IBM China Research Laboratory

GIS-Based Banking Branch Performance Evaluation through DEA and Regression Analysis

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Agenda

- 1 Background
- 2 Geographical Information System (GIS) – based Statistical Analysis
- 3 Data Envelopment Analysis (DEA)
- 4 Comparative analysis and cross application
- 5 Further directions

Background

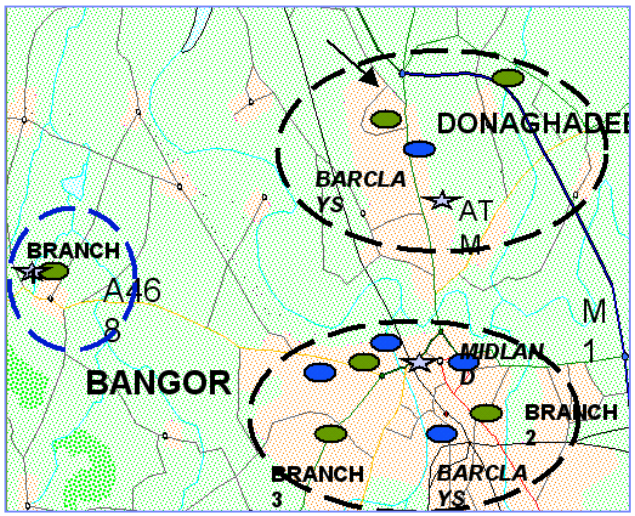
- Why this topic: branch performance evaluation?
  - Banking branches serve as the most important channel
  - Branch networks need to be adjusted and reinvigorated to improve profitability continuously
  - Each branch performance should be evaluated to identify key gaps so as to guide future branch transformation

- Current research
  - Focus on using statistical models or data mining techniques on banking internal business data
  - Limited linkage to external environment around branches (e.g., massive geographic environment or demographic information)

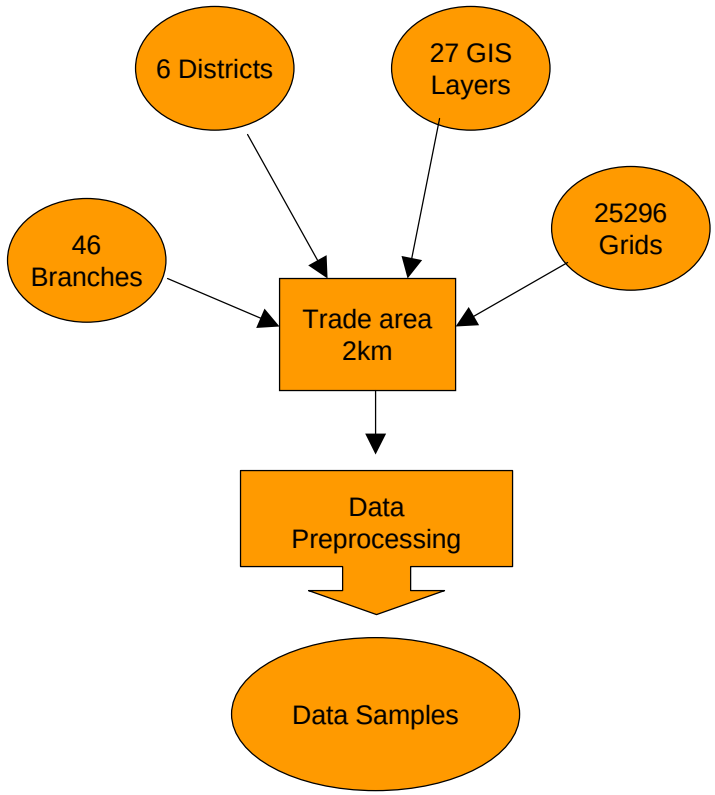
- Deposit as one KPI in this paper
  - In China, banks typically regard the ability of attracting deposits as one of the their KPIs

GIS-based Statistical Analysis for Branch Evaluation

- 1 GIS Data Sample

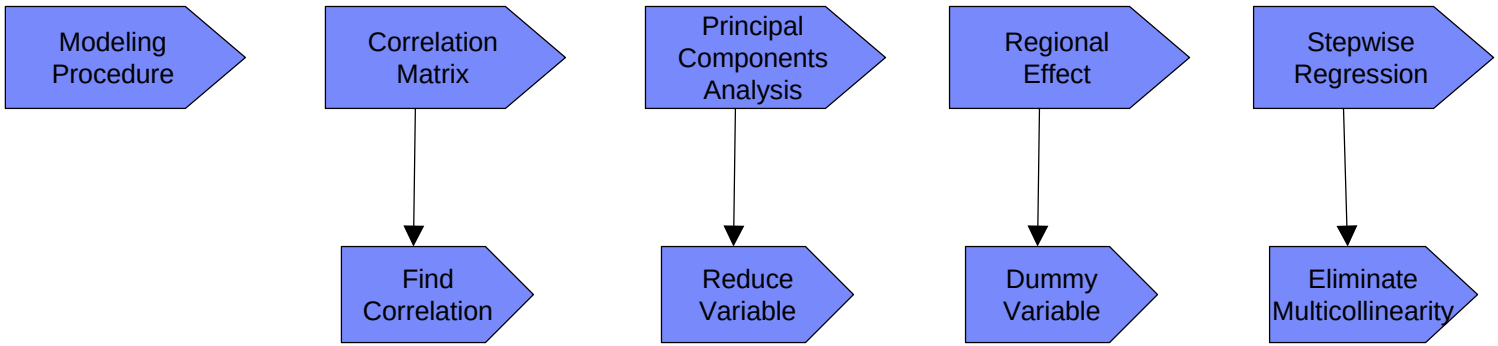


25296 grids (200m*200m)



GIS-based Statistical Analysis for Branch Evaluation

- 2 Estimation procedure



GIS-based Statistical Analysis for Branch Evaluation

- 3 Results
- 1) Estimation findings

Summary of estimates for Deposits Volume

Independent Variable	Description	Regression coefficient	Standard error	Beta Coefficient	F ratio	Significance Level
S_HPL_P	Hospital	24.09	19.1	0.12	1.5906	0.21
G_BRCNT	Own branches	-980.22	338.47	-0.26	8.3871	0.01
S_GOV	Government	1.97	1.46	0.17	1.8281	0.18
S_HTL	Hotel	38.57	6.11	0.71	39.9127	0
D3	The third district	1960.3	1504.21	0.11	1.6983	0.2

R^2= 0.7584, Adjusted R^2= 0.7282, SE= 3697.6, F-ratio= 20.3436

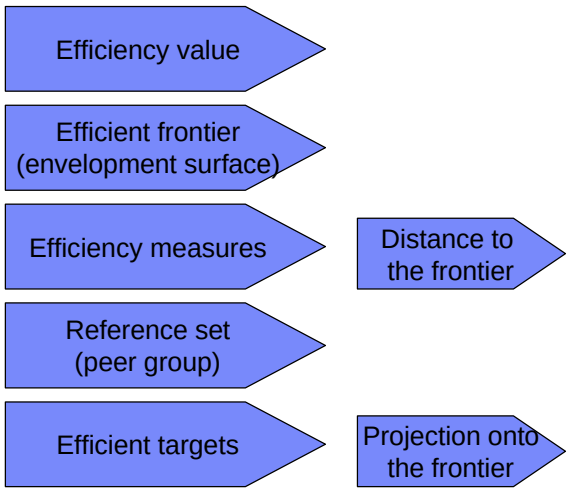
- 2) Results explanations
  - (+) Hotel has a strong positive effect
  - (+) Hospital and government have a relatively weak positive effect
  - (-) Bank competition in the area has an inverse effect in deposits attraction
  - (+) Positive regional effect of district D3
- Note
  - Some insignificant variables are included: hospital, government, D3
- Limit
  - Variable selection risks
  - Multicollinearity

Data Envelopment Analysis

1. Introduction of Data Envelopment Analysis
   - DEA is a linear programming technique for measuring the relative efficiency of decision making units (DMUs) where each DMU has a multitude of desired outputs or needed inputs

2. Advantages than regression
   - Multiple inputs and multiple outputs

3. DEA can provide us:



4. Motivation of this paper
   - Given geographic environment, i.e. market potentials

Which branch has better performance?

5. Model settings

Model	Variable return-to-scale
Input	GIS layers
Output	deposit
Orientation	output

DEA for bank branch performance evaluation

- Overall results
  - Efficiency and reference set
  - Totally
    - Efficient branches: 11 (24%)
    - Average efficiency: 1.54
  - D1 and D5
    - More efficient branches and higher efficiency

Efficiency and reference set

Branch	DEA technical efficiency	Best-practice branch reference set					
B1	1						
B2	1						
B3	1.5544	B4	0.87	B39	0.13		
B4	1						
B5	1.7588	B38	1				
B6	1.2924	B38	0.75	B7	0.25		
B7	1						
B8	1.2020	B38	0.63	B4	0.26	B7	0.11

Overall results with distribution by districts

District	D1	D2	D3	D4	D5	D6	Overall
# Branches	8	11	7	11	5	4	46
# Efficient	4	1	1	1	3	1	11
% Efficient	50%	9%	14%	9%	60%	25%	24%
Average score	1.2260	1.9861	1.4191	1.6182	1.2659	1.2497	1.5373
Average deposits	23010	12462	12906	9025	10664	9567	13095

- Score>1 indicate output expansion
- Ranking of best branches

D1: better performance
D5: poor geographic information

DEA for bank branch performance evaluation

- Further investigations
  - Best practice branches ranking
  - Less efficient branches improvements

Less efficient branches deposits expansions

Branch	Actual deposits	Potential deposits expansions
Less efficient branches	35	
Total deposits	371555	
All branches	46	
Total deposits	602356	
	Total potential deposits expansions	242489
	Expansion as % of total deposits	40.26%

Investigation for best practice branches

Best branches	Super Efficiency	Best branches used as peers	Total peer coefficient	Average peer coefficient
B42	Infeasible	3	2.67	0.89
B7	0.5138	3	0.66	0.22
B1	0.5267	6	0.19	0.03
B4	0.5760	15	9.45	0.63
B38	0.5854	15	9.36	0.62
B39	0.6759	15	8.58	0.57
B43	0.7126	0	-	-
B2	0.8393	0	-	-
B9	0.8757	3	0.57	0.19
B20	0.9010	8	3.03	0.38
B27	0.9964	1	0.50	0.50

- B1 and B7 belong to D1
- B38 and B39 belong to D5

Comparative analysis

- Comparative analysis between DEA and regression results

Comparison between DEA and regression results

Branch	Actual deposits [a]	DEA findings		Regression findings		Model difference [c]
		Targeting deposits	Potential deposits expansions [b]	Estimated deposits	Residuals	
Best branches						
Matching branches	22365	-	-7620	-	-6054	-
Total branches	20982	14980	-7185	16194	-4788	-1821
Matching ratio	9/11 (82%)	Average super efficiency	0.71/0.72			
Less efficient branches						
Matching branches	9929	-	7321	-	2441	-
Total branches	10616	17544	6928	11772	1156	5772
Matching ratio	23/35 (66%)	Average efficiency	1.78/1.7			
Total matching ratio	32/46(70%)					

[a] Average value is calculated, the same for other columns.

[b] Potential deposits reductions for best branches.

[c] Arrived at by subtracting the fifth column from the third column.

The two methods are more consistent for revealing the best branches and the worst branches. But for average performing branches, the conclusions may turn out to be conflicting.

Cross application

- Cross application of regression and DEA

Profile of branch B10 (efficiency=1.78)

Factors	Contribution to estimated deposits					Benchmark contribution (%) to target	
	Difference [b]	Estimates [a]		B10		B4	B7
			All-branch average	Observed	Target	65%	35%
Hospital	-283.7	200.7	20.1	8.33	8.33	76%	24%
Own branches	-1342.9	-3264.1	2	3.33	-	-	-
Government	2096.1	3027.6	471.7	1533.33	417.88	40%	60%
Hotel	6308.9	9224	75.6	239.15	239.15	22%	78%
District 3	-	0	-	0	-	-	-
Intercept	-	10118	-	10118	-	-	-
Deposits		19303		16292	29068	53%	47%
Residuals /Expansions		3011			12776		

[a] Arrived at by multiplying the forth columns by the corresponding regression coefficients.

[b] Arrived at by multiplying the difference between the third and forth columns by the corresponding regression coefficients.

The decision making process should be implemented combining the results.

Further directions

- Further directions for banking branch performance evaluation