Classification of Peer Groups from Cluster Analysis Using IPEDS Data
Presentation Outline

• What are peers and why examine them?

• Relevant previous research

• UH Mānoa example
  • Research Question
  • Methodology
  • Results

• Lessons Learned
What are Peer Institutions?

• Peer – similar role, scope, mission
  - Teeter and Brinkman (2003)

• Other types of comparison groups
  
  • Competitor – students, faculty, finances
  
  • Aspirational – At Mānoa, we call these “benchmark” institutions; those to emulate
  
  • Predetermined
    • Natural – athletic conference, region (WAC)
    • Traditional – historical (Ivy)
    • Jurisdictional – political or legal jurisdiction (state lines)
    • Classification – national reporting (Carnegie)
      - Teeter and Brinkman (2003)
Why Have Peer Institutions?

• Strategic Planning
  • Inform policy
  • Accreditation

• Performance Benchmarking
  • Faculty compensation
  • Teaching loads
  • Tuition schedules
  • Budget alignment
  • Used by other institutions for performance comparison
  • Surveys supply peer lists to prospective students and parents to compare cost and graduation rates
Relevant Previous Research

### Previous UH Mānoa Peer List (Circa 1994)

- Colorado State University at Fort Collins
- Iowa State University at Ames
- Louisiana State University at Baton Rouge
- Oregon State University at Corvallis
- University of California at Davis
- University of Georgia at Athens
- University of Kentucky at Lexington
- University of Missouri at Columbia
- University of North Carolina at Chapel Hill
- University of Tennessee at Knoxville
- University of Utah at Salt Lake City
- University of Virginia at Charlottesville

### Previous UH Mānoa Benchmark List (Circa 1994)

- Indiana University at Bloomington
- Michigan State University at East Lansing
- State University of New York (SUNY) at Buffalo
- University of Arizona at Tucson
- University of California at Berkeley
- University of California at Davis
- University of California at Los Angeles
- University of Colorado at Boulder
- University of Florida at Gainesville
- University of Illinois at Urbana-Champaign
- University of Iowa at Iowa City
- University of Maryland at College Park
- University of Michigan at Ann Arbor
- University of Minnesota at Twin Cities
- University of Missouri at Columbia
- University of Oregon at Eugene
- University of Washington at Seattle
Research Question

What are the 10 (or n) most similar institutions to UH Mānoa?
Step 1: Variable Selection

- Data Collection from IPEDS Executive Peer Tool.
- > 7,000 institutions in IPEDS.
- Over 175 variables to choose from.
- 2010 data used.

Initial Screening of IPEDS Data:

<table>
<thead>
<tr>
<th>Criterion</th>
<th>Count</th>
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</thead>
<tbody>
<tr>
<td># Schools in IPEDS Universe</td>
<td>&gt; 7,000</td>
</tr>
<tr>
<td>Degree granting</td>
<td>4,774</td>
</tr>
<tr>
<td>Public, 4-year</td>
<td>679</td>
</tr>
<tr>
<td>Enrollment Between 10,000 AND Greater than 20,000</td>
<td>274</td>
</tr>
<tr>
<td>Research Universities (very high research activity)</td>
<td>70</td>
</tr>
<tr>
<td>Highest Degree Offered: Doctoral (Research, Scholarship, Prof.)</td>
<td>64</td>
</tr>
</tbody>
</table>

Final = 64 Institutions
Public Institutions to Choose From

Arizona State University  
Colorado State University-Fort Collins  
Florida State University  
Georgia State University  
Indiana University-Bloomington  
Iowa State University  
Louisiana State University and Agricultural & Mechanical College  
Michigan State University  
Mississippi State University  
North Carolina State University at Raleigh  
North Dakota State University-Main Campus  
Ohio State University-Main Campus  
Oregon State University  
Pennsylvania State University-Main Campus  
Purdue University-Main Campus  
Rutgers University-New Brunswick  
Stony Brook University  
Texas A & M University-College Station  
The University of Tennessee  
The University of Texas at Austin  
University at Buffalo  
University of Alabama at Birmingham  
University of Arizona  
University of Arkansas  
University of California-Berkeley  
University of California-Davis  
University of California-Irvine  
University of California-Los Angeles  
University of California-San Diego  
University of Central Florida  
University of Cincinnati-Main Campus  
University of Colorado Boulder  
University of Connecticut  
University of Delaware  
University of Florida  
University of Georgia  
University of Hawai'i at Manoa  
University of Houston  
University of Illinois at Chicago  
University of Illinois at Urbana-Champaign  
University of Iowa  
University of Kansas  
University of Kentucky  
University of Louisiana  
University of Maryland-College Park  
University of Michigan-Ann Arbor  
University of Minnesota-Twin Cities  
University of Missouri-Columbia  
University of Nebraska-Lincoln  
University of New Mexico-Main Campus  
University of North Carolina at Chapel Hill  
University of Oklahoma Norman Campus  
University of Oregon  
University of Pittsburgh-Pittsburgh Campus  
University of South Carolina-Columbia  
University of South Florida-Main Campus  
University of Utah  
University of Virginia-Main Campus  
University of Washington-Seattle Campus  
University of Wisconsin-Madison  
Virginia Commonwealth University  
Virginia Polytechnic Institute and State University  
Washington State University  
Wayne State University

n=64
Variable Selection

Eight IPEDS variables related to student characteristics initially chosen based on campus input:

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Transfer-in undergraduate enrollment</td>
</tr>
<tr>
<td>2</td>
<td>SAT critical reading 25th percentile score of first-time undergraduates</td>
</tr>
<tr>
<td>3</td>
<td>SAT critical reading 75th percentile score of first-time undergraduates</td>
</tr>
<tr>
<td>4</td>
<td>Number of doctor's degrees awarded</td>
</tr>
<tr>
<td>5</td>
<td>Revenues from tuition and fees per FTE enrollment</td>
</tr>
<tr>
<td>6</td>
<td>Graduation rate, overall, first-time full-time undergraduates</td>
</tr>
<tr>
<td>7</td>
<td>SAT Math 75th percentile score of first-time undergraduates</td>
</tr>
<tr>
<td>8</td>
<td>Retention rate, first-time full-time undergraduates</td>
</tr>
</tbody>
</table>
Data Preprocessing

- Considering Reliability & Validity of Data
- Standardization
- Address Outliers & Missing Data
- Descriptive Statistics
- Dimension Reduction
Step 2: Choosing a Methodology

- Criteria:
  - Relation to institution’s strategic planning priorities.
  - Flexible and easy to update.
  - Provides opportunity for campus input.

Quantitative Methodology

• Cluster Analysis
  - Exploratory technique used to classify a set of institutions into groups that are similar in some sense
  - The most commonly used quantitative method in peer selection
  - Several types of cluster analyses: agglomerative, 2-step sequential, and k-means.

• Supporting Methods to Cluster Analysis:
  - Factor Analysis
    - Can be used to reduce IPEDS variables into dimensions
  - Discriminant Analysis
    - Can be used to assess adequacy of classification in clustering
Agglomerative Clustering Example
**Data Management Tasks**

- Choose clustering procedure
  - Hierarchical Agglomerative Clustering
  - 2-step sequential
  - K-means

- Choose method for forming groups
  - Between-Groups Linkage
  - Within-Groups Linkage
  - Nearest Neighbor

- Choose statistic to measure distance
  - Standard Euclidian Distance
  - Correlation
  - Cosine
## Cluster Membership

Based on results, determined 6 clusters was sufficient

<table>
<thead>
<tr>
<th>Cluster Group 1</th>
<th>Cluster Group 2</th>
<th>Cluster Group 3</th>
<th>Cluster Group 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arizona State University</td>
<td>University of Central Florida</td>
<td>Florida State University</td>
<td>Ohio State University-Main Campus</td>
</tr>
<tr>
<td>University of Hawaii at Manoa</td>
<td></td>
<td>Indiana University-Bloomington</td>
<td>The University of Texas at Austin</td>
</tr>
<tr>
<td>University of Illinois at Chicago</td>
<td></td>
<td>Iowa State University</td>
<td>University of California-Berkeley</td>
</tr>
<tr>
<td>Georgia State University</td>
<td>University of Missouri-Columbia</td>
<td>Louisiana State University</td>
<td>University of California-Los Angeles</td>
</tr>
<tr>
<td>Mississippi State University</td>
<td>Michigan State University</td>
<td>North Carolina State University at Raleigh</td>
<td>University of California-San Diego</td>
</tr>
<tr>
<td>North Dakota State University</td>
<td>Purdue University-Main Campus</td>
<td>Michigan State University</td>
<td>University of Florida</td>
</tr>
<tr>
<td>Oregon State University</td>
<td>Rutgers University-New Brunswick</td>
<td>Stony Brook University</td>
<td>University of Illinois at Urbana-Champaign</td>
</tr>
<tr>
<td>University of Arizona</td>
<td>Texas A &amp; M University-College Station</td>
<td>The University of Tennessee</td>
<td>University of Maryland-College Park</td>
</tr>
<tr>
<td>University of Arkansas</td>
<td></td>
<td>University at Buffalo</td>
<td>University of Michigan-Ann Arbor</td>
</tr>
<tr>
<td>University of Cincinnati-Main Campus</td>
<td></td>
<td>University of California-Davis</td>
<td>University of Minnesota-Minneapolis</td>
</tr>
<tr>
<td>University of Hawaii at Manoa</td>
<td></td>
<td>University of California-Irvine</td>
<td>University of North Carolina at Chapel Hill</td>
</tr>
<tr>
<td>Arizona State University</td>
<td>University of Hawaii at Manoa</td>
<td>University of Colorado Boulder</td>
<td>University of Virginia-Main Campus</td>
</tr>
<tr>
<td>University of Hawaii at Manoa</td>
<td></td>
<td>University of Colorado Boulder</td>
<td>University of Washington-Seattle Campus</td>
</tr>
<tr>
<td>University of Illinois at Chicago</td>
<td></td>
<td>University of Colorado Boulder</td>
<td>University of Wisconsin-Madison</td>
</tr>
<tr>
<td>Georgia State University</td>
<td>University of Missouri-Columbia</td>
<td>University of Georgia</td>
<td>Insufficient Data</td>
</tr>
<tr>
<td>University of Hawaii at Manoa</td>
<td>University of Michigan-Ann Arbor</td>
<td>University of Iowa</td>
<td>University of Kansas</td>
</tr>
<tr>
<td>University of Hawaii at Manoa</td>
<td></td>
<td>University of Michigan-Ann Arbor</td>
<td>Wayne State University</td>
</tr>
<tr>
<td>University of Missouri-Columbia</td>
<td>University of Nebraska-Lincoln</td>
<td>University of Oklahoma Norman Campus</td>
<td></td>
</tr>
<tr>
<td>University of Oklahoma Norman Campus</td>
<td>University of Oklahoma Norman Campus</td>
<td>University of Pittsburgh-Pittsburgh Campus</td>
<td></td>
</tr>
<tr>
<td>University of South Carolina-Columbia</td>
<td>University of Pittsburgh-Pittsburgh Campus</td>
<td>University of South Carolina-Columbia</td>
<td></td>
</tr>
<tr>
<td>Virginia Commonwealth University</td>
<td>University of South Carolina-Columbia</td>
<td>Virginia Polytechnic Institute and State University</td>
<td></td>
</tr>
<tr>
<td>Washington State University</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Step 3: Data Analysis
### Number of clusters

<table>
<thead>
<tr>
<th>Cluster</th>
<th>University Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Colorado State University</td>
</tr>
<tr>
<td>2</td>
<td>Louisiana State University and Agricultural &amp; Mechanical College</td>
</tr>
<tr>
<td>3</td>
<td>Iowa State University</td>
</tr>
<tr>
<td>4</td>
<td>University of Nebraska-Lincoln</td>
</tr>
<tr>
<td>5</td>
<td>Stony Brook University</td>
</tr>
<tr>
<td>6</td>
<td>University of New Mexico-Main Campus</td>
</tr>
<tr>
<td>7</td>
<td>University of North Carolina at Chapel Hill</td>
</tr>
<tr>
<td>8</td>
<td>Georgia Institute of Technology-Main Campus</td>
</tr>
<tr>
<td>9</td>
<td>SUNY at Albany</td>
</tr>
<tr>
<td>10</td>
<td>University of Tennessee</td>
</tr>
<tr>
<td>11</td>
<td>University of Illinois at Harrisburg</td>
</tr>
<tr>
<td>12</td>
<td>University of Alabama at Birmingham</td>
</tr>
<tr>
<td>13</td>
<td>University of Cincinnati-Main Campus</td>
</tr>
<tr>
<td>14</td>
<td>University of Denver</td>
</tr>
<tr>
<td>15</td>
<td>University of Tennessee</td>
</tr>
<tr>
<td>16</td>
<td>University of Tennessee</td>
</tr>
<tr>
<td>17</td>
<td>University of North Carolina at Mansfield</td>
</tr>
<tr>
<td>18</td>
<td>University of Chicago</td>
</tr>
<tr>
<td>19</td>
<td>University of Tennessee</td>
</tr>
<tr>
<td>20</td>
<td>University of Tennessee</td>
</tr>
<tr>
<td>21</td>
<td>University of Missouri-Columbia</td>
</tr>
<tr>
<td>22</td>
<td>University of Minnesota-Columbia</td>
</tr>
<tr>
<td>23</td>
<td>University of Minnesota-Columbia</td>
</tr>
<tr>
<td>24</td>
<td>University of Denver</td>
</tr>
<tr>
<td>25</td>
<td>University of North Carolina at Raleigh</td>
</tr>
<tr>
<td>26</td>
<td>University of Virginia-Main Campus</td>
</tr>
</tbody>
</table>

### Data Analysis

- **ICICLE PLOT**
- **Proximity Matrix**
- **Agglomeration Schedule**
Discriminant Analysis

X Axis Factors: SAT Scores, Graduation Rate, Retention Rate, Revenues from Tuition and Fees

Y Axis Factors: Transfer-In Undergraduate Enrollment, Doctoral degrees awarded

Average Linkage (Between Groups)
Discriminant Analysis

X Axis Factors: SAT Scores, Graduation Rate, Retention Rate, Revenues from Tuition and Fees

Y Axis Factors: Transfer-In Undergraduate Enrollment, Doctoral degrees awarded
Group Membership

Most similar on student characteristics:

- Colorado State University
- Georgia State University
- Mississippi State University
- North Dakota State University
- Oregon State University
- University of Arizona
- University of Arkansas
- University of Cincinnati
- University of Hawaii at Manoa
- University of Houston
- University of Illinois at Chicago
- University of Kentucky
- University of Louisville
- University of New Mexico
- University of Oregon
- University of South Florida
- University of Utah
- Virginia Commonwealth U.
- Washington State University

n=19
Clustering by Research

- Repeat process for Mānoa’s Cluster (Green Group), Benchmarks (Orange Group), and High Benchmarks (Blue Group).

- 4 IPEDS variables related to research selected:

  1. Government grants and contracts as a percent of total core revenues
  2. Revenues from government grants and contracts per FTE enrollment
  3. Research expenses per FTE student
  4. Research expenses as percent of total core expenses

- Based on results, 5 clusters appropriate.
Plotting Research

**X Axis Factors:** Research Expenses

**Y Axis Factors:** Research Revenues

- North Carolina
- Washington
- UCLA
- UC Berkeley
- UC San Diego
- UC Davis
- Pittsburgh
- Wisconsin

- **n=16**
- **n=32**
- **n=8**

**Average Linkage (Between Groups):**
- 1
- 2
- 3
- 4
- 5
# Research Clusters

## Cluster Group 1
- Colorado State University-Fort Collins
- Louisiana State University and Agricultural & Mechanical
- Mississippi State University
- North Dakota State University-Main Campus
- Oregon State University
- University of Arizona
- University of Colorado Boulder
- University of Florida
- University of Georgia
- University of Iowa
- University of Maryland-College Park
- University of Michigan-Ann Arbor
- University of Minnesota-Twin Cities
- University of South Florida-Main Campus
- University of Virginia-Main Campus
- Virginia Polytechnic Institute and State University

## Cluster Group 2
- Florida State University
- Georgia State University
- Iowa State University
- Michigan State University
- North Carolina State University at Raleigh
- Ohio State University-Main Campus
- Purdue University-Main Campus
- Rutgers University-New Brunswick
- Stony Brook University

## Cluster Group 3 (continued)
- Texas A & M University-College Station
- The University of Tennessee
- The University of Texas at Austin
- University at Buffalo
- University of Arkansas
- University of California-Irvine
- University of Cincinnati-Main Campus
- University of Connecticut
- University of Delaware
- University of Houston
- University of Illinois at Chicago
- University of Illinois at Urbana-Champaign
- University of Kentucky
- University of Louisville
- University of Missouri-Columbia
- University of Nebraska-Lincoln
- University of New Mexico-Main Campus
- University of Oklahoma Norman Campus
- University of Oregon
- University of South Carolina-Columbia
- University of Utah
- Virginia Commonwealth University
- Washington State University

## Cluster Group 4
- Indiana University-Bloomington
- University of California-Berkeley
- University of California-Davis
- University of California-Los Angeles
- University of California-San Diego
- University of Hawaii at Manoa
- University of North Carolina at Chapel Hill
- University of Pittsburgh-Pittsburgh
- University of Washington-Seattle Campus

## Cluster Group 5
- University of Wisconsin-Madison

## Cluster Group Excluded
- Arizona State University
- Pennsylvania State University-Main Campus
- University of Alabama at Birmingham
- University of Central Florida
- University of Kansas
- Wayne State University
Campus Discussion

• Clustering on research alone shows that Mānoa stands out

• Combine Research + Student Characteristics

• Use a rank order approach

• Research variables equally weighted
## Rank Order

<table>
<thead>
<tr>
<th>Institution Name</th>
<th>Gov funds per total revenues</th>
<th>Gov funds per FTE enrollment</th>
<th>Research expenses per FTE student</th>
<th>Research expenses per total expenses</th>
<th>Avg. Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>University of Hawaii at Manoa</td>
<td>47%</td>
<td>58</td>
<td>53</td>
<td>54</td>
<td>57</td>
</tr>
<tr>
<td>Names removed</td>
<td>31%</td>
<td>47</td>
<td>42</td>
<td>45</td>
<td>53</td>
</tr>
<tr>
<td></td>
<td>33%</td>
<td>48</td>
<td>34</td>
<td>41</td>
<td>54</td>
</tr>
<tr>
<td></td>
<td>27%</td>
<td>39</td>
<td>48</td>
<td>43</td>
<td>25</td>
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<td>37%</td>
<td>53</td>
<td>33</td>
<td>26</td>
<td>41</td>
</tr>
<tr>
<td>Mississippi State University</td>
<td>33%</td>
<td>48</td>
<td>47</td>
<td>54</td>
<td>38.3</td>
</tr>
<tr>
<td>University of Kentucky</td>
<td>27%</td>
<td>39</td>
<td>33</td>
<td>26</td>
<td>38.8</td>
</tr>
<tr>
<td>Colorado State University at Fort Collins</td>
<td>37%</td>
<td>53</td>
<td>33</td>
<td>26</td>
<td>38.3</td>
</tr>
<tr>
<td>[..]</td>
<td>38%</td>
<td>54</td>
<td>56</td>
<td>56</td>
<td>55</td>
</tr>
<tr>
<td>University of Pittsburgh ‐ Pittsburgh</td>
<td>39%</td>
<td>55</td>
<td>55</td>
<td>52</td>
<td>51</td>
</tr>
<tr>
<td>University of California at Davis</td>
<td>34%</td>
<td>51</td>
<td>52</td>
<td>53</td>
<td>51</td>
</tr>
<tr>
<td>University of Iowa</td>
<td>29%</td>
<td>42</td>
<td>47</td>
<td>47</td>
<td>46</td>
</tr>
<tr>
<td>University of Colorado at Boulder</td>
<td>36%</td>
<td>52</td>
<td>38</td>
<td>27</td>
<td>37</td>
</tr>
<tr>
<td>University of California at San Diego</td>
<td>27%</td>
<td>37</td>
<td>36</td>
<td>26</td>
<td>31</td>
</tr>
<tr>
<td>[..]</td>
<td>45%</td>
<td>57</td>
<td>58</td>
<td>58</td>
<td>56</td>
</tr>
<tr>
<td>University of Washington at Seattle</td>
<td>39%</td>
<td>55</td>
<td>55</td>
<td>52</td>
<td>47</td>
</tr>
<tr>
<td>University of North Carolina at Chapel Hill</td>
<td>41%</td>
<td>56</td>
<td>57</td>
<td>50</td>
<td>36</td>
</tr>
<tr>
<td>University of California at Berkeley</td>
<td>34%</td>
<td>50</td>
<td>51</td>
<td>49</td>
<td>49</td>
</tr>
<tr>
<td>University of Wisconsin at Madison</td>
<td>25%</td>
<td>30</td>
<td>49</td>
<td>57</td>
<td>58</td>
</tr>
</tbody>
</table>

**Notes:** all figures are from fiscal year 2010.
“gov funds” refers to government grants and contracts
## Final Peer Group

<table>
<thead>
<tr>
<th>Previous Peer Group</th>
<th>New Peer Group*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colorado State University</td>
<td>Colorado State University</td>
</tr>
<tr>
<td>Iowa State University</td>
<td>Mississippi State University</td>
</tr>
<tr>
<td>Louisiana State University</td>
<td>Oregon State University</td>
</tr>
<tr>
<td>Oregon State University</td>
<td>University of Arizona</td>
</tr>
<tr>
<td>University of California at Davis</td>
<td>University of Illinois at Chicago</td>
</tr>
<tr>
<td>University of Georgia</td>
<td>University of Kentucky</td>
</tr>
<tr>
<td>University of Kentucky</td>
<td>University of New Mexico</td>
</tr>
<tr>
<td>University of Missouri</td>
<td>University of South Florida</td>
</tr>
<tr>
<td>University of North Carolina</td>
<td>University of Utah</td>
</tr>
<tr>
<td>University of Tennessee</td>
<td></td>
</tr>
<tr>
<td>University of Utah</td>
<td></td>
</tr>
<tr>
<td>University of Virginia</td>
<td></td>
</tr>
</tbody>
</table>

*Approved Spring 2012

B Previously was Mānoa Benchmark

P Previously was Mānoa Peer

AAU Member of AAU
### Previous Benchmark Group

- Indiana University at Bloomington
- Michigan State University
- State University of New York (SUNY) at Buffalo
- University of Arizona
- University of California at Berkeley
- University of California at Davis
- University of California at Los Angeles
- University of Colorado at Boulder
- University of Florida
- University of Illinois at Urbana-Champaign
- University of Iowa
- University of Maryland at College Park
- University of Michigan at Ann Arbor
- University of Minnesota at Twin Cities
- University of Missouri at Columbia
- University of Oregon
- University of Washington at Seattle

### New Benchmark Group*  

<table>
<thead>
<tr>
<th>University of California at Davis</th>
<th>B,P,AAU</th>
</tr>
</thead>
<tbody>
<tr>
<td>University of California at Irvine</td>
<td>AAU</td>
</tr>
<tr>
<td>University of Colorado Boulder</td>
<td>B,AAU</td>
</tr>
<tr>
<td>University of Iowa</td>
<td>B,AAU</td>
</tr>
<tr>
<td>University of Pittsburgh-Pittsburgh Campus</td>
<td>AAU</td>
</tr>
<tr>
<td>University of Tennessee</td>
<td>P</td>
</tr>
</tbody>
</table>

*Approved Spring 2012

B Previously was Mānoa Benchmark

P Previously was Mānoa Peer

AAU Member of AAU
Lessons Learned

- The role of institutional research
  - Provide analytical support
  - Formative collaboration with campus groups
  - Exploratory and iterative process
  - Clear, simple methodology
  - Flexible, easy to update
  - Focus on key variables
Questions

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