Classification of Peer Groups from Cluster Analysis Using IPEDS Data

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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

<table>
<thead>
<tr>
<th>PREVIOUS UH MANOA PEER LIST (Circa 1994)</th>
<th>PREVIOUS UH MANOA BENCHMARK LIST (Circa 1994)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colorado State University at Fort Collins</td>
<td>Indiana University at Bloomington</td>
</tr>
<tr>
<td>Iowa State University at Ames</td>
<td>Michigan State University at East Lansing</td>
</tr>
<tr>
<td>Louisiana State University at Baton Rouge</td>
<td>State University of New York (SUNY) at Buffalo</td>
</tr>
<tr>
<td>Oregon State University at Corvallis</td>
<td>University of Arizona at Tucson</td>
</tr>
<tr>
<td>University of California at Davis</td>
<td>University of California at Berkeley</td>
</tr>
<tr>
<td>University of Georgia at Athens</td>
<td>University of California at Davis</td>
</tr>
<tr>
<td>University of Kentucky at Lexington</td>
<td>University of California at Los Angeles</td>
</tr>
<tr>
<td>University of Missouri at Columbia</td>
<td>University of Colorado at Boulder</td>
</tr>
<tr>
<td>University of North Carolina at Chapel Hill</td>
<td>University of Florida at Gainesville</td>
</tr>
<tr>
<td>University of Tennessee at Knoxville</td>
<td>University of Illinois at Urbana-Champaign</td>
</tr>
<tr>
<td>University of Utah at Salt Lake City</td>
<td>University of Iowa at Iowa City</td>
</tr>
<tr>
<td>University of Virginia at Charlottesville</td>
<td>University of Maryland at College Park</td>
</tr>
</tbody>
</table>

| University of Michigan at Ann Arbor     | University of Michigan at Ann Arbor |
| University of Minnesota at Twin Cities  | University of Minnesota at Twin Cities |
| University of Missouri at Columbia      | University of Missouri at Columbia |
| University of Oregon at Eugene          | University of Oregon at Eugene |
| University of Washington at Seattle     | 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>Category</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td># Schools in IPEDS Universe</td>
<td>&gt; 7,000</td>
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<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 Louisville
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:

1. Transfer-in undergraduate enrollment
2. SAT critical reading 25th percentile score of first-time undergraduates
3. SAT critical reading 75th percentile score of first-time undergraduates
4. Number of doctor's degrees awarded
5. Revenues from tuition and fees per FTE enrollment
6. Graduation rate, overall, first-time full-time undergraduates
7. SAT Math 75th percentile score of first-time undergraduates
8. Retention rate, first-time full-time undergraduates
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

1. LSU
2. UNM
3. LSU
4. UNM
5. LSU
6. UNM
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>Colorado State University-Fort Collins</td>
<td>Florida State University</td>
<td>Ohio State University-Main Campus</td>
</tr>
<tr>
<td>University of Central Florida</td>
<td>Georgia State University</td>
<td>Indiana University-Bloomington</td>
<td>The University of Texas at Austin</td>
</tr>
<tr>
<td>Mississippi State University</td>
<td>Iowa State University</td>
<td>Louisiana State University</td>
<td>University of California-Berkeley</td>
</tr>
<tr>
<td>North Dakota State University</td>
<td>Michigan State University</td>
<td>North Carolina State University</td>
<td>University of California-Los Angeles</td>
</tr>
<tr>
<td>Oregon State University</td>
<td>Purdue University-Main Campus</td>
<td>Ohio State University</td>
<td>University of California-San Diego</td>
</tr>
<tr>
<td>University of Arizona</td>
<td>Rutgers University-New Brunswick</td>
<td>Stony Brook University</td>
<td>University of Florida</td>
</tr>
<tr>
<td>University of Arkansas</td>
<td>The University of Tennessee</td>
<td>Texas A &amp; M University-College Station</td>
<td>University of Illinois at Urbana-Champaign</td>
</tr>
<tr>
<td>University of Cincinnati-Main Campus</td>
<td></td>
<td></td>
<td>University of Maryland-College Park</td>
</tr>
<tr>
<td>University of Hawaii at Manoa</td>
<td></td>
<td></td>
<td>University of Michigan-Ann Arbor</td>
</tr>
<tr>
<td>University of Houston</td>
<td></td>
<td></td>
<td>University of Minnesota-Twin Cities</td>
</tr>
<tr>
<td>University of Illinois at Chicago</td>
<td></td>
<td></td>
<td>University of North Carolina at Chapel Hill</td>
</tr>
<tr>
<td>University of Kentucky</td>
<td></td>
<td></td>
<td>University of Virginia-Main Campus</td>
</tr>
<tr>
<td>University of Louisville</td>
<td></td>
<td></td>
<td>University of Washington-Seattle Campus</td>
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<td>University of New Mexico</td>
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<tr>
<td>University of South Florida</td>
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<td>Pennslyvania State University</td>
</tr>
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<td>University of Utah</td>
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<tr>
<td>Virginia Commonwealth University</td>
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<tr>
<td>Washington State University</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Cluster Group 5</th>
<th>Cluster Group 6</th>
</tr>
</thead>
<tbody>
<tr>
<td>University of Alabama at Birmingham</td>
<td>Insufficient Data</td>
</tr>
<tr>
<td>University of Kansas</td>
<td>Wayne State University</td>
</tr>
</tbody>
</table>
Step 3: Data Analysis

DENDOGRAM

North Carolina State University at Raleigh
Virginia Polytechnic Institute and State University
University of Nebraska-Lincoln

University of Michigan
University of Minnesota
University of Wisconsin-Madison

University of California-Berkeley
University of California at Los Angeles
University of California at Santa Barbara

Georgia Institute of Technology-Main Campus
Data Analysis

- 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

MANOA
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)
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

n=32

n=16

n=8

North Carolina

Washington

UC San Diego

UC Davis

Pittsburgh

UC Berkeley

UCLA

MANOA

Wisconsin

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 2 (continued)
- 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 3
- Indiana University-Bloomington

### Cluster Group 4
- University of Michigan-Ann Arbor
- University of Minnesota-Twin Cities
- University of Oregon
- University of South Carolina-Columbia
- University of Utah
- Virginia Commonwealth University
- Washington State University

### 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>Rank 1</th>
<th>Gov funds per FTE enrollment</th>
<th>Rank 2</th>
<th>Research expenses per FTE student</th>
<th>Rank 3</th>
<th>Research expenses per total expenses</th>
<th>Rank 4</th>
<th>Avg. Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>University of Hawaii at Manoa</td>
<td>47%</td>
<td>58</td>
<td>$22,740</td>
<td>53</td>
<td>$19,051</td>
<td>54</td>
<td>41%</td>
<td>57</td>
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<tr>
<td>Names removed</td>
<td>31%</td>
<td>47</td>
<td>$12,002</td>
<td>42</td>
<td>$12,255</td>
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<td>36%</td>
<td>53</td>
<td>46.8</td>
</tr>
<tr>
<td>Mississippi State University</td>
<td>33%</td>
<td>48</td>
<td>$10,802</td>
<td>34</td>
<td>$11,458</td>
<td>41</td>
<td>37%</td>
<td>54</td>
<td>44.3</td>
</tr>
<tr>
<td>University of Kentucky</td>
<td>27%</td>
<td>39</td>
<td>$15,229</td>
<td>48</td>
<td>$11,928</td>
<td>43</td>
<td>24%</td>
<td>25</td>
<td>38.8</td>
</tr>
<tr>
<td>University of Pittsburgh‐Pittsburgh</td>
<td>37%</td>
<td>53</td>
<td>$10,414</td>
<td>33</td>
<td>$8,104</td>
<td>26</td>
<td>31%</td>
<td>41</td>
<td>38.3</td>
</tr>
<tr>
<td>University of California at Davis</td>
<td>38%</td>
<td>54</td>
<td>$24,461</td>
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<tr>
<td>University of Iowa</td>
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<td>51</td>
<td>$20,156</td>
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</tr>
<tr>
<td>University of Colorado at Boulder</td>
<td>29%</td>
<td>42</td>
<td>$13,940</td>
<td>47</td>
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<td>32%</td>
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<td>45.5</td>
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<tr>
<td>University of North Carolina at Chapel Hill</td>
<td>36%</td>
<td>52</td>
<td>$11,495</td>
<td>38</td>
<td>$8,125</td>
<td>27</td>
<td>29%</td>
<td>37</td>
<td>38.5</td>
</tr>
<tr>
<td>University of California at Irvine</td>
<td>27%</td>
<td>37</td>
<td>$11,419</td>
<td>36</td>
<td>$9,772</td>
<td>36</td>
<td>26%</td>
<td>31</td>
<td>35.0</td>
</tr>
<tr>
<td>University of Washington at Seattle</td>
<td>45%</td>
<td>57</td>
<td>$30,123</td>
<td>58</td>
<td>$24,558</td>
<td>58</td>
<td>40%</td>
<td>56</td>
<td>57.3</td>
</tr>
<tr>
<td>University of Wisconsin at Madison</td>
<td>39%</td>
<td>55</td>
<td>$24,168</td>
<td>55</td>
<td>$17,662</td>
<td>52</td>
<td>32%</td>
<td>47</td>
<td>52.3</td>
</tr>
<tr>
<td>University of California at San Diego</td>
<td>41%</td>
<td>56</td>
<td>$29,017</td>
<td>57</td>
<td>$16,067</td>
<td>50</td>
<td>28%</td>
<td>36</td>
<td>49.8</td>
</tr>
<tr>
<td>University of California at Berkeley</td>
<td>34%</td>
<td>50</td>
<td>$18,233</td>
<td>51</td>
<td>$15,192</td>
<td>49</td>
<td>33%</td>
<td>49</td>
<td>49.8</td>
</tr>
<tr>
<td>University of California at San Diego</td>
<td>25%</td>
<td>30</td>
<td>$15,286</td>
<td>49</td>
<td>$23,322</td>
<td>57</td>
<td>41%</td>
<td>58</td>
<td>48.5</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
## Final Benchmark Group

### Previous Benchmark Group

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

### New Benchmark Group*

<table>
<thead>
<tr>
<th>University</th>
</tr>
</thead>
<tbody>
<tr>
<td>University of California at Davis B,AAU</td>
</tr>
<tr>
<td>University of California at Irvine AAU</td>
</tr>
<tr>
<td>University of Colorado Boulder B,AAU</td>
</tr>
<tr>
<td>University of Iowa B,AAU</td>
</tr>
<tr>
<td>University of Pittsburgh-Pittsburgh Campus AAU</td>
</tr>
<tr>
<td>University of Tennessee P</td>
</tr>
<tr>
<td>University of California at San Diego AAU</td>
</tr>
<tr>
<td>University of North Carolina at Chapel Hill P, AAU</td>
</tr>
<tr>
<td>University of Washington at Seattle Campus B,AAU</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

John Stanley
Institutional Analyst
University of Hawaii at Mānoa
Mānoa Institutional Research Office
jstanley@hawaii.edu
808-956-5366

Link to presentation: