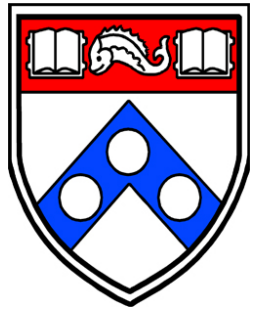
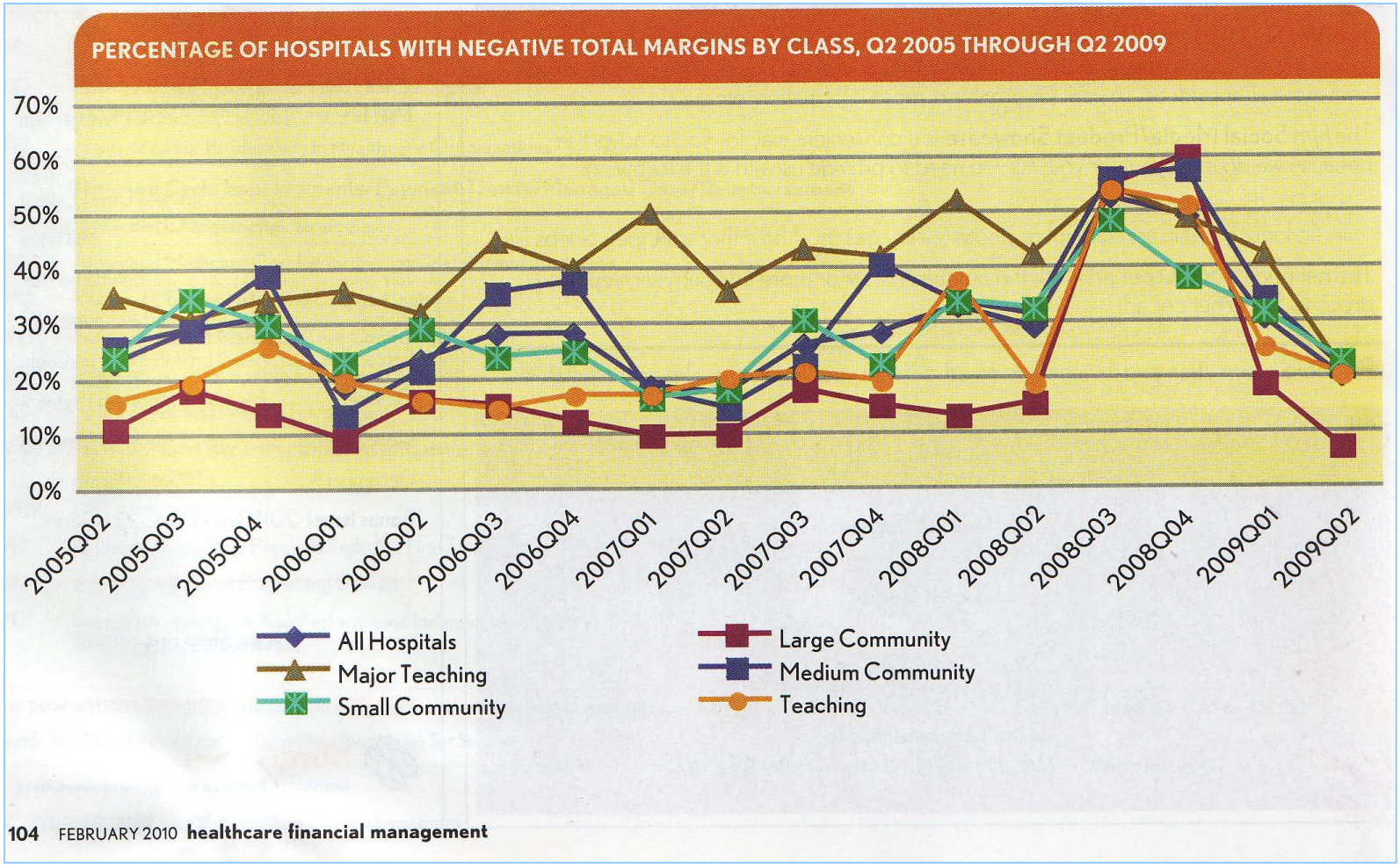
HFMA Philadelphia Chapter
Data Analytics Boot Camp

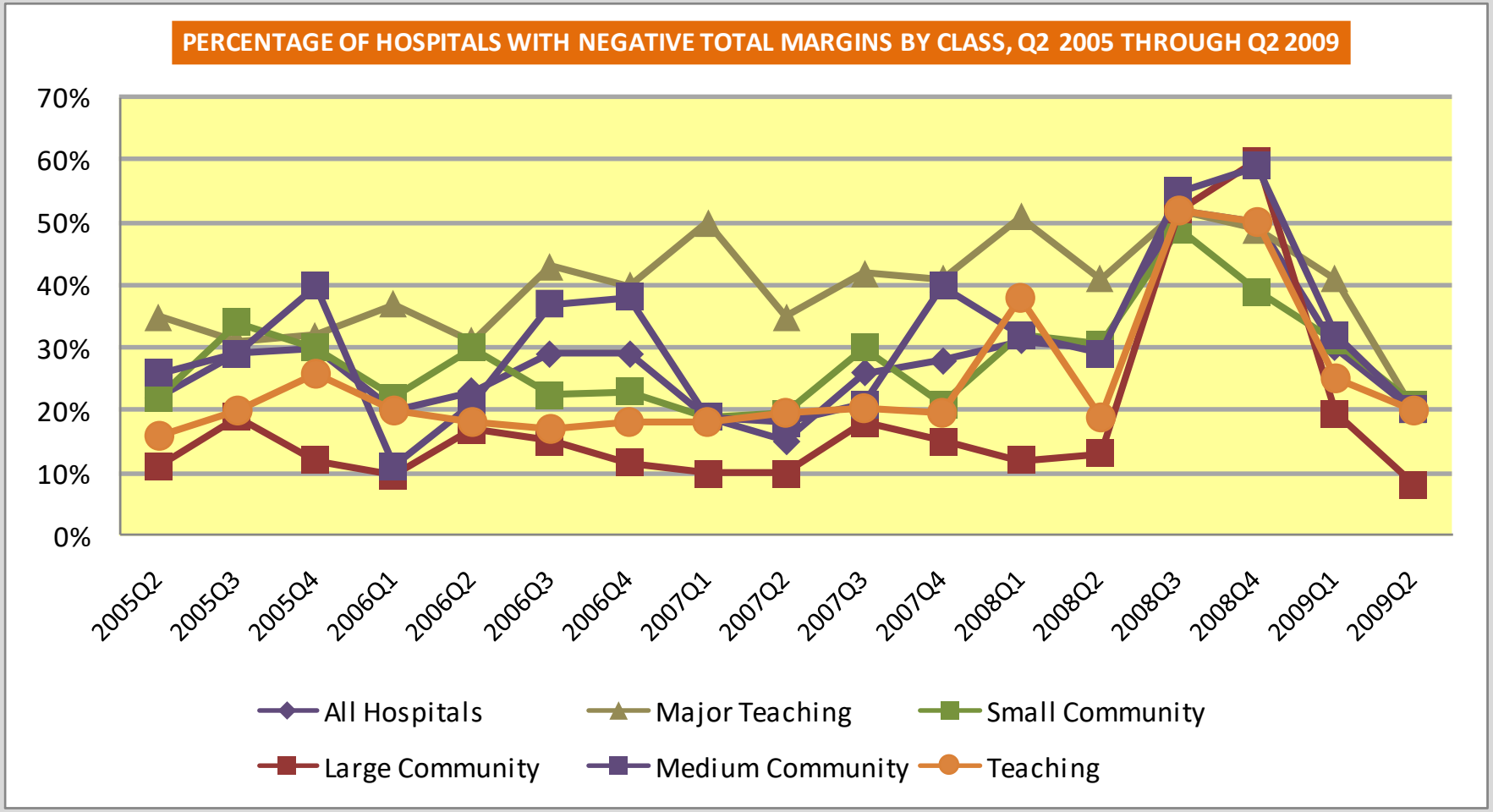
Data Visualization:
Developing Effective Graphical Presentations

Paul Junker, MS
Penn Medicine
March 29, 2017



HFMA Graph


PERCENTAGE OF HOSPITALS WITH NEGATIVE TOTAL MARGINS BY CLASS, Q2 2005 THROUGH Q2 2009
70%
60%
50%
40%
30%
20%
10%
0%
2005Q02
2005Q03
2005Q04
2006Q01
2006Q02
2006Q03
2006Q04
2007Q01
2007Q02
2007Q03
2007Q04
2008Q01
2008Q02
2008Q03
2008Q04
2009Q01
2009Q02
All Hospitals
Major Teaching
Small Community
Large Community
Medium Community
Teaching
104 FEBRUARY 2010 healthcare financial management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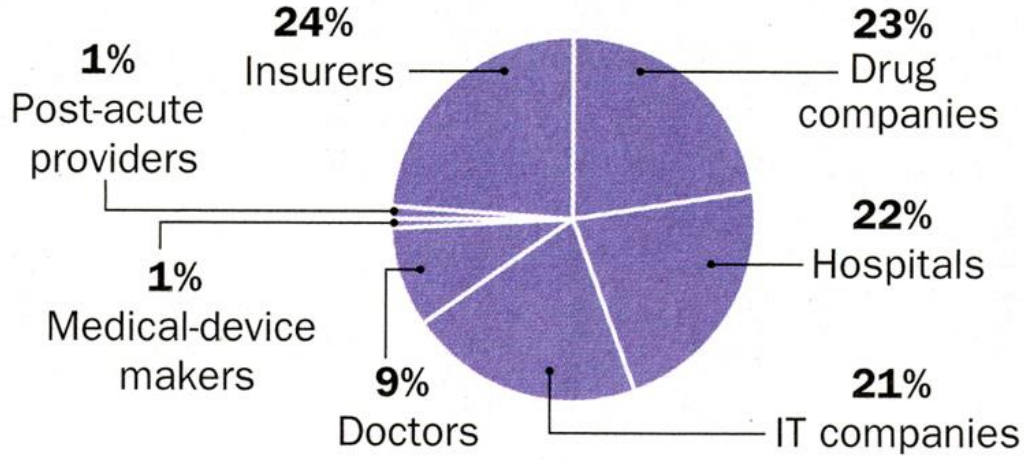
2007Q3
2007Q4
2008Q1
2008Q2
2008Q3
2008Q4
2009Q1
2009Q2
All Hospitals
Major Teaching
Small Community
Large Community
Medium Community
Teaching

Modern Healthcare Chart

Does this graph communicate its message?

READERS SEE INSURERS, DRUG FIRMS AMONG REFORM BENEFICIARIES

Who will benefit most from the new healthcare reform legislation? Not doctors, post-acute providers and devicemakers, according to respondents participating in a *Modern Healthcare* online poll

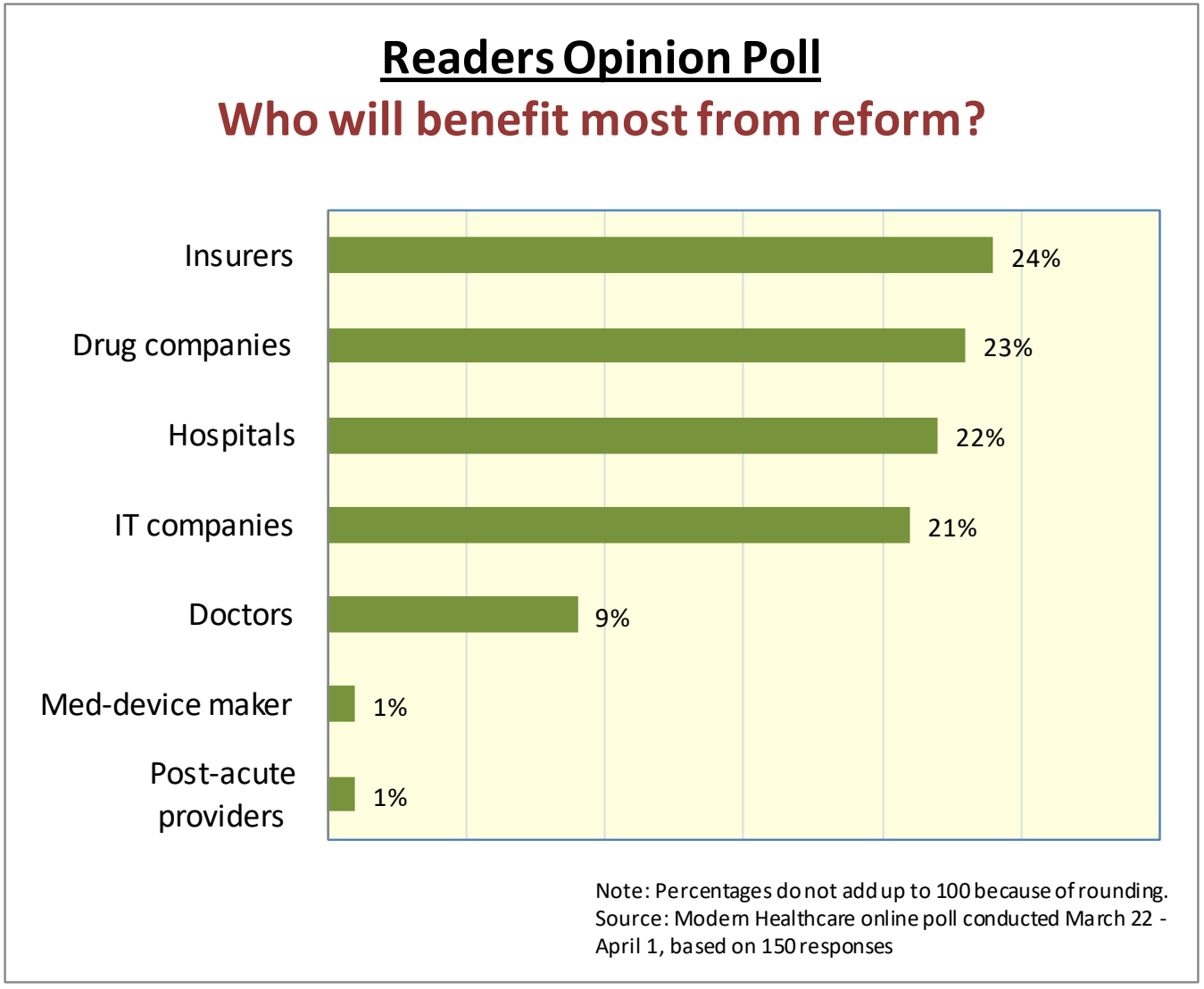


Note: Percentages do not add up to 100 because of rounding.

Source: Modern Healthcare online poll conducted March 22-April 1, based on 150 responses

Modern Healthcare, 4/5/2010, page 19

Modern Healthcare Chart – one possible alternative



Recreation of graph from:
Modern Healthcare, 4/5/2010, page 19

Show me the money!

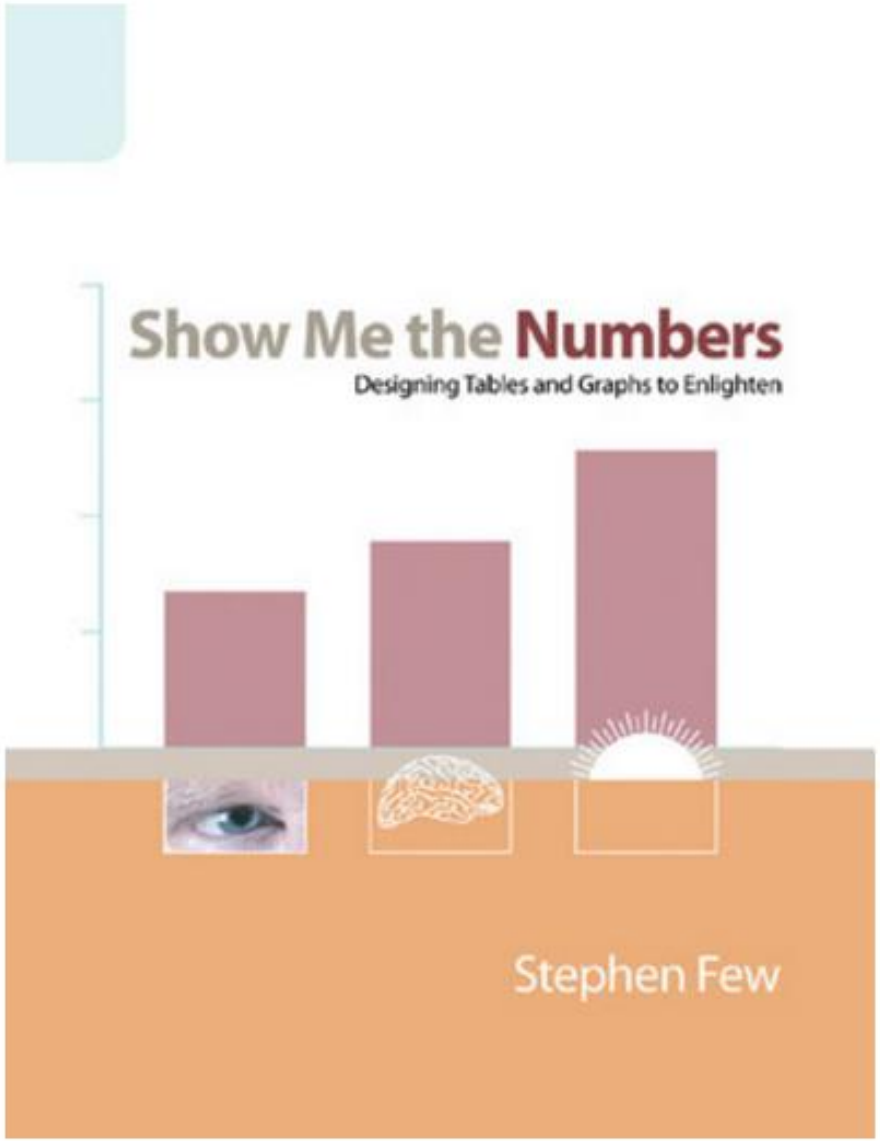
"Over the past five years, demand for data analysts has grown by **372%**"

"[For analysts] demand for data-visualisation skills has shot up by **2,574%**."

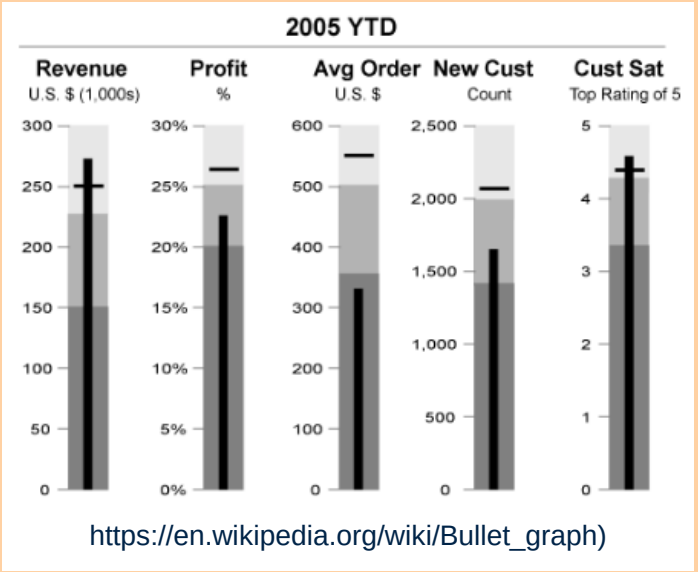
The Economist, Jan-14-2017, "Lifelong learning is becoming an economic imperative"

VISUALIZATION LEADERS

Stephen Few – The Data Presentation Guru!



Principal,
Perceptual Edge
Created Bullet Graph



https://en.wikipedia.org/wiki/Bullet_graph)

Edward Tufte – Professor Emeritus, Yale

- Popularized Sparklines (and much more)
- Does not like .ppt (ignore the irony here!)
- Graphics tend to be as much art as graphs
- www.edwardtufte.com

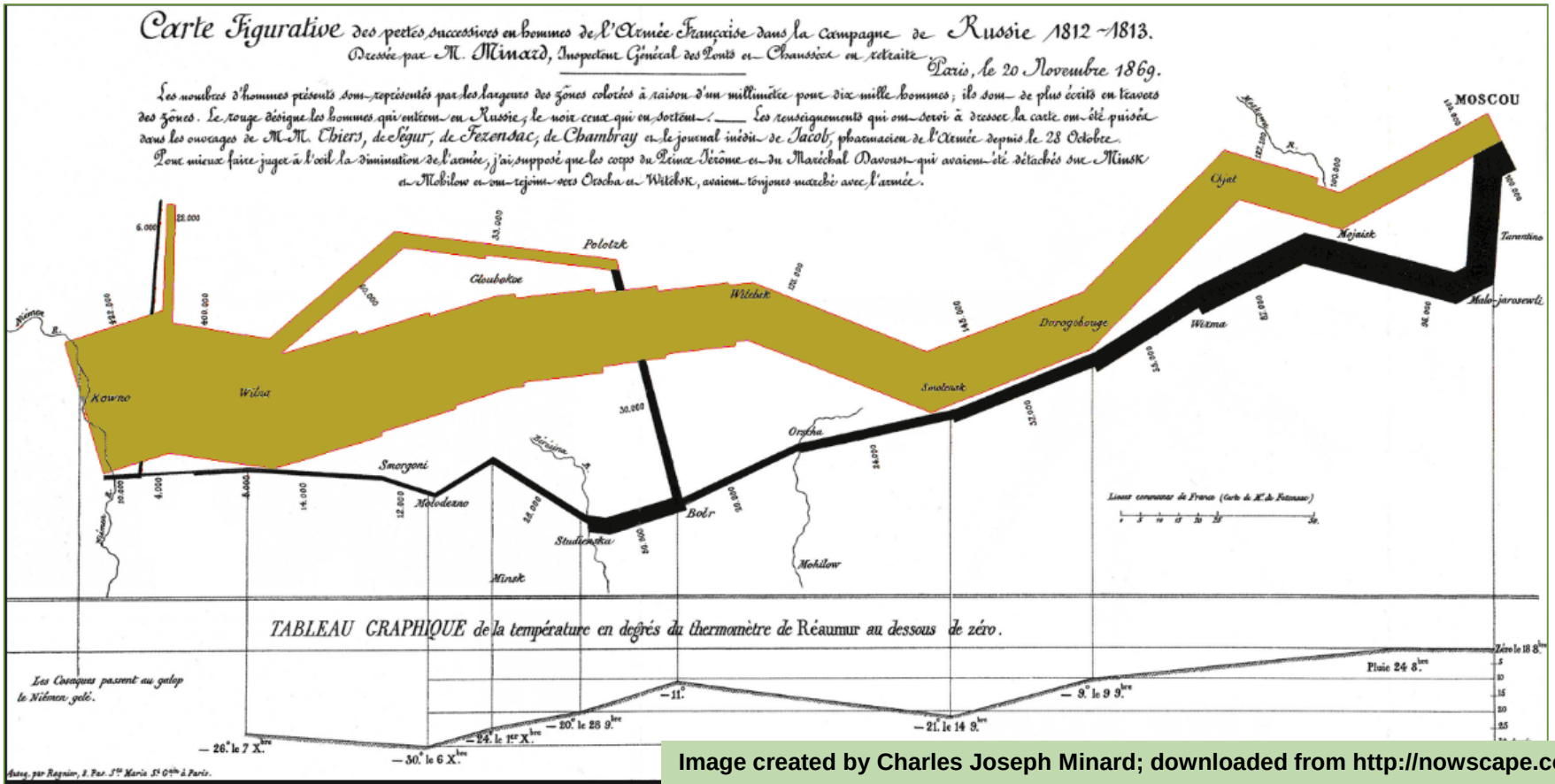


Image created by Charles Joseph Minard; downloaded from http://nowscape.com

Jana Schaich Borg – Duke University Neuroscientist Post-Doc

Professor

www.coursera.org

Specialization: Excel to MySQL: Analytic Techniques for Business

Images courtesy: www.clipartbest.com

Goals

- **Improve Excel graphing skills, esp. for novices**
- **Educate about good vs. bad graph design**
- **Expose some new visualization ideas**
- **Ultimate goal of a graph is to accurately communicate information**
  - "Simplicity in Design" – Stephen Few (pg 39 Show Me the Numbers)
- **Evaluate slides as we go through – decide what you like and don't like!**

Graphs versus Tables

- **Graphs**
  - Interpreted visually – all at once
  - Used to demonstrate patterns or shape of data
  - Demonstrate relationships between data
  - Highlight exceptions if present

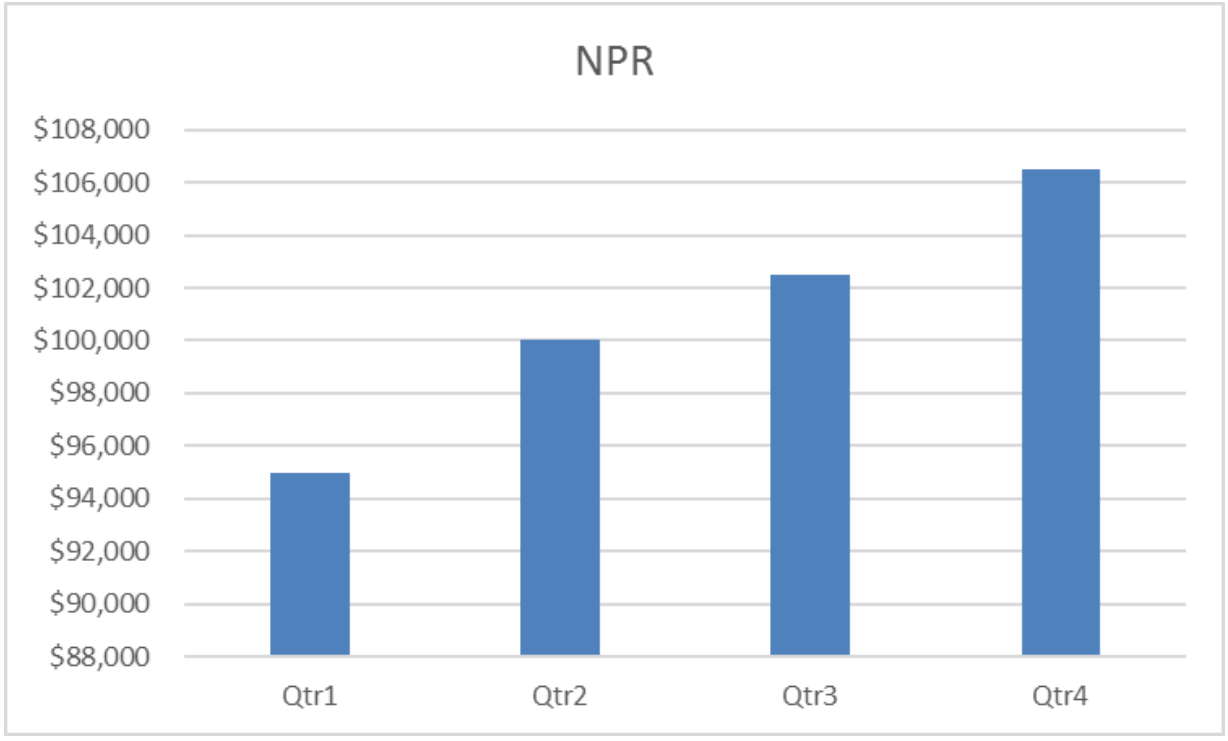
- **Tables** (not being covered in this presentation, but see end of slide deck if interested)
  - Interpreted verbally - sequentially
  - Best for:
    - Presenting actual values
    - Precise values are required and will be compared
    - Data has multiple units of measures: EG, dollars, admissions, ratios
    - Many sets of categorical data exist

Bar and Column charts

- **Emphasizes distinct categories**
  - Except for time-series, best to keep to less than seven categories
- **Should always begin at zero**
- **To highlight specific categories:**
  - Using Position is best – rank or sequential especially
  - Using Color is next best – avoid red & green in same graph
  - Using Density also good – especially if photocopying possible
- **Usage**
  - Ranking
  - Time-series (though line-graph often better)
  - Categorical comparisons, EG hospitals

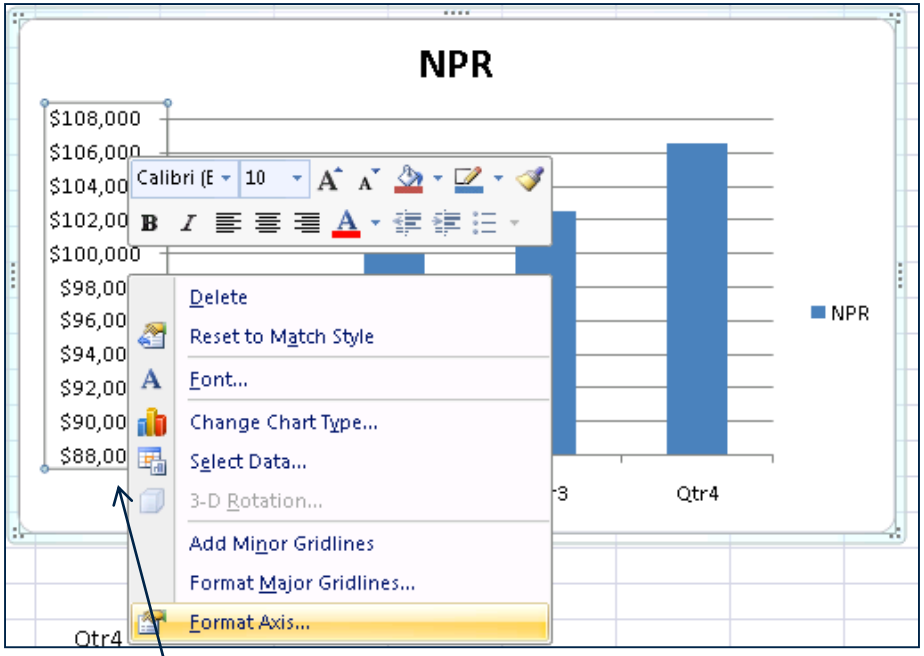
Column chart – start at zero

- **<u>Default</u> graph produced by Excel**
- **Notice the large in "increase" in NPR!!!!**
  - Need to change lower bound to $0

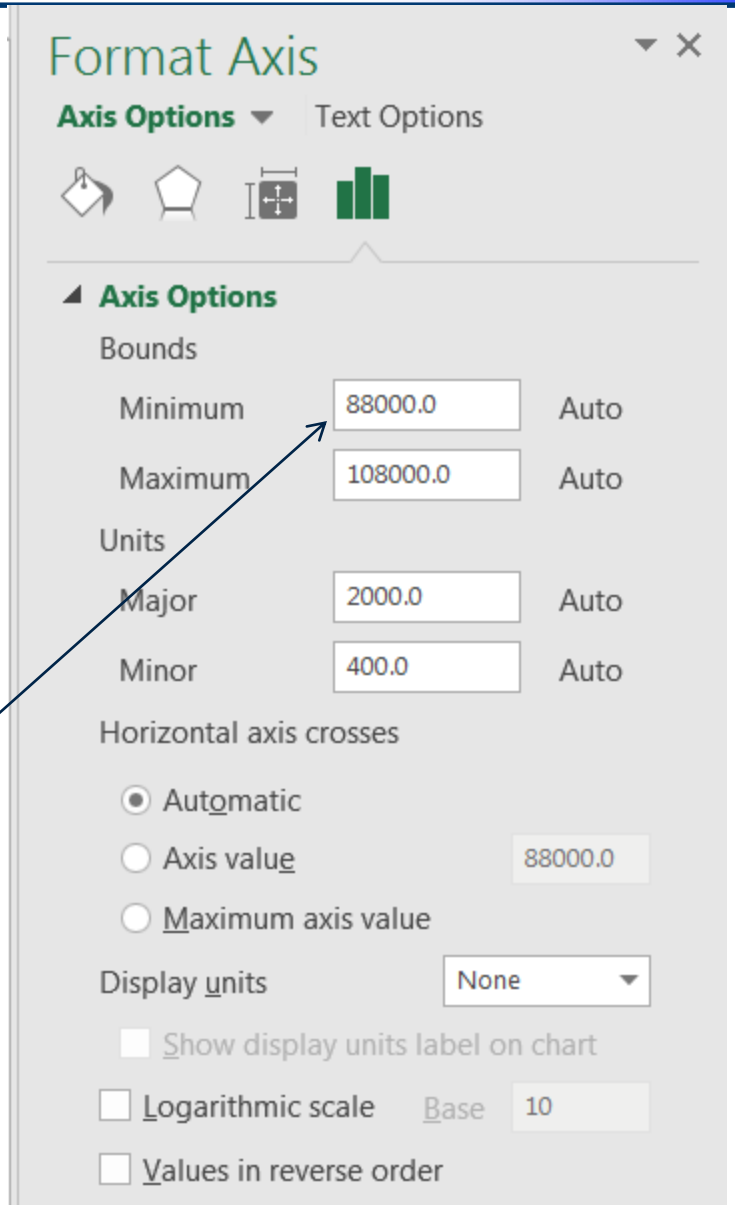


Quarter:	Qtr1	Qtr2	Qtr3	Qtr4
NPR:	$ 95,000	$ 100,000	$ 102,500	$ 106,500

Column chart – start at zero cont.

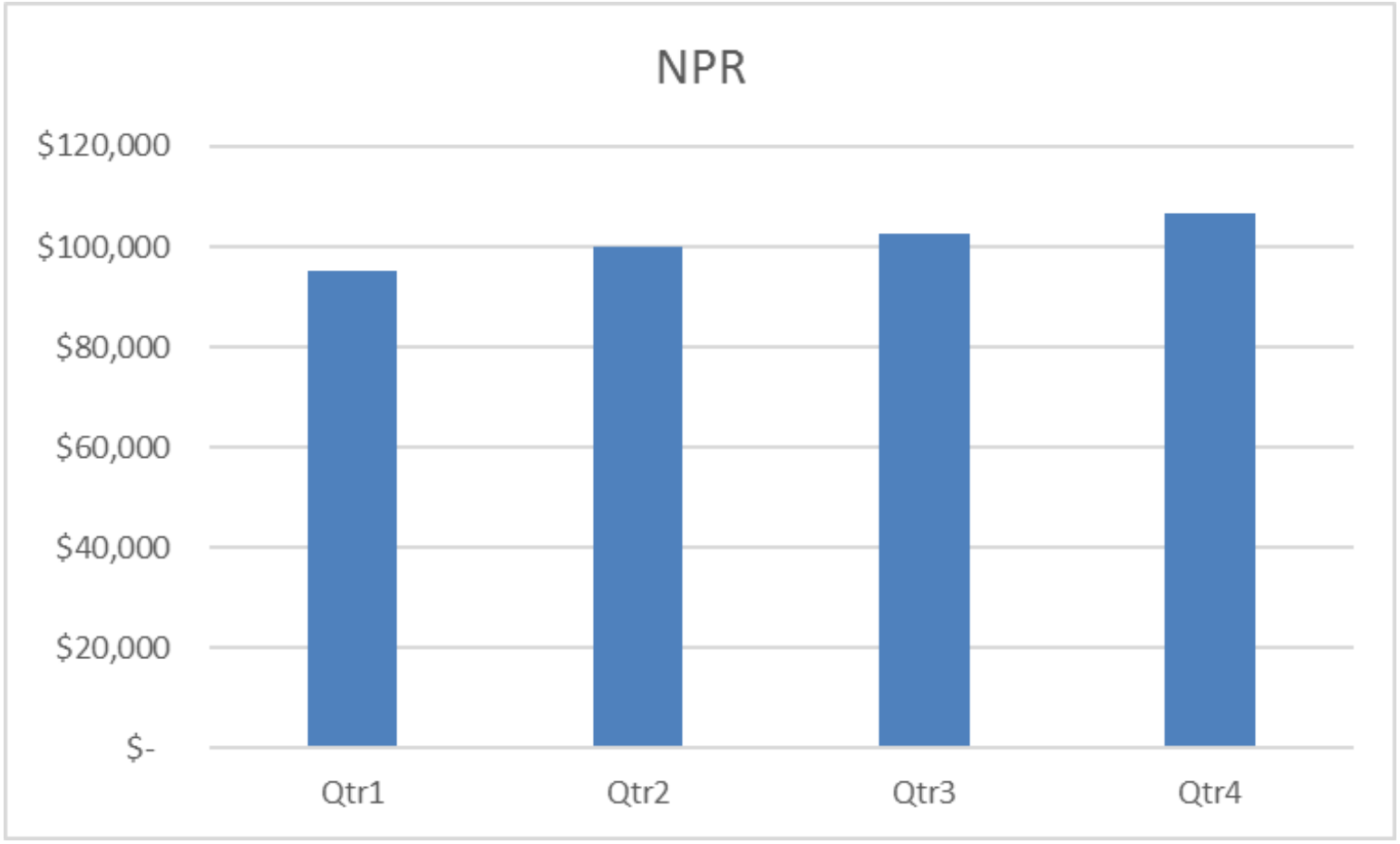


1. **Highlight Axis**
2. **Right Click, Format Axis**
3. **Change Minimum to: 0**



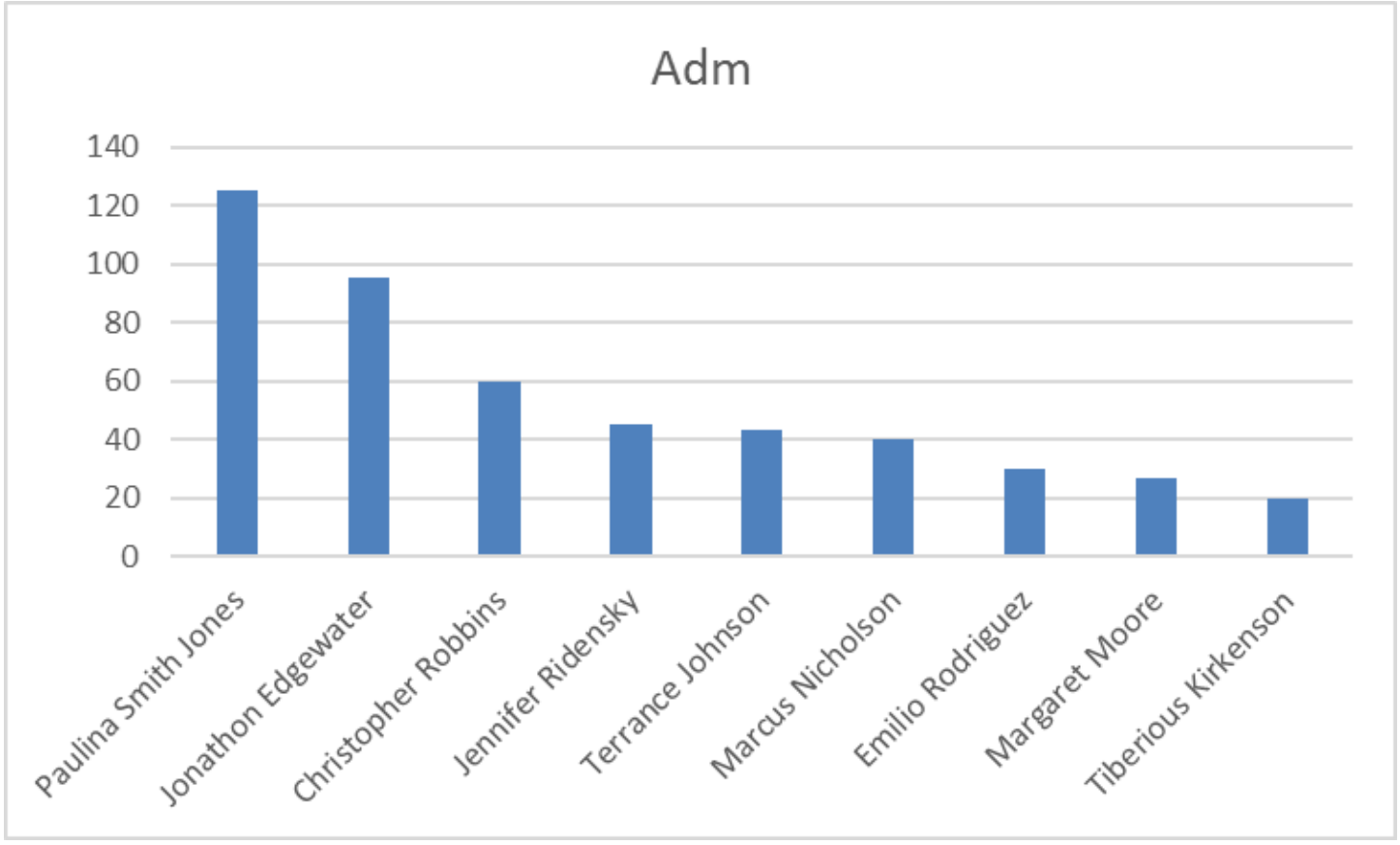
Column chart – start at zero cont.

- **Now the increase is proportional and does not look so dramatic**



Ranking Relationships

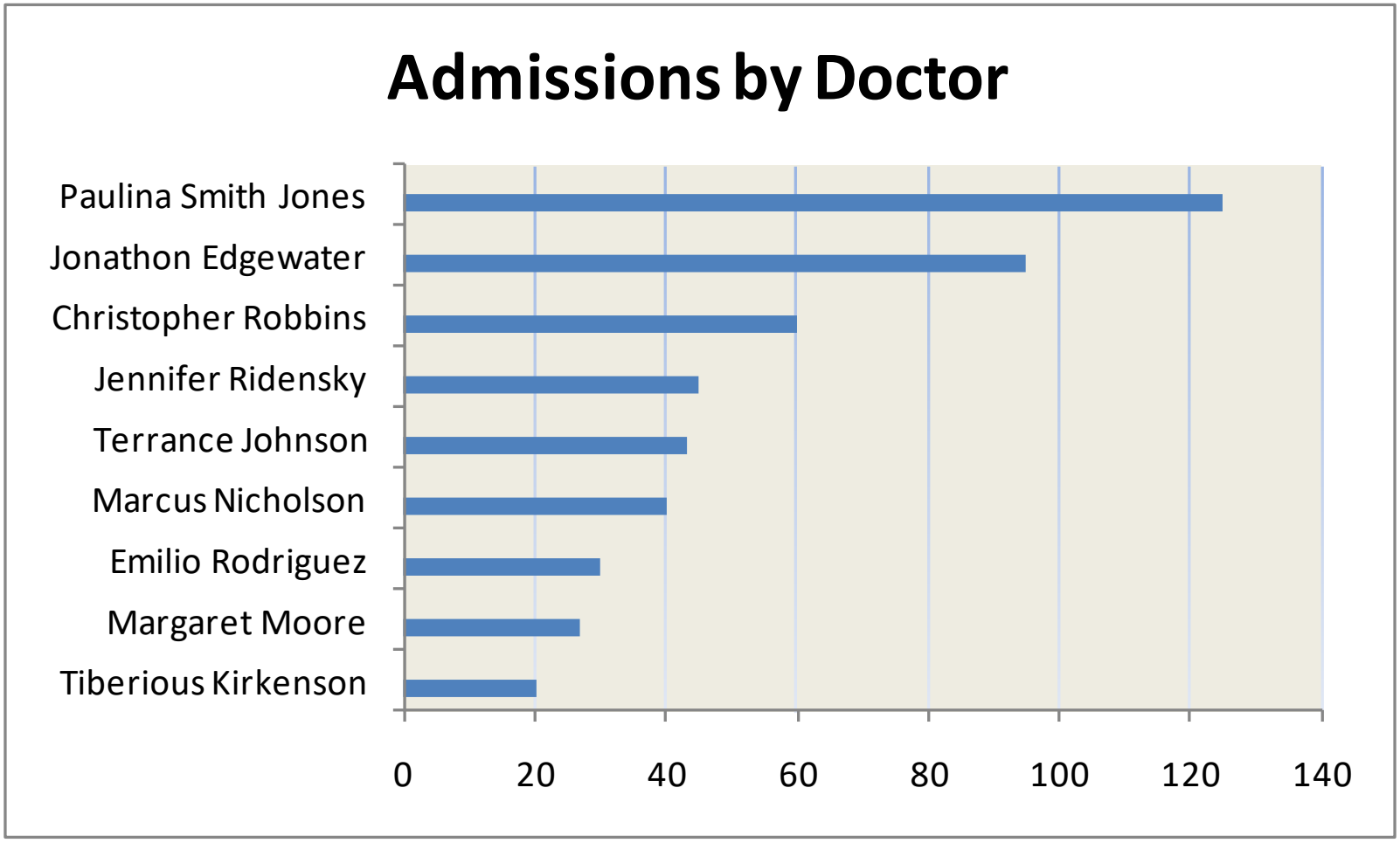
- Bar/Column charts excellent
- Below is default "column" chart – generated instantly using Alt-F1



What can we do to improve this?

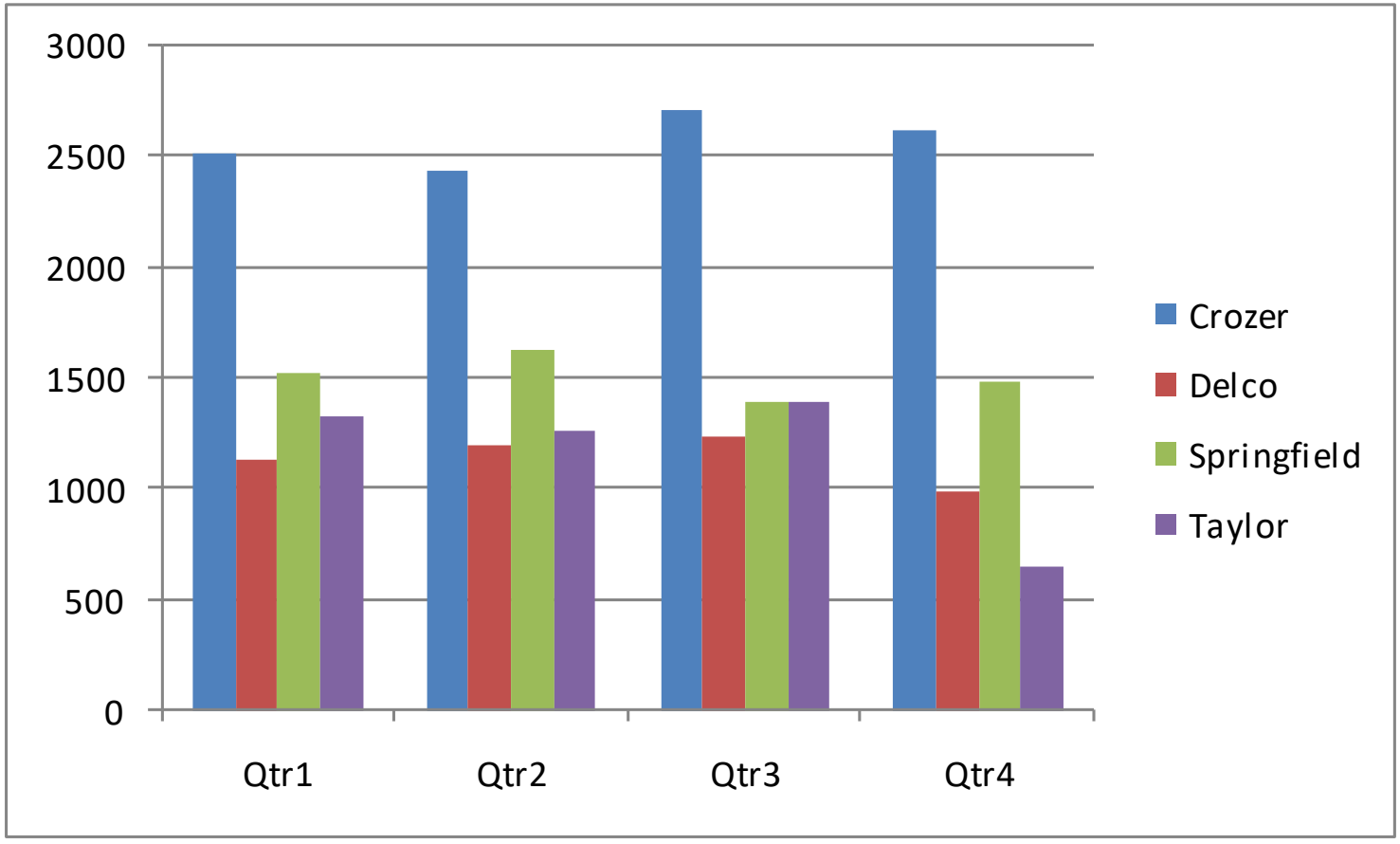
Ranking Relationship – improved chart

- Turned into a Bar chart - labels on left
- Title improved
- Gridlines set to "gradient"
- Background fill added



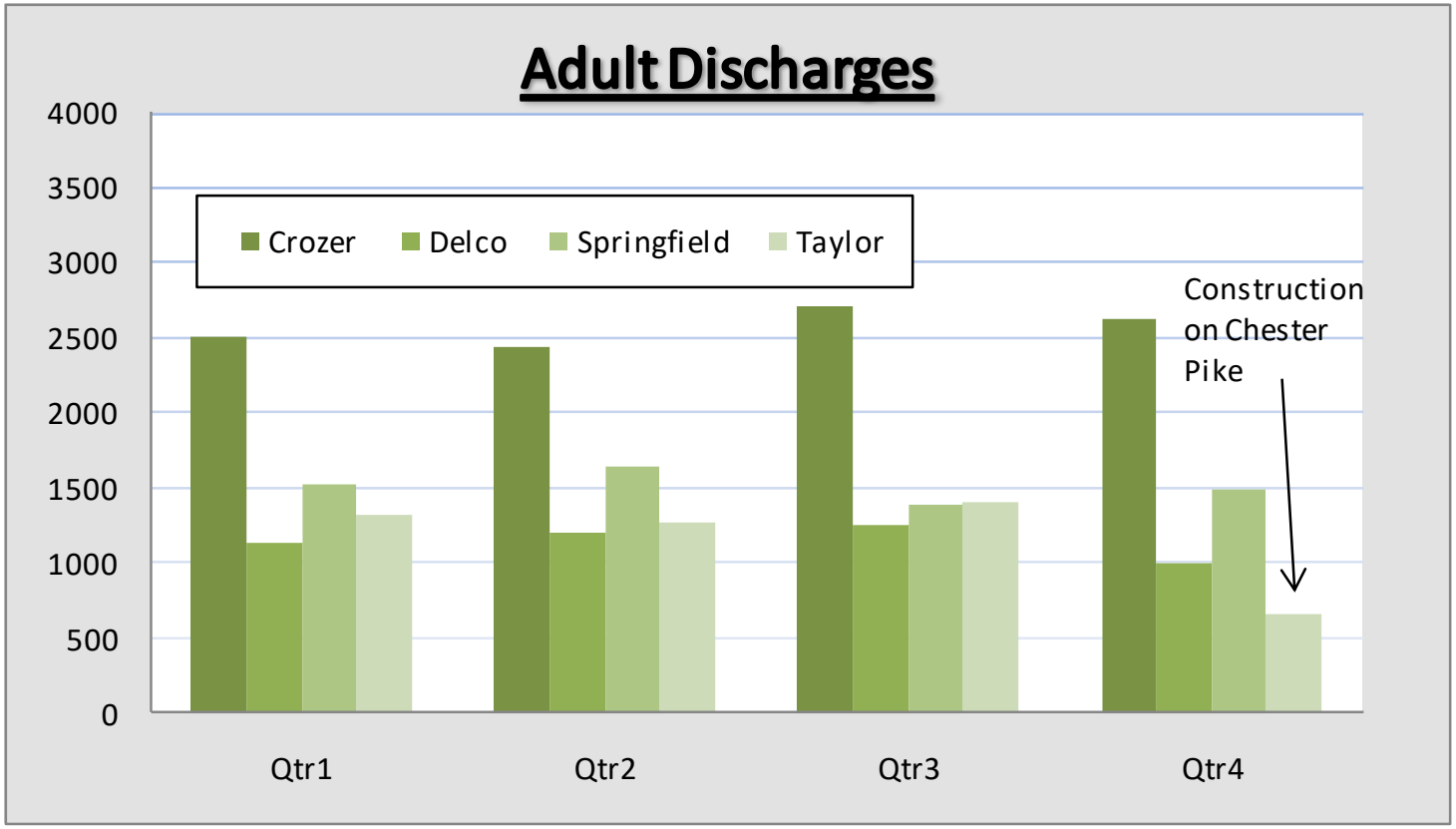
Column chart, four categories - default

- How can we improve? Assume chart will likely be photocopied.
- Note default colors have high color saturation



Note: Data Fictitious!

Column chart, four categories - Revised

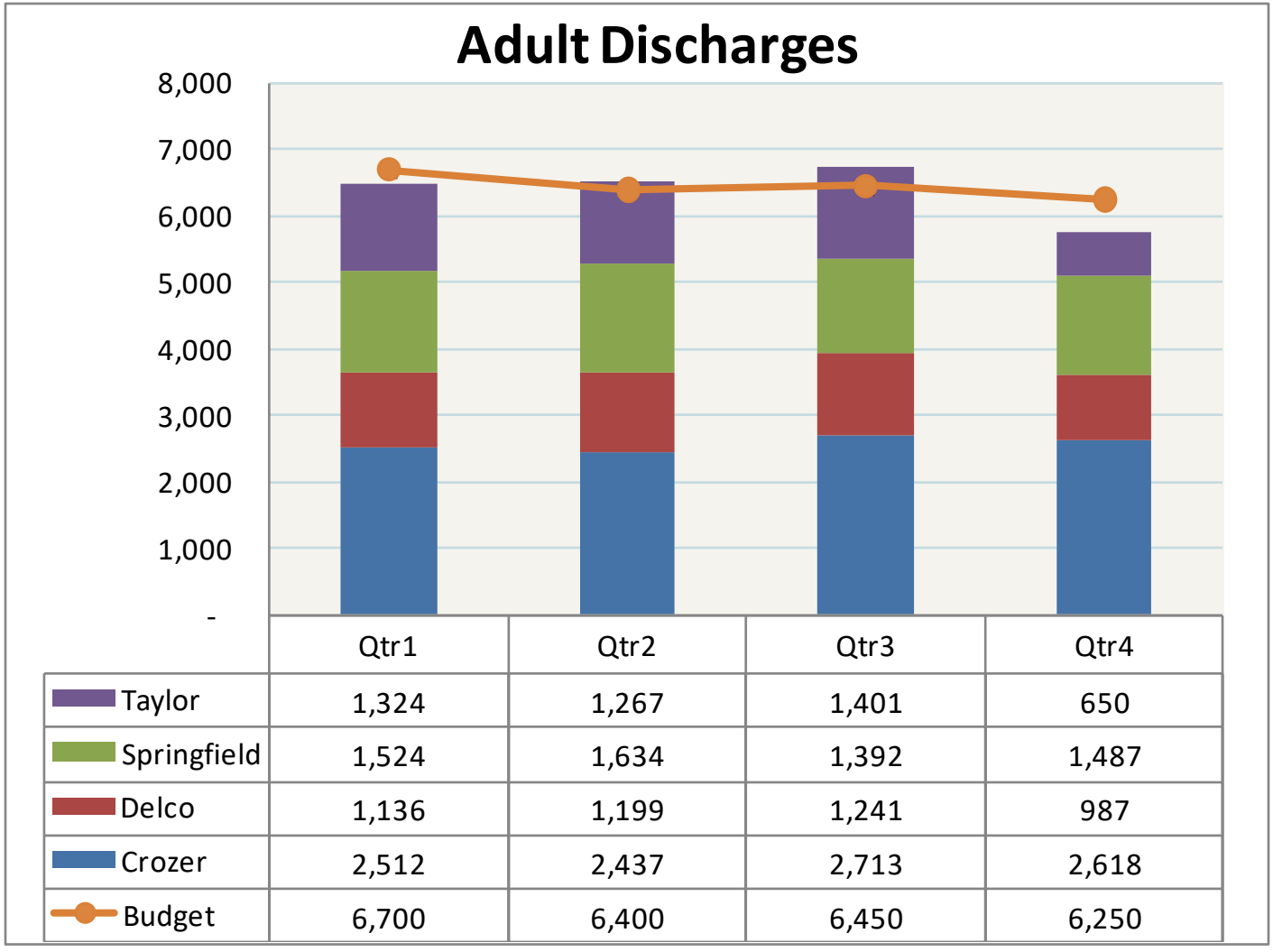


- Color changed to allow photocopying – density used instead
- Legend moved to ease individual hospital identification
- Note added to explain decrease in discharges
- Fill put around plot area so contrast is greater within fill area

Note: Data Fictitious!

Variance designs – column chart

- **Bar Chart – Actual Values; Line – Budgeted Values**



	Qtr1	Qtr2	Qtr3	Qtr4
Taylor	1,324	1,267	1,401	650
Springfield	1,524	1,634	1,392	1,487
Delco	1,136	1,199	1,241	987
Crozer	2,512	2,437	2,713	2,618
Budget	6,700	6,400	6,450	6,250

Excel 2016 Tip

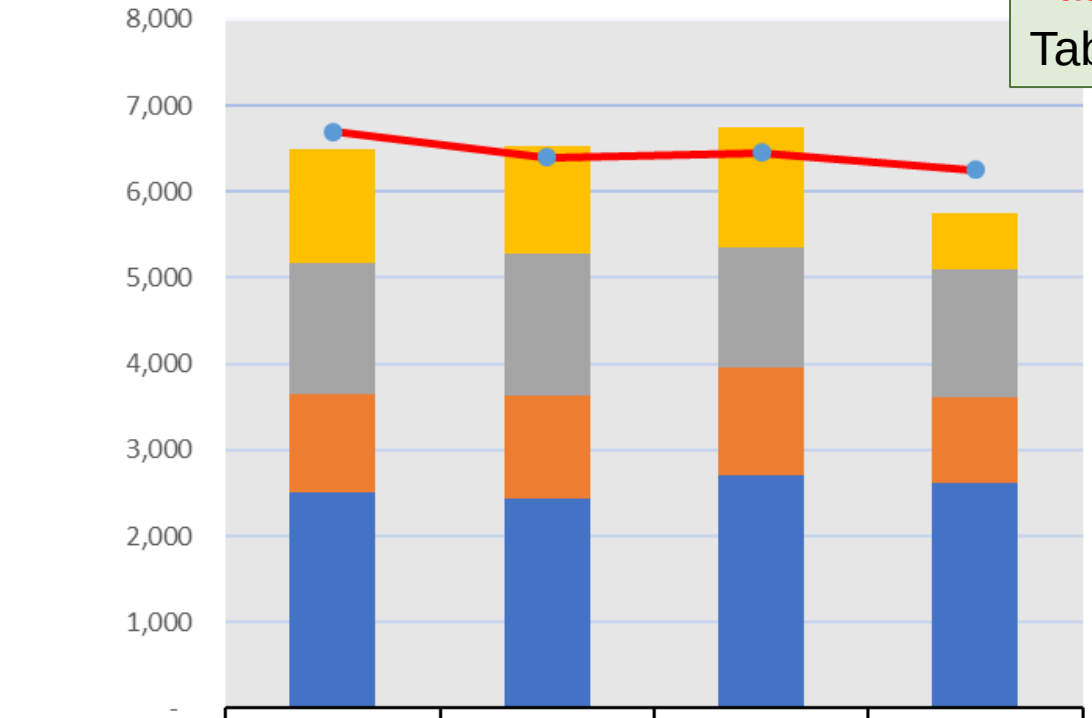
- **Create as Stacked Column Chart**
- **Highlighted "Budget" Data Series & right click**
- **Choose: Change Series Chart Type**
- **Select Line for "Budget" series**

Note: Data Fictitious!

Lessons thus far – column/bar charts

- **Legends can often be positioned better – even okay in plot area. Get as close to the data as possible.**
- **Column/bar charts should always start at zero**
- **Column/bar charts should not be used for more than 7 categories of data**
- **Default colors very saturated**
- **Use as little "non-data ink" as possible**
  - I do find it aesthetically pleasing to have a background color

Exercise 1



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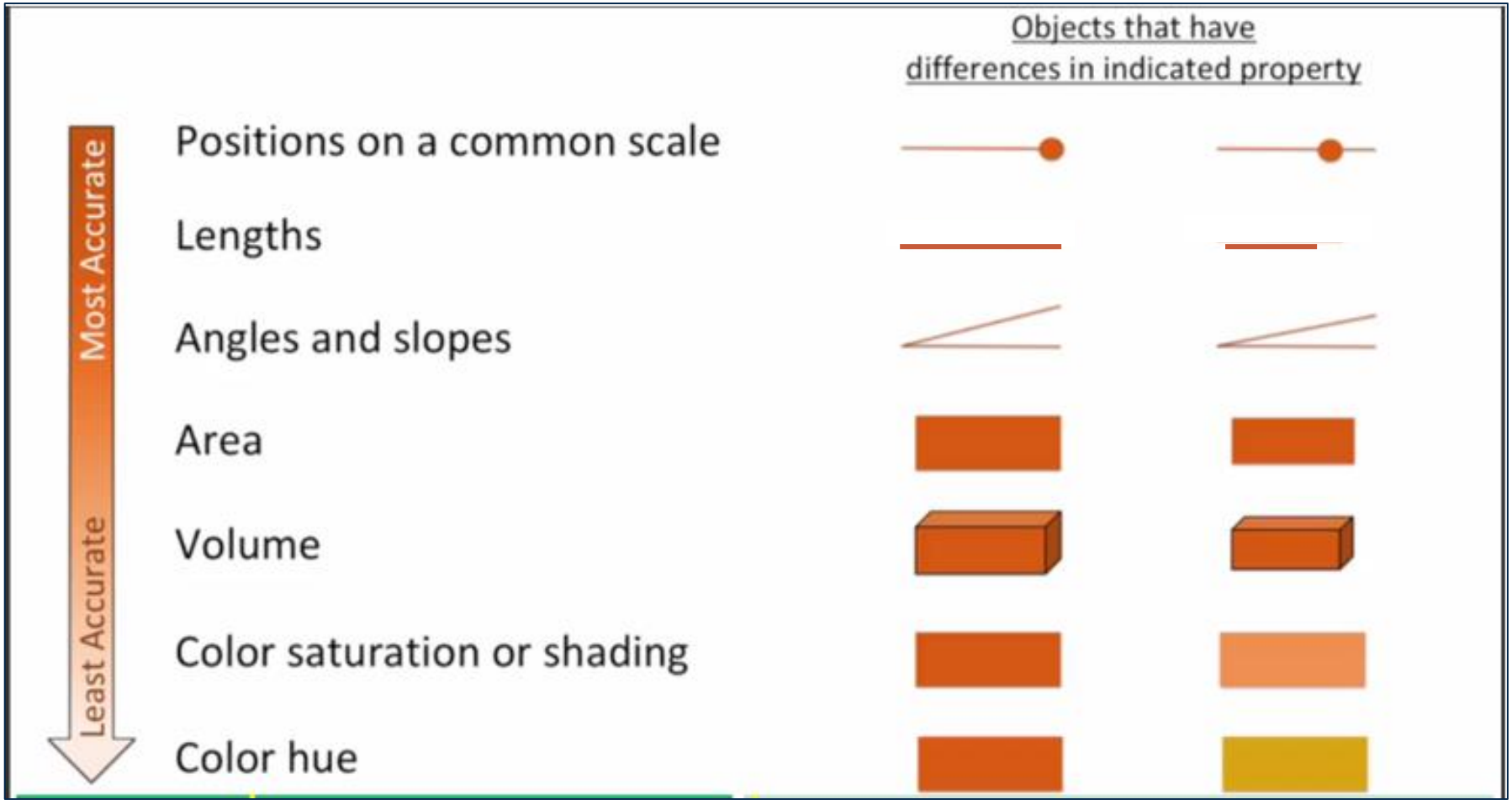
Budget	6,700	6,400	6,450	6,250

Recreate this graph

Paul Junker Exercise Files.xlsx

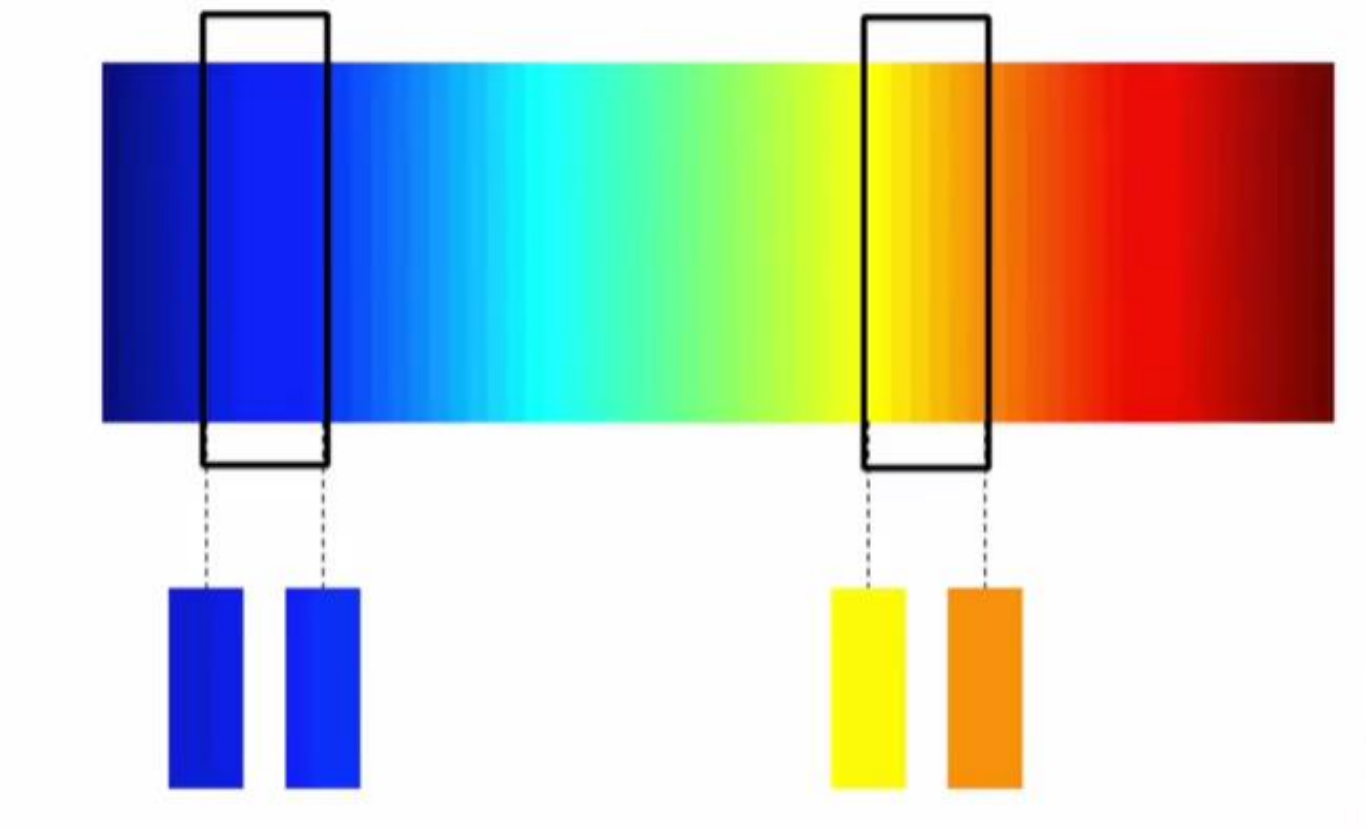
Tab: **Exer1 - Stacked Bar**

Visual Perception



Credit: Jana Schaich Borg, Neuroscientist, Duke University School of Medicine
www.coursera.org course: *Data Visualization and Communication with Tableau*

Visual perception



Both of these represent 1 unit numerical difference, which is not how human eyes interpret. Just be aware of this when creating colored heatmaps and maps.

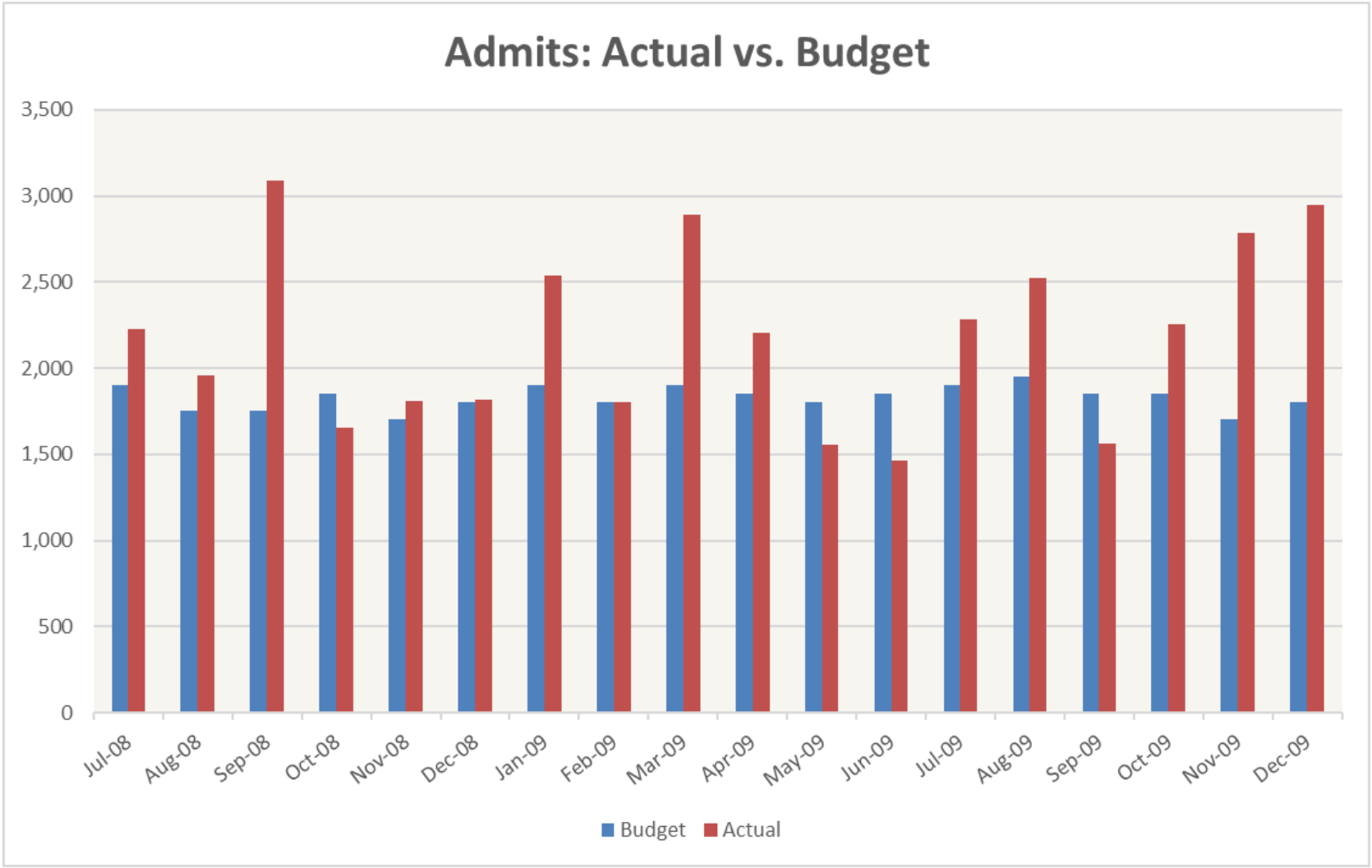
Credit: Jana Schaich Borg, Neuroscientist, Duke University School of Medicine
www.coursera.org: course Data Visualization and Communication with Tableau

Heatmap

Admits	First Date								
DOW	7/5/2009	7/12/2009	7/19/2009	7/26/2009	8/2/2009	8/9/2009	8/16/2009	8/23/2009	Grand Total
Sunday	49	52	45	42	47	37	43	34	349
Monday	95	86	100	83	110	74	86	92	726
Tuesday	111	109	97	107	109	119	93	102	847
Wednesday	83	92	115	101	82	104	84	74	735
Thursday	99	89	90	95	98	80	85	97	733
Friday	74	82	82	63	63	68	73	65	570
Saturday	42	43	48	56	26	52	43	45	355
Grand Total	**553**	**553**	**577**	**547**	**535**	**534**	**507**	**509**	**4,315**

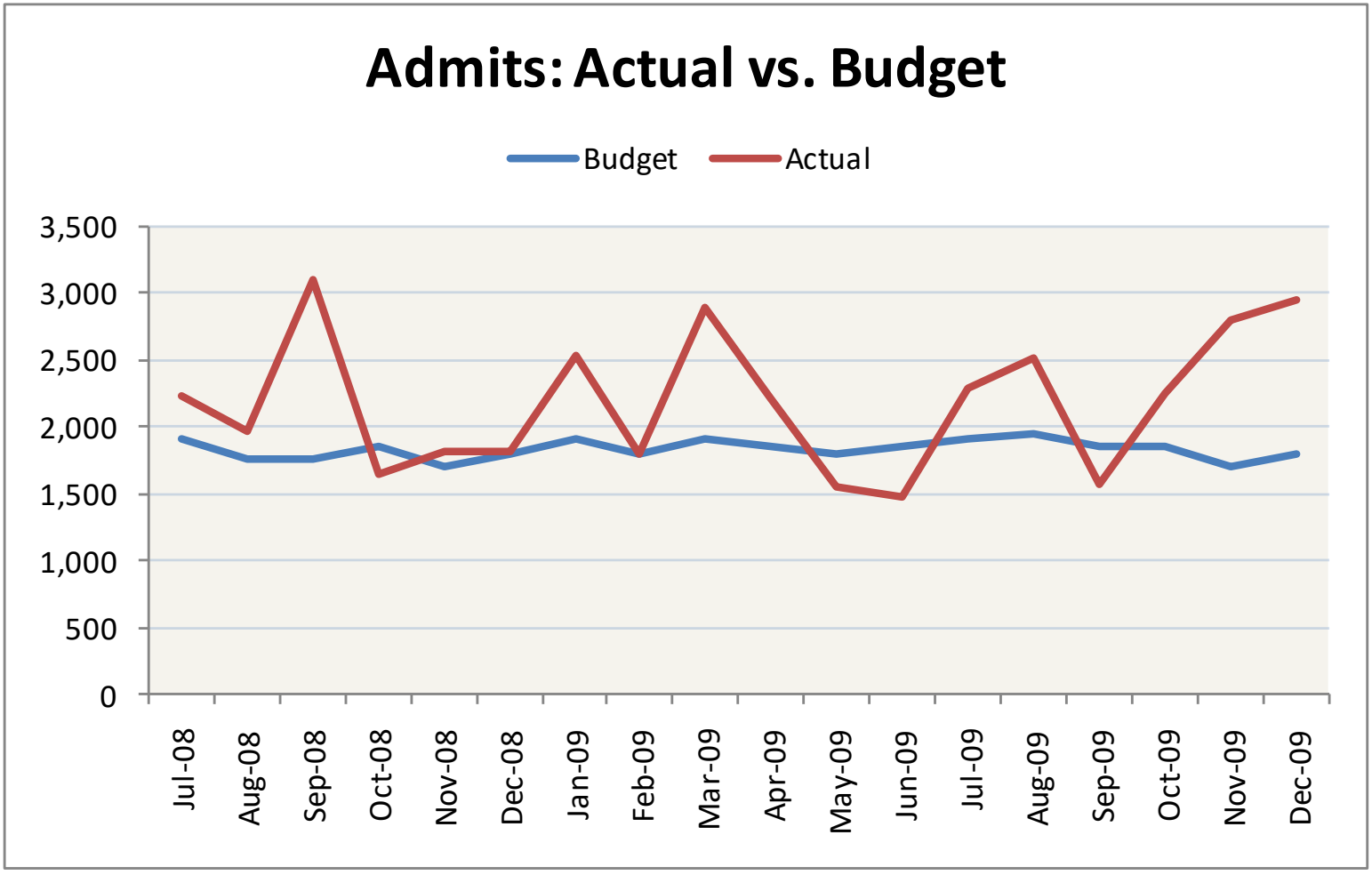
Variance Graphs

- This is a common column graph we've all seen.
- Which months are under budget?



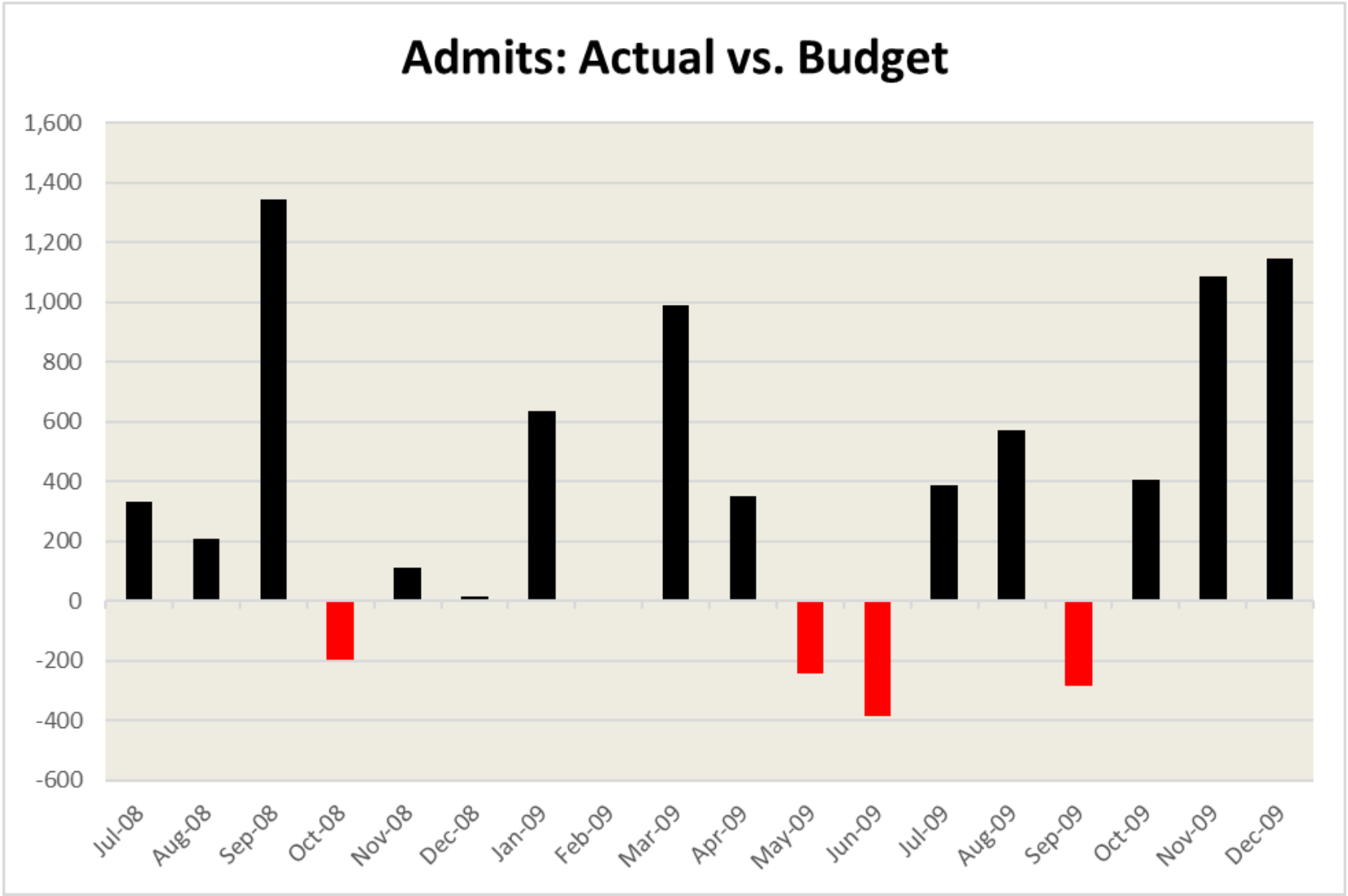
Variance designs – line graph

- **A basic line graph. What are some things we can do to improve?**



Variance designs – column/bar chart

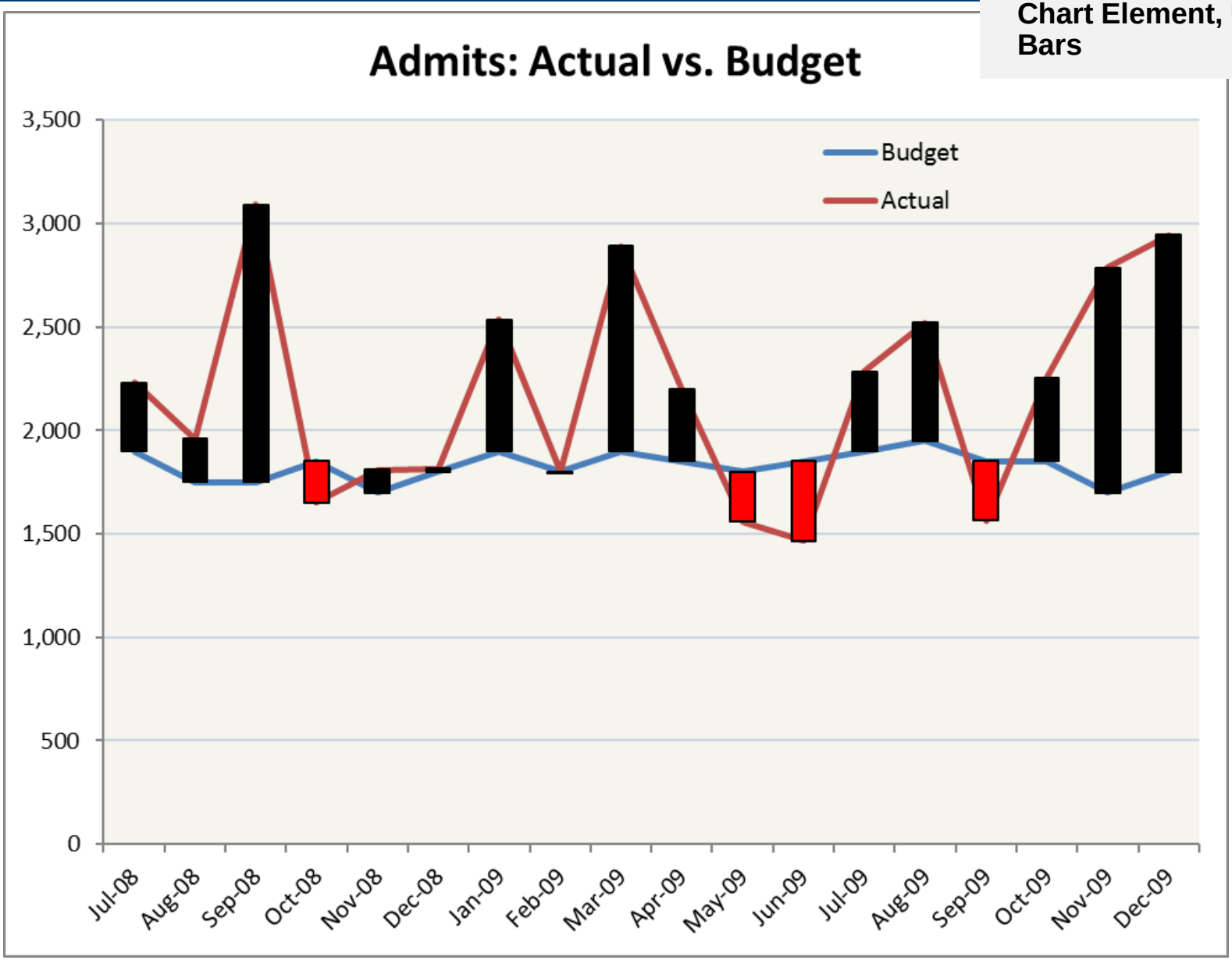
- Coloring positive and negative variances differently helps interpretation
- Note: this graph still starts at zero



Variance designs – Up/Down bars

Excel Tip

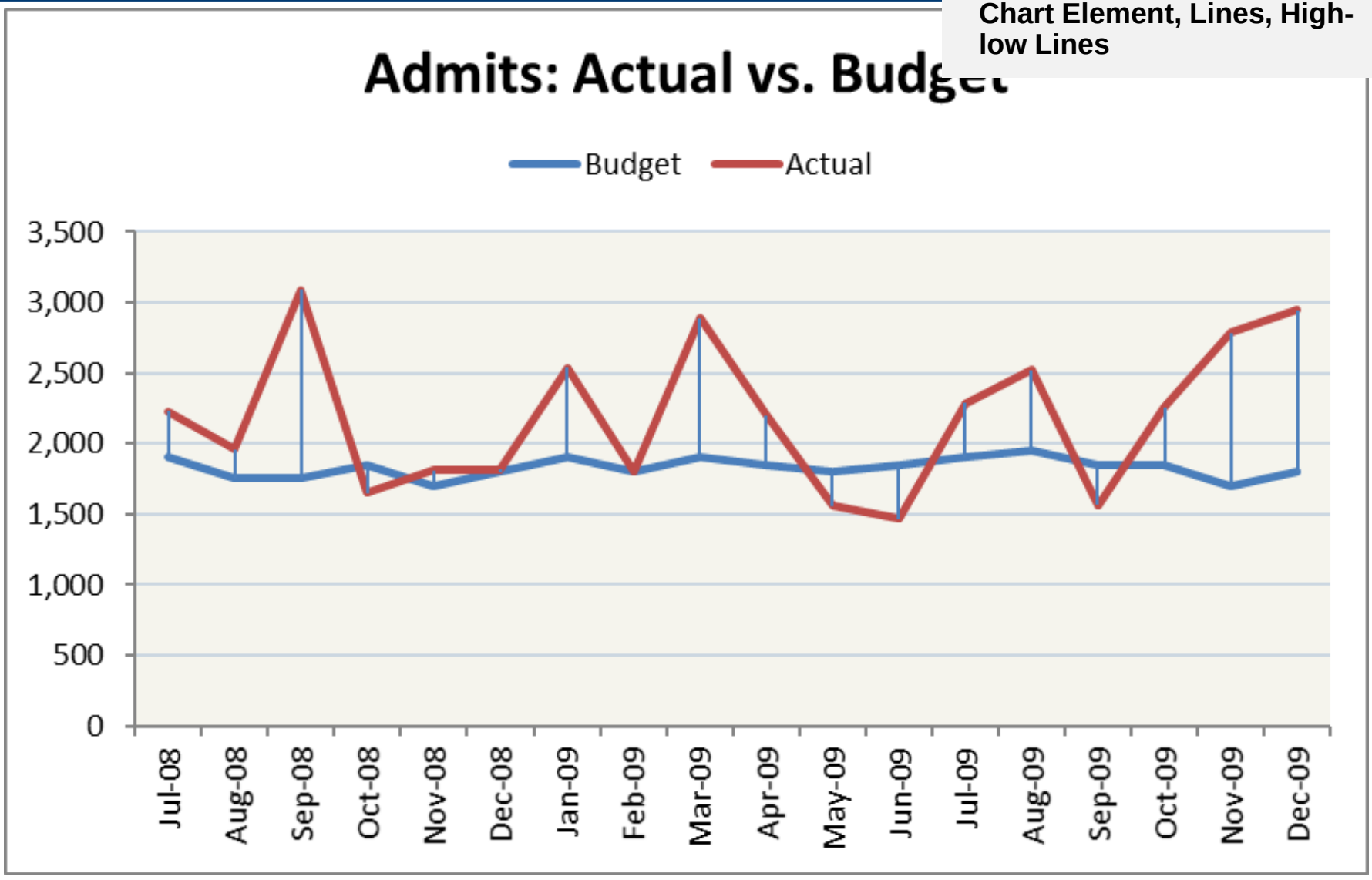
- **In Design tab, choose Add Chart Element, Up/Down Bars**



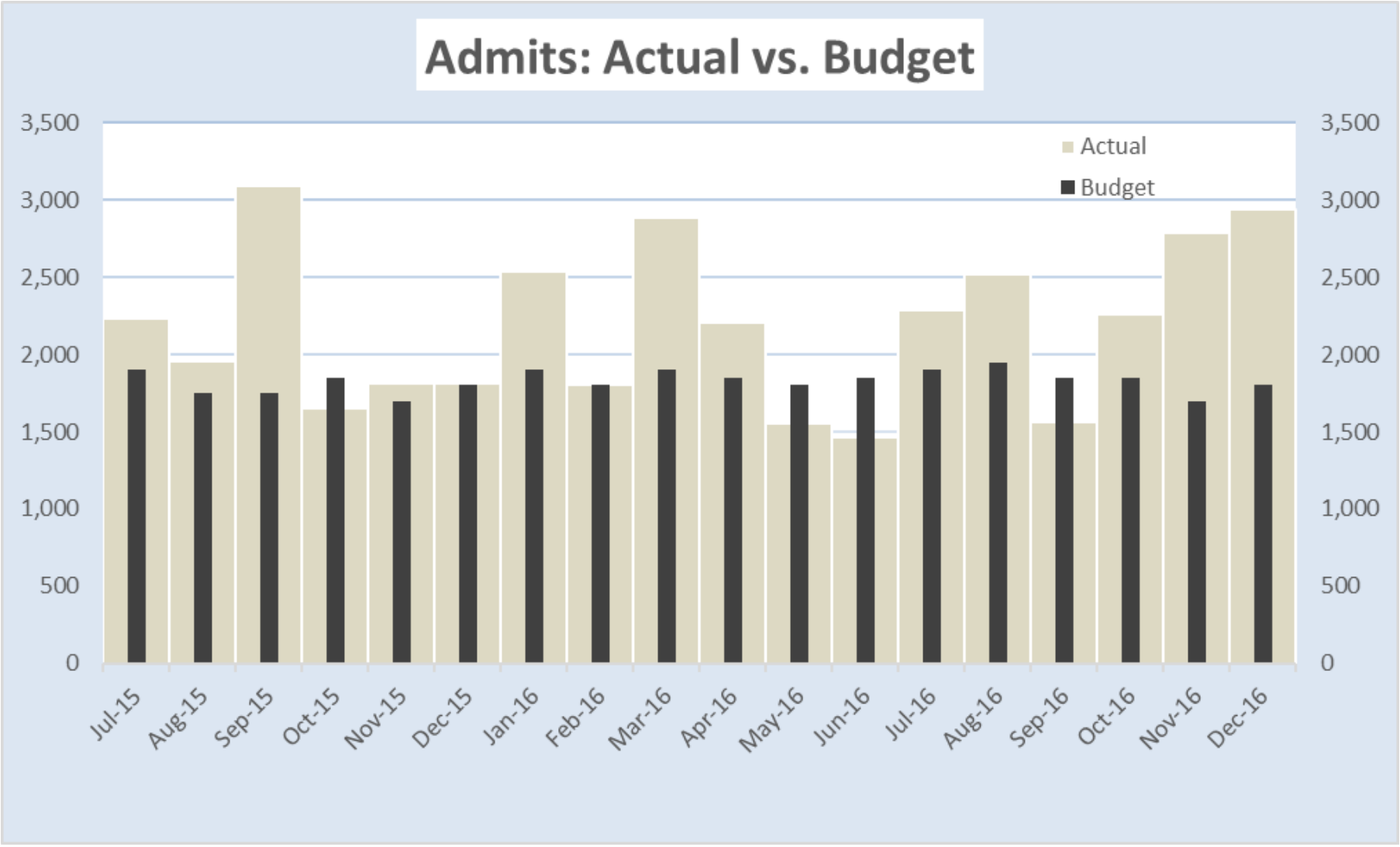
Variance designs – High/Low Lines

Excel Tip

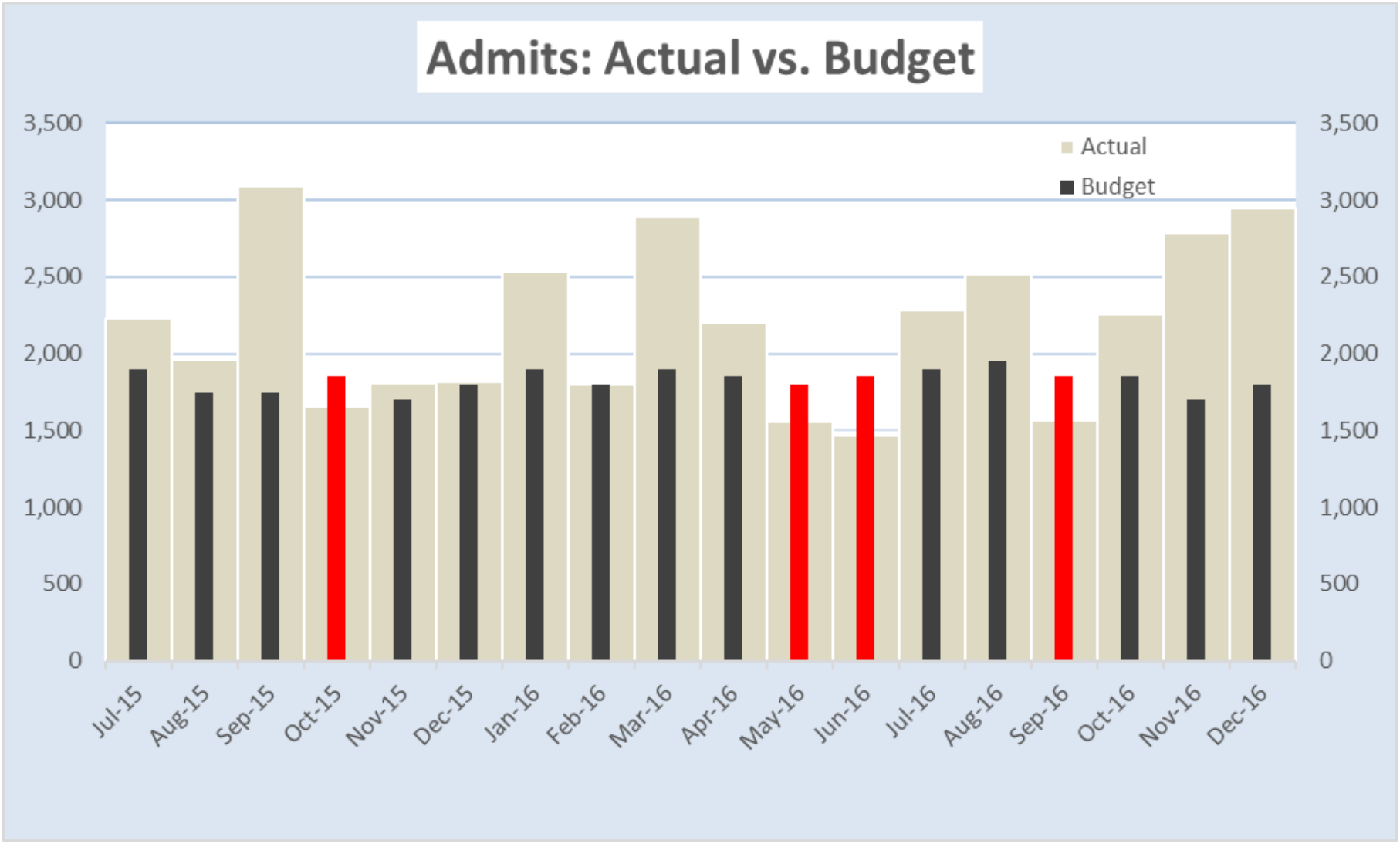
- **In Design tab, choose Add Chart Element, Lines, High-low Lines**



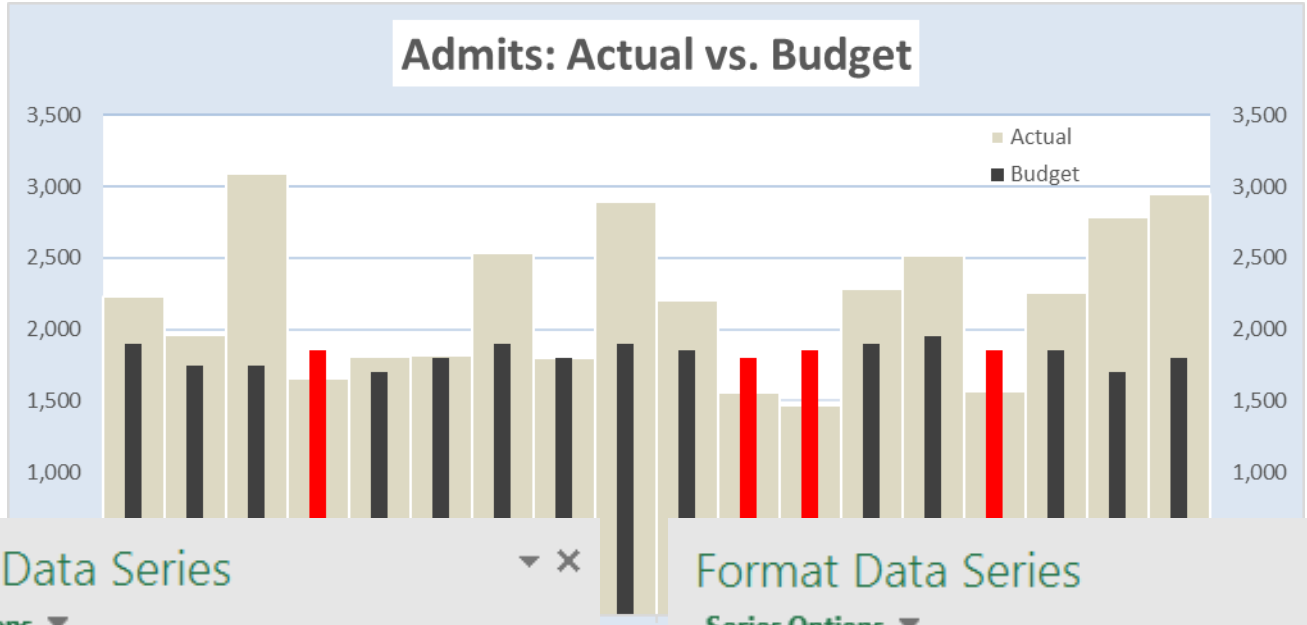
Variance designs – Double Bar Graph

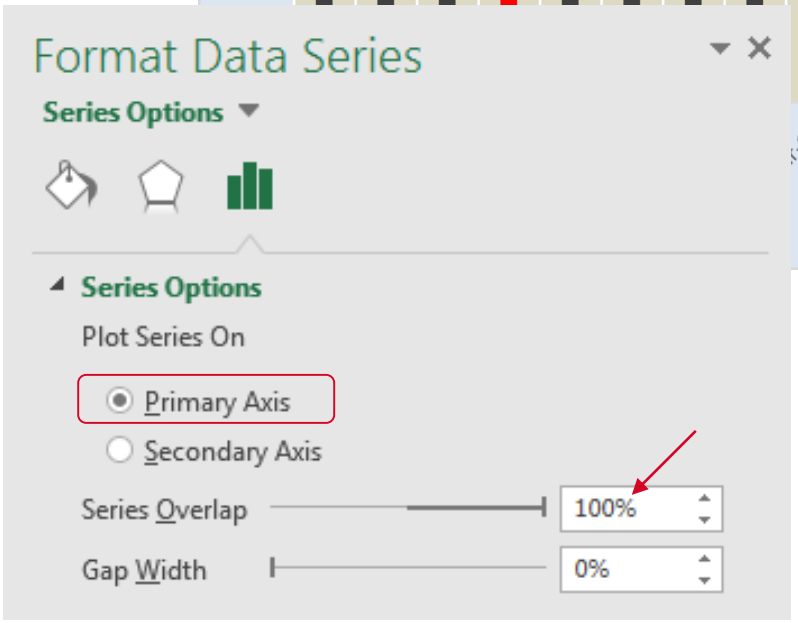


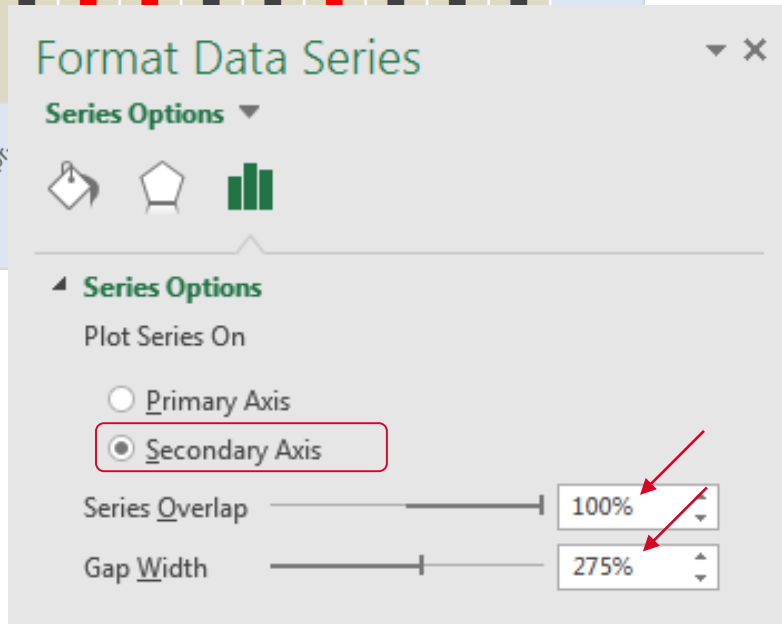
Double Bar Graph – Negative Variances Highlighted



Double Bar Graph – Excel Tips

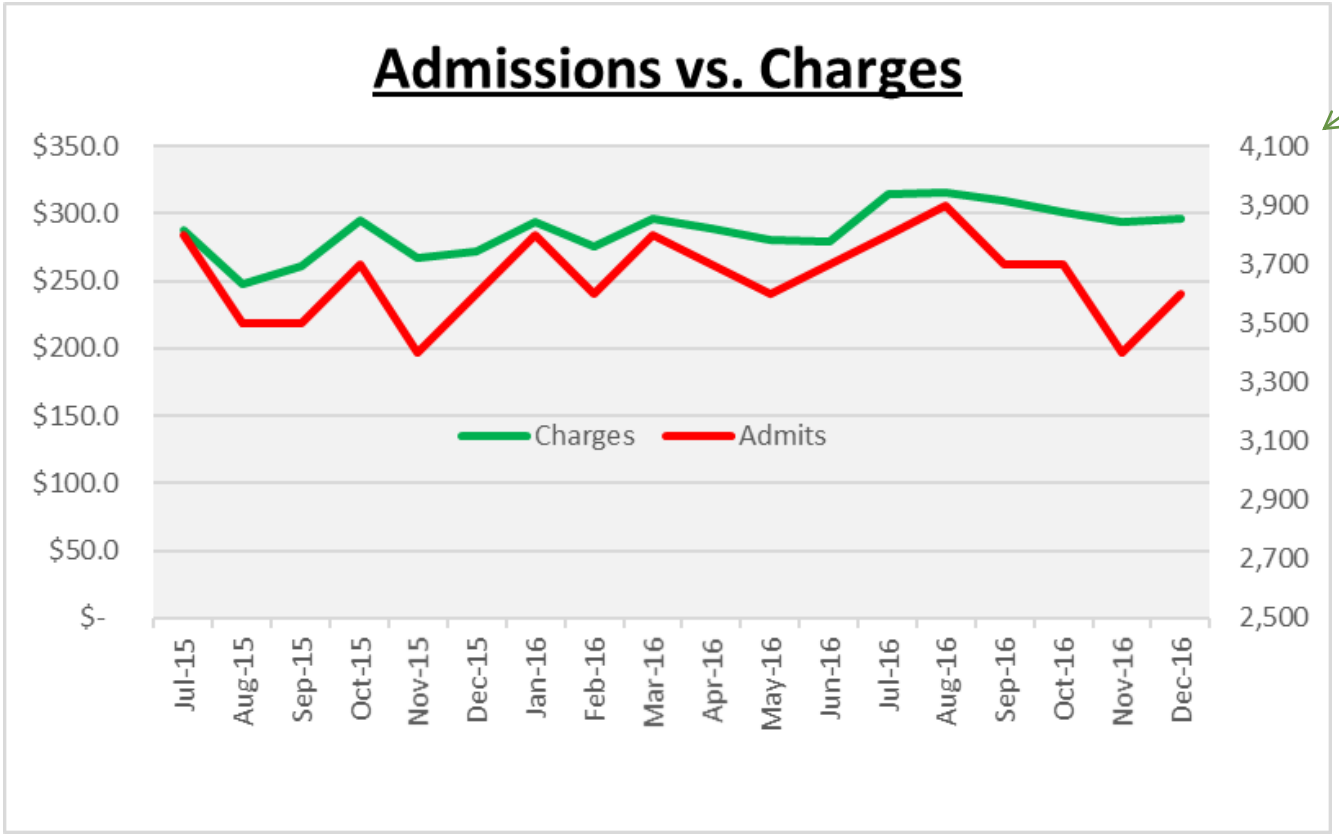






Secondary axis

- **Useful when dealing with two separate units of measure**
  - EG Dollars and Admissions



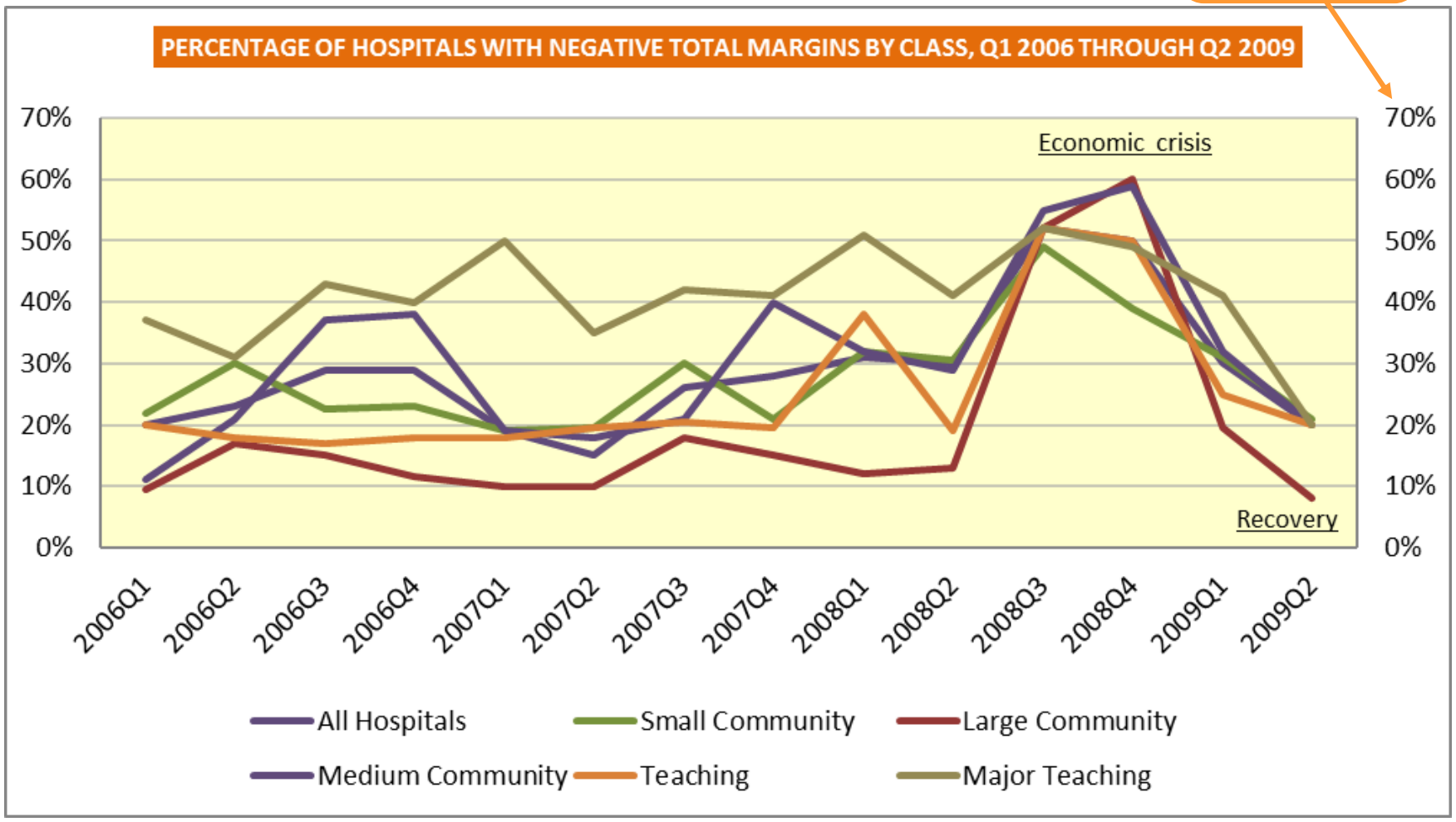
Secondary Axis

Excel 2016 Tip

1. **Create line graph with BOTH measures**
2. **Select the line you want to move to 2nd axis**
3. **Right click**
4. **Select "Format Axis"**
5. **Select "Secondary Axis"**

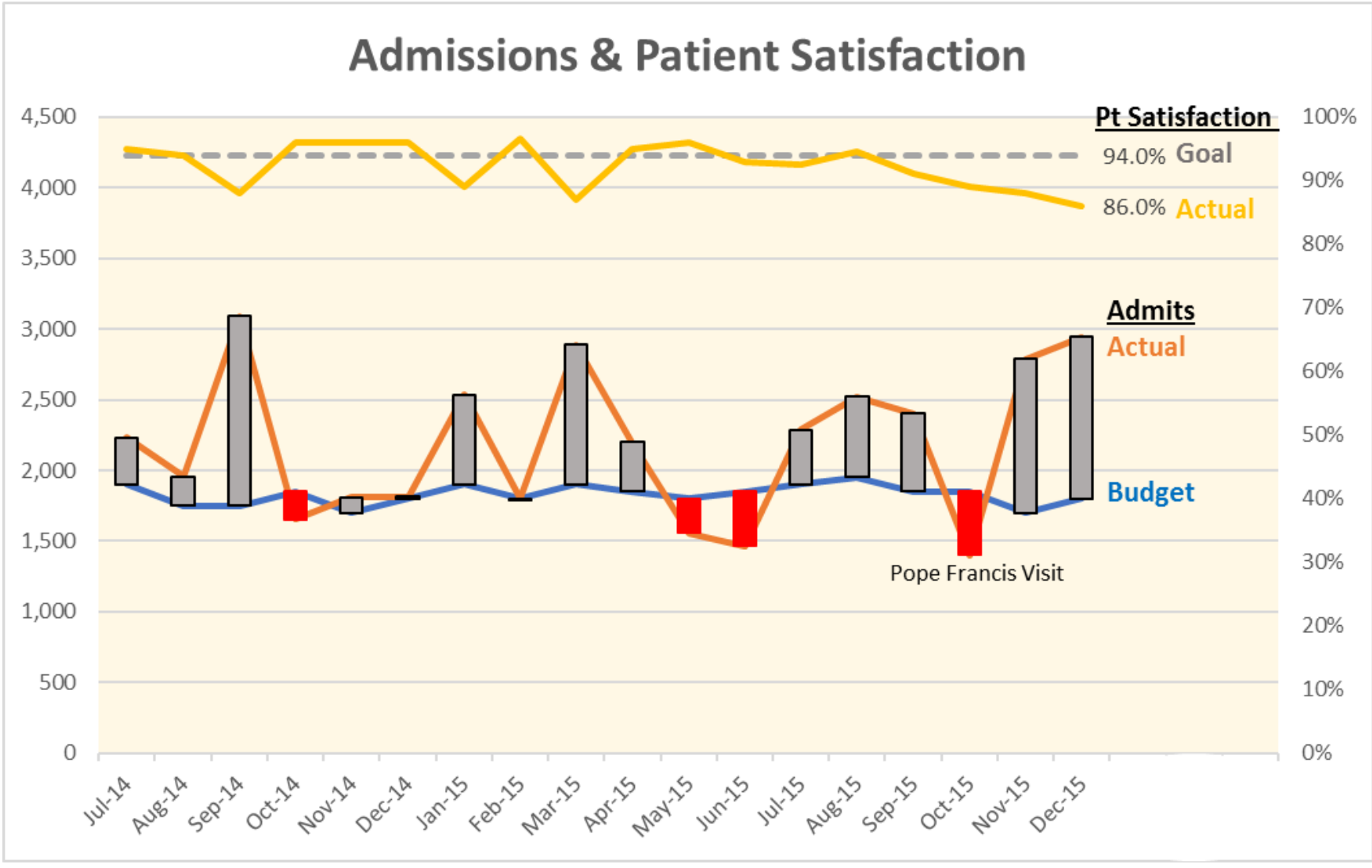
HFMA Graph

Used 2nd axis



Recreation of graph from:
Healthcare Financial Management Journal, Feb 2010, page 104

Exercise #2


Admissions & Patient Satisfaction
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Pt Satisfaction
94.0% Goal
86.0% Actual
Admits
Actual
Budget
Pope Francis Visit
Jul-14
Aug-14
Sep-14
Oct-14
Nov-14
Dec-14
Jan-15
Feb-15
Mar-15
Apr-15
May-15
Jun-15
Jul-15
Aug-15
Sep-15
Oct-15
Nov-15
Dec-15

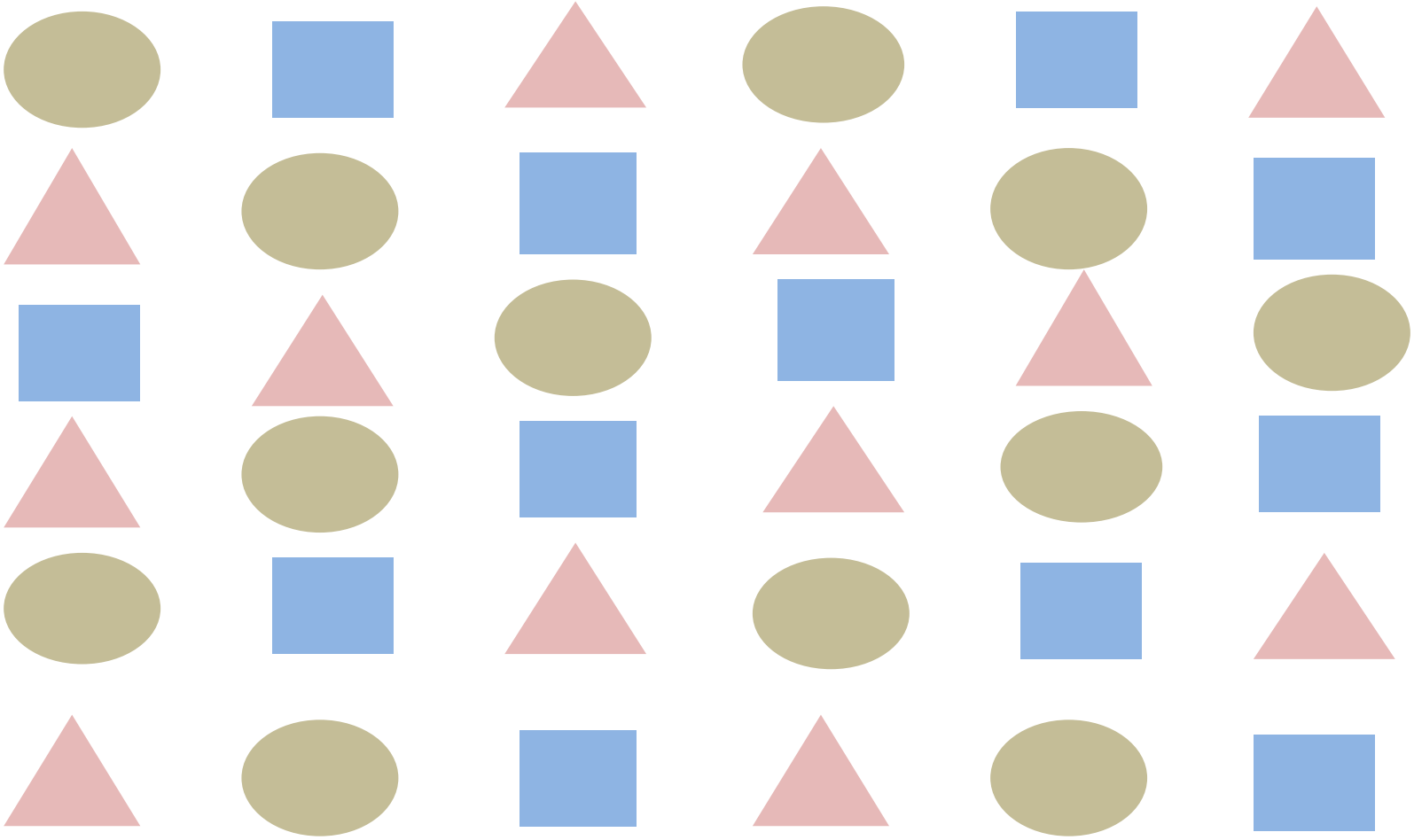
DATA DIFFERENTIATION

Data differentiation

- How many triangles?

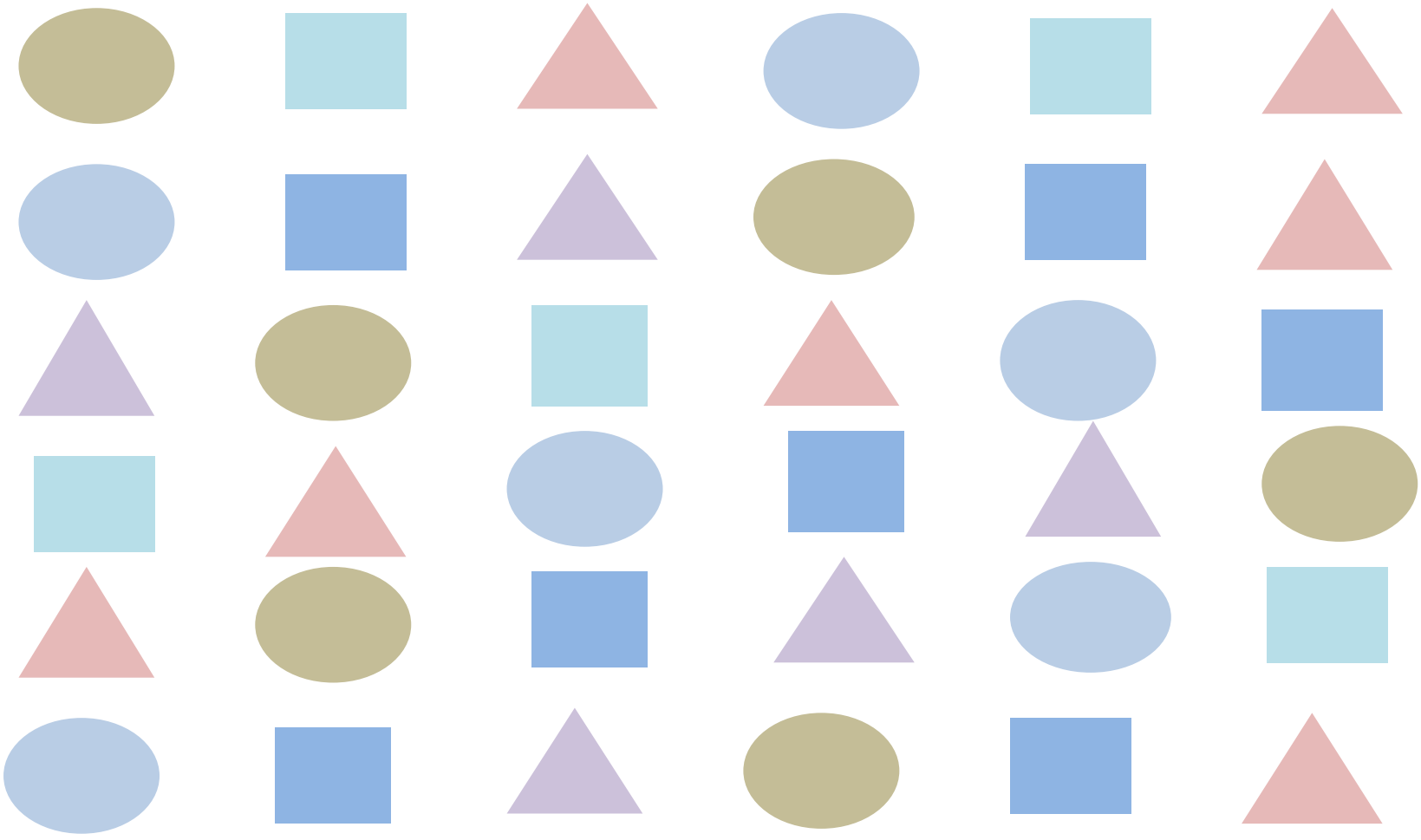
Data differentiation

- **How many circles?**
  - The different color of each object helps the eye quickly distinguish

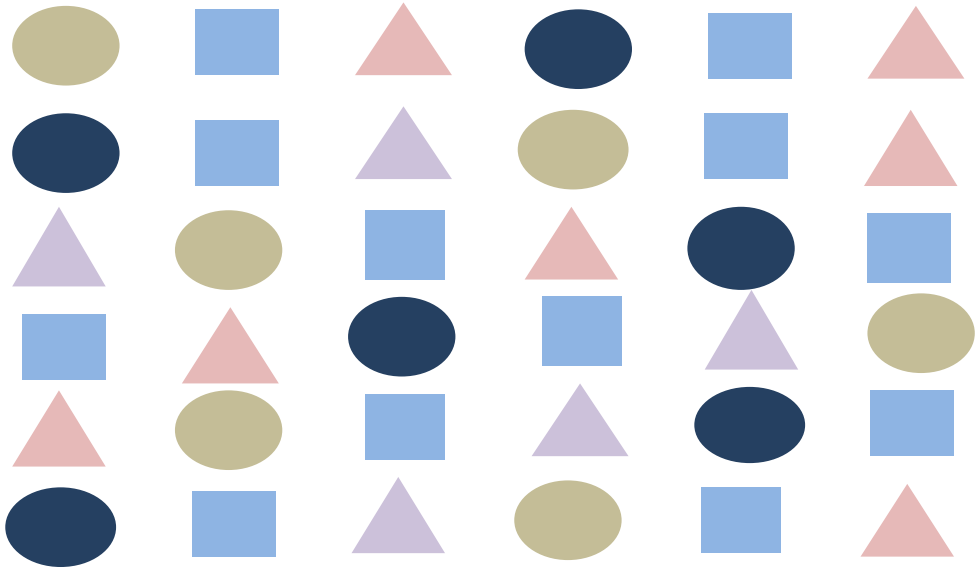


Data differentiation

- How many light blue circles?

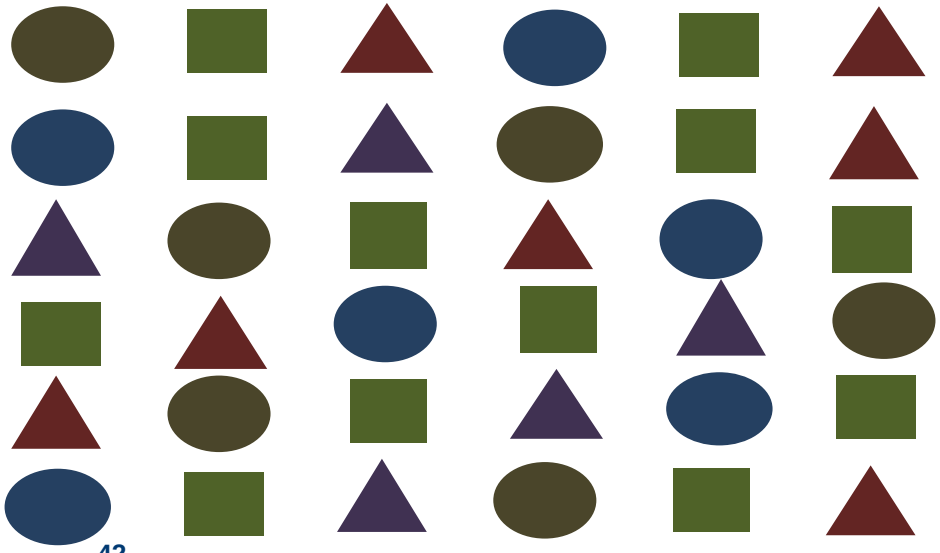


Data differentiation



Use a **greater saturation** in comparison to the other objects to help quickly identify the blue circles

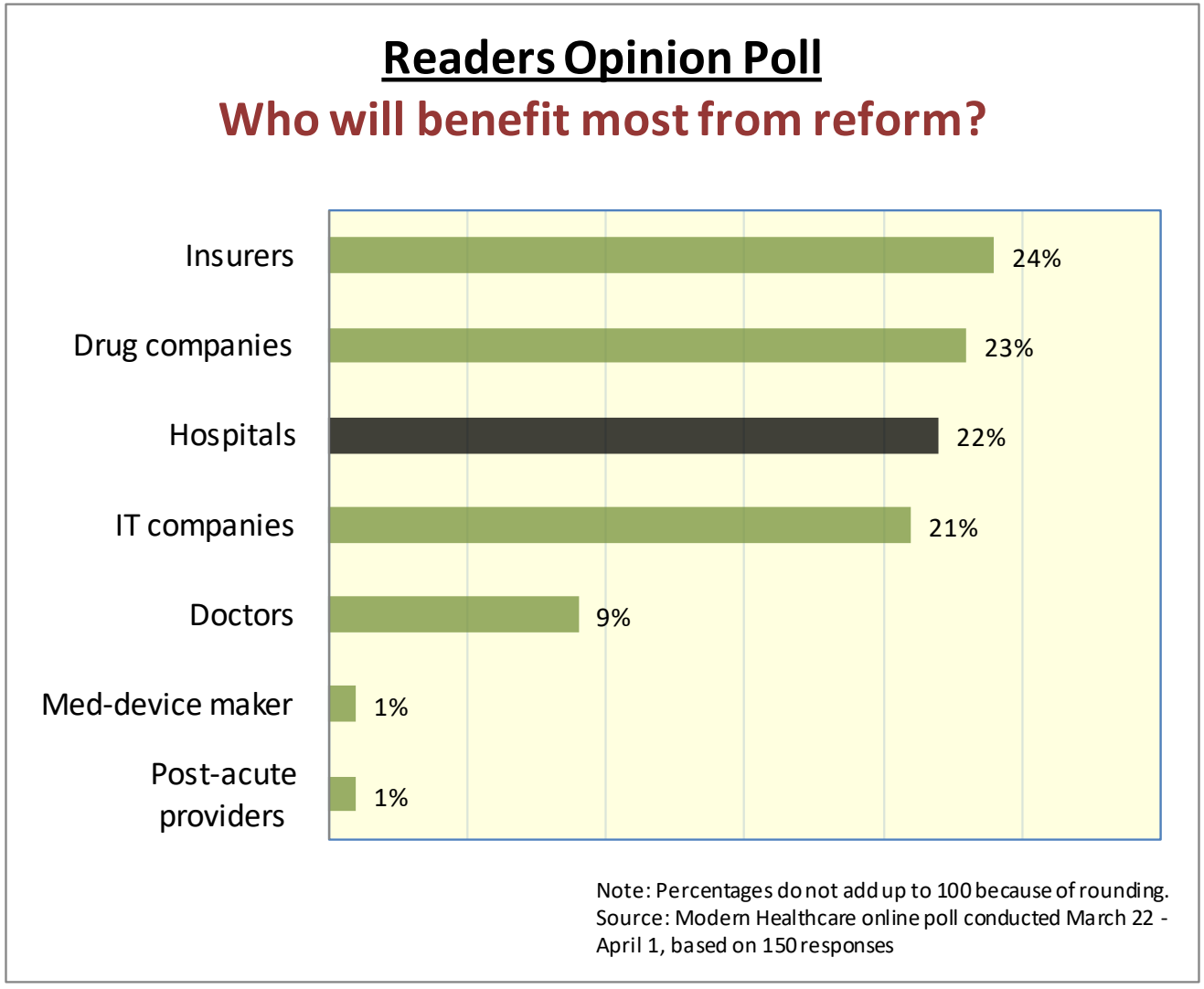
But it only works if the contrast to the other objects is substantial



Recommended Colors – Stephen Few

Red
Green
Yellow
Blue
Black
White
Pink
Cyan
Gray
Orange
Brown
Purple

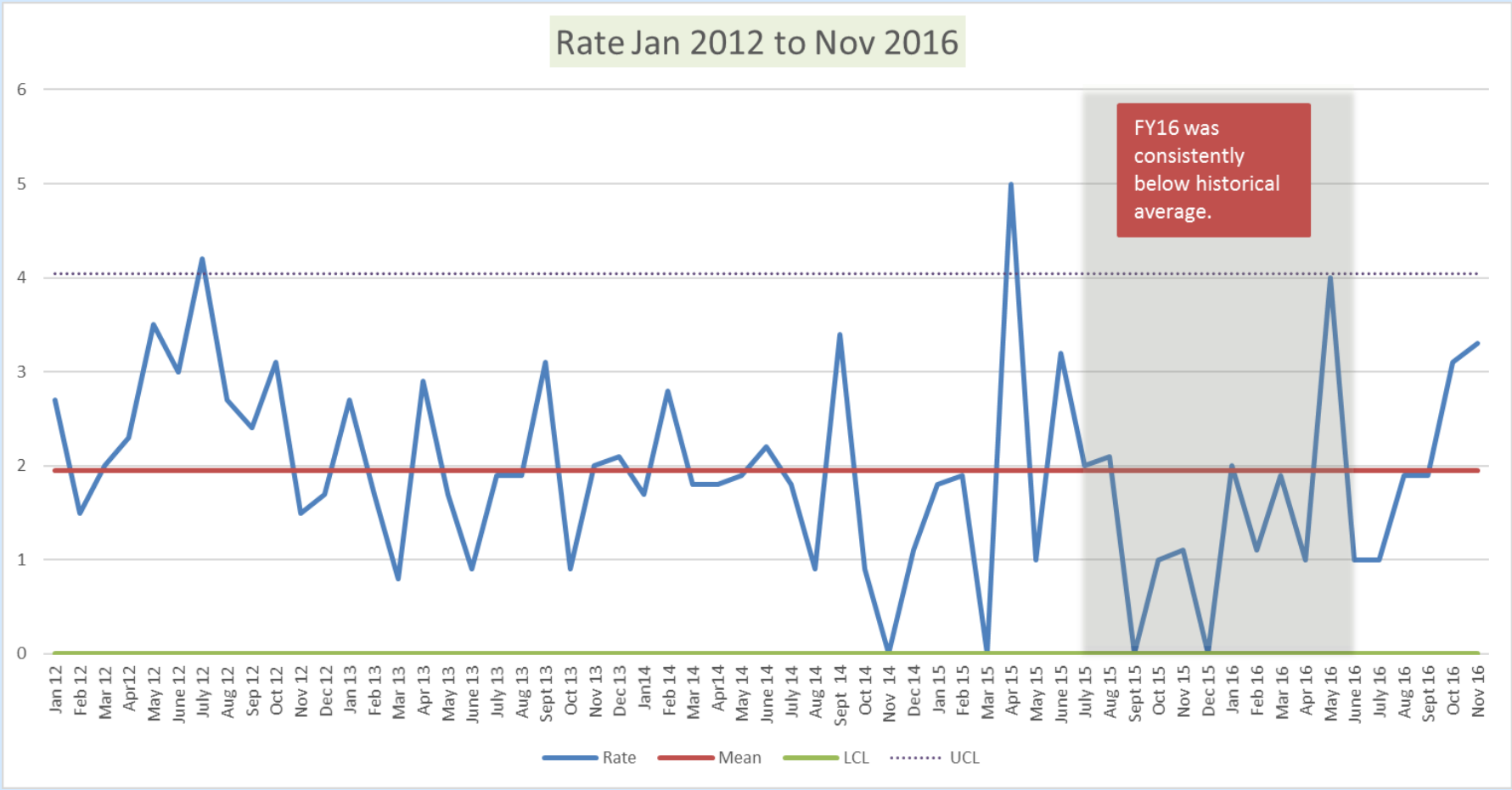
Modern Healthcare Chart



Recreation of graph from:
Modern Healthcare, 4/5/2010, page 19

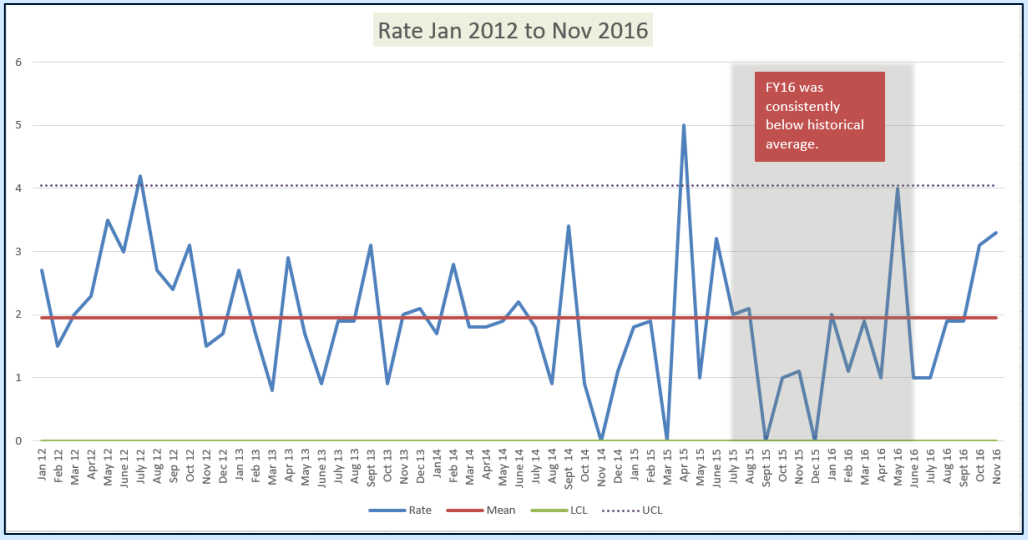
VISUALIZATIONS

Run or Control Charts



- **UCL = Upper Control Limit (mean + 3 x StdDev). Note: I used 2 StdDevs.**
- **LCL = Lower Control Limit (mean - 3 x StdDev). Note: I used 0 to avoid a (-).**

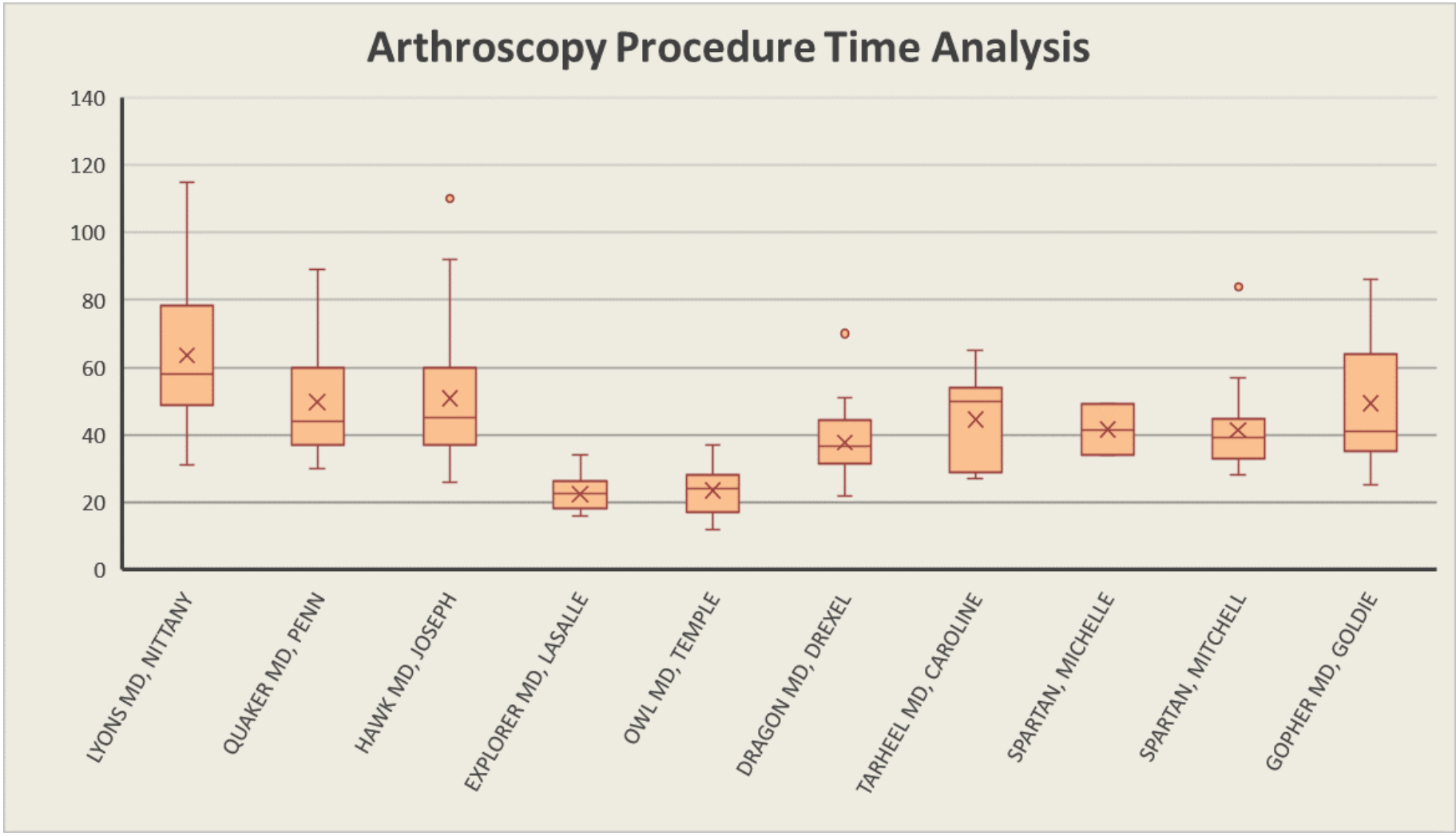
Run or Control Charts – Data Format



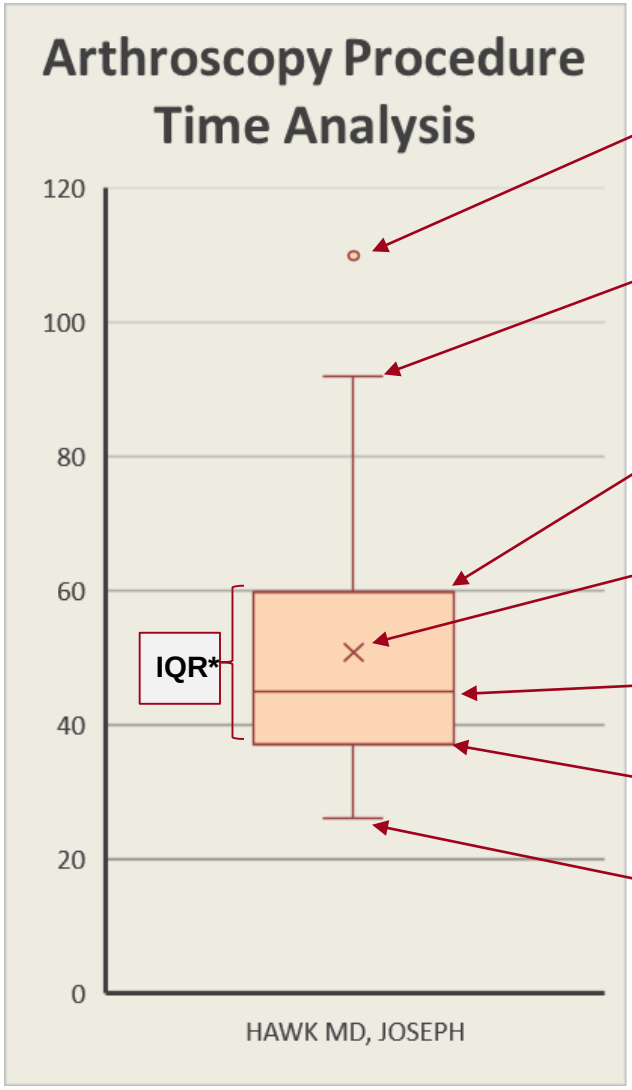
Notice how Mean, LCL & UCL are entered as constants on every row

Date	Rate	Mean	LCL	UCL
Jan 12	2.7	1.9	0.0	4.04
Feb 12	1.5	1.9	0.0	4.04
Mar 12	2.0	1.9	0.0	4.04
Apr12	2.3	1.9	0.0	4.04
May 12	3.5	1.9	0.0	4.04
June 12	3.0	1.9	0.0	4.04
July 12	4.2	1.9	0.0	4.04
Aug 12	2.7	1.9	0.0	4.04
Sep 12	2.4	1.9	0.0	4.04
Oct 12	3.1	1.9	0.0	4.04
Nov 12	1.5	1.9	0.0	4.04
Dec 12	1.7	1.9	0.0	4.04
Jan 13	2.7	1.9	0.0	4.04

Box & Whisker Chart – my fav ☺



Box & Whisker Chart



Outlier

Whisker, MAX value up to Q_3 + 1.5 * IQR

75th percentile

Mean

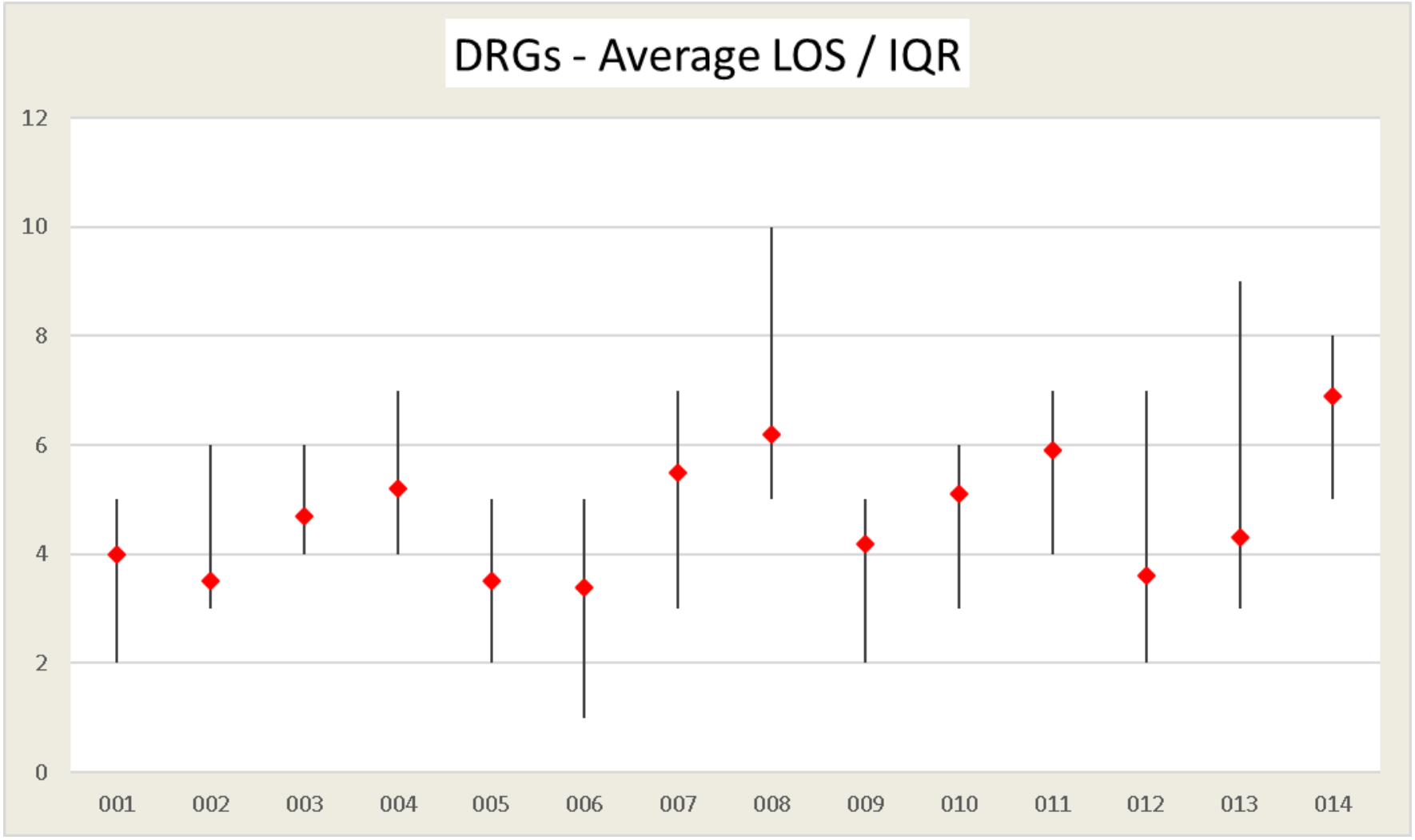
Median

25th percentile

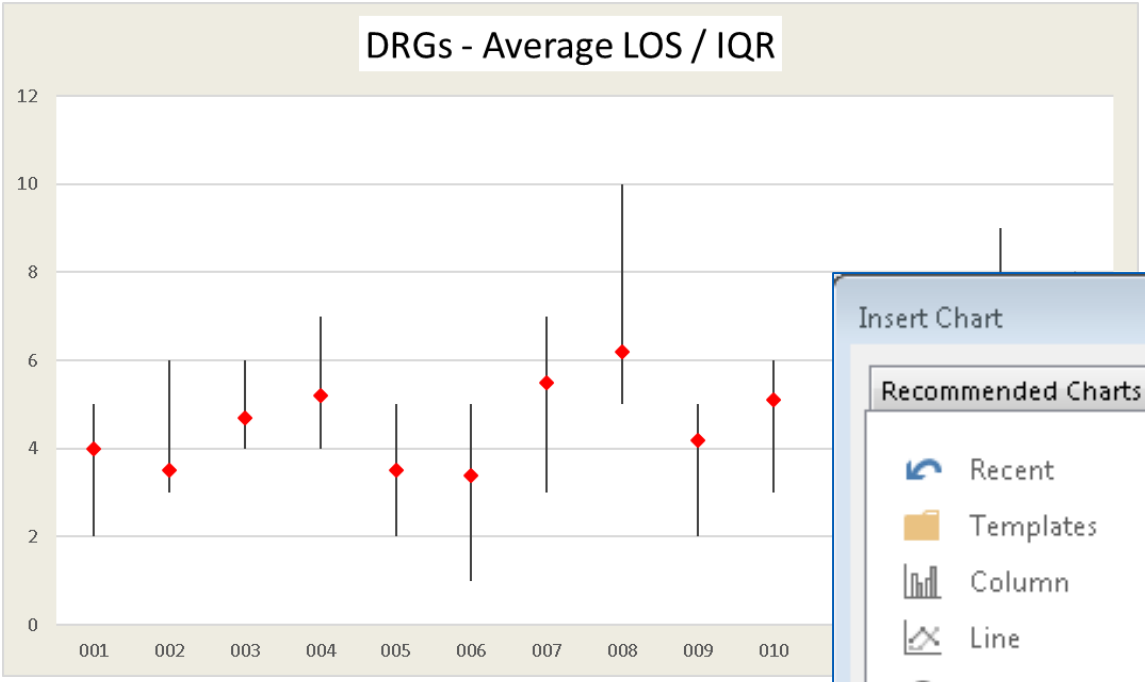
Whisker, MIN value up to Q_1 - 1.5 * IQR

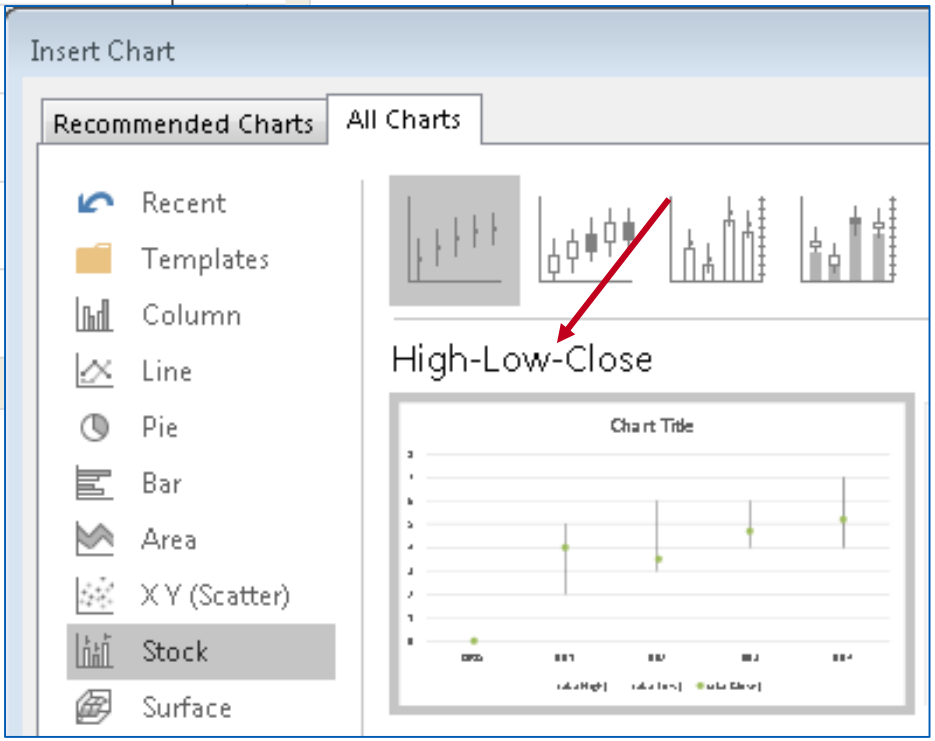
***Interquartile range: 25th to 75th percentile.**
EG, 60 + 38 = 98.

Stock Charts – Can offer interesting options



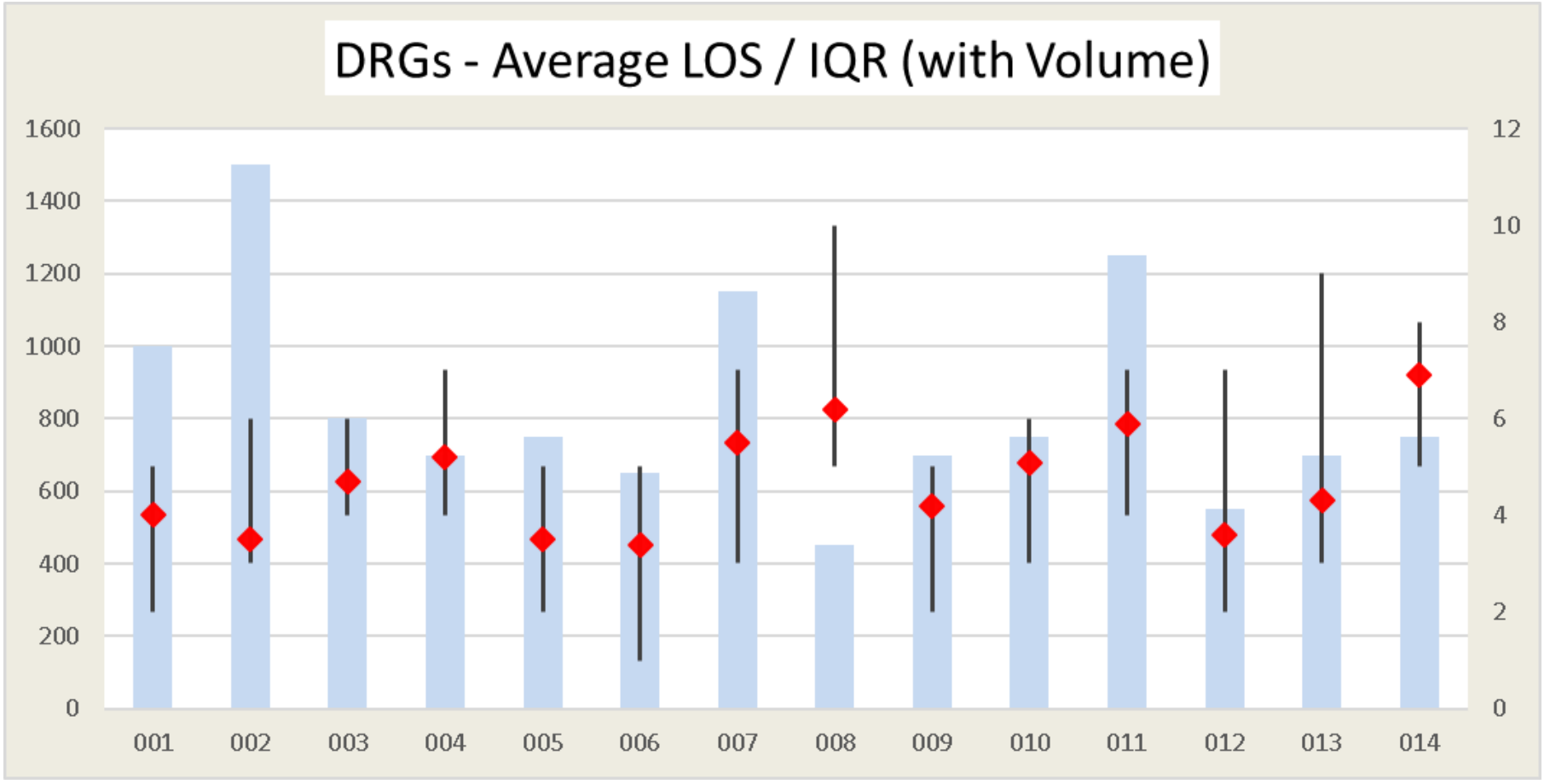
Stock Charts – design



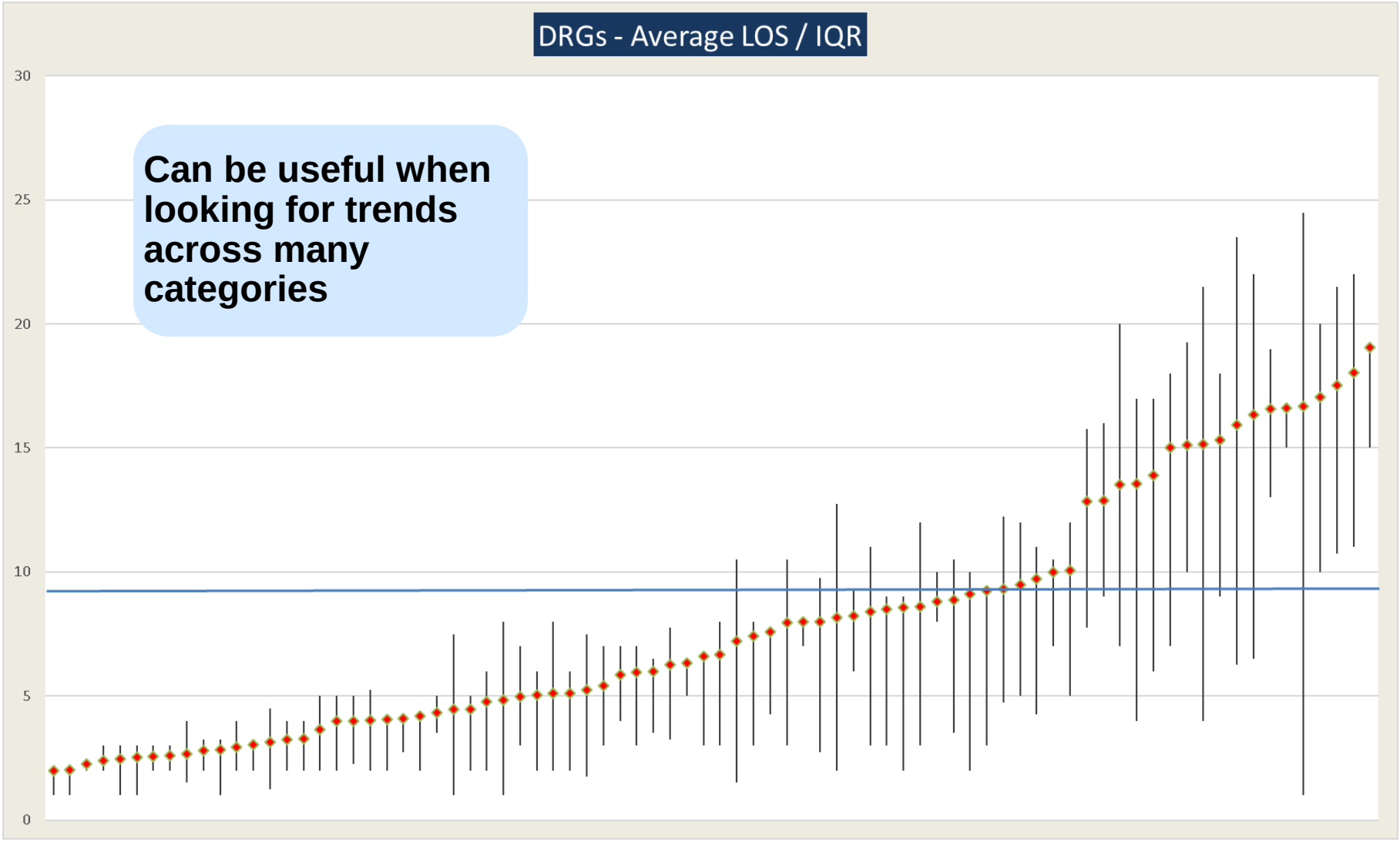


	(aka High)	(aka Low)	(aka Close)
DRG	Max	Min	Average
001	5	2	4
002	6	3	3.5
003	6	4	4.7
004	7	4	5.2

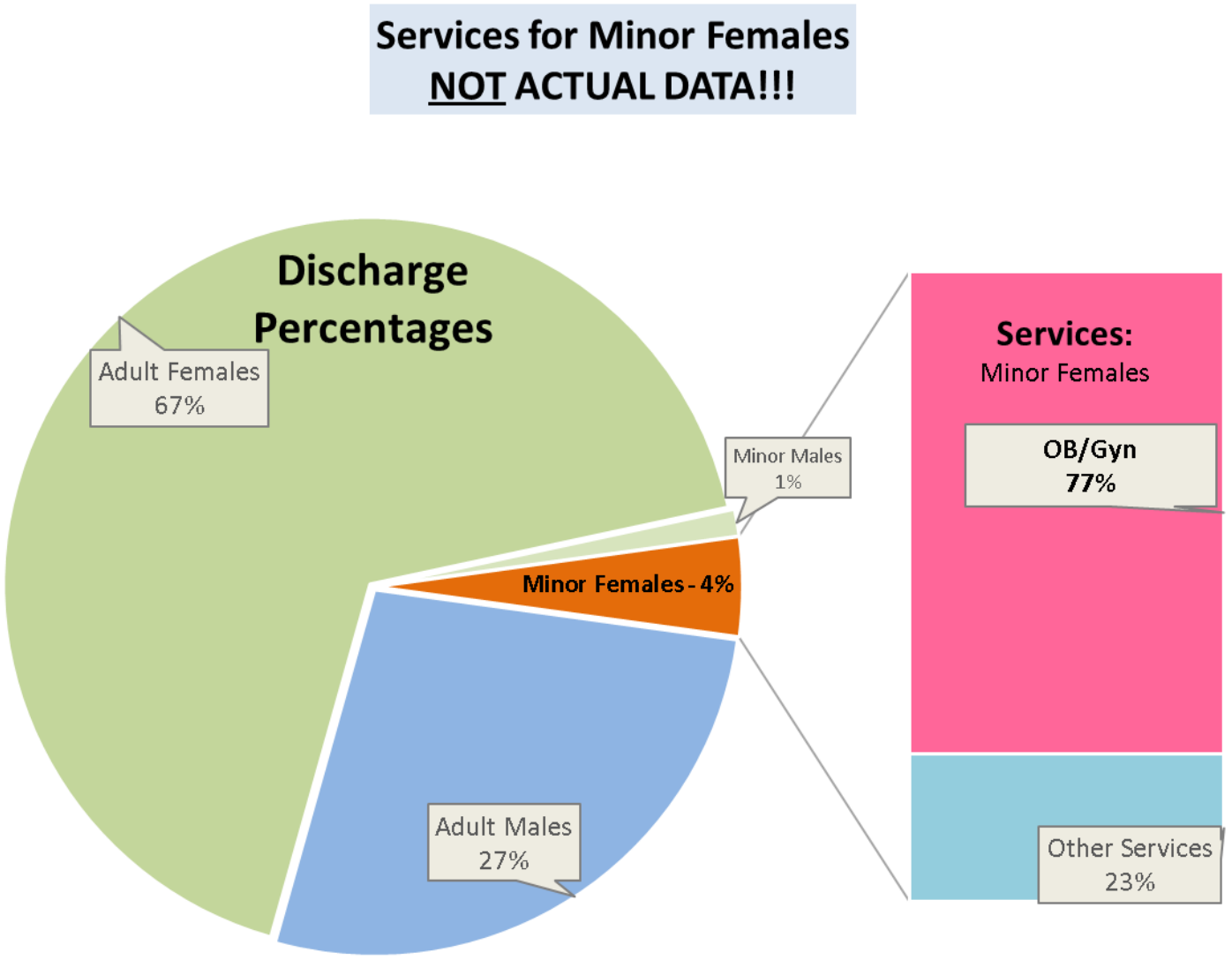
Stock Charts – volume, high, low, close



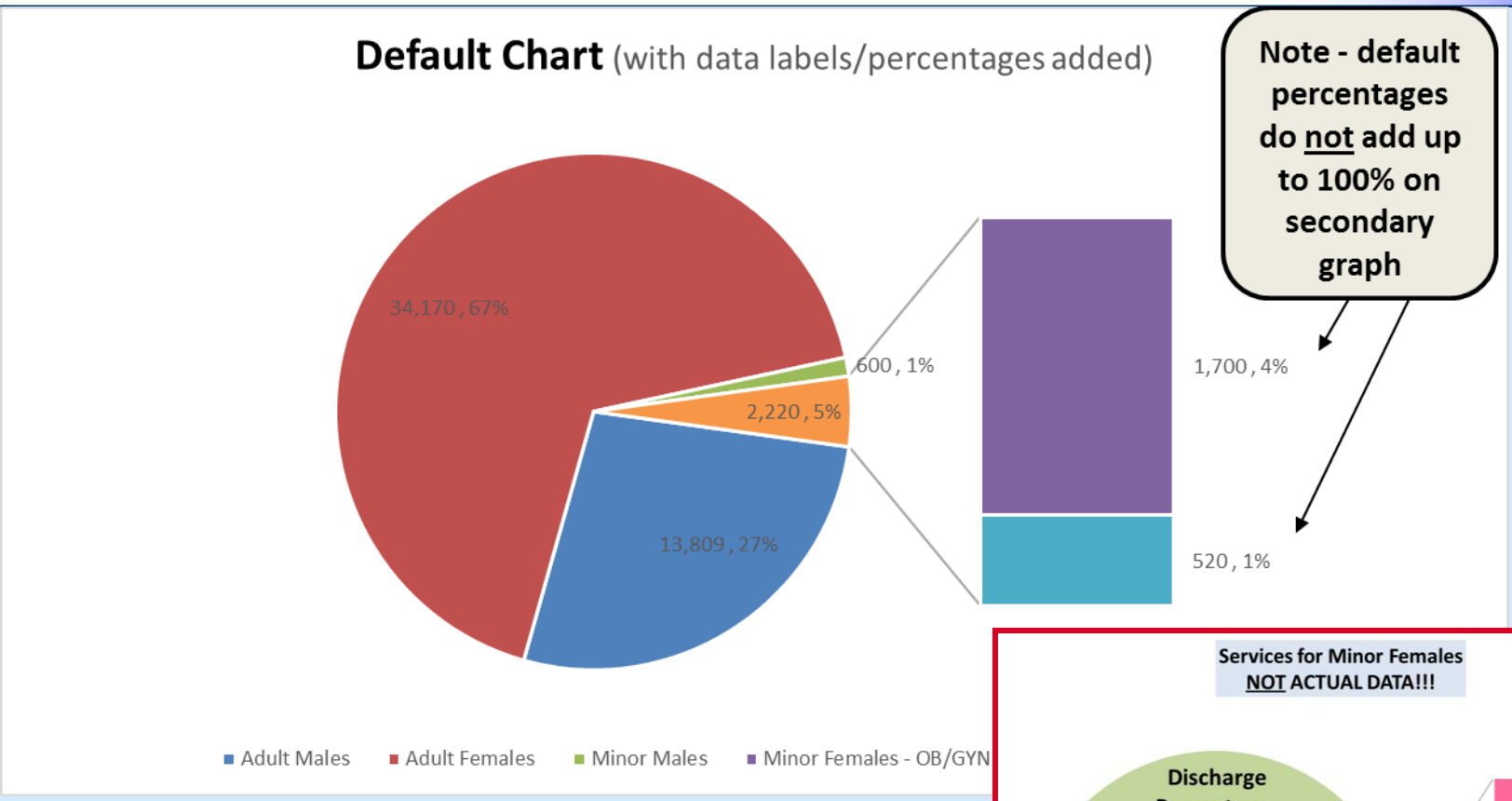
Stock Charts vs. Box & Whisker



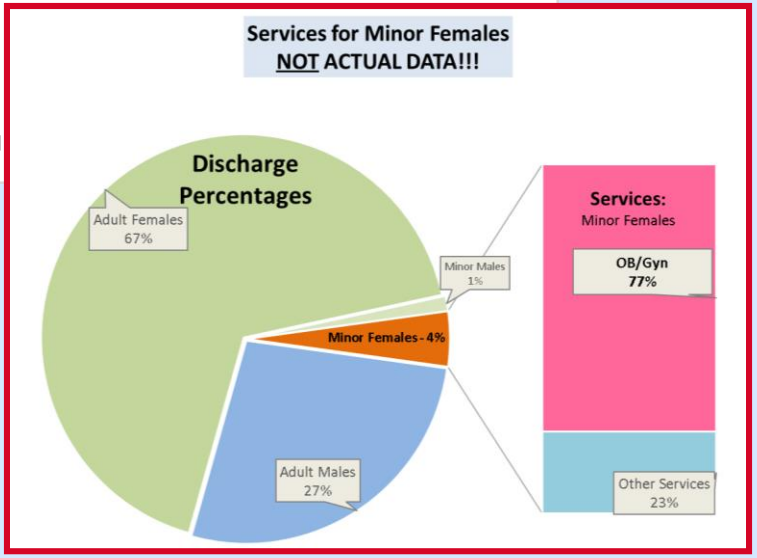
Bar of Pie chart



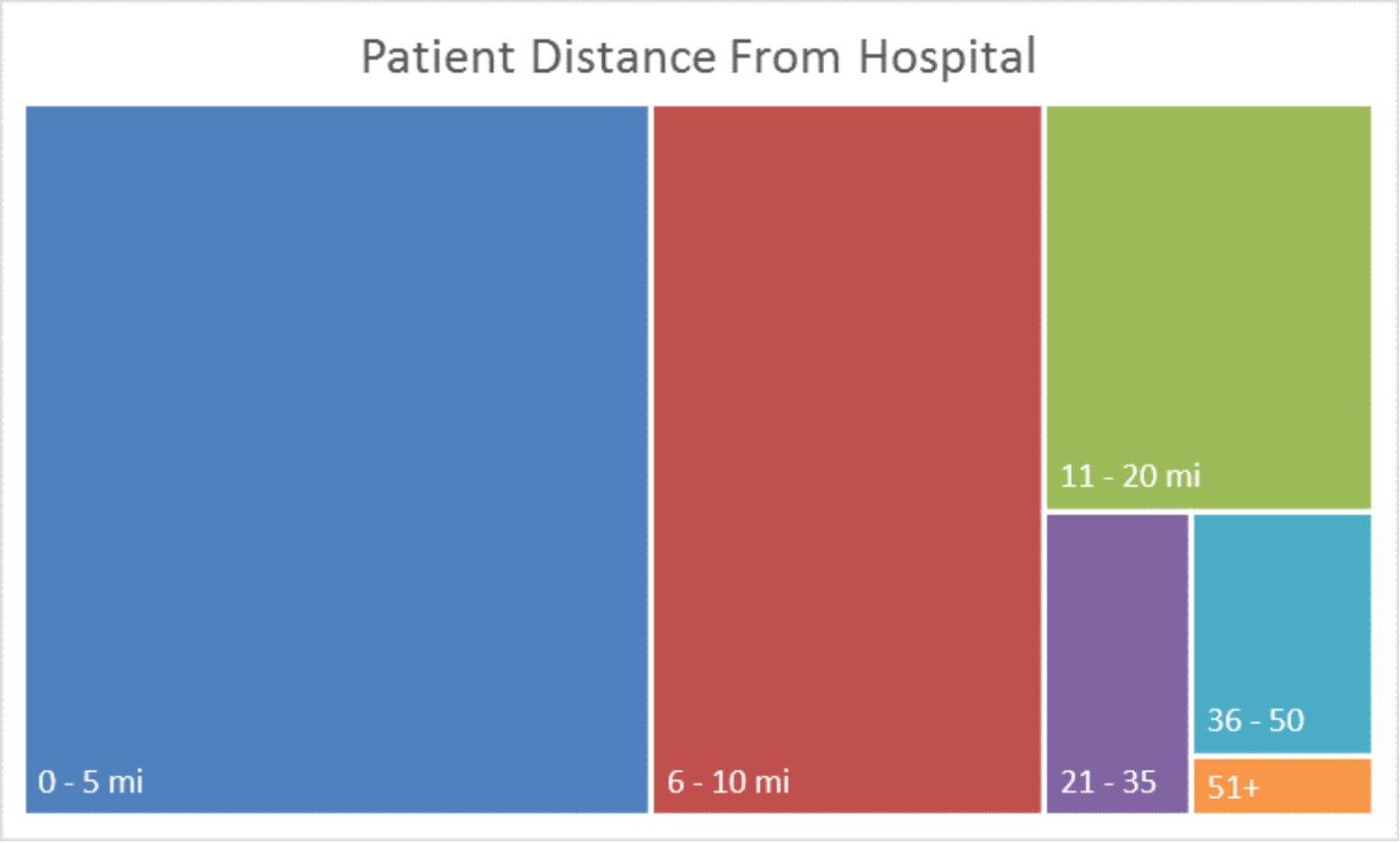
Bar of Pie - Default



Note - default percentages do not add up to 100% on secondary graph



Tree Maps – alternative to Pie Chart

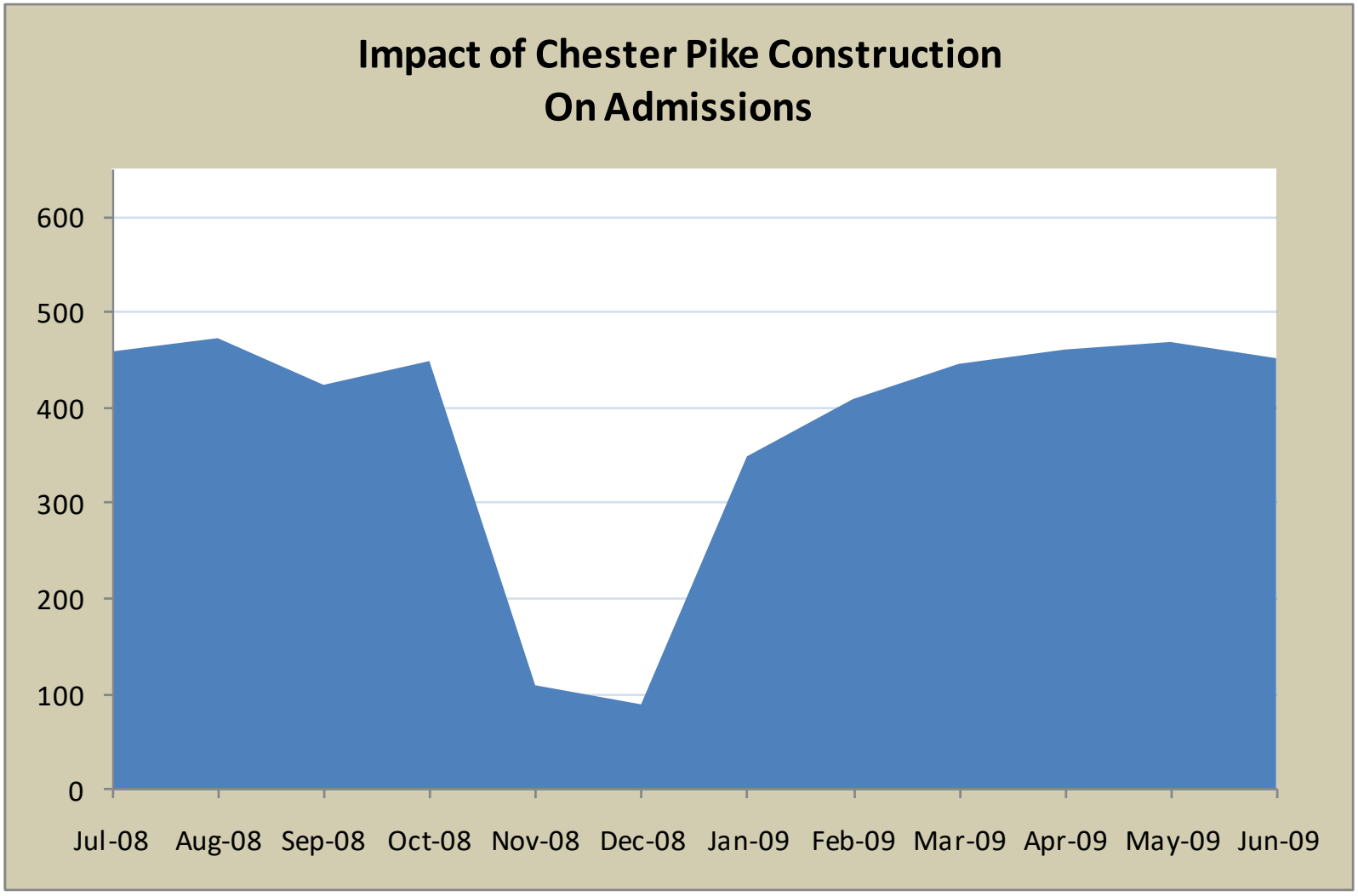


Excel Tip

- **Need to format data into a simple table**

Distance	Count
0 - 5 mi	40
6 - 10 mi	25
11 - 20 mi	12

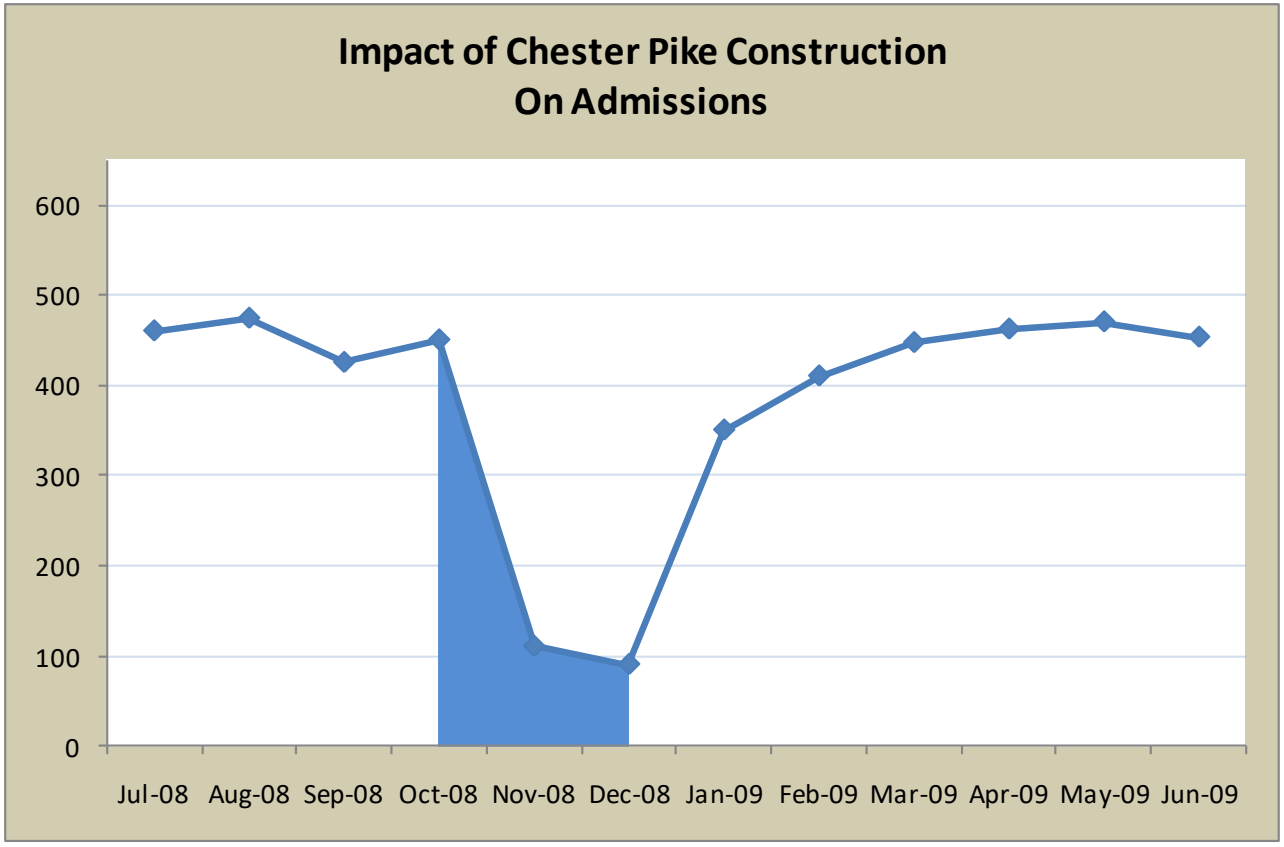
Area Chart



Note: Data Fictitious!

Line chart and Area chart combined

- **Here we're using an area fill to highlight a particular area of the chart**



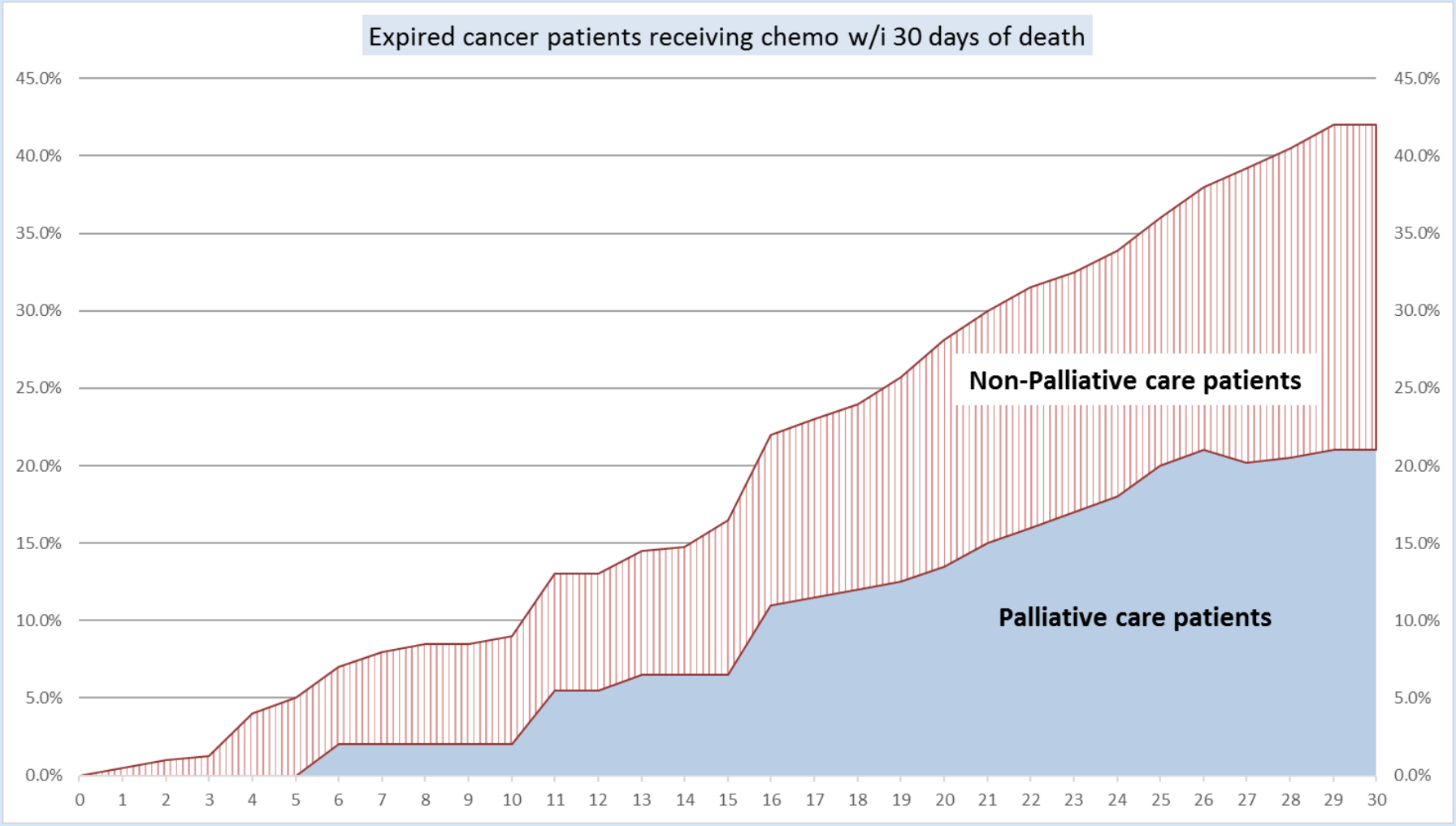
Excel Tip

- **"Area" is actually a second series of only the three values being highlighted**
- **This second series has a chart type of area**
- **The first series has a chart type of line**

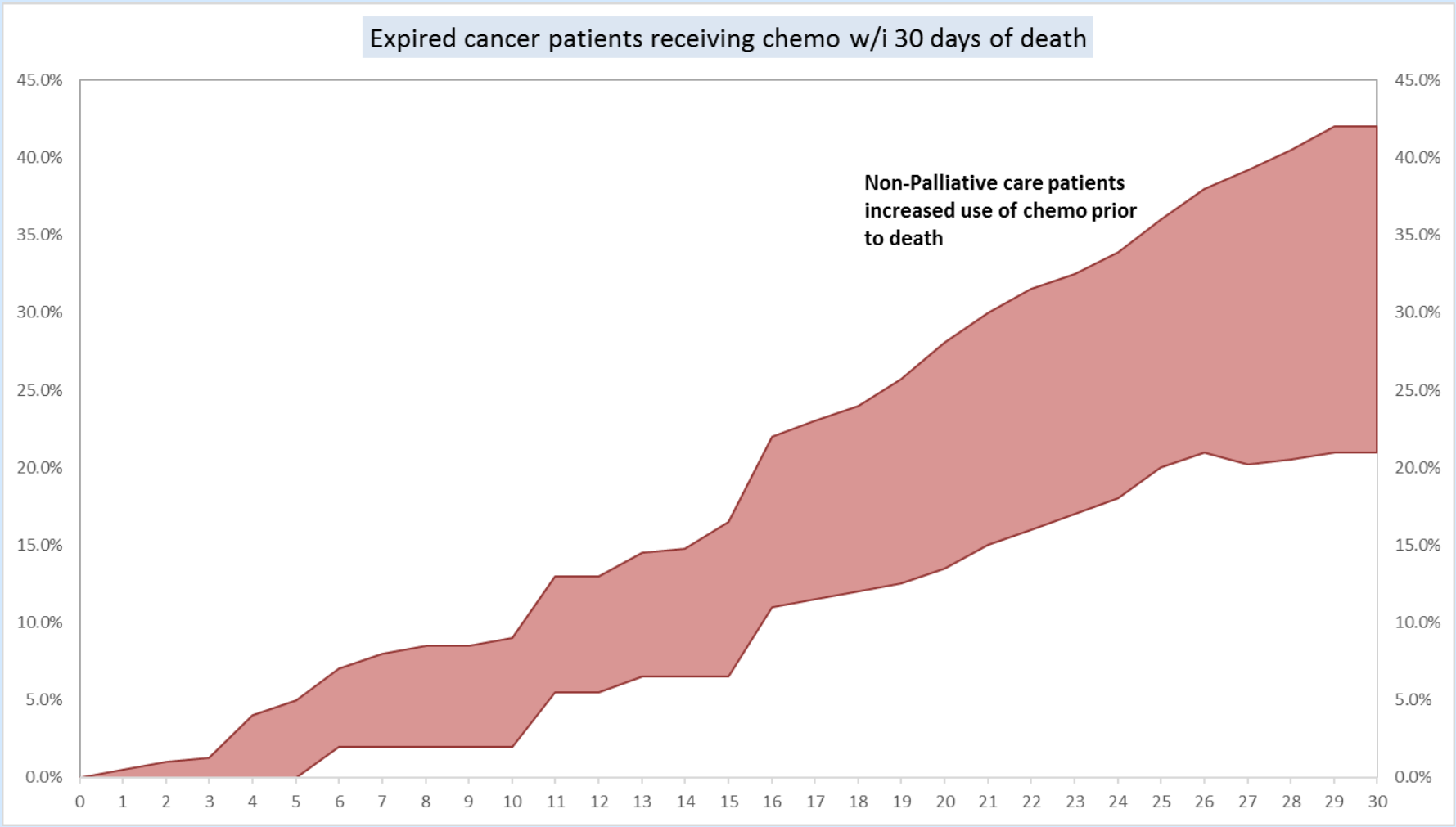
	Admits	Area Fill Values
Jul-08	460	
Aug-08	474	
Sep-08	425	
Oct-08	450	**450**
Nov-08	110	**110**
Dec-08	90	**90**
Jan-09	350	
Feb-09	410	
Mar-09	447	
Apr-09	462	
May-09	470	
Jun-09	453	

Note: Data Fictitious!

Stacked Area Chart



Stacked Area Chart



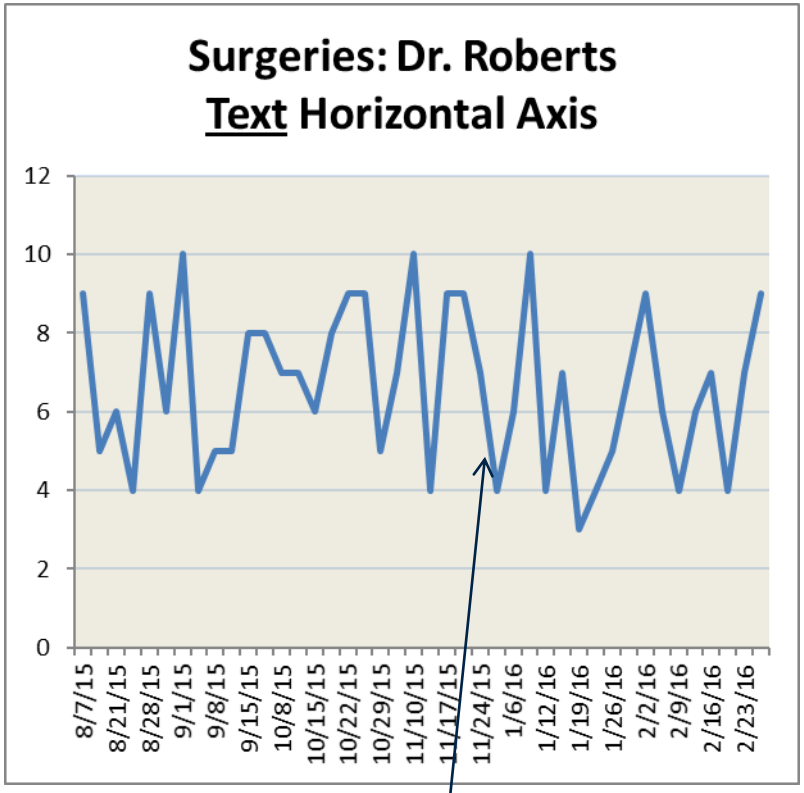
Thank you!

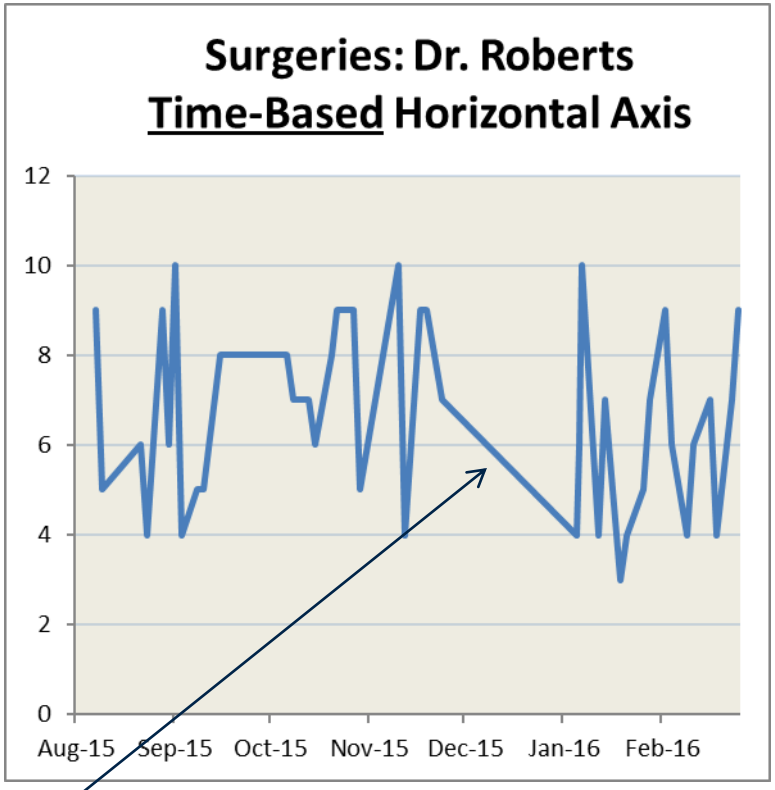
Are there any questions?

paul.junker@uphs.upenn.edu

Time based charts

- **Excel will sometimes interpret dates as text – leading to equal and possibly inaccurate spacing.**





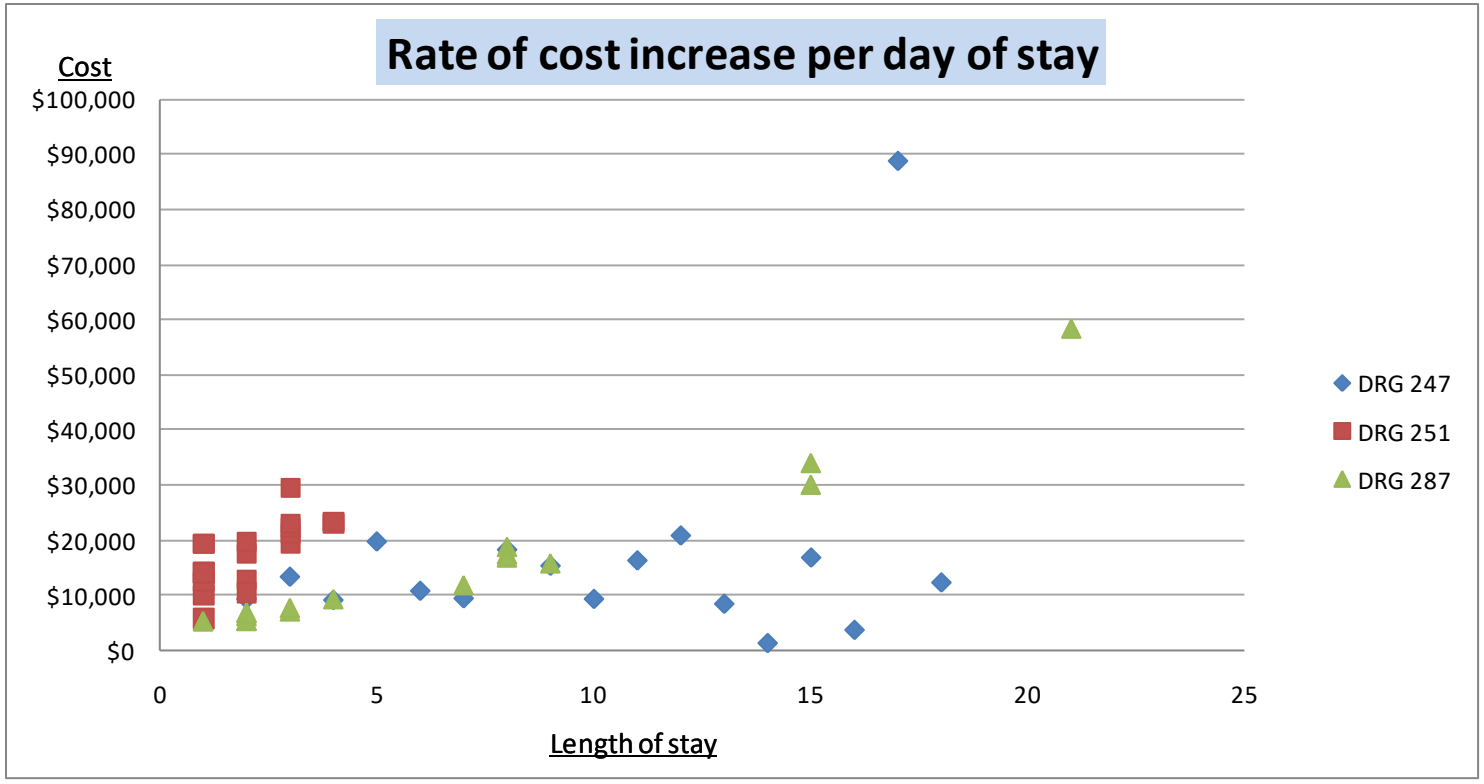
Notice how gaps in time are handled differently

Excel Tip

- **Highlight & right-click horizontal axis**
- **Select Format Axis and then Date axis**

Scatter plots

- Great at showing relationships between data
- Least intuitive in Excel to make

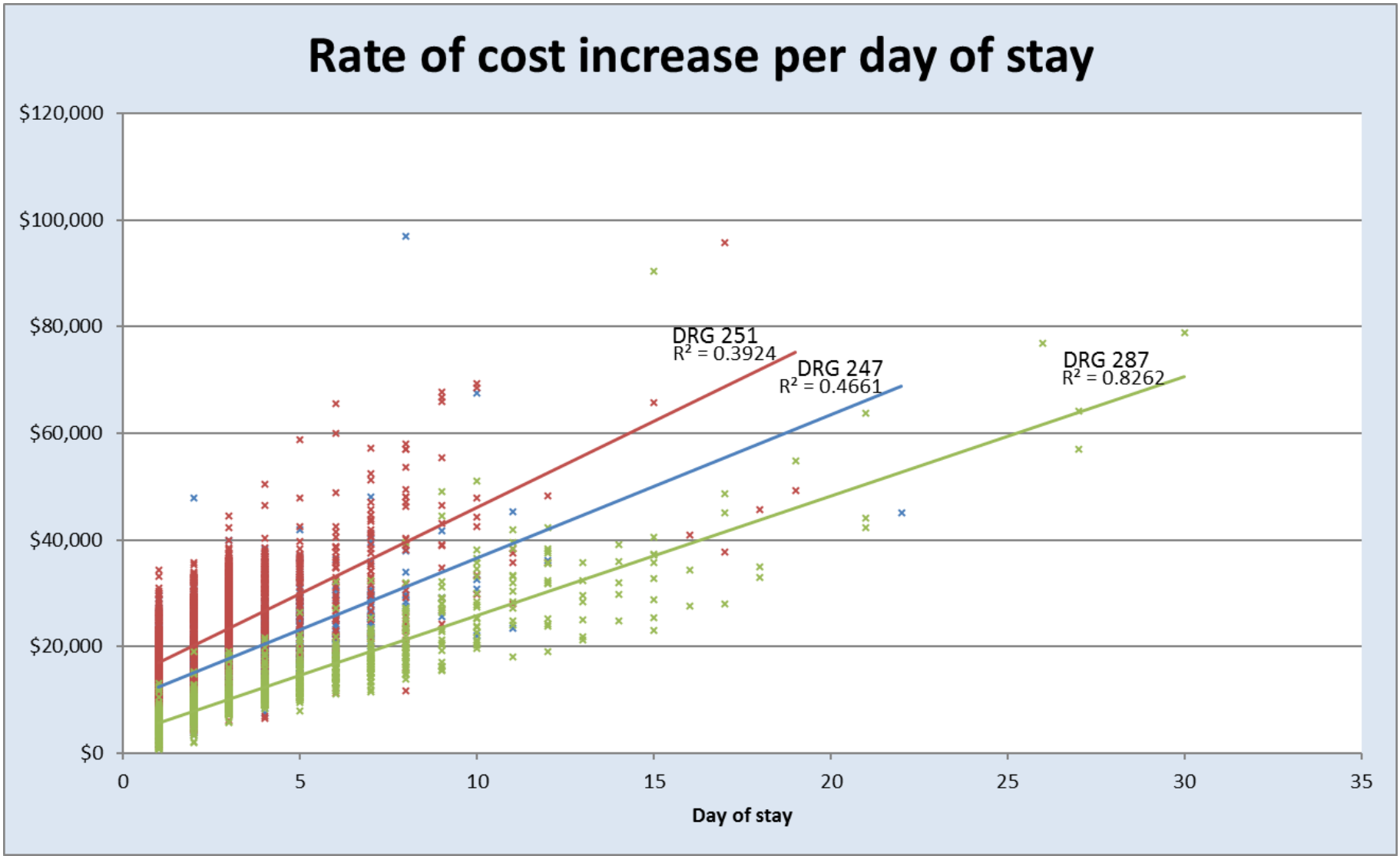


- Note use of different marker shapes & color to help differentiate

Note: Data Fictitious!

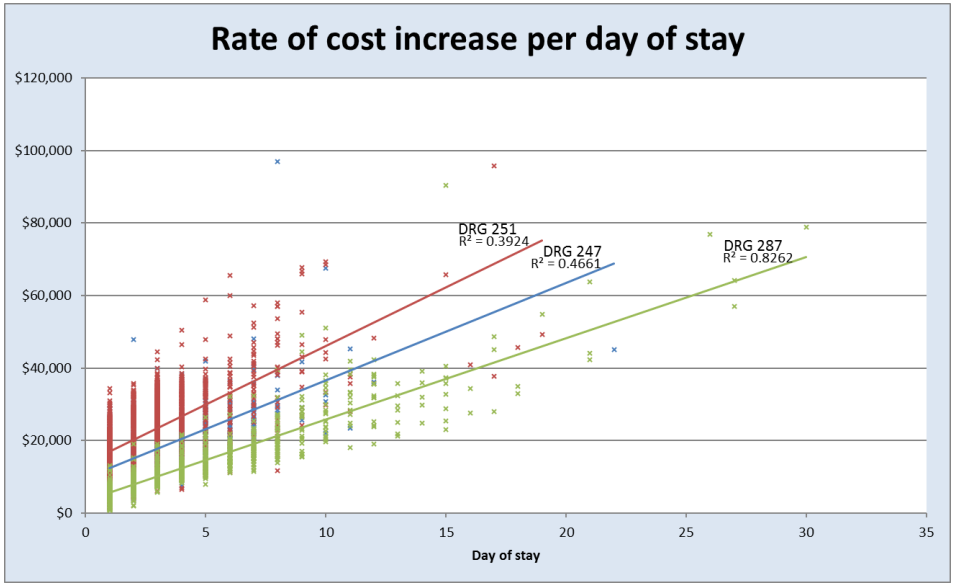
Scatter plots – numerous observations

- Make points smaller
- A trend line can show relationships of points



Scatter plot – process to create

- Notice how data had to be laid out – tedious
- Had to create chart with just one DRG
- Then add each DRG one by one

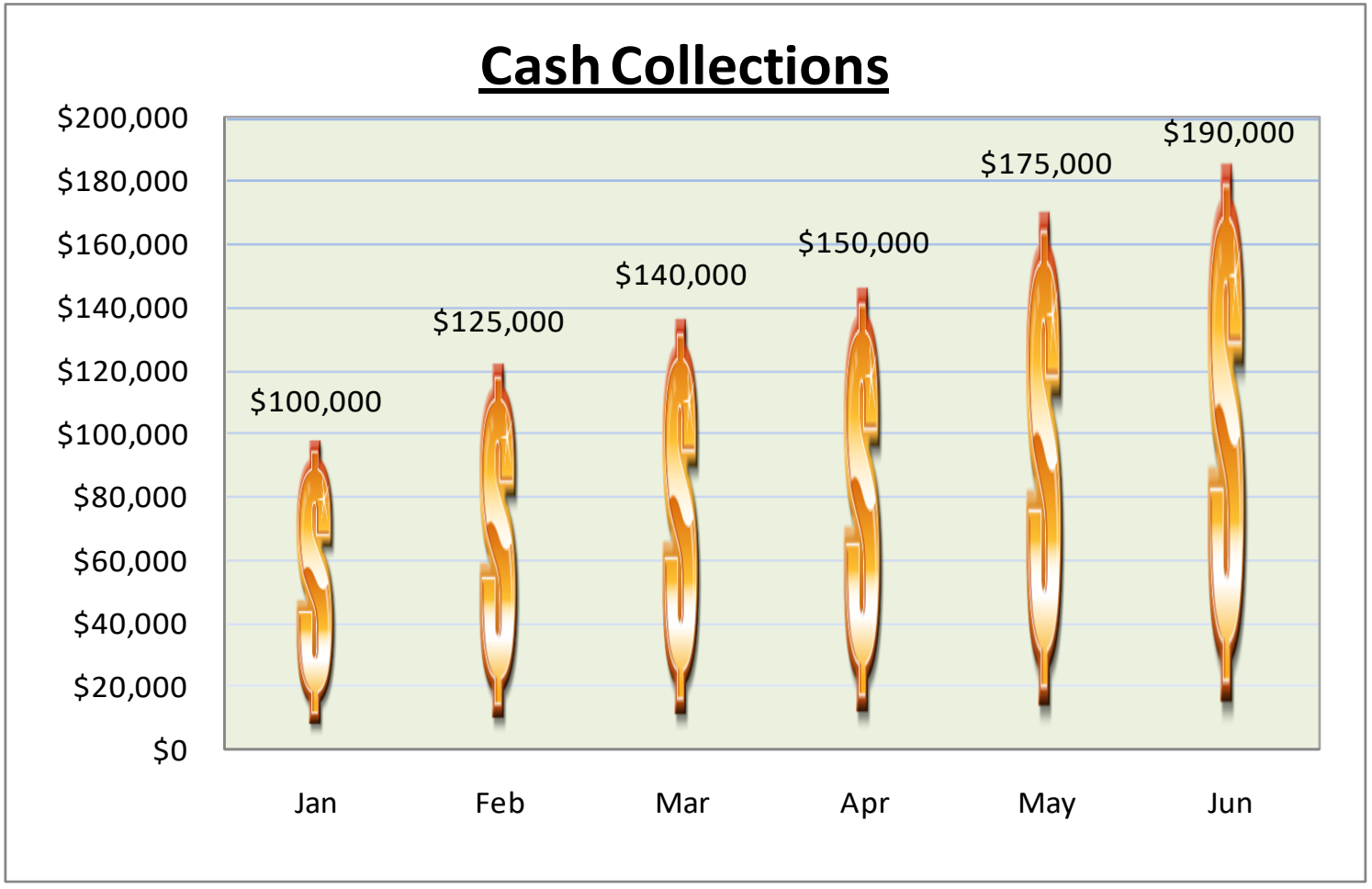


Note how title is DRG, not cost, and X axis repeated

Days	DRG 247	Days	DRG 251	Days	DRG 287
1	$13,720	1	$14,126	4	$9,142
1	$9,416	1	$9,857	15	$29,970
1	$13,429	2	$12,759	7	$11,683
1	$9,217	3	$19,351	15	$33,912
5	$19,804	1	$19,282	3	$6,922
1	$10,876	1	$12,342	1	$5,129
1	$9,522	2	$10,416	2	$5,229
3	$18,334	3	$21,094	1	$5,146
1	$15,417	2	$17,406	2	$6,063
2	$9,405	3	$29,376	2	$5,172

Clip art

- Adding clip art can spice up a graph in the right situation. Don't overdue!

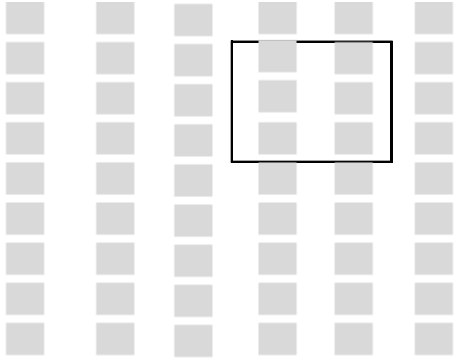


Excel 2016 Tip

- Right Click Format Data Series
- Fill, Picture . . .
- Online…or File …

Data differentiation

- Encircling data is the strongest way to highlight items



- Spacing is the mildest way to highlight items

Tables

- **Interpreted verbally or sequentially**
- **Best for:**
  - Presenting actual values
  - Precise values are required and will be compared
  - Data has multiple units of measures: EG, dollars, admissions, ratios
  - Many (>7 or 8) sets of categorical data exist

Tables

What were charges for Emergency Medicine in Feb?

	July	August	Sept	Oct	Nov	Dec	Jan	Feb	Mar	April	May	June	Total
CARDIAC SURGERY	$828,165	$279,438	$414,142	$732,448	$1,123,084	$732,734	$245,928	$206,251	$1,101,246	$251,700	$280,042	$127,291	$6,322,469
CARDIOVASCULAR MEDICINE	$7,554,156	$7,357,233	$7,059,429	$9,870,092	$11,318,293	$9,260,119	$7,690,409	$10,594,540	$14,803,326	$10,745,045	$12,761,809	$9,608,069	$118,622,520
COLORECTAL SURGERY	$1,541,169	$1,737,254	$1,022,696	$1,711,106	$1,731,105	$905,158	$1,212,169	$1,218,138	$1,647,662	$1,564,247	$1,735,603	$1,422,791	$17,449,098
DETAINED NEWBORN	$2,566,638	$3,933,442	$2,734,252	$2,762,165	$1,512,805	$3,339,815	$3,185,286	$3,882,430	$3,605,058	$2,828,180	$1,898,284	$1,842,327	$34,090,682
EMERGENCY MEDICINE	$470,165	$250,223	$1,539,570	$862,428	$896,313	$832,998	$1,638,390	$648,871	$557,905	$404,451	$186,375	$111,629	$8,399,318
FAMILY MEDICINE	$167,292	$272,879	$579,365	$586,049	$841,976	$735,664	$1,574,226	$76,885	$422,032	$655,052	$638,003	$978,919	$7,528,342
GASTROENTEROLOGY	$1,222,464	$1,064,711	$802,486	$674,465	$1,516,635	$666,124	$859,321	$3,730,569	$798,418	$2,753,513	$851,338	$1,200,939	$16,140,983
GYNECOLOGICAL ONCOLOGY	$369,829	$256,263	$409,523	$884,847	$380,863	$325,877	$350,815	$279,134	$596,456	$330,005	$567,467	$324,385	$5,075,464
GYNECOLOGY	$484,252	$562,144	$452,155	$1,000,763	$989,465	$968,753	$744,696	$624,105	$721,767	$577,340	$728,598	$564,305	$8,418,343
INFECTIOUS DISEASES	$175,060	$0	$42,903	$81,896	$15,640	$174,323	$193,532	$120,289	$371,174	$151,530	$24,142	$396,912	$1,747,401
MATERNAL FETAL MEDICINE	$17,594	$151,081	$54,412	$89,588	$85,553	$50,055	$13,571	$57,662	$0	$16,047	$110,419	$73,471	$719,453
MEDICINE	$10,009,281	$8,883,430	$10,193,911	$12,987,060	$10,290,264	$12,337,825	$13,568,819	$11,126,453	$12,054,253	$13,121,597	$11,436,887	$12,475,128	$138,484,908
NEUROLOGY	$523,824	$257,785	$646,944	$509,173	$552,825	$588,229	$646,737	$345,495	$528,256	$378,641	$396,098	$889,899	$6,263,906
NEUROSURGERY	$3,705,979	$4,763,990	$3,936,781	$5,628,072	$4,658,125	$4,564,504	$5,397,726	$4,946,315	$5,497,991	$5,459,492	$5,588,531	$4,765,447	$58,912,953
NEWBORN	$4,039,228	$3,912,493	$2,972,080	$4,489,169	$3,564,747	$4,506,773	$5,066,916	$6,501,821	$4,097,503	$4,304,923	$2,663,492	$3,744,641	$49,863,786
OBSTETRICS	$7,762,366	$7,900,912	$7,577,916	$7,893,084	$6,042,684	$7,704,375	$8,281,213	$6,590,218	$7,577,968	$7,094,715	$7,292,518	$8,299,623	$90,017,592
ONCOLOGY	$11,197,106	$8,701,800	$7,419,851	$8,298,134	$8,216,469	$9,324,872	$8,216,898	$9,941,504	$10,592,899	$11,812,061	$9,443,657	$7,229,013	$110,394,264
ORTHAPAEDICS	$11,221,908	$11,969,906	$10,596,389	$12,790,191	$10,576,119	$11,878,192	$11,620,916	$13,659,814	$11,735,232	$10,447,090	$10,706,321	$11,265,309	$138,467,387
OTORHINOLARYNGOLOGY - ENT	$1,035,877	$980,720	$1,083,267	$1,040,232	$908,379	$945,180	$1,143,694	$1,199,686	$983,927	$1,104,530	$2,056,440	$1,339,216	$13,821,148
PLASTIC SURGERY	$185,746	$135,928	$329,671	$292,839	$346,449	$298,361	$269,043	$365,162	$173,707	$309,667	$254,007	$246,185	$3,206,765
PSYCHIATRY	$6,018,507	$7,703,234	$6,126,461	$7,309,736	$5,801,032	$6,492,756	$8,561,968	$7,892,776	$7,687,845	$8,243,660	$6,265,484	$8,593,797	$86,697,256
PULMONARY/CRITICAL CARE	$3,222,142	$2,371,527	$1,464,977	$3,118,234	$1,756,951	$2,039,222	$3,123,270	$2,322,991	$6,688,598	$3,686,072	$3,009,216	$2,407,102	$35,210,302
RENAL METABOLIC	$443,558	$307,110	$861,305	$599,555	$280,022	$386,606	$582,689	$1,831,793	$604,852	$268,297	$346,967	$123,212	$6,635,966
REPRODUCTIVE ENDOCRINOLOGY	$89,996	$73,772	$0	$205,061	$121,925	$164,377	$255,436	$197,233	$173,852	$481,173	$83,620	$74,672	$1,921,117
RHEUMATOLOGY	$0	$75,902	$0	$67,815	$192,024	$9,738	$555,702	$0	$0	$16,160	$14,143	$108,981	$1,040,465
SKILLED NURSING FACILITY	$1,378,392	$2,186,248	$1,605,608	$1,364,549	$1,602,764	$1,807,591	$1,466,820	$1,406,141	$1,405,121	$2,098,328	$1,310,949	$1,591,534	$19,224,045

Note: Data Fictitious!

Tables - spacing

- If there are not too many rows, we can expand spacing.
- Maximum amount of space should be 50%
- Note: Few (and PJ) likes titles of numeric columns aligned “right”.

	July	August	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Total
CARDIAC SURGERY	$828,165	$279,438	$414,142	$732,448	$1,123,084	$732,734	$245,928	$206,251	$1,101,246	$5,663,436
CARDIOVASCULAR MEDICINE	$7,554,156	$7,357,233	$7,059,429	$9,870,092	$11,318,293	$9,260,119	$7,690,409	$10,594,540	$14,803,326	$85,507,597
COLORECTAL SURGERY	$1,541,169	$1,737,254	$1,022,696	$1,711,106	$1,731,105	$905,158	$1,212,169	$1,218,138	$1,647,662	$12,726,457
DETAINED NEWBORN	$2,566,638	$3,933,442	$2,734,252	$2,762,165	$1,512,805	$3,339,815	$3,185,286	$3,882,430	$3,605,058	$27,521,891
EMERGENCY MEDICINE	$470,165	$250,223	$1,539,570	$862,428	$896,313	$832,998	$1,638,390	$648,871	$557,905	$7,696,863
NEUROLOGY	$523,824	$257,785	$646,944	$509,173	$552,825	$588,229	$646,737	$345,495	$528,256	$4,599,268
FAMILY MEDICINE	$167,292	$272,879	$579,365	$586,049	$841,976	$735,664	$1,574,226	$76,885	$422,032	$5,256,368
GASTROENTEROLOGY	$1,222,464	$1,064,711	$802,486	$674,465	$1,516,635	$666,124	$859,321	$3,730,569	$798,418	$11,335,193
GYNECOLOGICAL ONCOLOGY	$369,829	$256,263	$409,523	$884,847	$380,863	$325,877	$350,815	$279,134	$596,456	$3,853,607
MATERNAL FETAL MEDICINE	$17,594	$151,081	$54,412	$89,588	$85,553	$50,055	$13,571	$57,662	$0	$519,516
MEDICINE	$10,009,281	$8,883,430	$10,193,911	$12,987,060	$10,290,264	$12,337,825	$13,568,819	$11,126,453	$12,054,253	$101,451,296
TOTAL	$25,270,577	$24,443,739	$25,456,730	$31,669,421	$30,249,716	$29,774,598	$30,985,671	$32,166,428	$36,114,612	$266,131,492

Note: Data Fictitious!

Tables - shading

- Another option – add shading to every other row

	July	August	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Total
CARDIAC SURGERY	$828,165	$279,438	$414,142	$732,448	$1,123,084	$732,734	$245,928	$206,251	$1,101,246	$5,663,436
CARDIOVASCULAR MEDICINE	$7,554,156	$7,357,233	$7,059,429	$9,870,092	$11,318,293	$9,260,119	$7,690,409	$10,594,540	$14,803,326	$85,507,597
COLORECTAL SURGERY	$1,541,169	$1,737,254	$1,022,696	$1,711,106	$1,731,105	$905,158	$1,212,169	$1,218,138	$1,647,662	$12,726,457
DETAINED NEWBORN	$2,566,638	$3,933,442	$2,734,252	$2,762,165	$1,512,805	$3,339,815	$3,185,286	$3,882,430	$3,605,058	$27,521,891
EMERGENCY MEDICINE	$470,165	$250,223	$1,539,570	$862,428	$896,313	$832,998	$1,638,390	$648,871	$557,905	$7,696,863
FAMILY MEDICINE	$167,292	$272,879	$579,365	$586,049	$841,976	$735,664	$1,574,226	$76,885	$422,032	$5,256,368
GASTROENTEROLOGY	$1,222,464	$1,064,711	$802,486	$674,465	$1,516,635	$666,124	$859,321	$3,730,569	$798,418	$11,335,193
GYNECOLOGICAL ONCOLOGY	$369,829	$256,263	$409,523	$884,847	$380,863	$325,877	$350,815	$279,134	$596,456	$3,853,607
MATERNAL FETAL MEDICINE	$17,594	$151,081	$54,412	$89,588	$85,553	$50,055	$13,571	$57,662	$0	$519,516
MEDICINE	$10,009,281	$8,883,430	$10,193,911	$12,987,060	$10,290,264	$12,337,825	$13,568,819	$11,126,453	$12,054,253	$101,451,296
NEUROLOGY	$523,824	$257,785	$646,944	$509,173	$552,825	$588,229	$646,737	$345,495	$528,256	$4,599,268

Note: Data Fictitious!

Tables – white space

- A little white space can make the total stand out

	July	August	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Total
CARDIAC SURGERY	$828,165	$279,438	$414,142	$732,448	$1,123,084	$732,734	$245,928	$206,251	$1,101,246	$5,663,436
CARDIOVASCULAR MEDICINE	$7,554,156	$7,357,233	$7,059,429	$9,870,092	$11,318,293	$9,260,119	$7,690,409	$10,594,540	$14,803,326	$85,507,597
COLORECTAL SURGERY	$1,541,169	$1,737,254	$1,022,696	$1,711,106	$1,731,105	$905,158	$1,212,169	$1,218,138	$1,647,662	$12,726,457
DETAINED NEWBORN	$2,566,638	$3,933,442	$2,734,252	$2,762,165	$1,512,805	$3,339,815	$3,185,286	$3,882,430	$3,605,058	$27,521,891
EMERGENCY MEDICINE	$470,165	$250,223	$1,539,570	$862,428	$896,313	$832,998	$1,638,390	$648,871	$557,905	$7,696,863
FAMILY MEDICINE	$167,292	$272,879	$579,365	$586,049	$841,976	$735,664	$1,574,226	$76,885	$422,032	$5,256,368
GASTROENTEROLOGY	$1,222,464	$1,064,711	$802,486	$674,465	$1,516,635	$666,124	$859,321	$3,730,569	$798,418	$11,335,193
GYNECOLOGICAL ONCOLOGY	$369,829	$256,263	$409,523	$884,847	$380,863	$325,877	$350,815	$279,134	$596,456	$3,853,607
MATERNAL FETAL MEDICINE	$17,594	$151,081	$54,412	$89,588	$85,553	$50,055	$13,571	$57,662	$0	$519,516
MEDICINE	$10,009,281	$8,883,430	$10,193,911	$12,987,060	$10,290,264	$12,337,825	$13,568,819	$11,126,453	$12,054,253	$101,451,296
NEUROLOGY	$523,824	$257,785	$646,944	$509,173	$552,825	$588,229	$646,737	$345,495	$528,256	$4,599,268

Note: Data Fictitious!

Tables - grid

- Can use grid method to highlight total

SERVICE	July	August	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Total
CARDIAC SURGERY	$828,165	$279,438	$414,142	$732,448	$1,123,084	$732,734	$245,928	$206,251	$1,101,246	$5,663,436
CARDIOVASCULAR MEDICINE	$7,554,156	$7,357,233	$7,059,429	$9,870,092	$11,318,293	$9,260,119	$7,690,409	$10,594,540	$14,803,326	$85,507,597
COLORECTAL SURGERY	$1,541,169	$1,737,254	$1,022,696	$1,711,106	$1,731,105	$905,158	$1,212,169	$1,218,138	$1,647,662	$12,726,457
DETAINED NEWBORN	$2,566,638	$3,933,442	$2,734,252	$2,762,165	$1,512,805	$3,339,815	$3,185,286	$3,882,430	$3,605,058	$27,521,891
EMERGENCY MEDICINE	$470,165	$250,223	$1,539,570	$862,428	$896,313	$832,998	$1,638,390	$648,871	$557,905	$7,696,863
FAMILY MEDICINE	$167,292	$272,879	$579,365	$586,049	$841,976	$735,664	$1,574,226	$76,885	$422,032	$5,256,368
GASTROENTEROLOGY	$1,222,464	$1,064,711	$802,486	$674,465	$1,516,635	$666,124	$859,321	$3,730,569	$798,418	$11,335,193
GYNECOLOGICAL ONCOLOGY	$369,829	$256,263	$409,523	$884,847	$380,863	$325,877	$350,815	$279,134	$596,456	$3,853,607
MATERNAL FETAL MEDICINE	$17,594	$151,081	$54,412	$89,588	$85,553	$50,055	$13,571	$57,662	$0	$519,516
MEDICINE	$10,009,281	$8,883,430	$10,193,911	$12,987,060	$10,290,264	$12,337,825	$13,568,819	$11,126,453	$12,054,253	$101,451,296
NEUROLOGY	$523,824	$257,785	$646,944	$509,173	$552,825	$588,229	$646,737	$345,495	$528,256	$4,599,268
TOTAL	$25,270,577	$24,443,739	$25,456,730	$31,669,421	$30,249,716	$29,774,598	$30,985,671	$32,166,428	$36,114,612	$266,131,492

Tables - grid

- A gentle grid can help reader's find particular data
- The key is to not overwhelm the data with non-data ink

	July	August	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Total
CARDIAC SURGERY	$828,165	$279,438	$414,142	$732,448	$1,123,084	$732,734	$245,928	$206,251	$1,101,246	**$5,663,436**
CARDIOVASCULAR MEDICINE	$7,554,156	$7,357,233	$7,059,429	$9,870,092	$11,318,293	$9,260,119	$7,690,409	$10,594,540	$14,803,326	**$85,507,597**
COLORECTAL SURGERY	$1,541,169	$1,737,254	$1,022,696	$1,711,106	$1,731,105	$905,158	$1,212,169	$1,218,138	$1,647,662	**$12,726,457**
DETAINED NEWBORN	$2,566,638	$3,933,442	$2,734,252	$2,762,165	$1,512,805	$3,339,815	$3,185,286	$3,882,430	$3,605,058	**$27,521,891**
EMERGENCY MEDICINE	$470,165	$250,223	$1,539,570	$862,428	$896,313	$832,998	$1,638,390	$648,871	$557,905	**$7,696,863**
FAMILY MEDICINE	$167,292	$272,879	$579,365	$586,049	$841,976	$735,664	$1,574,226	$76,885	$422,032	**$5,256,368**
GASTROENTEROLOGY	$1,222,464	$1,064,711	$802,486	$674,465	$1,516,635	$666,124	$859,321	$3,730,569	$798,418	**$11,335,193**
GYNECOLOGICAL ONCOLOGY	$369,829	$256,263	$409,523	$884,847	$380,863	$325,877	$350,815	$279,134	$596,456	**$3,853,607**
MATERNAL FETAL MEDICINE	$17,594	$151,081	$54,412	$89,588	$85,553	$50,055	$13,571	$57,662	$0	**$519,516**
MEDICINE	$10,009,281	$8,883,430	$10,193,911	$12,987,060	$10,290,264	$12,337,825	$13,568,819	$11,126,453	$12,054,253	**$101,451,296**
NEUROLOGY	$523,824	$257,785	$646,944	$509,173	$552,825	$588,229	$646,737	$345,495	$528,256	**$4,599,268**
TOTAL	**$25,270,577**	**$24,443,739**	**$25,456,730**	**$31,669,421**	**$30,249,716**	**$29,774,598**	**$30,985,671**	**$32,166,428**	**$36,114,612**	**$266,131,492**

Note: Data Fictitious!

Tables - grid

- A gentle grid can help reader's find particular data
- This grid is more distracting,
  but helps users read down as well as across
  if columns are thinner

	July	August	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Total
CARDIAC SURGERY	$828,165	$279,438	$414,142	$732,448	$1,123,084	$732,734	$245,928	$206,251	$1,101,246	**$5,663,436**
CARDIOVASCULAR MEDICINE	$7,554,156	$7,357,233	$7,059,429	$9,870,092	$11,318,293	$9,260,119	$7,690,409	$10,594,540	$14,803,326	**$85,507,597**
COLORECTAL SURGERY	$1,541,169	$1,737,254	$1,022,696	$1,711,106	$1,731,105	$905,158	$1,212,169	$1,218,138	$1,647,662	**$12,726,457**
DETAINED NEWBORN	$2,566,638	$3,933,442	$2,734,252	$2,762,165	$1,512,805	$3,339,815	$3,185,286	$3,882,430	$3,605,058	**$27,521,891**
EMERGENCY MEDICINE	$470,165	$250,223	$1,539,570	$862,428	$896,313	$832,998	$1,638,390	$648,871	$557,905	**$7,696,863**
FAMILY MEDICINE	$167,292	$272,879	$579,365	$586,049	$841,976	$735,664	$1,574,226	$76,885	$422,032	**$5,256,368**
GASTROENTEROLOGY	$1,222,464	$1,064,711	$802,486	$674,465	$1,516,635	$666,124	$859,321	$3,730,569	$798,418	**$11,335,193**
GYNECOLOGICAL ONCOLOGY	$369,829	$256,263	$409,523	$884,847	$380,863	$325,877	$350,815	$279,134	$596,456	**$3,853,607**
MATERNAL FETAL MEDICINE	$17,594	$151,081	$54,412	$89,588	$85,553	$50,055	$13,571	$57,662	$0	**$519,516**
MEDICINE	$10,009,281	$8,883,430	$10,193,911	$12,987,060	$10,290,264	$12,337,825	$13,568,819	$11,126,453	$12,054,253	**$101,451,296**
NEUROLOGY	$523,824	$257,785	$646,944	$509,173	$552,825	$588,229	$646,737	$345,495	$528,256	**$4,599,268**
TOTAL	**$25,270,577**	**$24,443,739**	**$25,456,730**	**$31,669,421**	**$30,249,716**	**$29,774,598**	**$30,985,671**	**$32,166,428**	**$36,114,612**	**$266,131,492**

Note: Data Fictitious!

Tables – fill color

- A fill color can help highlight specific column

	July	August	Sept	Q1 Total	Oct	Nov	Dec	Q2 Total
CARDIAC SURGERY	$828,165	$279,438	$414,142	$1,521,745	$732,448	$1,123,084	$732,734	$2,588,266
CARDIOVASCULAR MEDICINE	$7,554,156	$7,357,233	$7,059,429	$21,970,818	$9,870,092	$11,318,293	$9,260,119	$30,448,504
COLORECTAL SURGERY	$1,541,169	$1,737,254	$1,022,696	$4,301,119	$1,711,106	$1,731,105	$905,158	$4,347,369
DETAINED NEWBORN	$2,566,638	$3,933,442	$2,734,252	$9,234,332	$2,762,165	$1,512,805	$3,339,815	$7,614,785
EMERGENCY MEDICINE	$470,165	$250,223	$1,539,570	$2,259,958	$862,428	$896,313	$832,998	$2,591,739
FAMILY MEDICINE	$167,292	$272,879	$579,365	$1,019,536	$586,049	$841,976	$735,664	$2,163,689
GASTROENTEROLOGY	$1,222,464	$1,064,711	$802,486	$3,089,661	$674,465	$1,516,635	$666,124	$2,857,224
GYNECOLOGICAL ONCOLOGY	$369,829	$256,263	$409,523	$1,035,615	$884,847	$380,863	$325,877	$1,591,587
MATERNAL FETAL MEDICINE	$17,594	$151,081	$54,412	$223,087	$89,588	$85,553	$50,055	$225,196
MEDICINE	$10,009,281	$8,883,430	$10,193,911	$29,086,622	$12,987,060	$10,290,264	$12,337,825	$35,615,149
NEUROLOGY	$523,824	$257,785	$646,944	$1,428,553	$509,173	$552,825	$588,229	$1,650,227
TOTAL	$25,270,577	$24,443,739	$25,456,730	$75,171,046	$31,669,421	$30,249,716	$29,774,598	$91,693,735

Note: Data Fictitious!

Pivot table

- Shows trend of admissions by DOW and by week

Admits	First Date								
DOW	7/5/2009	7/12/2009	7/19/2009	7/26/2009	8/2/2009	8/9/2009	8/16/2009	8/23/2009	Grand Total
Sunday	49	52	45	42	47	37	43	34	349
Monday	95	86	100	83	110	74	86	92	726
Tuesday	111	109	97	107	109	119	93	102	847
Wednesday	83	92	115	101	82	104	84	74	735
Thursday	99	89	90	95	98	80	85	97	733
Friday	74	82	82	63	63	68	73	65	570
Saturday	42	43	48	56	26	52	43	45	355
Grand Total	**553**	**553**	**577**	**547**	**535**	**534**	**507**	**509**	**4,315**

Tables – conditional formatting for trends

- **Green shows high admit dates; red low.**
- **Intensity of color indicates how far number is above/below average.**
- **This took two mouse clicks (after creation of pivot table).**
  - Conditional Formatting, Color Scales

Admits	First Date								
DOW	7/5/2009	7/12/2009	7/19/2009	7/26/2009	8/2/2009	8/9/2009	8/16/2009	8/23/2009	Grand Total
Sunday	49	52	45	42	47	37	43	34	349
Monday	95	86	100	83	110	74	86	92	726
Tuesday	111	109	97	107	109	119	93	102	847
Wednesday	83	92	115	101	82	104	84	74	735
Thursday	99	89	90	95	98	80	85	97	733
Friday	74	82	82	63	63	68	73	65	570
Saturday	42	43	48	56	26	52	43	45	355
Grand Total	**553**	**553**	**577**	**547**	**535**	**534**	**507**	**509**	**4,315**

Most Admits occur on Tuesdays

Admits down in August!!

Table – highlight highest/lowest values

- Highest month highlighted in green; lowest in red
- Used conditional formatting, top/bottom rules
- Used copy/paste format to copy rule from row to row
- Notice use of gentle gridline

SERVICE	July	August	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Total
CARDIAC SURGERY	$828,165	$279,438	$414,142	$732,448	$1,123,084	$732,734	$245,928	$206,251	$1,101,246	$5,663,436
CARDIOVASCULAR MEDICINE	$7,554,156	$7,357,233	$7,059,429	$9,870,092	$11,318,293	$9,260,119	$7,690,409	$10,594,540	$14,803,326	$85,507,597
COLORECTAL SURGERY	$1,541,169	$1,737,254	$1,022,696	$1,711,106	$1,731,105	$905,158	$1,212,169	$1,218,138	$1,647,662	$12,726,457
DETAINED NEWBORN	$2,566,638	$3,933,442	$2,734,252	$2,762,165	$1,512,805	$3,339,815	$3,185,286	$3,882,430	$3,605,058	$27,521,891
EMERGENCY MEDICINE	$470,165	$250,223	$1,539,570	$862,428	$896,313	$832,998	$1,638,390	$648,871	$557,905	$7,696,863
FAMILY MEDICINE	$167,292	$272,879	$579,365	$586,049	$841,976	$735,664	$1,574,226	$76,885	$422,032	$5,256,368
GASTROENTEROLOGY	$1,222,464	$1,064,711	$802,486	$674,465	$1,516,635	$666,124	$859,321	$3,730,569	$798,418	$11,335,193
GYNECOLOGICAL ONCOLOGY	$369,829	$256,263	$409,523	$884,847	$380,863	$325,877	$350,815	$279,134	$596,456	$3,853,607
MATERNAL FETAL MEDICINE	$17,594	$151,081	$54,412	$89,588	$85,553	$50,055	$13,571	$57,662	$0	$519,516
MEDICINE	$10,009,281	$8,883,430	$10,193,911	$12,987,060	$10,290,264	$12,337,825	$13,568,819	$11,126,453	$12,054,253	$101,451,296
NEUROLOGY	$523,824	$257,785	$646,944	$509,173	$552,825	$588,229	$646,737	$345,495	$528,256	$4,599,268
TOTAL	$25,270,577	$24,443,739	$25,456,730	$31,669,421	$30,249,716	$29,774,598	$30,985,671	$32,166,428	$36,114,612	$266,131,492

Tables

- Which three doctors have the largest charge amounts?
- Which three have the largest payment amounts?
- Which doctors have more the 85 admissions?

Doctor	Charges	Payment
015065	$1,600,000	$600,000
021162	$14,300,000	$2,500,000
021212	$7,100,000	$1,400,000
021402	$7,200,000	$1,100,000
021501	$2,300,000	$400,000
021600	$6,300,000	$900,000
021725	$8,300,000	$1,300,000
021733	$7,000,000	$1,300,000
021865	$4,300,000	$500,000
022343	$9,500,000	$1,500,000
023143	$5,800,000	$900,000
023754	$2,900,000	$400,000
023838	$6,700,000	$1,100,000

Doctor	Adm	Days
015065	10	80
021063	140	530
021162	90	470
021212	100	460
021402	30	130
021501	80	430
021600	90	580
021725	80	250
021733	30	330
021865	110	520
022343	80	460
022848	30	230
023093	100	530

Tables – bars and icons

- Added color bars and icon sets to help users visually interpret data
- Can make Excel-based dashboards more appealing

Bars

Doctor	Charges	Payment
015065	$1,600,000	$600,000
021162	$14,300,000	$2,500,000
021212	$7,100,000	$1,400,000
021402	$7,200,000	$1,100,000
021501	$2,300,000	$400,000
021600	$6,300,000	$900,000
021725	$8,300,000	$1,300,000
021733	$7,000,000	$1,300,000
021865	$4,300,000	$500,000
022343	$9,500,000	$1,500,000
023143	$5,800,000	$900,000
023754	$2,900,000	$400,000
023838	$6,700,000	$1,100,000

Icons and Bars (values hidden)

Doctor	Adm	Days
015065	10	80
021063	140	530
021162	90	470
021212	100	460
021402	30	130
021501	80	430
021600	90	580
021725	80	250
021733	30	330
021865	110	520
022343	80	460
022848	30	230
023093	100	530

Tables – totals at top

- There's no rule that totals need to be at the bottom
- Can be useful for longer tables/reports

Department: Cardiovascular Medicine

Total:	**$141,400,000**	**$23,000,000**	**1,570**	**7,280**	**54.18**

Doctor	Charges	Payment	Adm	Days	CMI
015065	$1,300,000	$500,000	10	60	23.04
021063	$100,000	$0	0	0	1.49
021162	$11,300,000	$2,000,000	110	420	166.90
021212	$5,600,000	$1,100,000	70	370	98.04
021402	$5,700,000	$900,000	80	360	82.74
021501	$1,800,000	$300,000	20	100	24.59
021600	$5,000,000	$700,000	60	340	64.07
021725	$6,600,000	$1,000,000	70	460	80.65
021733	$5,500,000	$1,000,000	60	200	82.68
021865	$3,400,000	$400,000	20	260	28.49
022343	$7,500,000	$1,200,000	90	410	97.20
022848	$100,000	$0	0	10	2.06
023093	$28,500,000	$4,300,000	320	1,000	381.26
023143	$4,600,000	$700,000	60	360	65.31

Note: Data Fictitious!

Most legible fonts

- **Serif fonts**

  Times New Roman

  Palatino

  Courier

- **Sans-Serif fonts**

  Arial

  Verdana

  Tahoma

Personal numeric preferences

- **Prefer currency to accounting:**
  - Reason: number of non-dollar associated measure in healthcare helps distinguish, EG days from payments
  - AICPA has different opinion

Accounting:	$ 500,000
Currency:	$500,000

- **Use commas between thousands**
- **Percentages don't need tenths . . . but end user's like**
- **Usually prefer to exclude cents on financial numbers**
- **Prefer negative numbers in red**
  - **Custom number format to make % red: 0.0%;[Red](0.0%)**

Wrapping it up

- **Focus attention to the story**
- **Limit non-data ink**
- **Avoid 3D and Pie Charts**
- **Colors are good when used correctly**
  - Consider possibility of photo-copying
  - Use milder colors, except for items you wish to highlight
  - Be aware of visual perception
- **If a graph doesn't communicate message, revise it**
- **Be creative and have fun with it!**

References

1. Few, Stephen. 2004. *Show me the numbers*. Analytics Press. Oakland, CA

2. Borg, Jana Schaich. 2017. “Data Visualization and Communication with Tableau”. www.coursera.org.

3. Jelen, Bill “Mr. Excel”. 2007. *Charts and graphs for Microsoft Office Excel 2007*. Que. Indianapolis, IN.

4. Heath, Chip; Heath, Dan. 2007. *Made to stick: why some ideas survive and others die*. Random House. New York, NY.

5. Walkenbach, John. 2007. *Excel 2007 graphs.* Wiley. Hoboken, NJ.