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## ***Hospital Inpatient Workload for Tactical Decision-Making***

References describing scientific knowledge in OR management, surgical suite staffing, anesthesia staffing, and surgical case scheduling are available in the comprehensive bibliography of articles at ([click here](#)). I have published more than 175 papers in the field. I have practical experience in applying the statistical methods, having worked with more than 70 surgical facilities.

Data envelopment analysis can be applied to US state and national databases to compare (benchmark) hospitals' production of surgery. The University charges \$2000. Examples of the minimal data required from each hospital are shown on pages 3-4 and 10-11 of this PDF file. Upon receipt of the information, a PDF file with results is generally sent by e-mail within 3 days.

Usually the methodology is performed simultaneously with a financial analysis to decide whether to allocate additional block time to a specialty. [Click here](#) for consultation details, [click here](#) for the abstract of the article, and [click here](#) for a PDF of the full text:

O'Neill L, Dexter F. Tactical increases in operating room block time based on financial data and market growth estimates from data envelopment analysis.  
*Anesthesia & Analgesia* 104: 355-368, 2007.

The following are other types of questions that are answered using the analysis:

- How does each specialty inpatient workload compare to the volume of other key specialties, based on statistical population distribution?
- What would be the likely impact of hiring a new thoracic (or vascular, neurological, etc.) surgeon on the hospital's specialty workload?
- Is thoracic surgery inpatient workload of 121 lung resections high or low compared to that of orthopedics' 213 hip replacements, urology's 132 nephrectomies, and cardiac surgery's 304 coronary artery bypass grafts?
- If a new urologist were recruited, would the hospital likely grow the practice and perform more surgery, or simply have another urologist?
- Are there sufficient patients for each specialty residing close to the hospital?
- To what extent is inpatient specialty OR workload limited by population size as compared to existing capacity or hospital visibility within the community?
- Orthopedic surgery has a very high contribution margin per operating room hour. Operating room capacity is being expanded by running some ORs for 10 hr instead of 8 hr. Should the additional OR time be planned for orthopedics? Are there really more cases to be done?

After the PDF report is sent, such additional questions can be discussed by phone or e-mail. The University charges \$250 per hour.

## Summary of the Data Envelopment Analysis for General Hospital January 1, 2007

### **Outputs - Counts of hospital discharges including the listed procedures**

|              |                                     |
|--------------|-------------------------------------|
| AAA          | Abdominal aortic aneurysm resection |
| CABG         | Coronary artery bypass graft        |
| Colorectal   | Colorectal resection                |
| Craniotomy   | Craniotomy, not for trauma          |
| Hip          | Hip replacement                     |
| Hysterectomy | Hysterectomy                        |
| Lung         | Lung resection                      |
| Nephrectomy  | Nephrectomy                         |

### **Specialty for which listed procedures are a reliable surrogate for the "inpatient workload"**

|                          |
|--------------------------|
| Vascular surgery         |
| Cardiac surgery          |
| General surgery          |
| Neurological surgery     |
| Orthopedics              |
| Gynecology               |
| General thoracic surgery |
| Urology                  |

### **Inputs**

|          |   |
|----------|---|
| County   | Estimated hospital charges for the above 8 procedures performed on residents of hospital's          |
| Region   | county and region, normalized by the land area of hospital's county and region                      |
| Beds     | Staffed beds at the hospital  |
| Surgeons | Surgeons who performed at least three cases of any one of the above 8 procedures at the hospital    |
| Tech     | Number of nine high technology services offered at the hospital (e.g., solid organ transplantation) |

### **References**

O'Neill L, Dexter F. Market capture of inpatient perioperative services using data envelopment analysis. *Health Care Management Science* 7:263-273, 2004

Dexter F, O'Neill L. Data envelopment analysis to determine by how much hospitals can increase elective inpatient surgical workload for each specialty. *Anesthesia & Analgesia* 99: 1492-1500, 2004

O'Neill L, Dexter F. Methods for understanding super-efficient data envelopment analysis results with an application to hospital inpatient surgery. *Health Care Management Science* 8: 291-298, 2005

O'Neill L, Dexter F. Tactical increases in operating room block time based on financial data and market growth estimates from data envelopment analysis. *Anesthesia & Analgesia* 104: 355-368, 2007

Dexter F, O'Neill L, Lei X, Ledolter J. Sensitivity of super-efficient data envelopment analysis results to individual decision-making units: an example of surgical workload by specialty. *Health Care Management Science* 11: 307-318, 2008

**Instructions**

Press Tab key to go from one field to the next. Answer questions sequentially, as successive questions rely on preceding answers. Overwrite example responses with your own. If a question is confusing, e-mail me at Franklin-Dexter@Ulowa.edu.

**Upload the completed file at** <http://www.franklindexter.net/upload.htm>

If you do not receive an e-mail from me within one day confirming receipt of the file, call me at 319-621-6360.

State in which hospital is located

Florida

Hospital name precisely as reported to the State of Florida

General Hospital

Staffed acute and intensive care beds at General Hospital, both surgical and non-surgical. The value should be the close to that reported in the American Hospital Association annual survey.

423

First date of the start of the one year ( 365 day ) period to be studied

July 1, 2004

Name of county in which General Hospital is located

Lee

Alphabetical list of the names of counties that are contiguous to Lee county, regardless of how short is the common border. Include any counties that abut Lee county, even if they just touch. Include counties in adjacent states. PLEASE check spellings, because these entries will be aligned with U.S. Census data.

|        |         |         |          |  |  |  |  |  |  |
|--------|---------|---------|----------|--|--|--|--|--|--|
| Beaver | Fayette | Luzerne | Sullivan |  |  |  |  |  |  |
|--------|---------|---------|----------|--|--|--|--|--|--|

Yes or No questions specify availability of technological services at General Hospital. For each response, select ' Yes ' if there were at least 3 discharges or outpatient visits for such care between 7/1/2004 and 6/30/2005. Usually these questions are answered from general knowledge of the hospital. I provided DRG's solely if you wish to investigate the services provided at General Hospital.

|     |  |
|-----|--|
| Yes | Trauma care ( e.g., DRG 2, 27 – 30, 83, 84, 250 – 255, 280 – 282, 444 – 446, 484 – 487, or 506 – 509 ) |
| Yes | Cardiac surgery ( e.g., DRG 103 – 109, 135 – 137, or 525 )   |
| No  | Solid organ transplantation ( e.g., DRG 103, 302, 480, 481, 495, 512, or 513 )                         |
| Yes | Cardiac catheterization ( e.g., DRG 104, 106, 107, 124, 125, or 514 )                                  |
| Yes | Urological lithotripsy ( e.g., DRG 323, but do not just limit to hospitalizations )                    |
| Yes | Neonatal intensive care ( e.g., DRG 386 – 390 )  |
| Yes | Megavoltage radiation therapy ( e.g., DRG 409, but be sure to include the outpatient visits )          |
| Yes | Magnetic resonance imaging   |

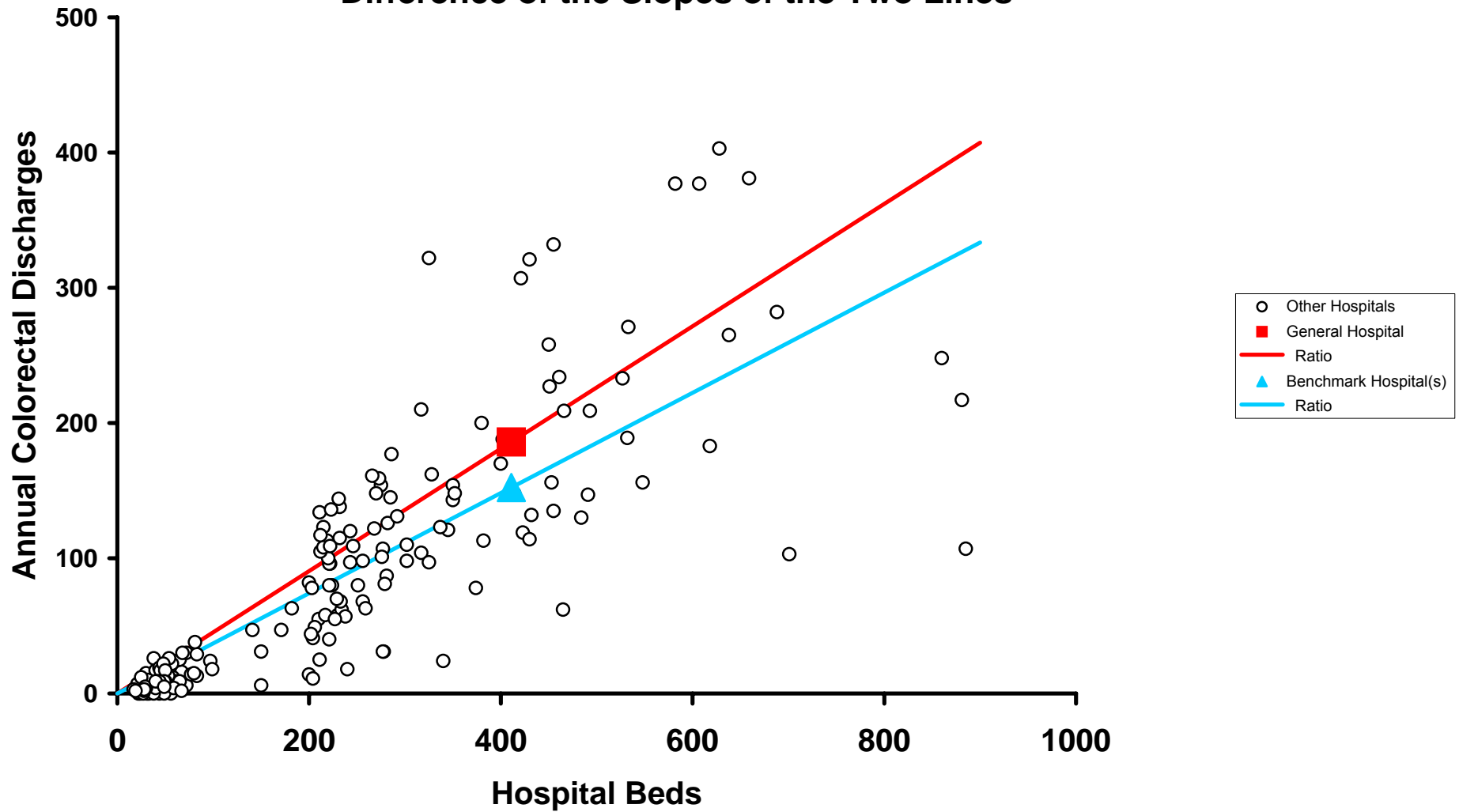
Enter the number of hospital discharges during the one year (365 days) period chosen above, 7/1/2004 to 6/30/2005. Enter how many different surgeons performed the procedure at least 3 times during the year at General Hospital. Include a patient if the DRG matches or if any of the ICD-9-CM procedure codes match, primary or secondary. The appropriate DRG and ICD-9-CM are listed below.

| Discharges | Surgeons | Clinical Classifications Software (CCS) description of the procedure(s) |
|------------|----------|---|
| 14         | 2        | AAA; Aortic resection, replacement or anastomosis (CCS 52)              |
| 756        | 3        | CABG; Coronary artery bypass graft (CCS 44)                             |
| 186        | 8        | Colorectal resection (CCS 78)   |
| 32         | 3        | Craniotomy in adults, not for trauma (DRG 1, 2, or 543)                 |
| 179        | 11       | Hip replacement, total and partial (CCS 153)                            |
| 459        | 22       | Hysterectomy, abdominal and vaginal (CCS 124)                           |
| 47         | 4        | Lung resection (CCS 36)   |
| 44         | 7        | Nephrectomy, partial or complete (CCS 104)                              |

Craniotomy is based on DRGs. The other procedures use the CCS grouping of ICD-9-CM. To facilitate your data exporting, each CCS's ICD-9-CM can be copied from the columns below. Alternatively, click on <http://www.hcup-us.ahrq.gov/toolssoftware/ccs/ccsfactsheet.jsp>

|      |          |            | Hip         |              | Lung      |             |
|------|----------|------------|-------------|--------------|-----------|-------------|
| AAA  | CABG     | Colorectal | Replacement | Hysterectomy | Resection | Nephrectomy |
| 3834 | 3610     | 4571       | 8151        | 683 3221     |           | 554         |
| 3844 | 3611     | 4572       | 8152        | 684 3222     |           | 5551        |
| 3864 | 3612     | 4573       | 8153        | 685 3229     |           | 5552        |
| 3971 | 3613     | 4574       |             | 6831         | 323 5553  |             |
| 3979 | 3614     | 4575       |             | 6851         | 324 5554  |             |
|      | 3615     | 4576       |             | 6859         | 325       |             |
|      | 3616     | 4579       |             | 686          |           |             |
|      | 3617     | 458 687    |             |              |           |             |
|      | 3619     | 4841       |             | 689          |           |             |
|      | 362 4849 |            |             |              |           |             |
|      | 363 485  |            |             |              |           |             |
|      | 3631     | 4861       |             |              |           |             |
|      | 3632     | 4862       |             |              |           |             |
|      | 3639     | 4863       |             |              |           |             |
|      |          | 4864       |             |              |           |             |
|      |          | 4865       |             |              |           |             |
|      |          | 4869       |             |              |           |             |

## Productivity Ratio Equals Percentage Difference of the Slopes of the Two Lines



## Productivity Ratios for General Hospital

|                 | AAA  | CABG        | Colorectal | Craniotomy | Hip<br>Replacement | Hysterectomy | Lung<br>Resection | Nephrectomy |
|-----------------|------|-------------|------------|------------|--------------------|--------------|-------------------|-------------|
| <b>Beds</b>     | -70% | <b>100%</b> | 20%        | -50%       | -30%               | <b>100%</b>  | 30%               | 40%         |
| <b>County</b>   | -70% | <b>100%</b> | 20%        | -50%       | -30%               | <b>100%</b>  | 30%               | 40%         |
| <b>Region</b>   | -70% | <b>100%</b> | 20%        | -50%       | -30%               | <b>100%</b>  | 30%               | 40%         |
| <b>Surgeons</b> | -80% | 60%         | 0%         | -60%       | -40%               | 60%          | 0%                | 20%         |
| <b>Tech.</b>    | -70% | <b>100%</b> | 20%        | -50%       | -30%               | <b>100%</b>  | 30%               | 40%         |

Data envelopment analysis chooses automatically those outputs and inputs that make General Hospital appear as efficient as possible. Those are the output and input combinations highlighted in bold red. The super-efficiency score of the hospital equals 100% plus the listed bold red value. Productivity ratios equal the ratios of (hospital's output / hospital's input) expressed as percentage differences from that of the corresponding benchmark hospital(s). For inputs, focus on the largest (most positive) values, as those are the bottlenecks to increased surgery. For outputs, focus on the smallest (most negative) values, as those are the specialties with the weakest market capture.

## Gaps for General Hospital

|                                     | Weight | AAA  | CABG | Colorectal | Craniotomy | Hip Replacement | Hysterectomy | Lung Resection | Nephrectomy |
|-------------------------------------|--------|------|------|------------|------------|-----------------|--------------|----------------|-------------|
| <b>Hospital 0</b>                   |        | 14   | 756  | 186        | 32         | 179             | 459          | 47             | 44          |
| Hospital 55                         | 0.64   | 31   | 244  | 143        | 57         | 263             | 210          | 26             | 23          |
| Hospital 127                        | 0.07   | 52   | 270  | 120        | 35         | 147             | 171          | 48             | 27          |
| Hospital 131                        | 0.13   | 53   | 671  | 156        | 62         | 160             | 276          | 31             | 24          |
| Hospital 154                        | 0.20   | 85   | 577  | 156        | 115        | 274             | 235          | 62             | 53          |
| Benchmark<br>(Weighted combination) |        | 48   | 382  | 152        | 70         | 255             | 232          | 37             | 30          |
| Difference                          |        | 34   | -374 | -34        | 38         | 76              | -227         | -10            | -14         |
| Gap                                 |        | 240% | -49% | -18%       | 119%       | 42%             | -49%         | -22%           | -31%        |

The same weight is applied to all procedures at each hospital. The weights are a direct consequence of the selection of inputs and outputs to make General Hospital appear as efficient as possible. The gap is the ratio of the difference to the current count of cases. A negative gap infers that more cases are being done than expected from the benchmark hospital(s). A positive gap shows the potential of General Hospital to increase its workload for the specialty.

**Summary of the Data Envelopment Analysis  
for Academic Hospital  
October 11, 2005**

***Outputs - Counts of hospital discharges including the listed procedures***

|              |                                     |
|--------------|-------------------------------------|
| AAA          | Abdominal aortic aneurysm resection |
| CABG         | Coronary artery bypass graft        |
| Colorectal   | Colorectal resection                |
| Craniotomy   | Craniotomy, not for trauma          |
| Hip          | Hip replacement                     |
| Hysterectomy | Hysterectomy                        |
| Lung         | Lung resection                      |
| Nephrectomy  | Nephrectomy                         |

***Specialty for which listed procedures are a reliable surrogate for the "inpatient workload"***

|                          |
|--------------------------|
| Vascular surgery         |
| Cardiac surgery          |
| General surgery          |
| Neurological surgery     |
| Orthopedics              |
| Gynecology               |
| General thoracic surgery |
| Urology                  |

***Inputs***

|          |   |
|----------|---|
| County   | Estimated hospital charges for the above 8 procedures performed on residents of hospital's          |
| Region   | county and region, normalized by the land area of hospital's county and region                      |
| Beds     | Staffed beds at the hospital  |
| Surgeons | Surgeons who performed at least three cases of any one of the above 8 procedures at the hospital    |
| Tech     | Number of nine high technology services offered at the hospital (e.g., solid organ transplantation) |

***References***

O'Neill L, Dexter F. Market capture of inpatient perioperative services using data envelopment analysis. *Health Care Management Science* 7:263-273, 2004

Dexter F, O'Neill L. Data envelopment analysis to determine by how much hospitals can increase elective inpatient surgical workload for each specialty. *Anesthesia & Analgesia* 99: 1492-1500, 2004

O'Neill L, Dexter F. Methods for understanding super-efficient data envelopment analysis results with an application to hospital inpatient surgery. *Health Care Management Science* 8: 291-298, 2005

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**Upload the completed file at** <http://www.franklindexter.net/upload.htm>

If you do not receive an e-mail from me within one day confirming receipt of the file, call me at 319-621-6360.

State in which hospital is located

California

Hospital name precisely as reported to the State of California

Academic Hospital

Staffed acute and intensive care beds at Academic Hospital, both surgical and non-surgical. The value should be the close to that reported in the American Hospital Association annual survey.

850

First date of the start of the one year ( 365 day ) period to be studied

July 1, 2004

Name of county in which Academic Hospital is located

Benton

Alphabetical list of the names of counties that are contiguous to Benton county, regardless of how short is the common border. Include any counties that abut Benton county, even if they just touch. Include counties in adjacent states. PLEASE check spellings, because these entries will be aligned with U.S. Census data.

|          |        |         |         |              |  |  |  |  |  |
|----------|--------|---------|---------|--------------|--|--|--|--|--|
| Buchanan | Clarke | Fremont | Jackson | Williamsburg |  |  |  |  |  |
|----------|--------|---------|---------|--------------|--|--|--|--|--|

Yes or No questions specify availability of technological services at Academic Hospital. For each response, select ' Yes ' if there were at least 3 discharges or outpatient visits for such care between 7/1/2004 and 6/30/2005. Usually these questions are answered from general knowledge of the hospital. I provided DRG's solely if you wish to investigate the services provided at Academic Hospital.

|     |  |
|-----|--|
| Yes | Trauma care ( e.g., DRG 2, 27 – 30, 83, 84, 250 – 255, 280 – 282, 444 – 446, 484 – 487, or 506 – 509 ) |
| Yes | Cardiac surgery ( e.g., DRG 103 – 109, 135 – 137, or 525 )   |
| Yes | Solid organ transplantation ( e.g., DRG 103, 302, 480, 481, 495, 512, or 513 )                         |
| Yes | Cardiac catheterization ( e.g., DRG 104, 106, 107, 124, 125, or 514 )                                  |
| Yes | Urological lithotripsy ( e.g., DRG 323, but do not just limit to hospitalizations )                    |
| Yes | Neonatal intensive care ( e.g., DRG 386 – 390 )  |
| Yes | Megavoltage radiation therapy ( e.g., DRG 409, but be sure to include the outpatient visits )          |
| Yes | Magnetic resonance imaging   |

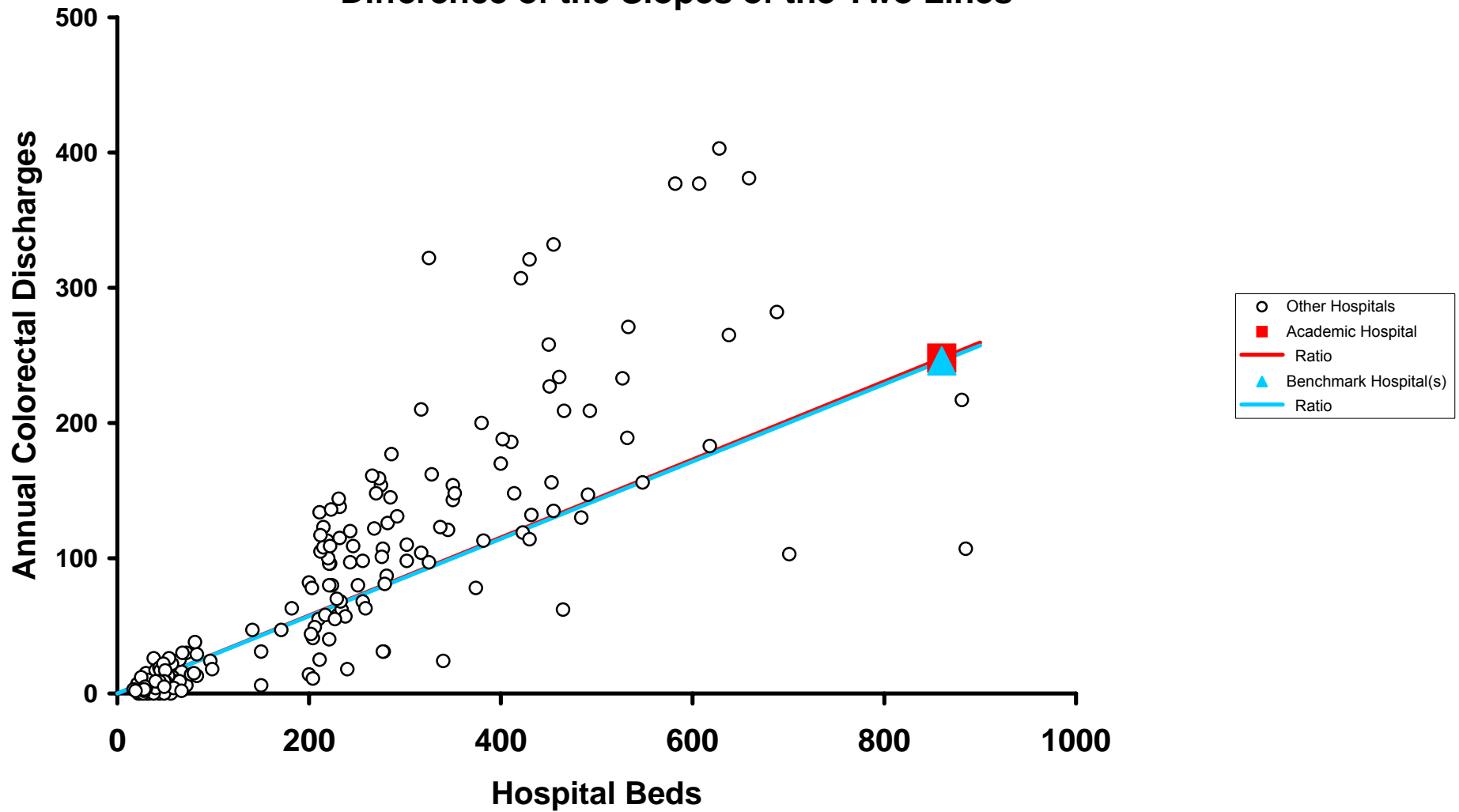
Enter the number of hospital discharges during the one year (365 days) period chosen above, 7/1/2004 to 6/30/2005. Enter how many different surgeons performed the procedure at least 3 times during the year at Academic Hospital. Include a patient if the DRG matches or if any of the ICD-9-CM procedure codes match, primary or secondary. The appropriate DRG and ICD-9-CM are listed below.

| Discharges | Surgeons | Clinical Classifications Software (CCS) description of the procedure(s) |
|------------|----------|---|
| 144        | 12       | AAA; Aortic resection, replacement or anastomosis (CCS 52)              |
| 284        | 5        | CABG; Coronary artery bypass graft (CCS 44)                             |
| 248        | 19       | Colorectal resection (CCS 78)   |
| 575        | 18       | Craniotomy in adults, not for trauma (DRG 1 or 2)                       |
| 271        | 11       | Hip replacement, total and partial (CCS 153)                            |
| 304        | 19       | Hysterectomy, abdominal and vaginal (CCS 124)                           |
| 151        | 3        | Lung resection (CCS 36)   |
| 164        | 9        | Nephrectomy, partial or complete (CCS 104)                              |

Craniotomy is based on DRGs. The other procedures use the CCS grouping of ICD-9-CM. To facilitate your data exporting, each CCS's ICD-9-CM can be copied from the columns below. Alternatively, click on <http://www.hcup-us.ahrq.gov/toolssoftware/ccs/ccsfactsheet.jsp>

|      |          |            | Hip         |              | Lung      |             |
|------|----------|------------|-------------|--------------|-----------|-------------|
| AAA  | CABG     | Colorectal | Replacement | Hysterectomy | Resection | Nephrectomy |
| 3834 | 3610     | 4571       | 8151        | 683 3221     |           | 554         |
| 3844 | 3611     | 4572       | 8152        | 684 3222     |           | 5551        |
| 3864 | 3612     | 4573       | 8153        | 685 3229     |           | 5552        |
| 3971 | 3613     | 4574       |             | 6831         | 323 5553  |             |
| 3979 | 3614     | 4575       |             | 6851         | 324 5554  |             |
|      | 3615     | 4576       |             | 6859         | 325       |             |
|      | 3616     | 4579       |             | 686          |           |             |
|      | 3617     | 458 687    |             |              |           |             |
|      | 3619     | 4841       |             | 689          |           |             |
|      | 362 4849 |            |             |              |           |             |
|      | 363 485  |            |             |              |           |             |
|      | 3631     | 4861       |             |              |           |             |
|      | 3632     | 4862       |             |              |           |             |
|      | 3639     | 4863       |             |              |           |             |
|      |          | 4864       |             |              |           |             |
|      |          | 4865       |             |              |           |             |
|      |          | 4869       |             |              |           |             |

## Productivity Ratio Equals Percentage Difference of the Slopes of the Two Lines



## Productivity Ratios for Academic Hospital

|                 | AAA  | CABG | Colorectal | Craniotomy  | Hip Replacement | Hysterectomy | Lung Resection | Nephrectomy |
|-----------------|------|------|------------|-------------|-----------------|--------------|----------------|-------------|
| <b>Beds</b>     | 50%  | -50% | 0%         | 210%        | -30%            | -10%         | 120%           | 210%        |
| <b>County</b>   | 140% | -20% | 60%        | <b>410%</b> | 10%             | 40%          | 250%           | <b>410%</b> |
| <b>Region</b>   | 120% | -20% | 50%        | 360%        | 0%              | 30%          | 220%           | 360%        |
| <b>Surgeons</b> | 90%  | -30% | 30%        | 310%        | -10%            | 10%          | 190%           | 310%        |
| <b>Tech.</b>    | 140% | -20% | 60%        | <b>410%</b> | 10%             | 40%          | 250%           | <b>410%</b> |

Data envelopment analysis chooses automatically those outputs and inputs that make Academic Hospital appear as efficient as possible. Those are the output and input combinations highlighted in bold red. The super-efficiency score of the hospital equals 100% plus the listed bold red value. Productivity ratios equal the ratios of (hospital's output / hospital's input) expressed as percentage differences from that of the corresponding benchmark hospital(s). For inputs, focus on the largest (most positive) values, as those are the bottlenecks to increased surgery. For outputs, focus on the smallest (most negative) values, as those are the specialties with the weakest market capture.

## Gaps for Academic Hospital

|                                     | Weight | AAA  | CABG | Colorectal | Craniotomy | Hip Replacement | Hysterectomy | Lung Resection | Nephrectomy |
|-------------------------------------|--------|------|------|------------|------------|-----------------|--------------|----------------|-------------|
| <b>Hospital 0</b>                   |        | 144  | 284  | 248        | 575        | 271             | 304          | 151            | 164         |
| Hospital 12                         | 0.77   | 43   | 215  | 130        | 106        | 202             | 176          | 28             | 21          |
| Hospital 126                        | 0.13   | 52   | 270  | 120        | 35         | 147             | 171          | 48             | 27          |
| Hospital 153                        | 0.24   | 85   | 577  | 156        | 115        | 274             | 235          | 62             | 53          |
| Benchmark<br>(Weighted combination) |        | 60   | 340  | 153        | 114        | 241             | 214          | 43             | 32          |
| Difference                          |        | -84  | 56   | -95        | -461       | -30             | -90          | -108           | -132        |
| Gap                                 |        | -58% | 20%  | -38%       | -80%       | -11%            | -29%         | -72%           | -80%        |

The same weight is applied to all procedures at each hospital. The weights are a direct consequence of the selection of inputs and outputs to make Academic Hospital appear as efficient as possible. The gap is the ratio of the difference to the current count of cases. A negative gap infers that more cases are being done than expected from the benchmark hospital(s). A positive gap shows the potential of Academic Hospital to increase its workload for the specialty.