Advanced Modeling Techniques for Benchmarked Data

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Presentation Overview

- Delaware Cost Study Overview
- Cost 2013: Update and Participation
- Best Practices: Description, Prediction, Projection
- Cost 2014: New Initiatives and Future Directions
- Comments and Questions
Continuous Improvement: Why Benchmark?

• The most integrated data system offers only clear insights into your institution (Case Study).

• Highly effective institutions engage in comprehensive benchmarking processes.

• *Internal benchmarking* refers to measuring similar operations, functions, or activities *within* the same unit or organization.

• *External benchmarking* refers to measuring similar operations, functions, or activities *outside* the same unit or organization.
What is the Delaware Cost Study?

• The National Study of Instructional Costs and Productivity (Delaware Cost Study) is a benchmarking project and data sharing consortia among four-year colleges and universities with over 200 institutions participating annually.

• Since 1996, over 600 institutions have participated, and over the past two decades, the Delaware Cost Study has become the “tool of choice” for comparative analysis of faculty teaching loads, direct instructional costs, and separately budgeted scholarly activity, within academic disciplines.

• Currently, the Cost Study is used major data and state agencies including:
  – Association of American Universities Data Exchange (AAUDE)
  – Southern Universities Group (SUG)
  – University of North Carolina (UNC) System
  – Pennsylvania State System of Higher Education (PaSSHE)
  – University of Missouri System
  – University of Nebraska System
  – Connecticut State University System (CSUS)
  – City University of New York (CUNY) System
Delaware Cost Study – Strengths and Limitations

• Strengths
  – Ideal tool for benchmarking instructional costs, research, and public service expenditures at the academic discipline level
  – Most systematic and rigorous conceptualization based on CIP levels
  – Assists institutional data and unit alignment
  – Assists in identifying cost distortions
  – Ideal for program reviews and accreditation
  – Ideal for establishing new program or department projections
  – Higher Education Consortia is a useful intermediary partner

• Limitations
  – Not a “whole cost” benchmarking tool for expenditure or tuition
  – Not a perfect 1:1 Program/Department/Academic Budget Unit match
  – Not a tool for performance funding
# Data Checklist for the Delaware Cost Study

"Who is teaching what to whom, and at what cost?"

**Unit of Analysis:** Academic Budget Units as identified by Classification of Instructional Programs (CIP) Code.

**Method:** Origin of Instructor - Instructional activity stays with the FTE instructor within unit where they are funded ("follow the money").

<table>
<thead>
<tr>
<th>Degree Data</th>
<th>HR Data</th>
<th>Course Data - by Course Section/Component</th>
<th>Finance Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Average of Three Prior Years</td>
<td>- Fall Census Data</td>
<td>- Detailed Analysis for Fall Term</td>
<td>- Fiscal Year data</td>
</tr>
<tr>
<td>Academic Budget Unit ID</td>
<td>Academic Budget Unit ID Funding Instructor</td>
<td>Academic Budget Unit ID</td>
<td>Academic Budget Unit ID</td>
</tr>
<tr>
<td>Completion Term or Date</td>
<td>Date (to be able to match to the Course Data Term)</td>
<td>Term Date</td>
<td>Fiscal Year</td>
</tr>
</tbody>
</table>

**Degree Major:**
- Bachelor's
- Master's
- Doctorate
- Professional

**Degree Type (i.e. Major, Minor, Certificate):**
- Total FTE
- Instructional FTE
- Separately Budgeted FTE
- Tenure Status
- Personnel Classification (Faculty, Director, TA)
- Other Contract type (Supplemental)
- Funding Source (i.e. Account)
- Funding Source Academic Budget Unit ID (If different from regular funding)
- Instructor Status (i.e. Active, Leave with Pay)

**IS TEACHING WHAT TO WHOM:**
- Instructor of Record Name/Identification
- Workload for Course
- Course Name/Number
- Course Level (Lower UG, Upper UG, Graduate)
- Course Component(s)/Type (Lec/Lab/Indiv Instruction)
- Day/Time of Meeting
- Credit Value of Course
- Number of Students Enrolled

**AND AT WHAT COST?**
- Accounting Period
- Funding Source (i.e. Account)
- Direct Instructional Expenditures (Includes Unit Research)
- Salaries
- Benefits
- Other than Personnel Expenditures
- Direct Expenditures for Separately Budgeted Research
- Direct Expenditures for Separately Budgeted Public Service
Growing the Delaware Cost Study

Institutional Participation, 2005 - 2013

- Institutional Participation
- Participation Trendline
Delaware Cost Study Representation

Delaware Cost Study Participation by Carnegie Classification Relative to Carnegie Classification Overall

- **2013 Delaware Cost Study (n=218)**
  - Baccalaureate: 12.4%
  - Master's: 31.7%
  - Doctoral: 7.3%
  - Research Intensive: 48.6%

- **All-Time Delaware Cost Study (n=600)**
  - Baccalaureate: 20.5%
  - Master's: 25.3%
  - Doctoral: 5.7%
  - Research Intensive: 48.5%

- **Carnegie Classification (n=1,608)**
  - Baccalaureate: 41.7%
  - Master's: 40.5%
  - Doctoral: 12.9%
  - Research Intensive: 4.9%
Why do institutions participate in the Delaware Cost Study?

- According to the National Center for Education Statistics, 76 – 82 percent of the variation in cost is located at the academic disciplinary level.
Delaware Cost Study Data Uses

- Academic/Accreditation Program Review
- Faculty Hiring/Disparity
- Chair Key Performance Indicators
- Deans Dashboard
- Senior Budgeting/President/Provost Planning/Projections
- Identifying Cost Distortions in Budgeting Formulas
- Developing New Programs/Departments Grants
- and Research Expenditure Benchmarking
- External Audit/System Review Tool
- Student/Faculty Recruitment/Retention Tool
- General Unit and Institutional Improvement
Getting the Most from Delaware Cost Study Data

- Description
- Prediction
- Projection
### Assessing Student Credit Hour Production and Direct Instructional Expenditure

<table>
<thead>
<tr>
<th>Student Credit Hours per FTE Faculty as Percentage of Carnegie Classification</th>
<th>Low</th>
<th>Moderate</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td></td>
<td>Theater</td>
<td>Physics, Chemical Engineering</td>
</tr>
<tr>
<td>Moderate</td>
<td>Criminal Justice, Political Science</td>
<td>Biology, Music</td>
<td>Chemistry</td>
</tr>
<tr>
<td>High</td>
<td>Communication, English, History, Psychology, Sociology</td>
<td>Mathematics</td>
<td></td>
</tr>
</tbody>
</table>
Benchmarking Instructional Activity – Psychology

Undergraduate Student Credit Hour Share by Faculty Rank relative to Carnegie Classification
Key Performance Indicators by Carnegie Classification
Benchmarking Unit Activity by Carnegie Classification

<table>
<thead>
<tr>
<th>University College + Discipline</th>
<th>CIP</th>
<th>Total FTE Faculty</th>
<th>FTE Students Taught Per FTE Instructional Faculty</th>
<th>INSTRUCTIONAL EXPENDITURES PER FTE STUDENT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>University</td>
<td>Peer Avg</td>
<td>University</td>
</tr>
<tr>
<td></td>
<td></td>
<td>as Pct of Peer</td>
<td></td>
<td>University</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Avg</td>
<td></td>
<td>University</td>
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<td>AdS Ethnic, Cultural Minority, Gender, and Group Studies</td>
<td>5.02</td>
<td>BM</td>
<td>22.3</td>
<td>12.6</td>
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<tr>
<td>AdS Communication and Media Studies</td>
<td>9.01</td>
<td>BM</td>
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<td>15.7</td>
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<td>BMD</td>
<td>105.4</td>
<td>13</td>
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<td>BMD</td>
<td>54.0</td>
<td>20.2</td>
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<tr>
<td>AdS Mathematics</td>
<td>27.01</td>
<td>BMD</td>
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<tr>
<td>AdS Philosophy</td>
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<td>AdS Chemistry</td>
<td>40.05</td>
<td>BMD</td>
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<tr>
<td>AdS Geological and Earth Sciences/Geosciences</td>
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<td>BMD</td>
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<td>BMD</td>
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<tr>
<td>University College + Discipline</td>
<td>CIP</td>
<td>Degrees Awarded</td>
<td>University Total FTE Faculty</td>
<td>University</td>
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<td>--------------------------------------------------------------------</td>
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<tr>
<td>A&amp;5 Ethnic, Cultural Minority, Gender, and Group Studies</td>
<td>5.02</td>
<td>BM</td>
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<tr>
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<td>A&amp;5 History</td>
<td>54.01</td>
<td>BMD</td>
<td>39.5</td>
<td>$ -</td>
</tr>
</tbody>
</table>
Peer Ratio Access – Institutional Login

- Once you have logged institutionally, click on “Peer Analysis” and then “Peer Ratio Data.”

Reporting Institutions by Discipline

To assist in selecting your peer groups, EXCEL files are available that list the 2011 NSICP institutions that reported data for the discipline. Included in the files are the institution name and its Carnegie classification, highest degree offered in the discipline, and undergraduate degrees as percent of total degrees awarded in the discipline. Disciplines for which norms are not provided due to the small number of reporting institutions are not included in the following lists.

Select by Discipline: Accounting and Related Services - 52.03
Select by CIP Code: 1.01 - Agricultural Business and Management

Peer Analysis - Download your requested EXCEL files of norms and institutional ratios of customized reports.

This module allows participants who requested electronic customized reports on their peers to download from this secured web site the EXCEL files that contain the peer norms and the EXCEL files that contain individual institutional ratios. You may request up to five peer analyses for 10 or more participating institutions at no charge. Please allow approximately 2 weeks from the receipt of your paper request for the files to be available to you at this site. You will be informed when the files are available.

Similar to the National Norms, the peer norms are given in 4 tables for the 4-digit CIPs. Please refer to the Table Definitions given in the main menu for clarification of table contents. The individual institutional ratios of your peers are provided in 4 EXCEL files. These are the data points from which the norms are calculated. Data for the requesting institution are included in these files whether or not the requesting institution was included in the peer group. You may download these files if you choose to do further analysis. Institutional identities are not given. Please refer to Column Definitions for the file contents.

Request form for Customized Peer Analysis Report

Peer Ratio Data - Produce ratios files for downloading as EXCEL files or viewing the data.

This module provides participants with the capability to download from our database a set of ratios for your peers. Similar to the customized study, you may select no less than 10 institutions and obtain the set of ratios for your peer group. Your own institution’s data is automatically included and is designated with an “∗”. These data are given in 4 EXCEL files and are in the same format as those produced in the customized study. Please refer to Column Definitions for the file contents. No peer norms are produced if you choose to use this option. You may obtain as many sets of peer data as you choose.

Excel Macro to Calculate Refined Means

NOW AVAILABLE: Excel Macro which provides you with unlimited sets of refined means for peer analyses. The macro is used in conjunction with downloaded Peer Ratio Data sets. For a one-time charge of $250, you can purchase the macro and analyze any year of Delaware Study data in which you participated. The macro allows you to create unlimited peer groups and see immediate results in the form of refined means similar to those we produce for institutions requesting customized studies.

An example of the Macro’s output is available here. The Macro runs on a downloaded peer ratio file. In the example file, you will see the four rows inserted after each set of five peer results displaying the mean, n, standard deviation, and refined mean for each CIP. Also, the values found to be outliers are highlighted in gray, while the refined mean cells highlighted in yellow indicate where a refined mean is calculated on less than 5 values. Please contact Allison Walters at awalters@udel.edu for more information.
Peer Ratio Access – Institutional Login

- Once you have selected "Peer Ratio Data,” select ten or more institutions, the results will be generated in a manner that can be viewed and/or downloaded into Microsoft Excel. Additional instruction are on the right of the page.
Advanced Modeling Techniques Utilizing Cost Study Peer Ratio Tool

• *Cluster analysis* is a series of statistical techniques designed to identify how similar (or different) some observations are from one another.

• Cluster analysis is a data classification technique rather than a test for statistical significance.

• The next-nearest-neighbor is a cluster analysis approach designed to assess how close data points are to a specific point based upon majority. If \( k=3 \), red triangle. If \( k=5 \), blue square.
Advanced Modeling Techniques Utilizing Cost Study Peer Ratio Tool

• Physics is a discipline with relatively high costs and high variability, even among comparable Research Very High (RVH) institutions.

• Conducting RVH cluster analyses with Cost Study data enables the researcher to explore the relationship between key variables related to Direct Instructional Expenditure (DIE)/Full-Time Equivalent (FTE) Student.

• High research expenditures is associated with lower personnel costs as a percentage of total expenditure as units are spending more on other than personnel costs.
Regression: Best Fit Lines

• A regression is a best-fit line that lies closer to the data points than any other possible line according to a least squares standard statistical measure of closeness.

• Ordinary Least Squares (OLS) regression is a statistical improvement bivariate statistical analyses because they allow the researcher to “control for” or “separate” certain aspects of independent variables on a dependent variable.

• Regression analysis is like a mosaic of real life experiences that allow complicated patterns of interaction to be disentangled on a statistical level.
Advanced Modeling Techniques Utilizing Delaware Cost Study Data

- An Ordinary Least Squares (OLS) Regression model allows for the researcher to predict DIE/FTE Student for RVH Physics. (Weighting for Percent Undergraduate Degree)

- Findings indicate for every one percent increase in personnel cost as a percentage of total departmental expenditure is associated with a $142.84 decrease in DIE/FTE Student (p=.01).

- For every one dollar increase in research expenditure per T/TT FTE faculty is associated with a $0.007 increase in DIE/FTE Student (p=.03).
Advanced Modeling Techniques Utilizing Delaware Cost Study Data

- Monte Carlo methods allow for the simulation of estimated future costs. When simulating the DIE/FTE Student, 1,000,000 times, a 90 percent confidence interval can be estimated.

- For RVH Physics, the average DIE/FTE Student is $9,344.83.

- For RVH Physics departments, there is a 5% chance a department’s DIE/FTE Student cost will be above $12,449.86. For RVH Physics, there is a 5% chance a department’s DIE/FTE Student cost will be below $6,677.95.

- Monte Carlo sensitivity analyses allow for the researcher to manipulate variables to influence projections.
Moving Forward: Implementation and Support

- Online Data Collection Walkthrough
- Online Video Access
- Webinar (Office Hour Support Forum)
- Personal Support
- First Year Conference Call
- Prospective Conferences/Workshops (SAIR, NEAIR)
Future Directions: Higher Education Consortia

- Over the past year, the Higher Education Consortia has worked with four-year colleges, universities, and systems to facilitate unit and institutional improvement on a limited basis. These services are now available to all institutions and systems.

- Data Alignment

- Statistical Solutions (Data Mining, OLS, HLM, SEM, PSM, MCS, Survival)

- Academic Program Review

- Internal and External Benchmarking

- Enrollment Management/Modeling

- Institutional Effectiveness Workshops/In-Service Solutions

- Special Projects
Addressing Your Questions and Comments

• What questions do you have at this time?
Take Away: The Delaware Cost Study is a resource.

- The Delaware Cost Study is a useful tool for providing comparative analysis of faculty teaching loads, direct instructional costs, and separately budgeted scholarly activity, all within academic disciplines.

- Delaware Cost Study is useful for data alignment, system integration, unit improvement, and institutional effectiveness.

- A failure to monitor these variables may lead to expenditure distortion in planning and budget models (ABB, RCM, PBB, ZBB).

- Cost Study data (courses taught, research and public service expenditures) may be useful for Academic Program Reviews (APR).

- Cost Study data may be useful for proposing, planning and developing new departmental programs.