

**Validating the PRIDIT method for  
determining hospital  
quality with outcomes data  
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## Outline

- 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 Ridity scores
  - Take binary, categorical, and continuous data
  - Empirical cumulative distribution function on variables
  - Transform and normalize using ridity 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

Process measure	Average		Jefferson hospital	
	US	PA	Adherence	Patients (N)
Antibiotic timing	87%	88%	82%	303
Correct antibiotic	93%	93%	98%	302

- 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

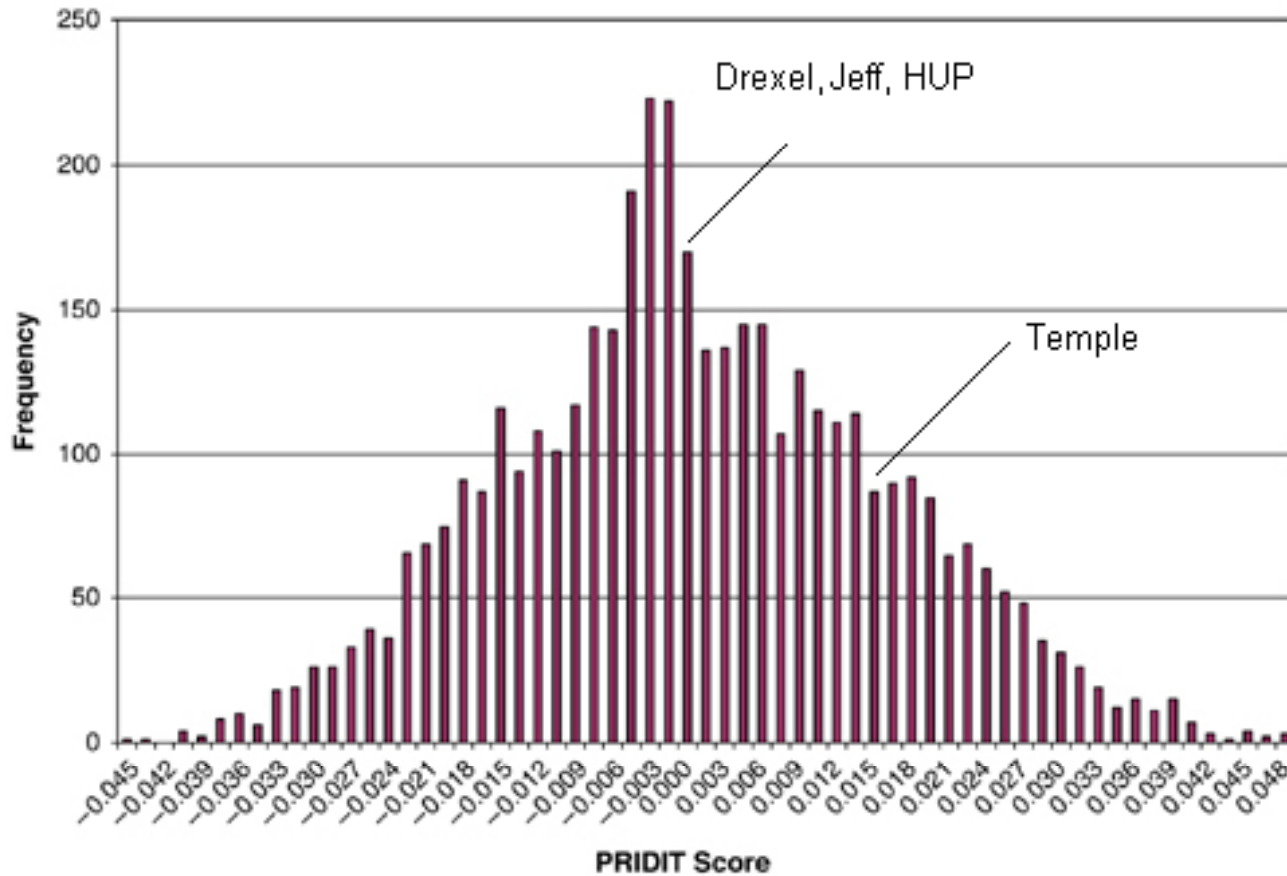
# A few variables accounted for most of the variation in quality

- 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

# Actuarial implications

- 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)