Aerial view of Lakewood. Built in 1950 as part of surge in homebuilding for returning veterans of WW2. Went from small village to 70,000 in three years. Completed 50 houses per day. 17,000 houses in 3 years.
Lakewood is an epitome of modern sprawl. Cities spreading out instead of becoming denser as they grow. Present some statistics on decentralization, talk about employment decentralization in Los Angeles.

At end talk a little bit about how to present categorical data in your tables.

First some statistics on changes in density.
Measuring Density

- Population density = people/area
- How fast does density fall as we move away from center?
- One measure:
  - Percent of population within x miles
  - How to compare large versus small cities?

Let’s start by measuring changes in population density.

Here note that while percent within X miles is logical, it has the problem of comparing large and small cities. Need a measure that does that. Ask students what they think. Guide towards percent decline in density per mile.
Density Gradient

\[ y = y_0 e^{-\theta u} \]

- \( y \) is people per square mile (density)
- \( y_0 \) is density at CBD
- \( u \) is miles from the CBD
- \( \theta \) is the density gradient
- \( e \) is the exponential function

Here is concept that captures percent decline in density per mile
Understanding the Density Gradient

\[ y = y_0 e^{-\theta u} \]

\[ \frac{dy}{du} = -\theta y_0 e^{-\theta u} \]

\[ \frac{dy}{du} = -\theta y \]

\[ \frac{dy}{du} \frac{1}{y} = -\theta \]

Percentage change in density from moving one mile further out

Theta is coefficient of percent decline. Works for large cities (with high densities at center) and small cities (with low densities)
Picturing the Density Gradient

$y$, people/sq. mile

$u$, miles
from CBD

low $\theta$

high $\theta$
Estimating the Density Gradient

- Start with basic relationship:
  \[ y = y_0 e^{-\theta u} \]

- Then take natural logarithms of both sides
  \[ \ln Y = \ln Y_0 - \theta u \]

- Collect data on \( \ln Y \) and \( u \) for census tracts
Plotting Data

lnY

u
Ask students how many are comfortable with regressions. We'll do more later. Do I need to go over this material?
Four cities are Baltimore, Milwaukee, Philadelphia and Rochester. This is from Mills cited in O'Sullivan.
<table>
<thead>
<tr>
<th>City</th>
<th>1970</th>
<th>1990</th>
</tr>
</thead>
<tbody>
<tr>
<td>New York</td>
<td>0.15</td>
<td>0.14</td>
</tr>
<tr>
<td>Philadelphia</td>
<td>0.14</td>
<td>0.13</td>
</tr>
<tr>
<td>Chicago</td>
<td>0.13</td>
<td>0.10</td>
</tr>
<tr>
<td>Detroit</td>
<td>0.10</td>
<td>0.08</td>
</tr>
<tr>
<td>Atlanta</td>
<td>0.15</td>
<td>0.10</td>
</tr>
<tr>
<td>Dallas</td>
<td>0.12</td>
<td>0.11</td>
</tr>
<tr>
<td>Denver</td>
<td>0.23</td>
<td>0.18</td>
</tr>
<tr>
<td>Los Angeles</td>
<td>0.07</td>
<td>0.06</td>
</tr>
<tr>
<td>San Francisco</td>
<td>0.13</td>
<td>0.14</td>
</tr>
<tr>
<td>Seattle</td>
<td>0.13</td>
<td>0.10</td>
</tr>
</tbody>
</table>

From Stacy, Ross and Usowski, Reg Science & Urban, 1998. Cited in O'Sullivan, 5th edition, Figure 9.3 page 207
Why Have Densities Fallen?

Ask students what they think? Try to guide them towards answers from model: higher income, faster commuting gives access to cheaper land. Then guide them to employment decentralization.
Incentives for Decentralizing Employment

- Housing prices lower as move away from CBD
- Compensate for longer commutes
- Employees in suburban locations can benefit from lower housing prices without commute
- Firms don’t have to pay as much
Reasons Not to Centralize

- Agglomeration economies in center
To Centralize or Not to Centralize

☐ What activities really benefit from central location? Finance
  ▪ Face to face communication important

☐ What activities don’t benefit any longer from central location? Manufacturing
  ▪ Access to ports once important
  ▪ Railroad access also important
  ▪ Access to ring highways now important
The Logic of Subcenters

- Employment concentration, but not in center
- Some benefits of agglomeration without costs
- What types of industries might form subcenters?

Try to get students to think of types of industries appropriate for subcenters. Suppose center has finance. Maybe manufacturing could be a subcenter. Main manufacturer plus parts suppliers. Detroit is good example. LA with airplane industry. How about Hollywood?
Look at Employment in LA

- Guiliano and Small
- Used Journey to Work data for 1980
- 1146 transportation analysis zones (AZs)

AZ are bigger than census tracts. About a thousand acres. 640 acres is a square mile.
Defining Subcenters

- Start with AZ with more than 10 workers per acre
- Add adjoining AZ if also more than 10 workers per acre
- Keep adding
- Group of AZs is a subcenter if employment > 10,000 workers

For acre, think football field
Outer Centers

- No subcenters in Ventura, San Bernardino and Riverside
- Lower minimum to 7,000 workers
- Add an “outer center” in each
  - Oxnard
  - Riverside
  - San Bernardino

When they applied this method, didn’t get any subcenters in Ventura, San Bernardino or Riverside counties.

So, for those counties only, they lowered minimum to 7,000 workers. Picked up one center in each county. Call “outer centers”
Result: 32 employment centers

- 1 center (downtown LA)
- 28 subcenters (>10,000 workers)
- 3 outer centers (<10,000 workers)
1 is downtown LA, 2 is West LA, 3 is Santa Monica, 4 is Hollywood, 5 is LAX
Four largest form arc from Santa Monica to downtown. They call this the Wilshire Corridor.
The top five together they call the Core.
### Five Largest Employment Centers

<table>
<thead>
<tr>
<th>Rank</th>
<th>Location</th>
<th>Employment (1,000’s)</th>
<th>Employ. Density (no/acre)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Downtown LA</td>
<td>469</td>
<td>36</td>
</tr>
<tr>
<td>2</td>
<td>LA West</td>
<td>176</td>
<td>26</td>
</tr>
<tr>
<td>3</td>
<td>Santa Monica</td>
<td>65</td>
<td>17</td>
</tr>
<tr>
<td>4</td>
<td>Hollywood</td>
<td>64</td>
<td>21</td>
</tr>
<tr>
<td>5</td>
<td>LAX</td>
<td>59</td>
<td>17</td>
</tr>
<tr>
<td>Location</td>
<td>Percent of Region Employment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-------------------------------</td>
<td>-----------------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Downtown</td>
<td>10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other core (2-5)</td>
<td>7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other subcenters (5-32)</td>
<td>15</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Not in subcenter</td>
<td>68</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note that downtown is dominant center but almost 68% of employment is not in centers. Think of service industries, schools, etc.
Mean Commuting Distance and Time

<table>
<thead>
<tr>
<th></th>
<th>miles</th>
<th>minutes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Within centers</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Downtown</td>
<td>13.9</td>
<td>29.5</td>
</tr>
<tr>
<td>Other core</td>
<td>11.2</td>
<td>24.8</td>
</tr>
<tr>
<td>Other LA county</td>
<td>13.2</td>
<td>27.2</td>
</tr>
<tr>
<td>Outer counties</td>
<td>8.3</td>
<td>17.2</td>
</tr>
<tr>
<td><strong>Not in centers</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LA county</td>
<td>10.8</td>
<td>22.8</td>
</tr>
<tr>
<td>Orange county</td>
<td>9.9</td>
<td>21.0</td>
</tr>
<tr>
<td>Outer counties</td>
<td>8.8</td>
<td>18.1</td>
</tr>
</tbody>
</table>

If employment very decentralized, don’t expect commuting times to be very different for different subcenters.

But, notice that commuting times and distances are longer for downtown. So, still character of basic model.
Employment Density in Los Angeles-2000
Conclusion

- Modern cities less dense, more spread out
  - Demand for housing is greater
  - Commuting is faster (if highway system capacity OK)
  - Employment spread out
- Centers still dominate (especially if good public transit system)

On last point, note New York, San Francisco, Chicago. Large center city requires lots of employees. If all commute by auto, lots of congestion. Parking space. Need to overcome that.
Many of you have done tables with categorical data. Here are a few examples.
Many more.
Want to talk about tables with categorical data
Here is data from 2000 Census for my neighborhood and for the urban area.

What do you think of that table? How could we make it better?

Two geographies are different sizes so hard to compare. What do we do? Use percentages

<table>
<thead>
<tr>
<th>Owner occupied</th>
<th>Census Tract 1.02</th>
<th>Santa Barbara Urban Area</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>911</td>
<td>36,618</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Renter occupied</th>
<th></th>
<th>35,455</th>
</tr>
</thead>
</table>
Here is percentages. Now easier to compare.

This is true for many other categorical data.
Next Time

The Homevoter Hypothesis

William Fischel
Dartmouth College