as cutoff60,
g.total as cutoff90,
h.total as cutoff120
from tmp120 h
left join tmp10 a
on h.taz_origin=a.taz_origin
left join tmp20 b
on h.taz_origin=b.taz_origin
left join tmp30 c
on h.taz_origin=c.taz_origin
left join tmp40 d
on h.taz_origin=d.taz_origin
left join tmp50 e
on h.taz_origin=e.taz_origin
left join tmp60 f
on h.taz_origin=f.taz_origin
left join tmp90 g
on h.taz_origin=g.taz_origin
go

drop view tmp10
go
drop view tmp20
go
drop view tmp30
go
drop view tmp40
go
drop view tmp50
go
drop view tmp60
go
drop view tmp90
go
drop view tmp120
go
```

Appendix B: Reclassified Destination Categories and Specific Destinations

Destination Category	Original NAICS Code & Classification	
Capital goods and Heavy home accessories	441110	New Car Dealers
	441120	Used Car Dealers
	441210	Recreational Vehicle Dealers
	441221	Motorcycle Dealers
	441222	Boat Dealers
	441229	All Other Motor Vehicle Dealers
	441310	Automotive Parts and Accessories Stores
	441320	Tire Dealers
	532111	Passenger Car Rental
	532112	Passenger Car Leasing
	532120	Truck, Utility Trailer, and RV (Recreational Vehicle) Rental and Leasing
	811111	General Automotive Repair
	811112	Automotive Exhaust System Repair
	811113	Automotive Transmission Repair
	811118	Other Automotive Mechanical and Electrical Repair and Maintenance
	811121	Automotive Body, Paint, and Interior Repair and Maintenance
	811122	Automotive Glass Replacement Shops
	811191	Automotive Oil Change and Lubrication Shops
	811192	Car Washes
	811198	All Other Automotive Repair and Maintenance
	442110	Furniture Stores
	442210	Floor Covering Stores
	442291	Window Treatment Stores
	442299	All Other Home Furnishings Stores
	444120	Paint and Wallpaper Stores
	444190	Other Building Material Dealers
	444210	Outdoor Power Equipment Stores
	444220	Nursery, Garden Center, and Farm Supply Stores
	532210	Consumer Electronics and Appliances Rental
	811411	Home and Garden Equipment Repair and Maintenance
	811412	Appliance Repair and Maintenance
	811420	Upholstery and Furniture Repair

Destination Category	Original NAICS Code & Classification	
Clothing, Boutique, Light Home Accessories, and other related	446120	Cosmetics, Beauty Supplies, and Perfume Stores
	448110	Men's Clothing Stores
	448120	Women's Clothing Stores
	448140	Family Clothing Stores
	448210	Shoe Stores
	448150	Clothing Accessories Stores
	448190	Other Clothing Stores
	448310	Jewelry Stores
	448320	Luggage and Leather Goods Stores
	451110	Sporting Goods Stores
	451120	Hobby, Toy, and Game Stores
	451130	Sewing, Needlework, and Piece Goods Stores
	451140	Musical Instrument and Supplies Stores
	451220	Prerecorded Tape, Compact Disc, and Record Stores
	451211	Book Stores
	451212	News Dealers and Newsstands
	452111	Department Stores (except Discount Department Stores)
	452112	Discount Department Stores
	452990	All Other General Merchandise Stores
	453110	Florists
	453210	Office Supplies and Stationery Stores
	453220	Gift, Novelty, and Souvenir Stores
	453910	Pet and Pet Supplies Stores
	453920	Art Dealers
	453991	Tobacco Stores
	812111	Barber Shops
	812112	Beauty Salons
	812113	Nail Salons
	812191	Diet and Weight Reducing Centers
	812199	Other Personal Care Services
	453998	All Other Miscellaneous Store Retailers (except Tobacco Stores)
	453310	Used Merchandise Stores
	443111	Household Appliance Stores

Clothing, Boutique, Light Home Accessories, and other related (Con't)	443112	Radio, Television, and Other Electronics Stores
	443120	Computer and Software Stores
	443130	Camera and Photographic Supplies Stores
	444130	Hardware Stores
	446110	Pharmacies and Drug Stores
	446130	Optical Goods Stores
	446191	Food (Health) Supplement Stores
	446199	All Other Health and Personal Care Stores
	811430	Footwear and Leather Goods Repair

Destination Category	Original NAICS Code & Classification	
Big Box	452910	Warehouse Clubs and Supercenters
	444110	Home Centers

Destination Category	Original NAICS Code & Classification	
Food	445110	Supermarkets and Other Grocery (except Convenience) Stores
	445120	Convenience Stores
	445210	Meat Markets
	445220	Fish and Seafood Markets
	445230	Fruit and Vegetable Markets
	445291	Baked Goods Stores
	311811	Retail Bakeries
	445292	Confectionery and Nut Stores
	445299	All Other Specialty Food Stores
	445310	Beer, Wine, and Liquor Stores

Destination Category	Original NAICS Code & Classification	
Restaurants	722110	Full-Service Restaurants
	722211	Limited-Service Restaurants
	722212	Cafeterias
	722213	Snack and Nonalcoholic Beverage Bars
	722410	Drinking Places (Alcoholic Beverages)

Destination Category	Original NAICS Code & Classification	
Entertainment Venues	512131	Motion Picture Theaters (except Drive-Ins)
	512132	Drive-In Motion Picture Theaters
	711110	Theater Companies and Dinner Theaters
	711120	Dance Companies
	711130	Musical Groups and Artists
	711190	Other Performing Arts Companies
	711211	Sports Teams and Clubs
	711212	Racetracks
	711219	Other Spectator Sports
	712110	Museums
	712120	Historical Sites
	712130	Zoos and Botanical Gardens
	713110	Amusement and Theme Parks
	713120	Amusement Arcades
	713210	Casinos (except Casino Hotels)
	713290	Other Gambling Industries
	713950	Bowling Centers
721120	Casino Hotels	

Destination Category	Original NAICS Code & Classification	
Recreation	713940	Fitness and Recreational Sports Centers
	611620	Sports and Recreation Instruction
	713910	Golf Courses and Country Clubs
	713920	Skiing Facilities
	713930	Marinas
	721211	RV (Recreational Vehicle) Parks and Campgrounds
	721214	Recreational and Vacation Camps (except Campgrounds)

Destination Category	Original NAICS Code & Classification	
Health Care	621111	Offices of Physicians (except Mental Health Specialists)
	621210	Offices of Dentists
	621112	Offices of Physicians, Mental Health Specialists
	621310	Offices of Chiropractors
	621320	Offices of Optometrists
	621330	Offices of Mental Health Practitioners (except Physicians)
	621340	Offices of Physical, Occupational and Speech Therapists, and Audiologists
	621391	Offices of Podiatrists
	621399	Offices of All Other Miscellaneous Health Practitioners
	621410	Family Planning Centers
	621420	Outpatient Mental Health and Substance Abuse Centers
	621491	HMO Medical Centers
	621492	Kidney Dialysis Centers
	621493	Freestanding Ambulatory Surgical and Emergency Centers
	621498	All Other Outpatient Care Centers
	622210	Psychiatric and Substance Abuse Hospitals
	622310	Specialty (except Psychiatric and Substance Abuse) Hospitals
	621511	Medical Laboratories
	621512	Diagnostic Imaging Centers
	621610	Home Health Care Services
	621910	Ambulance Services
	621991	Blood and Organ Banks
	621999	All Other Miscellaneous Ambulatory Health Care Services
	622110	General Medical and Surgical Hospitals
	623110	Nursing Care Facilities
	623210	Residential Mental Retardation Facilities
	623220	Residential Mental Health and Substance Abuse Facilities
	623311	Continuing Care Retirement Communities
	623312	Homes for the Elderly
	623990	Other Residential Care Facilities

Destination Category	Original NAICS Code & Classification	
Financial Services	522110	Commercial Banking
	522120	Savings Institutions
	522130	Credit Unions
	522190	Other Depository Credit Intermediation
	<i>All other Financial and Insurance (520000) classifications</i>	

Destination Category	Original NAICS Code & Classification	
Education	624410	Child Day Care Services
	611110	Elementary and Secondary Schools
	611210	Junior Colleges
	611310	Colleges, Universities, and Professional Schools
	611410	Business and Secretarial Schools
	611420	Computer Training
	611430	Professional and Management Development Training
	611511	Cosmetology and Barber Schools
	611512	Flight Training
	611513	Apprenticeship Training
	611519	Other Technical and Trade School
	611610	Fine Arts Schools
	611630	Language Schools
	611691	Exam Preparation and Tutoring
	611692	Automobile Driving Schools
	611699	All Other Miscellaneous Schools and Instruction

Destination Category	Original NAICS Code & Classification	
Personal Services	624120	Services for the Elderly and Persons with Disabilities
	624190	Other Individual and Family Services
	624210	Community Food Services
	624221	Temporary Shelters
	624229	Other Community Housing Services
	624230	Emergency and Other Relief Services
	624310	Vocational Rehabilitation Services
	721110	Hotels (except Casino Hotels) and Motels

Personal Service (Con't)	721191	Bed-and-Breakfast Inns
	721199	All Other Traveler Accommodation
	721310	Rooming and Boarding Houses
	811211	Consumer Electronics Repair and Maintenance
	811212	Computer and Office Machine Repair and Maintenance
	811213	Communication Equipment Repair and Maintenance
	811219	Other Electronic and Precision Equipment Repair and Maintenance
	323114	Quick Printing
	561439	Other Business Service Centers
	811310	Commercial and Industrial Machinery and Equipment (except Automotive and Electronic) Repair and Maintenance
	811490	Other Personal and Household Goods Repair and Maintenance
	812210	Funeral Homes and Services
	812220	Cemeteries and Crematories
	812310	Coin-Operated Laundries and Drycleaners
	812320	Dry cleaning and Laundry Services (except Coin-Operated)
	812910	Pet Care (except Veterinary) Services
	812921	Photofinishing Laboratories (except One-Hour)
	812922	One-Hour Photofinishing
	812990	All Other Personal Services Professional, and Similar Organizations
	813110	Religious Organizations
	813311	Human Rights Organizations
	813312	Environment, Conservation and Wildlife Organizations
	813319	Other Social Advocacy Organizations
	813410	Civic and Social Organizations
	813910	Business Associations
	813920	Professional Organizations
	813930	Labor Unions and Similar Labor Organizations
	813940	Political Organizations
	813990	Other Similar Organizations (except Business, Professional, Labor, and Political Organizations)
	492110	Couriers
	492210	Local Messengers and Local Delivery