ECONOMIC AND LAND USE MODELING

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Tradional Forecasting Model

The region is divided into zones and by trend or regression analysis, the population and employment are determined for each.

Network Assignment Model

All trips are assigned to networks. Some modeling efforts allowed capacity constraints on assignments which caused looping back through modal split and zonal interchange models.

Trip Interchange Modal Split Model

The traffic between zones is allocated to the available modes of transportation according to factors of trip, trip maker, and model.

Zonal Interchange Model

Based on data from origin and destination surveys, the origins by zone are distributed by a model as destinations to zones.

Trip Generation Model

The frequency of origins or destinations of trips in each zone is determined by land use and socio-economic factors.

Precursor and Postprocessor Models

• Before the model, input data/forecasts required. This is also modeled. This includes: demographics, economics, land use.
• After the model forecasts are produced, analysis must be done.

Economic Base Modeling

• Basic vs. Non-basic activities.
• What is basic industry?
• What is non-basic?

Location Quotients

\[
\frac{\sum_{s} \text{Employment}_{sp}}{\sum_{s} \sum_{p} \text{Employment}_{sp}} \left/ \frac{\sum_{p} \text{Employment}_{sp}}{\sum_{p} \sum_{s} \text{Employment}_{sp}} \right.
\]

• Where s = sector of the economy, p = location

Interpretation

• If LQ>1, this indicates a relative concentration of the activity in area I, compared to the region as a whole.
• If LQ =1, the area has a share of the activity in accordance with its share of the base.
• If LQ<1, the area has less of a share of the activity than is more generally, or regionally, found.
**LQ - Example**

<table>
<thead>
<tr>
<th></th>
<th>Employment in Transportation Equipment Manufacturing</th>
<th>Total Employment</th>
</tr>
</thead>
<tbody>
<tr>
<td>King County</td>
<td>53,000</td>
<td>729,341</td>
</tr>
<tr>
<td>Washington State</td>
<td>84,955</td>
<td>1,773,259</td>
</tr>
</tbody>
</table>

**LQ - Solution**

- Numerator: $\frac{53,000}{729,341} = 0.073$
- Denominator: $\frac{84,955}{1,773,259} = 0.048$
- $LQ = \frac{0.073}{0.048} = 1.51$
- Conclusion: King County has a concentration on transportation equipment manufacturing (no surprise, Boeing is there).

**Location Quotient: Minnesota Data**

<table>
<thead>
<tr>
<th>Industry</th>
<th>Location Quotient</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medical Devices</td>
<td>0.6</td>
</tr>
<tr>
<td>Paper</td>
<td>0.9</td>
</tr>
<tr>
<td>Printing</td>
<td>1.0</td>
</tr>
<tr>
<td>Food</td>
<td>0.6</td>
</tr>
<tr>
<td>Industrial Equipment</td>
<td>0.7</td>
</tr>
<tr>
<td>Lumber and Wood Products</td>
<td>0.6</td>
</tr>
<tr>
<td>Health Services</td>
<td>0.6</td>
</tr>
<tr>
<td>Finance Insurance and Real Estate</td>
<td>0.6</td>
</tr>
<tr>
<td>High Technology</td>
<td>0.7</td>
</tr>
<tr>
<td>Business Services</td>
<td>1.0</td>
</tr>
<tr>
<td>Furniture</td>
<td>0.4</td>
</tr>
</tbody>
</table>

**Shift/Share Analysis**

- LQ only tells you what is, not what might be.
- Growth in the activity in a specific sector depends on
  - The study area’s share of national (or regional) growth.
  - The mix change in activities.
  - And the shift change of activities toward the study area.

**Employment $e$ in Sector $i$ at Time $t+n$**

\[
e_i^{t+n} - e_i^t = \text{share change} + \text{mix change} + \text{shift change} = e_i \left[ \frac{E_i^{t+n}}{E^t} - 1 \right] + e_i \left[ \frac{E_i^{t+n}}{E_i^t} - \frac{E_i^{t+n}}{E^t} \right] + e_i \left[ \frac{E_i^{t+n}}{E_i^t} - \frac{E_i^{t+n}}{E_i^t} \right]
\]

Where $E$ is total employment, $e$ is local employment, activity is $i$ and $t$ is point in time.

**Shift-Share Discussion**

- Requires more information
The document contains a mixture of text and diagrams related to land use and traffic zones. The text is not fully legible due to the quality of the image, but it appears to discuss variables and a model called the Lowry Model. The Lowry Model is described as follows:

- We are given the area of each tract, and the amount of land therein which is not usable by any of the activities with which we are concerned. The remainder of the land in each tract is available for use by basic establishments, retail establishments, and households. All land not otherwise assigned is treated as available for residential use.

\[ A_j = A_j^U + A_j^B + A_j^R + A_j^H \]
**Basic Sector**

- For each tract, we are given exogenously the quantity of land used by basic establishments \(A_j^b\) and the employment opportunities provided by these establishments \(E_j^b\).

**Retail Sector**

- Retail establishments are divided into \(m\) groups, each of which has a characteristic production function; the elements of this production function which enter directly into the model are: minimum efficient size of establishment, number of clients required to support one employer, and number of square feet of space per employee. Since local consumer demand provides the market for establishments of this sector, we may treat employment in each line of retail trade as roughly a function of the number of households in the region.

\[
E^k = a^k + \sum_{j=1}^{m} E_j^k
\]

**Retail Distribution**

- The distribution of this retail employment among the square-mile tracts depends on the strength of the market at each location. Assuming that shopping trips originate either from homes or from workplaces, the market potential of any given location can be defined as a weighted index of the numbers of households in the surrounding areas, and the number of persons employed nearby.

\[
E_j^k = b^k \left( \sum_{i=1}^{k} \frac{c_i N_i}{T_i^b} \right) + d^k E_j
\]

**Retail Land Consumption**

- Finally, with the aid of exogenously-determined employment-density coefficients \(e^k\) for each line of trade, we can determine the amount of land in each tract which will be occupied by retail establishments.

\[
A_j^k = \sum_{k=1}^{m} e^k E_j^k
\]

**Household Sector**

- The region’s population of households may be regarded as a function of total employment.
- The number of households in each tract is a function of that tract’s accessibility to employment opportunities.
- The coefficient \(g\) is a scale factor whose value is determined by the requirement that the sum of tract populations must equal the total population of the region as determined below.

\[
N = \sum_{j=1}^{m} E_j \quad N_j = \sum_{j=1}^{m} E_j^k \quad N = \sum_{j=1}^{m} N_j
\]

**Constraints 1/3**

- In order to limit the dispersion of retail employment, we impose a minimum-size constraint \((Z_k)\), expressed in terms of employment. If the market potential of a particular location does not justify an establishment above this minimum size, the “customers” are sent elsewhere.

\[
E_j^k \geq Z_j \text{ or else } E_j^k = 0
\]
**Constrains 2/3**

- In order to prevent the system from generating excessive population densities in location with high accessibility indices, we impose a maximum-density constraint \( Z_j^H \). The value of this constraint (number of households permitted per 1,000 square feet of residential space) may vary from tract to tract, as would be the case under zoning ordinances.

\[
N_j \leq Z_j^H A_j^H
\]

**Constraint 3/3**

- Finally, the amount of land set aside for retail establishments by Equation 6 must not exceed the amount available.

\[
A_j^R \leq A_j - A_j^U - A_j^B
\]