Validating the PRIDIT method for determining hospital quality with outcomes data

Robert Lieberthal, PhD, Dominique Comer, PharmD, Katherine O’Connell, BS

August 12, 2011
Acknowledgements

• Funding provided by the Society of Actuaries
  ➢ Through the Health Section
• Original algorithm and ongoing input from Richard Derrig
• Feedback from prior presentation at Temple University’s Department of Risk, Insurance & Healthcare Management
• Work in progress
• Examine the use of PRIDIT as a hospital quality measure
  ➢ Contemporaneous summary of process measures
  ➢ Does it capture outcomes?
• Validate the use of PRIDIT as predictor of hospital quality
  ➢ Are scores stable over time?
  ➢ Do current scores predict future scores and outcomes?
PRIDIT was developed as a fraud detection method

• Brockett and colleagues (Journal of Risk and Insurance, 2002)
• PRIDIT—PCA on Ridit scores
  ➢ Take binary, categorical, and continuous data
  ➢ Empirical cumulative distribution function on variables
  ➢ Transform and normalize using ridit scoring (best for categorical data)
• These variables proxy for an unobserved latent characteristic (i.e. fraud)
  ➢ Use PCA to assess variance and covariance of variables
  ➢ Those that account for the most of the variation get the highest weighting
  ➢ Use weightings and scores to determine likelihood of latent characteristic
• Measure is relative, not absolute
PRIDIT is an unsupervised learning technique

- Based on eigensystem
- Most efficient use of the data
- Variables used, and how to code categoricals, relies on expert judgment
- Two outputs
  - Relative rankings of unit of observation on latent characteristic
  - Multiplicative relative ranking of variable importance
Validating an unsupervised method for fraud

- Match it against other methods
  - Brockett et al compared their scores to expert opinion
  - How great is the correlation

- Match it against outcomes
  - A big problem in insurance fraud
  - Many fraudulent suspicions are dropped, settled, or take years to litigate

- Use it as a first pass approach
  - Fraud investigation is expensive
  - PRIDIT is designed as a cheap way to identify claims
  - Then just look at the threshold percentile of claims to investigate

- If you think this is easy, look at the “10% fraud” myth
Hospital Compare contains publicly reported hospital process measures

<table>
<thead>
<tr>
<th>Process measure</th>
<th>Average</th>
<th>Jefferson hospital</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>US</td>
<td>PA</td>
</tr>
<tr>
<td>Antibiotic timing</td>
<td>87%</td>
<td>88%</td>
</tr>
<tr>
<td>Correct antibiotic</td>
<td>93%</td>
<td>93%</td>
</tr>
</tbody>
</table>

- Hospital compare sample data, 7/1/2009-12/31/2009
- Both measures contain some discretion
Hospital quality gives me a chance to validate PRIDIT

- Hospital performance is measured categorically
  - Example: percent of the time the correct antibiotic was given
  - Percentage reported in whole numbers
  - Lots of clustering near or at 100%
  - Missing data due to too few observations

- Hospital characteristics are categorical
  - Ranking effect on categorical variable is often subjective
  - Level of teaching at the hospital—clear monotonic relationship
  - Hospital ownership (fp, nfp, government)—monotonic relationship less clear

- Risk adjusted outcomes data
  - Mortality (not too much variation, very important)
  - Readmissions (more of variation, less important)
My first step is to replicate my prior study

- Hospital Quality: A PRIDIT Approach (Health Services Research, 2008)
- My idea—aggregate all that information
  - No individual process measure is useful
  - Relative ranking of overall hospital quality is useful
  - Ranking of variables is useful—they’re expensive to collect
- Result—a tight distribution of quality in the middle
  - A few low and high quality outliers
  - Validated by much of the hospital quality literature
A few variables accounted for most of the variation in quality

- Patients given beta-blocker at arrival and at discharge
  - Well reported (~85%)
  - Majority but not total adherence (~85%)
- All 4 heart failure measures (esp. assessment of left ventricular function)
- Measures with total adherence not useful for measuring quality
  - Oxygen assessment for pneumonia-99% adherence!
- Surgical measures not well reported and so did not explain much variation
- More teaching indicates higher quality
  - No residency programs < some residency programs < full residency programs < residency and med school program
The result was an overall PRIDIT score

- Output on quality of hospitals and value of different variables
- Example: Jefferson University Hospital scored -0.00093 (national average is 0)
- Example: Heart failure measure *patients given assessment of left ventricular function* was weighted 0.69731 (maximum score is 1)
- No negative weights for variables
  - All process measures were associated with positive quality
  - Concern with teaching to the test hypothesis
  - If I had recoded the hospital characteristics, they would have been negative
- Small hospital bias caveats
  - Hospitals did not report measures with N<25 observations
  - I imputed an average value for unreported variables
  - I am considering missing data imputation or splitting the sample for current project
Hospital quality was evenly distributed

- Lots of hospitals in the middle, a few outliers of high and low quality
“So what” as part of the larger problem of quality measurement

• It’s just another way to measure quality
  ➢ Aggregation is a feature
  ➢ Process measures are instrumental
  ➢ Outcomes are the key variables of interest
  ➢ Future work—is the cost of those outcomes worth collecting the data?

• Solution: correlate the PRIDIT score to outcomes
  ➢ Contemporaneously at multiple points in time
  ➢ As a predictor of future outcomes
  ➢ Best case scenario—improvement in process measure $x$ leads to a mortality improvement of $y$
  ➢ Validation of PRIDIT method
• Expanding and justifying the use of PRIDIT
• Expanding actuarial methods into healthcare for research
• Expanding actuarial methods into healthcare for practitioners
  ➢ Building high quality hospital networks for in-network care
  ➢ Pay for performance programs
  ➢ If insurers can’t get paid to risk adjust, they can get paid for this
Place for your feedback

• We have just started this research
• The SOA is soliciting for a Project Oversight Group
  ➢ You could be on it if you’re a member
• We would like to get your feedback
• Where you will see this next
  ➢ SOA webpage (our final report)
  ➢ Journal publication (we are open to suggestions)