Visualization of Commuter Flow Using CTPP Data and GIS

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Overview of SCAG
Quick Facts of SCAG

- Nation’s largest Metropolitan Planning Organization (MPO)
- 6 counties and 191 cities
- 15 sub-regions
- 18.4 million people (2012)
- 38,000 square miles
- 16th largest economy in the world (GRP: $924 Billion in 2013)
Objectives

- Identify the major work destinations for each jurisdiction in the SCAG region
  - 191 cities and 6 counties
- Visualize the spatial patterns of the major work destinations for each jurisdiction
  - To understand where residents of each jurisdiction are employed
- Provide informational data resources to local jurisdictions for planning purposes
  - E.g. 2013 Local Profiles: Planning data reports
Previous Future Studies Goal

- Work destinations at different geographical level
  - Previous, we studied on place level
- Produce major work destination data using Census Transportation Planning Products (CTPP)
Census Transportation Planning Package (CTPP)

- The CTPP is a set of special tabulations designed by transportation planners using large sample surveys conducted by the Census Bureau. From 1970 to 2000, the CTPP and its predecessor, UTPP, used data from the decennial census long form (FHWA).
- Utilize continuous survey called American Community Survey (ACS).
- Three components of CTPP:
  - Part 1: Residence-based tabulations summarizing worker and household characteristics
  - Part 2: Workplace-based tabulations summarizing worker characteristics
  - Part 3: Worker flows between home and work, including travel mode
Methodology for Identifying Work Destination

- Using **CTPP 2006 - 2010 Census Tract Flows Query**

- Using Microsoft Access to select census tract-to-tract commuter data within SCAG’s region

- Using SAS program with *CTPP* raw datasets/
  * SAS: Statistical Analysis System
  * CTPP: Census Transportation Planning Products
Programming Scripts with CTPP Datasets

- CTPP (ACS) 2006-2010
  - Origin-Destination (OD)
  - Residence Area
  - Workplace Area

- Enumerated by 2010 Census Tracts
## Pros and Cons

<table>
<thead>
<tr>
<th>Pros</th>
<th>OnTheMap</th>
<th>Programming Scripts</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pros</strong></td>
<td>Easy-to-use interface and able to visualize data instantly</td>
<td>Able to manipulate data for multiple areas at once</td>
</tr>
<tr>
<td></td>
<td>Support analyses at multiple levels of geography</td>
<td>Improve efficiency of managing and processing big data</td>
</tr>
<tr>
<td><strong>Cons</strong></td>
<td>Not able to search/download for multiple locations</td>
<td>Incorporate with ArcGIS to visualize the data</td>
</tr>
</tbody>
</table>
# CTPP Raw Dataset

## CTPP raw dataset description

<table>
<thead>
<tr>
<th>Pos</th>
<th>Variable</th>
<th>Type</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>StateFP_R</td>
<td>Text</td>
<td>Residence state number</td>
</tr>
<tr>
<td>2</td>
<td>CountyFP_R</td>
<td>Text</td>
<td>Residence county number</td>
</tr>
<tr>
<td>3</td>
<td>TractFP_R</td>
<td>Text</td>
<td>Residence tract number</td>
</tr>
<tr>
<td>4</td>
<td>StateFP_W</td>
<td>Text</td>
<td>Workplace state number</td>
</tr>
<tr>
<td>5</td>
<td>CountyFP_W</td>
<td>Text</td>
<td>Workplace county number</td>
</tr>
<tr>
<td>6</td>
<td>TractFP_W</td>
<td>Text</td>
<td>Workplace tract number</td>
</tr>
<tr>
<td>7</td>
<td>EST</td>
<td>Text</td>
<td>Estimate of commuter</td>
</tr>
</tbody>
</table>
Identifying Major Work Destinations

- **O-D Analysis Steps**

  1. **Correspondence between**
     - Census Tract codes
     - Place codes
  2. **Merging**
     - O-D dataset
     - Place codes by Census Tract codes
  3. **Sorting dataset in descending order**
  4. **Ranking top 10 work destination**
  5. **Exporting CSV dataset to dbf file for GIS**
Identifying Major Work Destinations (Cont.)

```sas
DATA LEHD;
INFILE 'P:\LEHD\esri_uc_2014\docs\ca_od_main_JT01_2011.csv';
DSD MISSOVER FIRSTOBS = 2;
INPUT w_geocode h_geocode S000;
FORMAT BLK_W $S15. BLK_H $S15.;
BLK_W = compress(put(w_geocode,215.));
BLK_H = compress(put(h_geocode,215.));
RUN;
```

NOTE: The infile 'P:\LEHD\esri_uc_2014\docs\ca_od_main_JT01_2011.csv' is:
Filename: 'P:\LEHD\esri_uc_2014\docs\ca_od_main_JT01_2011.csv',
RECFM: V, LRECL: 256.File Size (bytes): 735924547,
Last Modified: 21May2013:19:06:08,

NOTE: 12042668 records were read from the infile 'P:\LEHD\esri_uc_2014\docs\ca_od_main_JT01_2011.csv'.
The minimum record length was 60.
The maximum record length was 72.
NOTE: The data set WORK.LEHD has 12042668 observations and 5 variables.

```
DATA LEHD;
INFILE 'P:\LEHD\esri_uc_2014\docs\ca_od_main_JT01_2011.csv';
DSD MISSOVER FIRSTOBS = 2;
INPUT w_geocode h_geocode S000;
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BLK_H = compress(put(h_geocode,215.));
RUN;
```

* Import SCAG's Correspondence table between Census Block and Place:
Visualizing Major Work Destinations

- Using ESRI ArcGIS application
  - *Data Driven Pages* - To create a multi-page map series from a single map document
- Using *Python* programming language
  - *Python* – Interpreted, object-oriented, high-level general-purpose programming language
Visualizing Major Work Destinations (Automated Mapping Workflow)

- Using ArcGIS and Python to create a series of work destination maps for 191 cities and 6 counties
Python Coding

- Importing ArcPy and ArcPy.mapping modules in Python to automatically create work destination maps
  - Data Driven Page, Definition Query, and Exporting functions in ArcGIS
    - `mxd.dataDrivenPages.currentPageID`
    - `lyr.definitionQuery = sqlExp`
    - `arcpy.mapping.ExportToJPEG`
OD Map at Census Tract Level

Original-Destination Commuter Flow Map: City of Los Angeles
Conclusions

- Significantly efficient in processing O-D analysis with SAS for numerous jurisdictions

- Data limitation of *CTPP* datasets (what limitation?)

- Python and ArcGIS improve the processing time and accuracy of map production

- Creating OD commuting flow at the Census Tract level helps to understand the travel pattern better
Future Studies

- Work destinations at different geographical level
- Incorporate socioeconomic data (SED) to create weighted commuter flow
- Include land use data when intersect place shapefile with tract shapefile to increase accuracy of manipulating the data
- Create an efficient and appropriate method to identify destination for each jurisdiction