Operational Analytics: Notes from a Dustbowl Empiricist
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Being “Frank”

• Director - Office of the Registrar/Academic Records
  – Business Intelligence (data warehousing, modeling, and reporting)
  – Academic Analytics
  – Decentralization of the Graduate School
  – LMS/Non-credit application implementation

• Doctoral Candidate, Educational Policy and Administration (expected May/June 2012)
  – Utilizing Principal-Agent Theory to Examine Baccalaureate Degree Production Efficiency of Public and Private Four-Year Research Universities
Overview

• Dust bowl empiricism
• Operational analytics
• 3 step process to degree progress
  – Data collection
  – Data analysis
  – Data presentation
Operational Analytics/Dust bowl Empiricism?

"Are you thinking what I'm thinking?"
Operational Analytics

• “A process that facilitates delivery of the in-depth and focused analysis of the performance of each key operational area of the business.”
  – Source: http://it.toolbox.com/wiki/index.php/Operational_Analytics
Source: http://www.cmo.com/web-analytics/you-say-reporting-i-say-analysis-whos-right
Dust Bowl Empiricism

• “The idea is that, in the absence of theory, a heap of unconnected facts is as barren as the American Dust Bowl.”
  – Source: The Sage Encyclopedia of Qualitative Research Methods, Volume 2
1930s

The Dust Bowl affected 100,000,000 acres (400,000 km²), centered on the panhandles of Texas and Oklahoma, and adjacent parts of New Mexico, Colorado, and Kansas.
Hathaway & McKinley
MMPI

- Minnesota Multiphasic Personality Inventory
  - Starke R. Hathaway (1903-1984) and J.C. McKinnley (1891-1950)
  - 566 true-false items designed to diagnose psychiatric symptoms
  - Selected from more than 1000 items covering health conditions, habits, personal and social attitudes, and psychiatric symptoms
  - Items showing the most differentiation in tests were selected
1000 items...?
Data Collection
Data Collection

• Complexity of student record data
  – Admissions
    • Pre-college characteristics
  – Student Record
    • Registration
    • Enrollment
    • Degree Progress
    • Financial
Complexity of Data

• Pre-year 1 variables
  – Demographic: ethnicity, gender
  – Geographic: country, state, high school…
  – Academic 1: test scores (act and sat), high school rank, entry transfer credits…
  – Academic 2: degree applicable credits, percent of degree complete (pre-y1)…
  – Financial: SES, Pell eligible, EFC…
Complexity of Data

• Time of admission
  – Registration status: NHS, NAS, degree seeking…
  – Academic: campus, college, major, credit load…
Complexity of Data

- Year 1, 2, 3, 4…
  - Status: enrolled/dropout, enrolled in entry college/major/campus…
  - Academic 1: college, major, campus…
  - Academic 2: cum credits, cum GPA, course taken…
  - Academic 3: term GPA, term credit load, term coursework…
  - Academic 4: degree progress credits earned/free electives/percentage complete…
Data Collection Issues

• Accuracy of data
  – Validated: high school diploma, GPA, test scores…
  – Self-identified: gender, ethnicity…

• Completeness of data
  – Critical to the analysis phase

  • Some analysis applications work differently with null values (e.g., average test scores)
Data Collection Issues

• Interpretation of terminology used
  – Test scores: specific vs composite
  – Major: pre-major vs undecided
  – Start Term: degree vs non-degree seeking

• Horizontal vs vertical data sets
  – Horizontal: one student – one row
  – Vertical: one student – multiple rows
Data Collection Issues

• Access to data
  – Admissions: prospect, applied, admitted
  – Matriculated: pre- vs post-year 1 data

• Temporal nature
  – Snapshot: annual, cohort, ten-year
    • Data source: data warehouse
  – Real time: registration and grade changes
    • Data source: production instance of SIS
Analysis and Presentation
System Dynamics

• “We cannot content ourselves with observing and analyzing situations at any single moment but must instead try to determine where the whole system is heading over time” (p. 40).
Academic Analytics

• Dr. Claudia Neuhauser
  – Ph.D Mathematics

• Frank Blalark
  – Ph.D. EDPA (expected May/June 2012)

• Adarsh Sivasanjaran
  – M.S. Electrical Engineering (expected May/June 2012)
College-specific Analysis

- The number of credits completed prior to entering the University as a NHS affects the time to degree completion and the likelihood of graduation.
- Shows a pattern that is different from other colleges.
2006 Entering NHS and the “Cushion”

<table>
<thead>
<tr>
<th>College</th>
<th>Total</th>
<th># At 120</th>
<th>#Above 120</th>
<th>#Above 135</th>
<th>%At 120</th>
<th>%Above 120</th>
<th>%Above 135</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>400</td>
<td>394</td>
<td>6</td>
<td>1</td>
<td>98.50%</td>
<td>1.50%</td>
<td>0.25%</td>
</tr>
<tr>
<td>2</td>
<td>600</td>
<td>573</td>
<td>27</td>
<td>5</td>
<td>95.50%</td>
<td>4.50%</td>
<td>0.83%</td>
</tr>
<tr>
<td>3</td>
<td>753</td>
<td>211</td>
<td>542</td>
<td>180</td>
<td>28.02%</td>
<td>71.98%</td>
<td>23.90%</td>
</tr>
<tr>
<td>4</td>
<td>359</td>
<td>324</td>
<td>35</td>
<td>11</td>
<td>90.25%</td>
<td>9.75%</td>
<td>3.06%</td>
</tr>
<tr>
<td>5</td>
<td>2463</td>
<td>2286</td>
<td>177</td>
<td>31</td>
<td>92.81%</td>
<td>7.19%</td>
<td>1.26%</td>
</tr>
<tr>
<td>6</td>
<td>83</td>
<td>60</td>
<td>23</td>
<td>1</td>
<td>72.29%</td>
<td>27.71%</td>
<td>1.20%</td>
</tr>
<tr>
<td>7</td>
<td>331</td>
<td>260</td>
<td>71</td>
<td>17</td>
<td>78.55%</td>
<td>21.45%</td>
<td>5.14%</td>
</tr>
<tr>
<td>ALL</td>
<td>4989</td>
<td>4108</td>
<td>881</td>
<td>246</td>
<td>82.34%</td>
<td>17.66%</td>
<td>4.93%</td>
</tr>
</tbody>
</table>

- A significant number of students need more than 120 credits to graduate (Table APAS credits)
- Students whose APAS has more than 125 credits and who graduate within four years tend to had more credits prior to entering the University as NHS
• Repeat the analysis with the 479 students whose status at Year 4 is either DEU or EEU
  
  – Calculate the average percentage of required APAS credits a student is above the minimum yearly goal of graduating in four years, namely increasing the percent of required credits by 25% per year.
  – Group I = required APAS credits is at most 125
  – Group II = require APAS credits exceeds 125
Inltratransparence

• “They must make decisions affecting a system whose momentary features they can only see partially, unclearly, in blurred and shadowy outline – or possibly not at all” (p. 40).
Complexity of Success
Ignorance

• “If we want to operate within a complex and dynamic system, we have to know not only what its current status is but what its will be or could be in the future” (p. 41).
Migration Flow Analysis

<table>
<thead>
<tr>
<th>DEU</th>
<th>Enrolled in campus of entry and college of entry</th>
</tr>
</thead>
<tbody>
<tr>
<td>DOU</td>
<td>Enrolled in campus of entry but from non-entry college</td>
</tr>
<tr>
<td>DOC</td>
<td>Enrolled in non-entry college</td>
</tr>
<tr>
<td>EOL</td>
<td>Enrolled at the Graduate or professional level on any campus</td>
</tr>
<tr>
<td>NEU</td>
<td>Not enrolled anymore at UM</td>
</tr>
</tbody>
</table>

**Completion Rates:**
- DEU: 90.23% completed
- DOU: 62.88% completed
- DOC: 60.16% completed
- NEU: 71.62% completed
- EOL: 83.87% completed
- EEU: 100.00% completed

**Student Flow:**
- **EEU (n=386):**
  - EEU (n=229) 100.00% completed
  - EEU (n=229) 100.00% completed
  - EEU (n=229) 100.00% completed
  - EEU (n=229) 100.00% completed
  - EEU (n=229) 100.00% completed

**Enrolled:**
- EEU (n=386)
- EEU (n=365)
- EEU (n=229)
- EEU (n=50)

**End of Y1:**
- EEU (n=386)
- EEU (n=365)
- EEU (n=229)
- EEU (n=50)

**End of Y2:**
- EEU (n=229)
- EEU (n=229)
- EEU (n=229)
- EEU (n=229)

**End of Y3:**
- EEU (n=229)
- EEU (n=229)
- EEU (n=229)
- EEU (n=229)

**End of Y4:**
- EEU (n=229)
- EEU (n=229)
- EEU (n=229)
- EEU (n=229)
Mistaken Hypothesis

• “People desire security. This is one of the (half) truths of psychology. And this desire prevents them from fully accepting the possibility that their assumptions may be wrong or incomplete” (p. 42).

ACT and GPA

• The average ACT scores of the incoming freshman classes have improved dramatically.
• A higher ACT score tends to increase first-year success as measured by First Year Cumulative GPA, but only up to a point.
• First Year Cumulative GPA is positively correlated with 4-year graduation rates.
Projection

- With the correlation between GPA and graduation rates, we would predict an increase of the 4-year graduation rate until 2012 when the 2008 entering cohort will be in its fourth year.

- Since the first-year GPA is no longer increasing, in fact, it decreased for the 2009 entering class, we would predict that the 2009 entering 4-year graduation rate (2013) will be lower than the 2008 entering cohort 4-year graduation rate (2012).
Summary

• Dust bowl empiricism and operational analytics
• Data collection, analysis, and presentation
• Dynamics, intra-transparence, ignorance, and mistaken hypothesis
Tools

- Matlab
- Tableau
- MS Word
- MS Excel
- Oracle SQL Server
- PeopleSoft
- DARS
Questions?
Contact Information

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