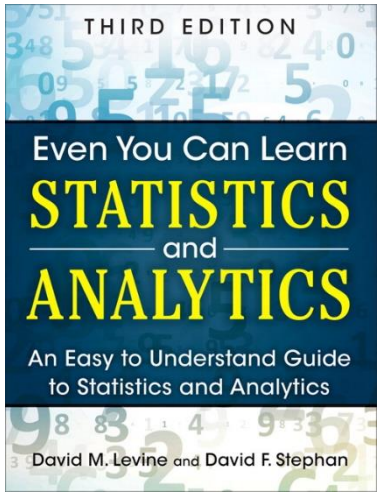
IMGD 2905

Presenting Data

Chapter 2



Outline

- Types of Charts (next)
- Game Analytics Examples
- Guidelines for Charts

Tables

- Generally, independent variable in left column and dependent variables next

Table 1. Number of student on campus and off by year

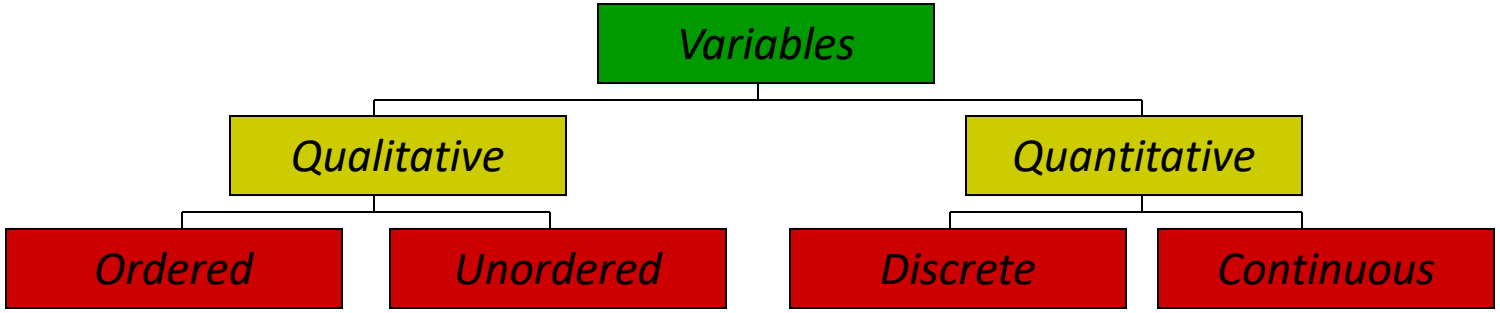
		Do you live on campus?	
		Off-campus	On-campus
Class rank	Freshman	37	100
	Sophomore	42	48
	Junior	90	8
	Senior	62	1
Total		231	157

- Number and caption
- Units labeled (as appropriate)
- Minimal vertical lines (or none)
- Lines only to break apart areas (or use Bold)

Make sure to consider *message*. Often much clearer in chart!

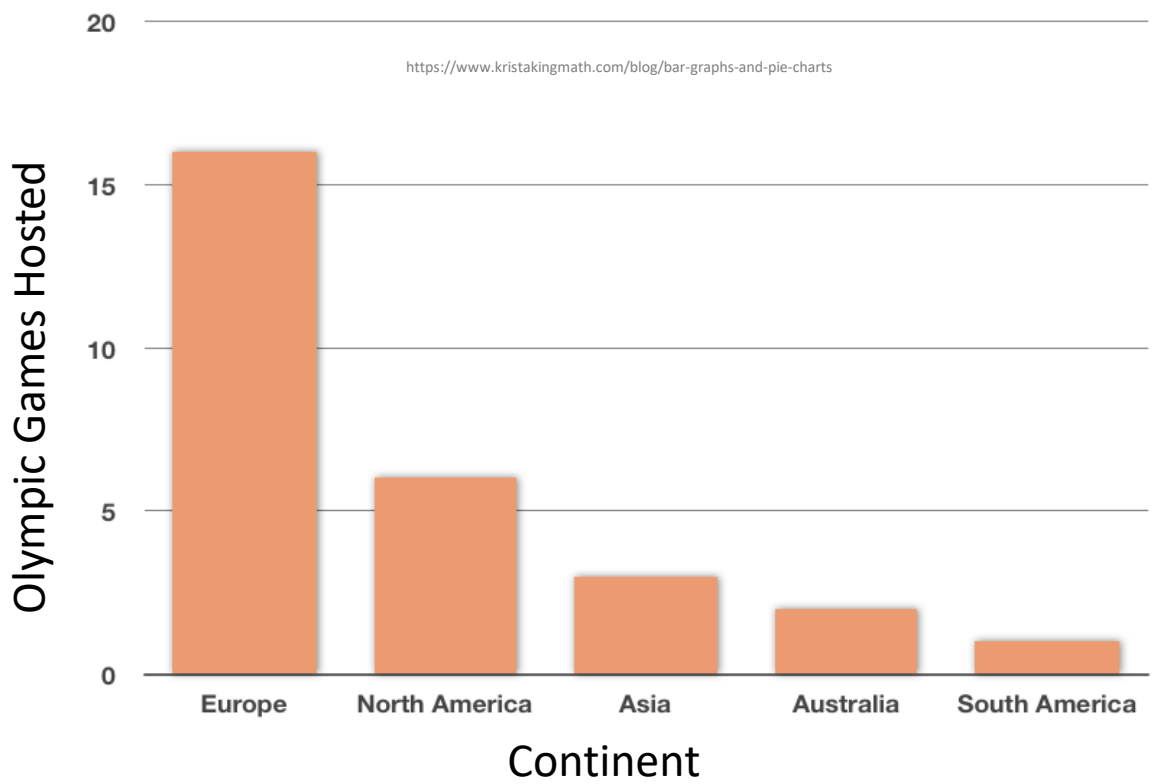
“Right” Chart Depends on Variable Type

- Qualitative (Categorical) variables
  - Can have states or subclasses
    - e.g., position: [striker, goalie, midfield]
  - Can be ordered or unordered
    - e.g., bronze, silver, gold → ordered
    - e.g., support, warrior, specialist → unordered
- Quantitative (Numeric) variables
  - Numeric levels
  - Discrete or continuous
    - e.g., goals in season, speed in meters
    - e.g., takedowns, win percentage



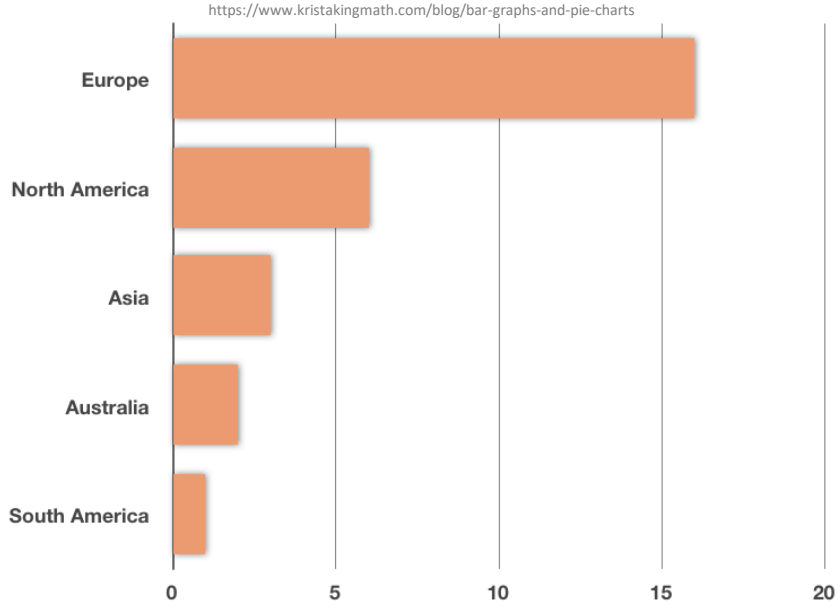
Categorical: Bar Chart (1 of 2)

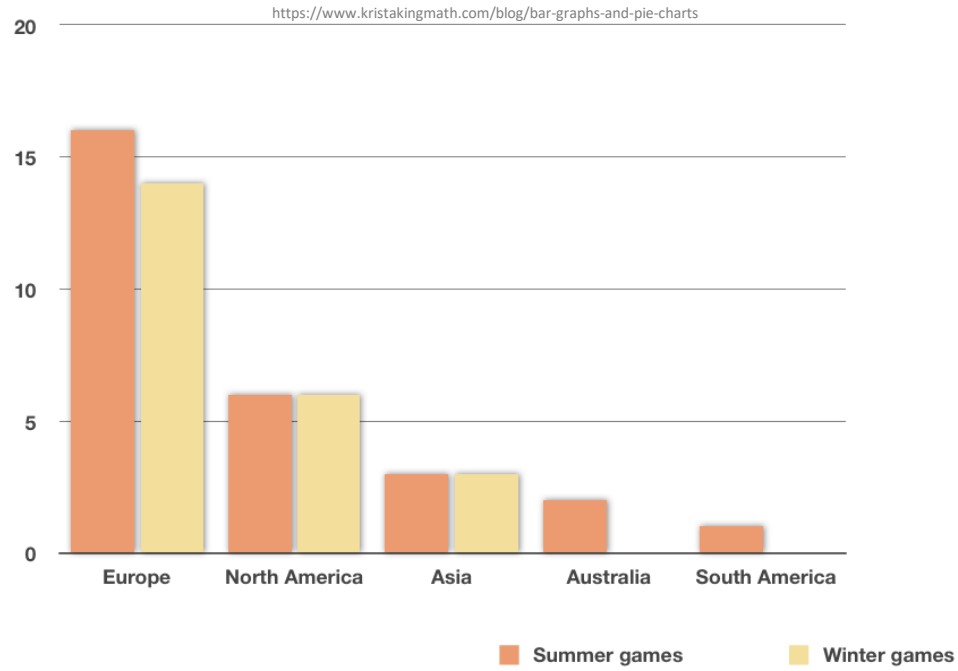
- Chart containing rectangles ("bars") where length represents count, amount, or percent (aka "column chart")
- Better than table for comparing numbers



Categorical: Bar Chart (2 of 2)

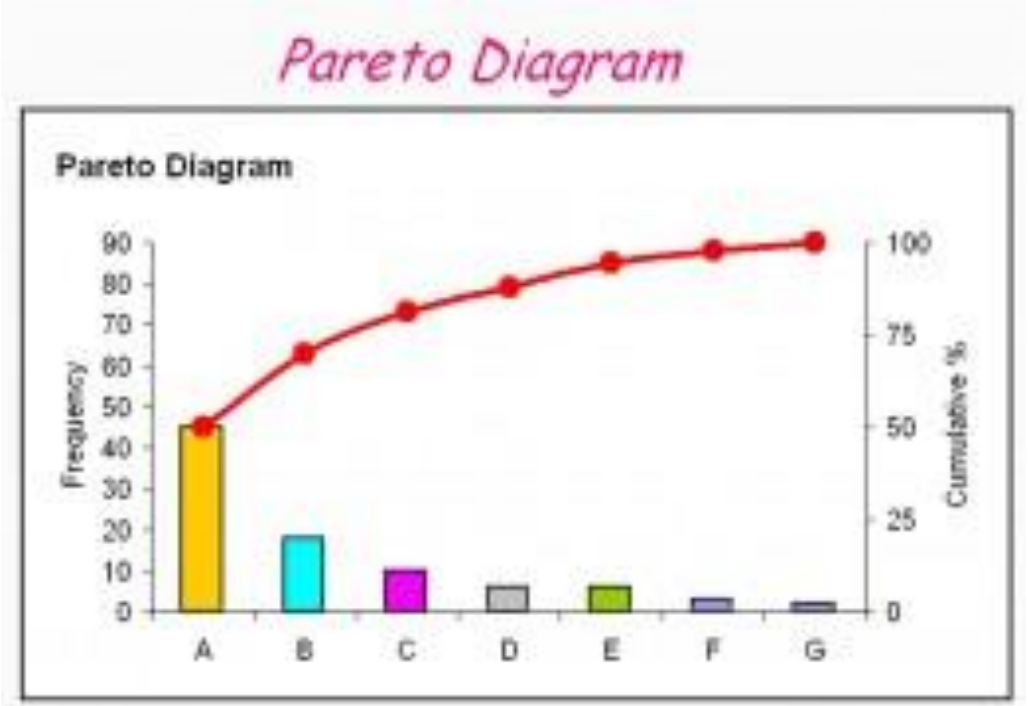
- Chart containing rectangles (“bars”) where length represents count, amount, or percent





Categorical: Pareto Chart

- Bar chart, arranged most to least frequent
- Line showing cumulative percent
- Helps identify most common



https://usercontent2.hubstatic.com/3767965_f520.jpg

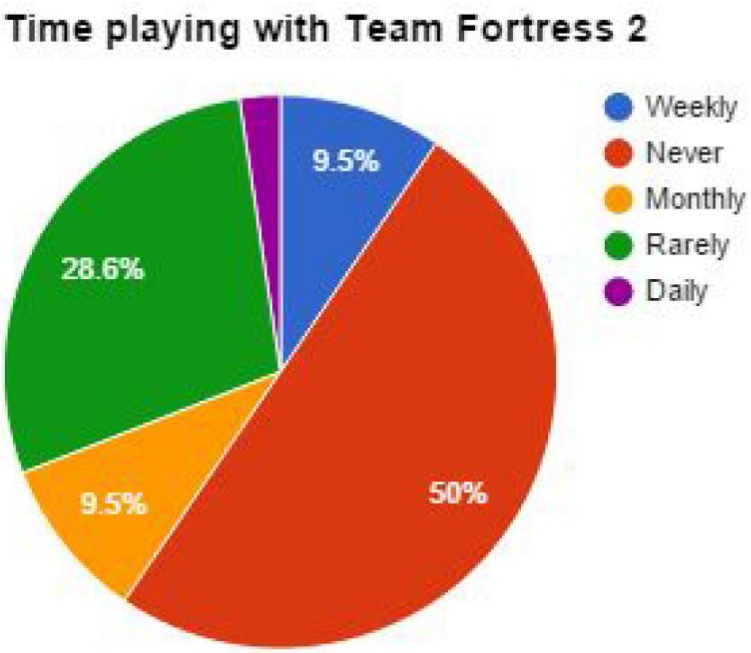
Demo: [imgdpops.xlsx]

Sort by column D (Data -> Sort high to low)
New column E for percent [=D2/SUM(D$2:D$11)]
Note: $ "locks" value in (e.g., D$2 versus D2)
New column F for running [=SUM(E$2:E2)]
Select B, D and F. Insert "combo chart"

Categorical: Pie Chart

- Wedge-shaped areas ("pie slices") – represent count, amount or percent of each category from whole
- Compare relative amounts at a glance
- Best if few slices since quantifying "size" of pie difficult
- Comparing pies also difficult

Demo: imgdpops.xlsx

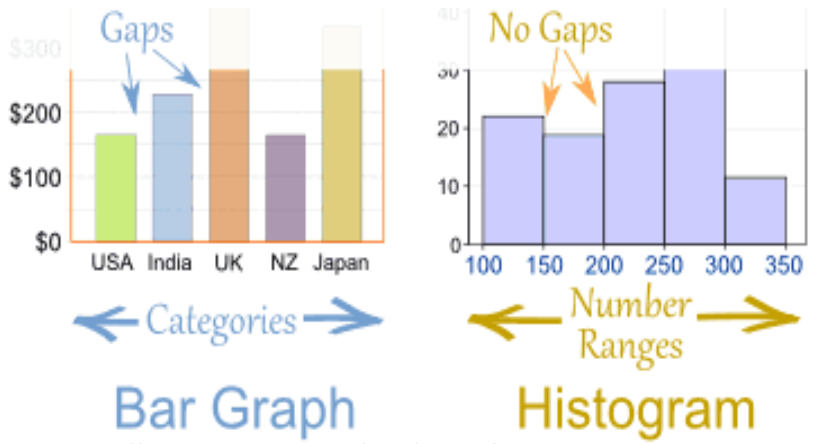


"The Effects of Latency and Jitter on a First Person Shooter: Team Fortress 2"

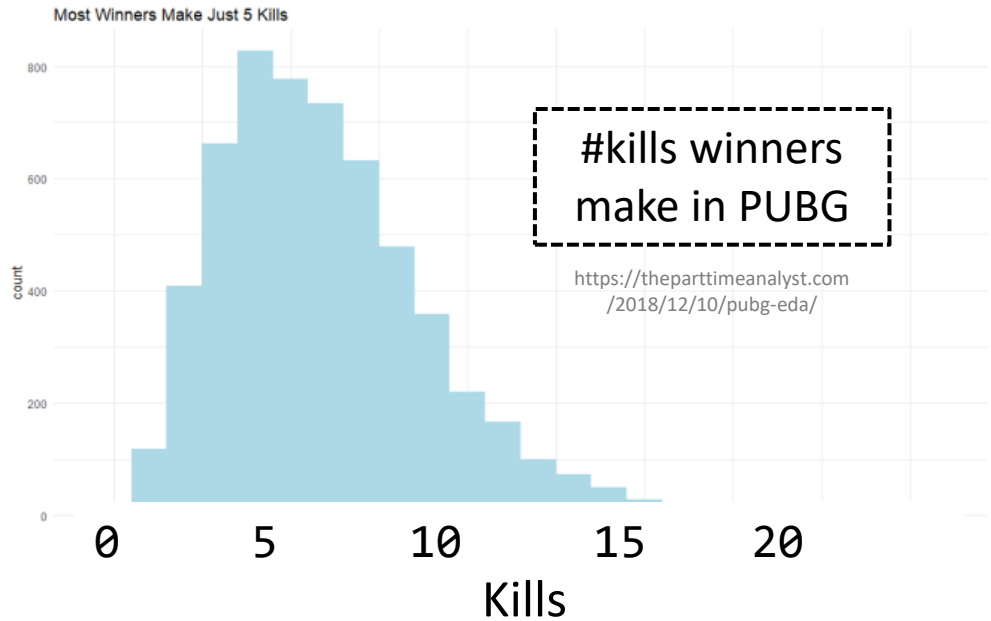
http://www.cs.wpi.edu/~claypool/iqp/tf2/

Histogram

- Bar chart for grouped numerical data
  - No (or small) gaps btwn adjacent bars

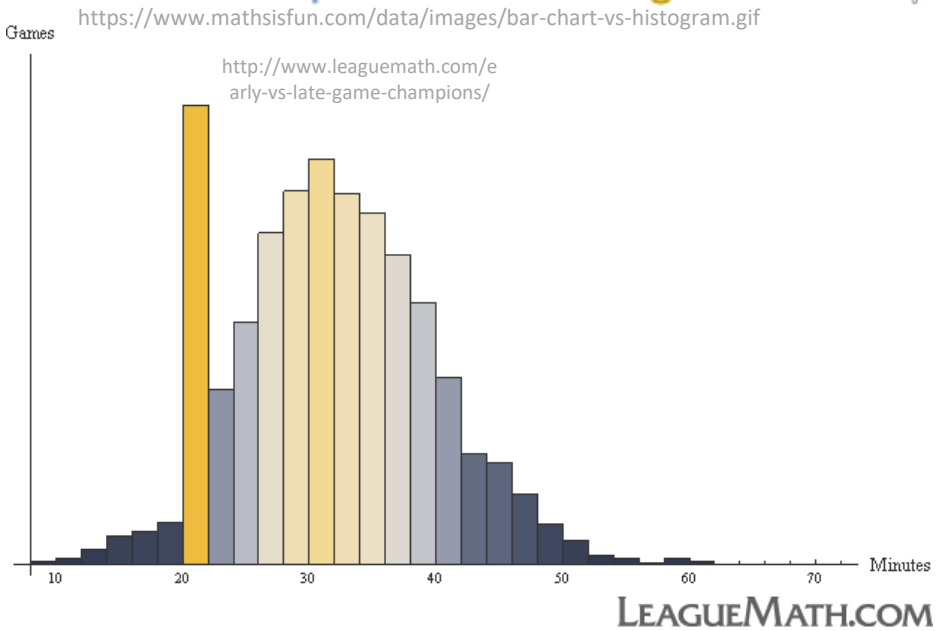


https://www.mathsisfun.com/data/images/bar-chart-vs-histogram.gif



#kills winners make in PUBG

https://theparttimeanalyst.com/2018/12/10/pubg-eda/



http://www.leaguemath.com/early-vs-late-game-champions/

Demo: grades.xlsx

Select GPA data
Insert → Statistics Chart → Histogram
Can adjust bins, overflow/underflow

Stem and Leaf Display

- "Histogram-lite" for analysis w/out software
  - e.g., points on homework

15,16,21,23,23,26,26,30,32,41

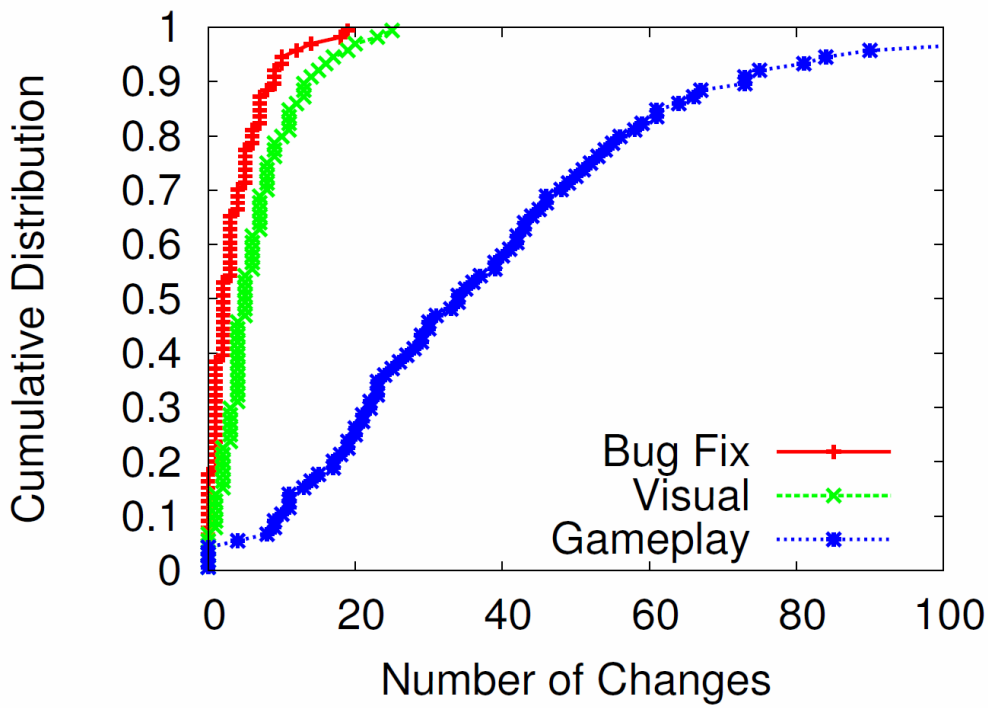
Stem	Leaf
1	5 6
2	1 3 3 6 6
3	0 2
4	1

how to place "32"

https://www.mathsisfun.com/data/stem-leaf-plots.html

Cumulative Distribution

- Cumulative amount of data with value or less
- Easy to see min, max, median
- Compare shapes of distributions



Demo: lol-patches.xlsx

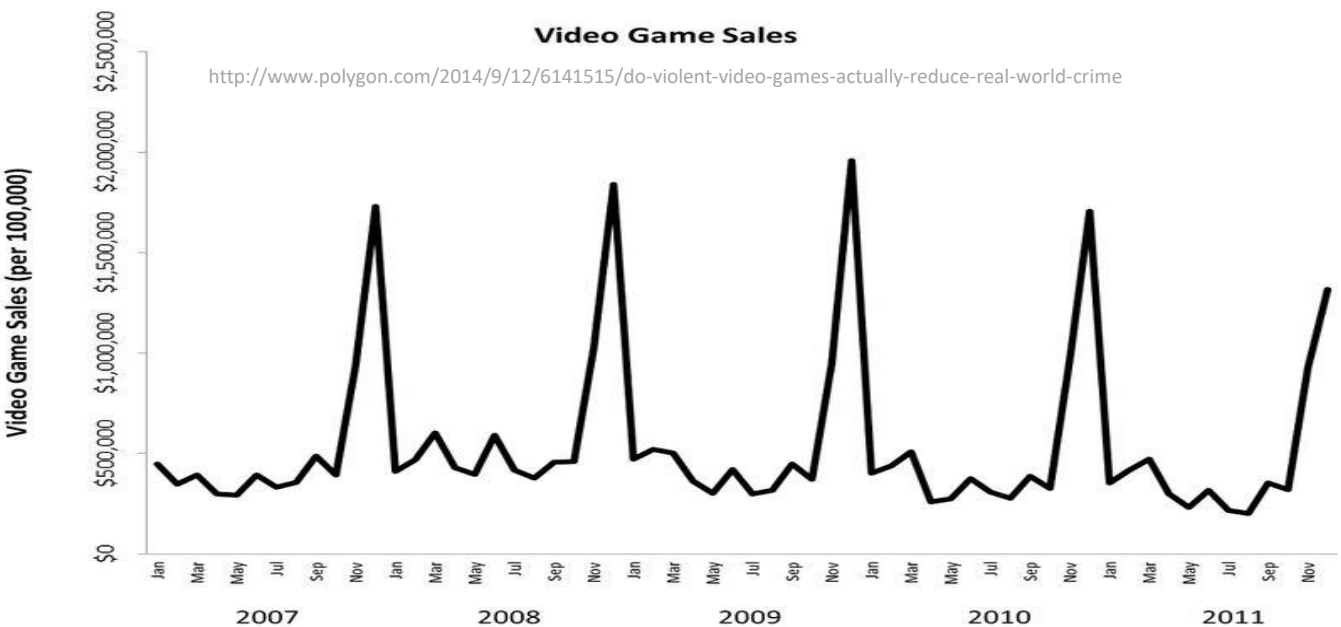
Select column R (Bug Fixes)
Sort low to high
New column S for percent [=ROW()/164]
Select column → paste down all
Select both column R and S
Insert → Scatter plot with lines

"Nerfs, Buffs and Bugs - Analysis of the Impact of Patching on League of Legends"
http://www.cs.wpi.edu/~claypool/papers/lol-crawler/

Time Series Plot

- Associate data with date
- Line graph with dates (proportionally spaced!)

http://www.soundandvision.com/content/violence-and-video-games



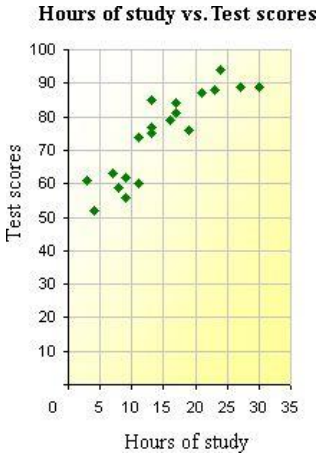
http://www.polygon.com/2014/9/12/6141515/do-violent-video-games-actually-reduce-real-world-crime

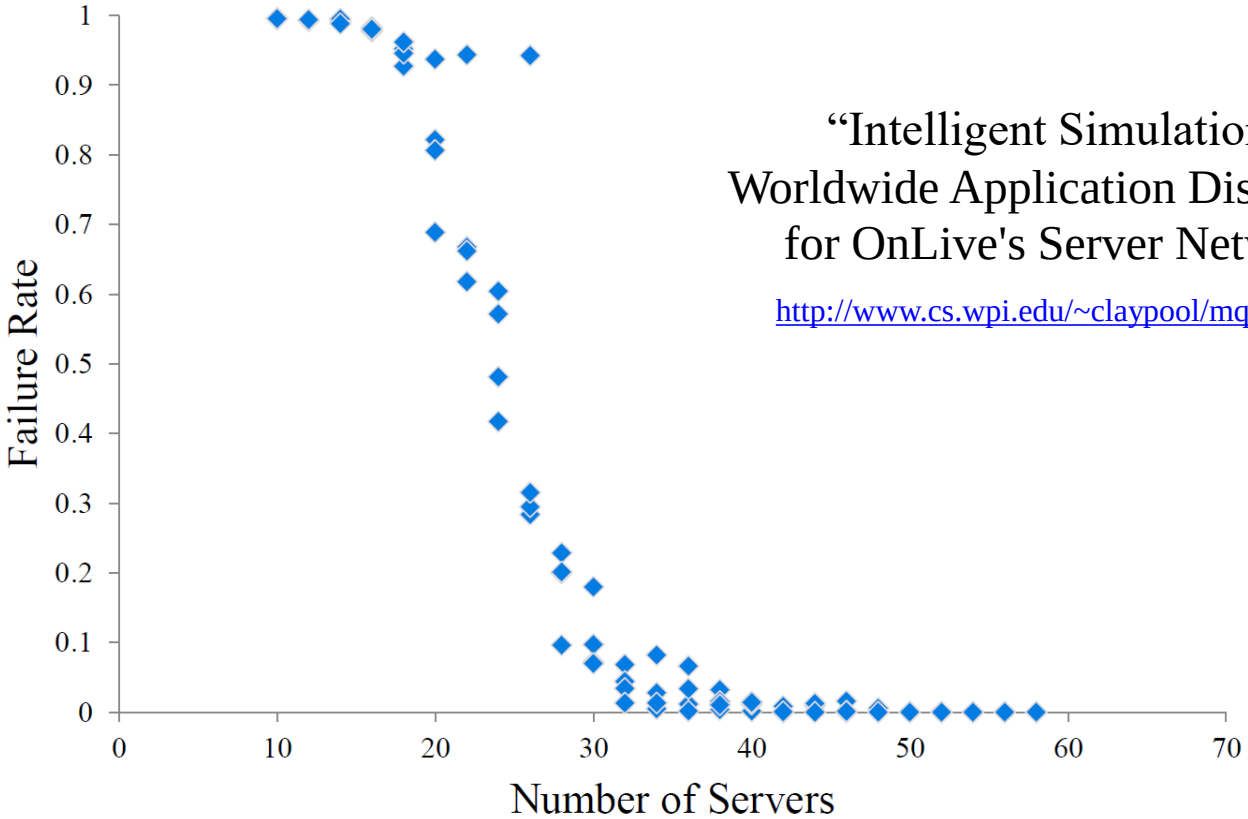
Demo: majors.xlsx

Sel. year and majors
Insert → Line Chart
→ More Line Charts

Two Variables – Scatter Plot

- Two numerical variables, one on each axis
- Reveal patterns in relationship
- Setup “right” models (later)





“Intelligent Simulation of Worldwide Application Distribution for OnLive's Server Network”

http://www.cs.wpi.edu/~claypool/mqp/onlive/

Demo: lol-rates.xlsx

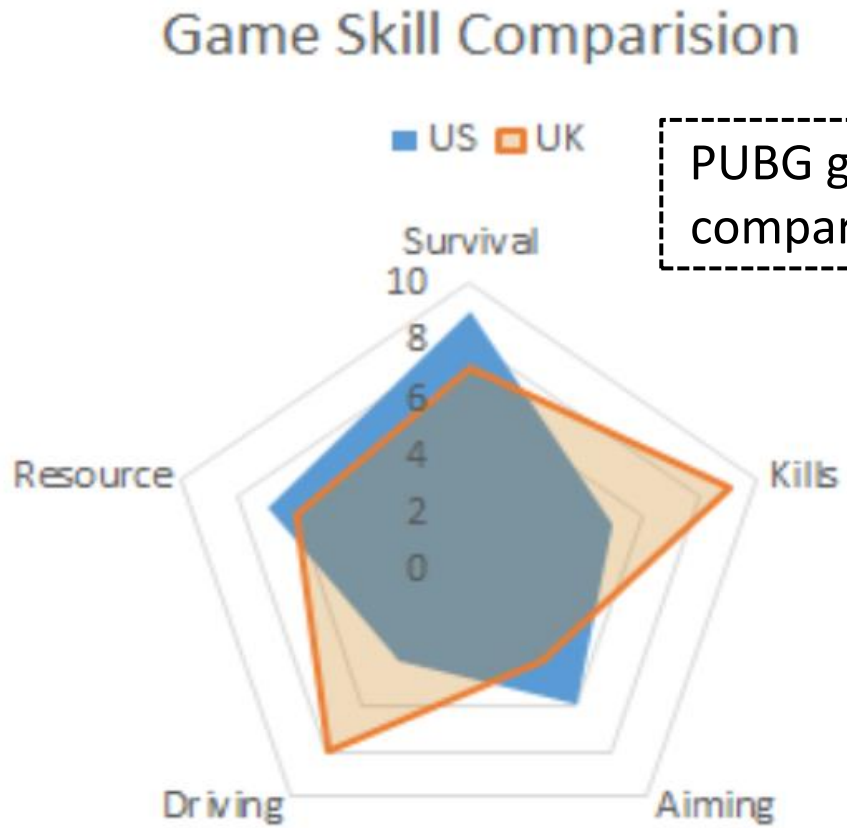
Select two of {win, pick, ban}
Insert → scatter plot

Radar Chart (1 of 2)

- Also called “star”, “spider”, “web” or “kiviat” charts
- Good for quick visual comparison, especially when axes unequal

Demo: [lol-rates.xlsx]

Select top line {win, pick, ban} + 3 row s (Ctrl-select)
Insert → Other → Radar scatter plot



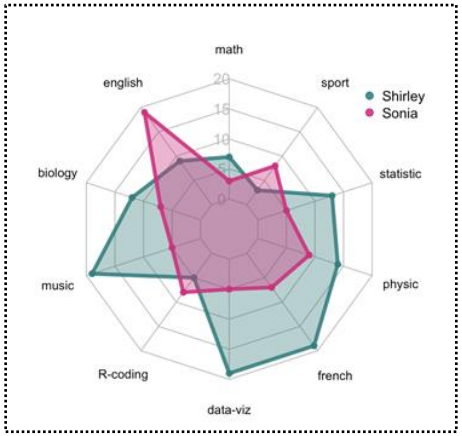
PUBG game comparison

https://www.exceltip.com/wp-content/uploads/2019/11/00213.png

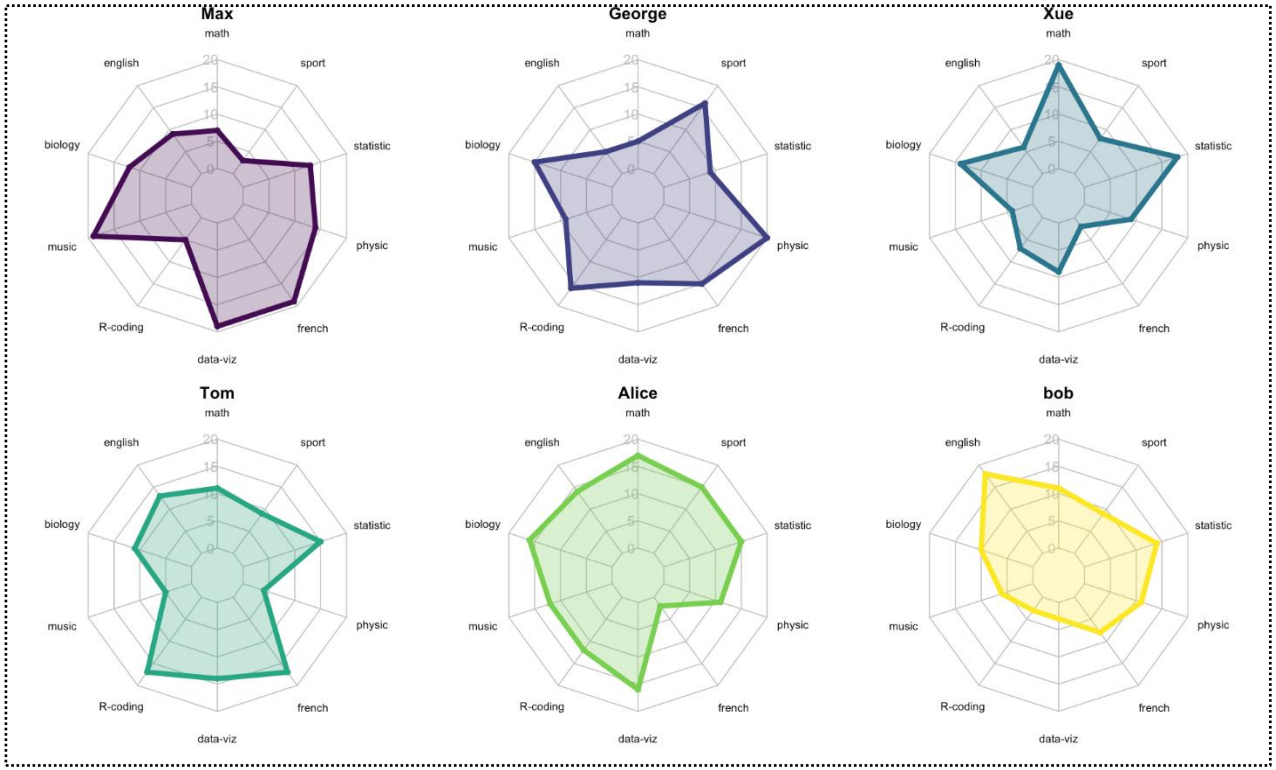
Note: need to normalize data to scale Axes
Insert column E (“B Norm”)
=E2/MAX(E$2:E42)
Copy and paste down

Radar Charts (2 of 2)

- Note, axes themselves hard to read values
- Value is to compare shapes



https://www.data-to-viz.com/caveat/spider.html



Many More Charts!

https://en.wikipedia.org/wiki/Chart

- Bubble
- Waterfall
- Tree
- Gap
- Polar
- Violin
- Candlestick
- Kagi
- Gantt
- Nolan
- Pert
- Smith
- Skyline
- Vowel
- Nomogram
- Natal

- If common chart effective for message, use
- Otherwise, learn/use other charts as needed
- But remember – may need to explain how to read

Outline

- Types of Charts (done)
- Game Analytics Examples (next)
- Guidelines for Charts

Game Analytics Charts

Gunter Wallner and Simone Kriglstein. “An Introduction to Gameplay Data Visualization”, *Game Research Methods*, pages 231-250, ETC Press, ISBN: 978-1-312-88473-1, 2015.
http://dl.acm.org/citation.cfm?id=2812792

- Player choices (e.g., build units)
- Density of activities (e.g., where spend time on map)
- Movement through levels

Player Choices – Pie-Chart

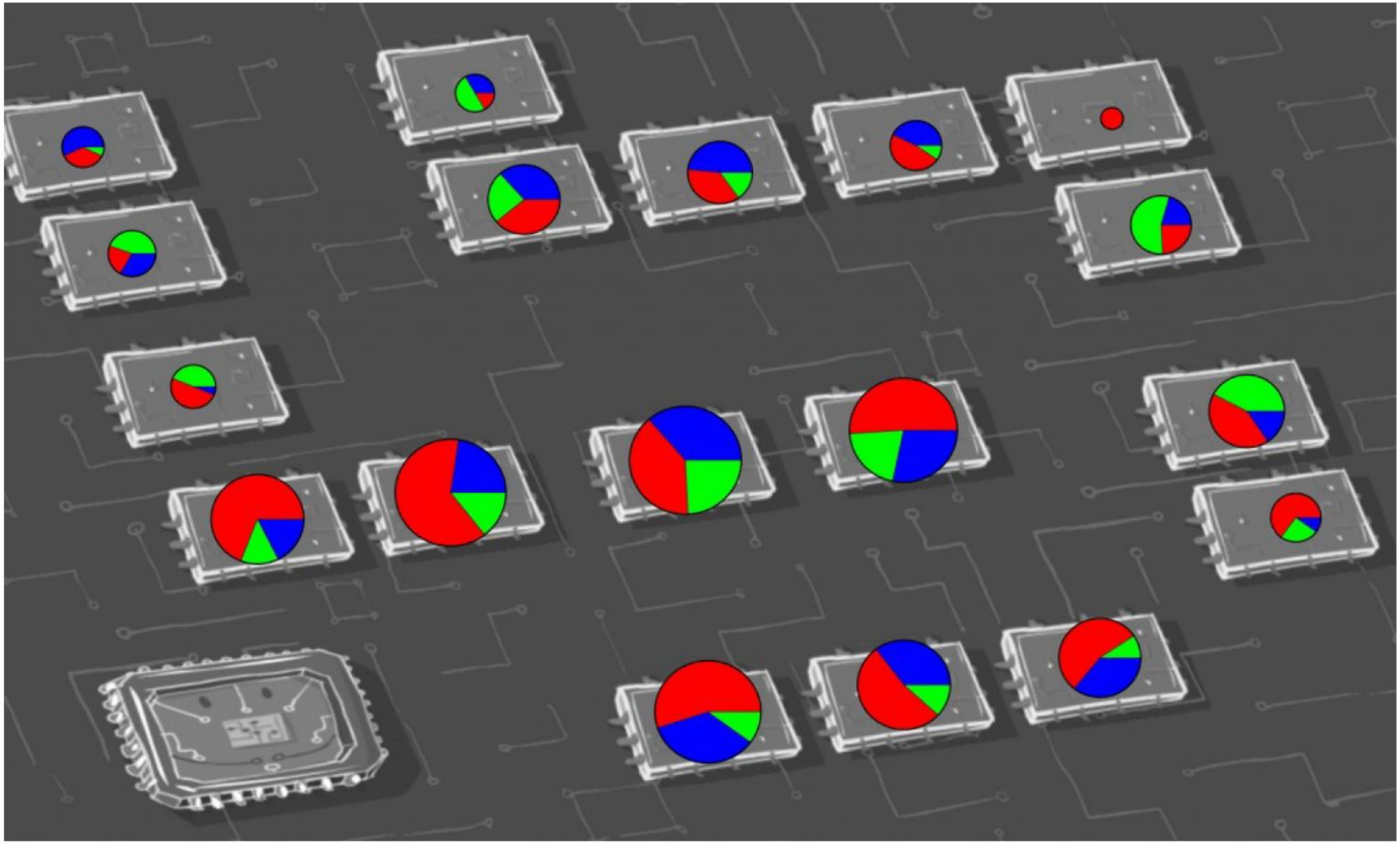


Figure 1. Pie-charts show which types of towers have been built on the different building lots. The radius of the pie-chart is proportional to the number of towers built (Kayali, et al., 2014).

(Custom game, comparative study)

Player Location – Heat Map (1 of 2)

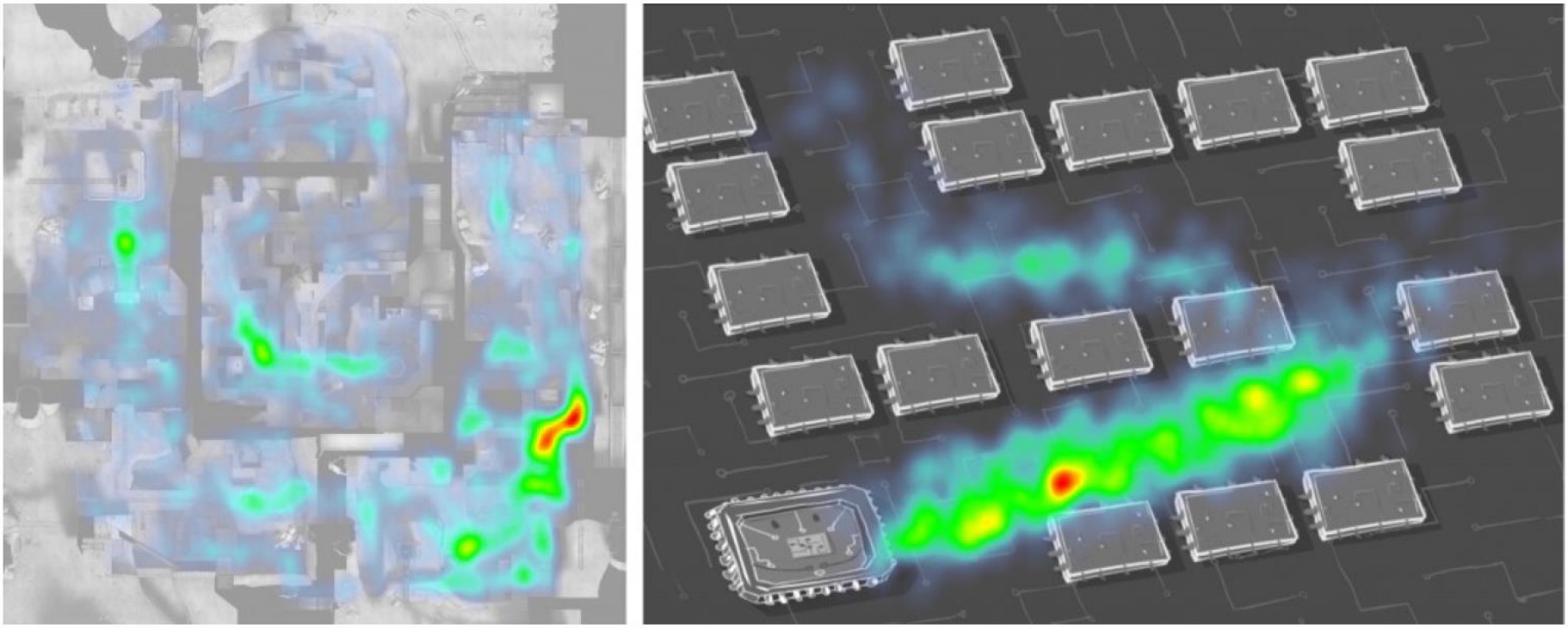


Figure 2. (a) Heatmap of death locations on the Team Fortress 2 map Goldrush. (b) Heatmap showing locations where players of a tower defense game collected coins dropped by defeated enemies (Kayali, et al., 2014).

Player Location – Heat Map (2 of 2)

http://www.gamasutra.com/blogs/JonathanDankoff/20140320/213624/Game_Telemetry_with_DNA_Tracking_on_Assassins_Creed.php

Assassin's Creed

Where play testers failed

Result: Make red areas easier

Note, Heat Map for Tables, Too!

	A	B	C	D
1		2014	2015	2016
2	January	600	708	594
3	February	607	984	749
4	March	901	886	908
5	April	608	615	835
6	May	715	833	734
7	June	520	663	618
8	July	731	521	950
9	August	709	663	987
10	September	633	863	979
11	October	533	651	841
12	November	996	958	749
13	December	792	717	875

Red means sales are low

Excel tutorial at: https://trumpexcel.com/heat-map-excel/

Movement (1 of 2)

(game: *Infinite Mario*, clone of Super Mario Bros.)

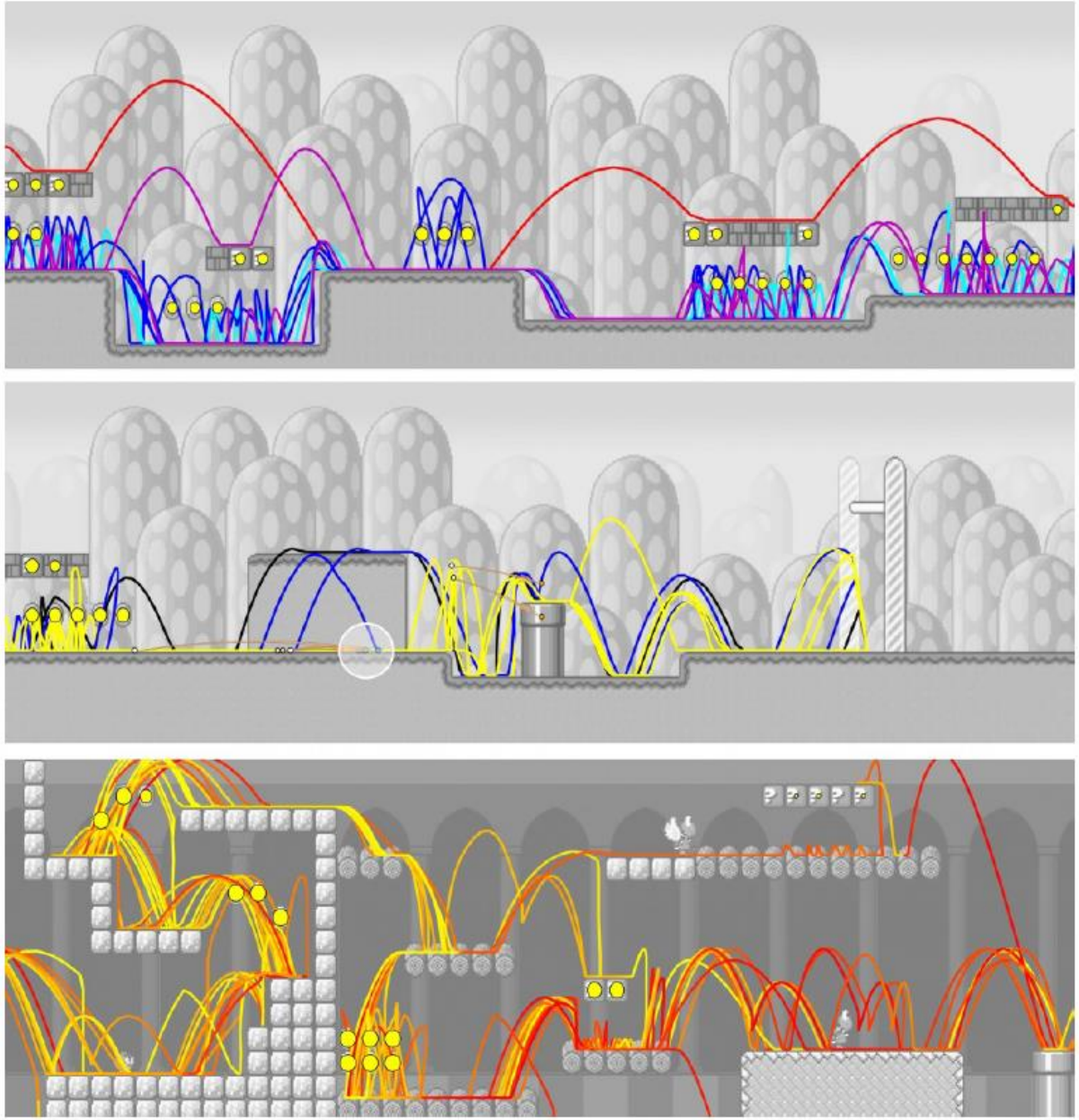


Figure 4. Examples of path visualizations coupled with color-coding to communicate additional information. Top: color coding reflects the reported expertise of players obtained through a pre-game survey. Middle: colors depict the state in which the player's character currently resides in. Bottom: the color-gradient reflects physiological data measured in the form of galvanic skin response (Mirza-Babaei, et al., 2014).

Movement (2 of 2)

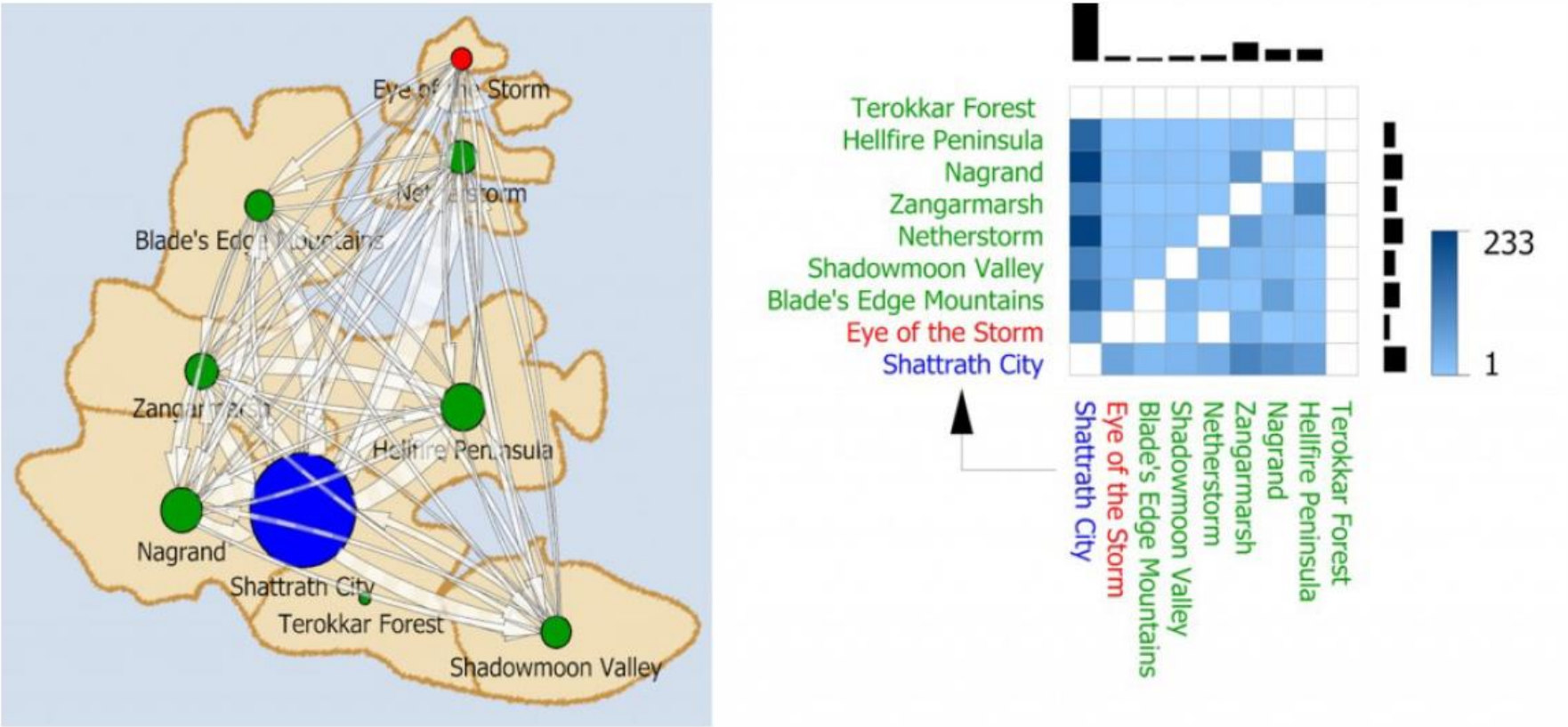
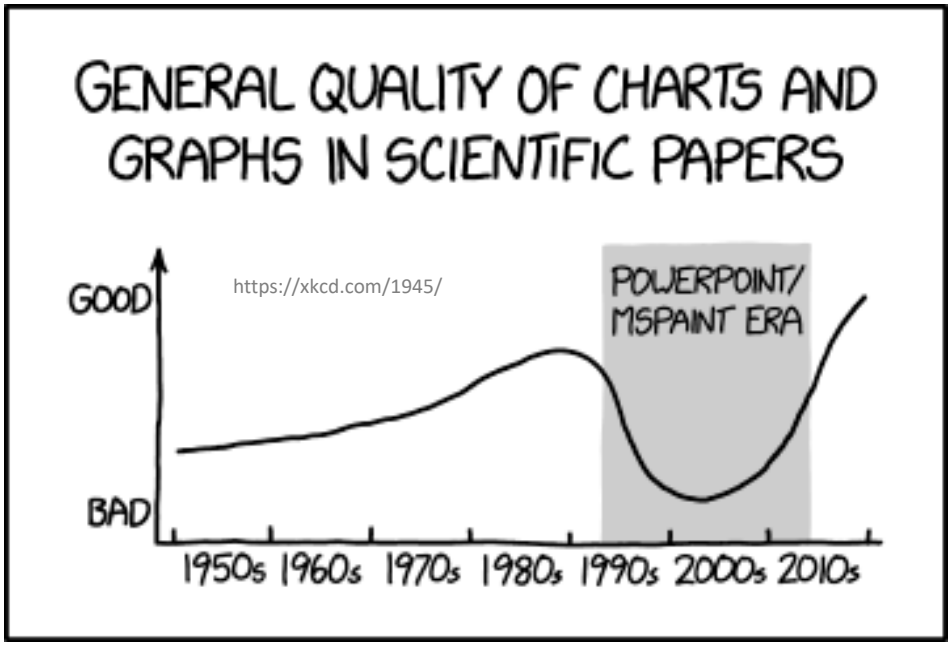


Figure 5. Left: Player movement between regions, cities, and battlegrounds on the World of Warcraft continent Outland. Right: Corresponding matrix view with cells colored according to the number of players moving from one area to another.

Outline

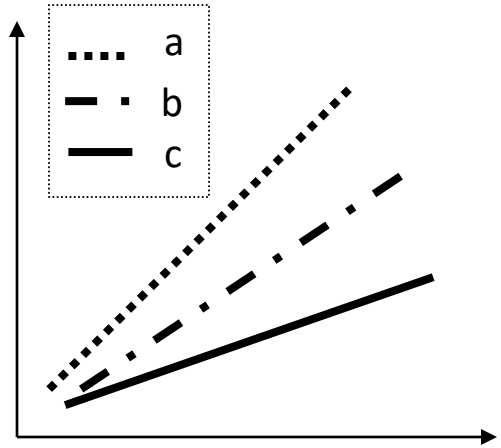
- Types of Charts (done)
- Game Analytics Examples (done)
- Guidelines for Charts (next)



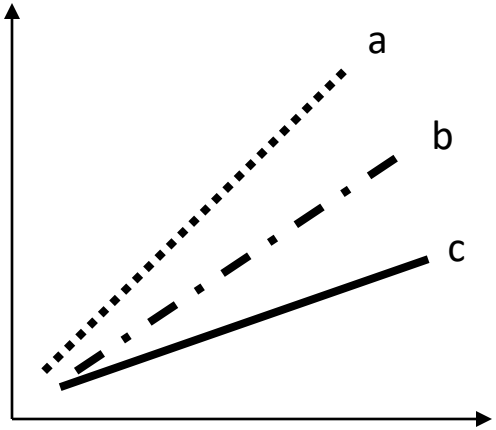
Guidelines for Good Charts (1 of 7)

- Require minimum effort from reader
  - Perhaps *most* important metric
  - Given two, can pick one that takes less reader effort

e.g.,



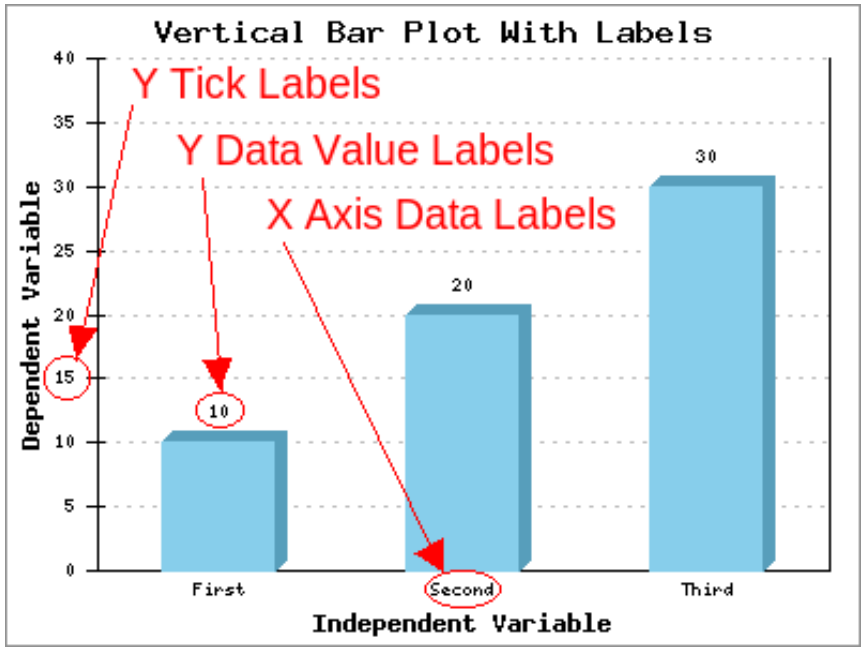
Direct Labeling



Legend Box

Guidelines for Good Charts (2 of 7)

- Maximize information
  - Make self-sufficient
  - Key words in place of symbols
    - e.g., “Gold IV” and not “Player A”
    - e.g., “Daily Games Played” not “Games Played”
  - Axis labels as informative as possible
    - e.g., “Game Time (seconds)” not “Game Time”
  - Help by using captions (or title, if stand-alone)
    - e.g., “Game time in seconds versus player skill in total hours played”



http://www.phplot.com/phplotdocs/conc-labels.html

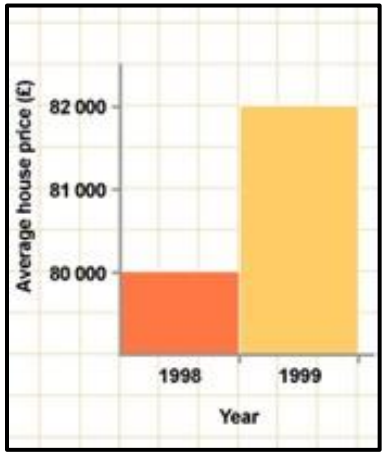
Guidelines for Good Charts (3 of 7)

- Minimize ink

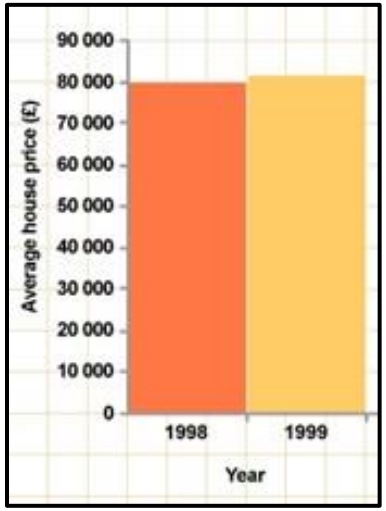
https://www.slideshare.net/NicoleMarinsek/darkhorse-line-chart

Guidelines for Good Charts (4 of 7)

- Use commonly accepted practices
  - Present what people expect
  - e.g., origin at (0,0)
  - e.g., independent (cause) on x-axis, dependent (effect) on y-axis
  - e.g., x-axis scale is linear
  - e.g., increase left to right, bottom to top
  - e.g., scale divisions equal, proportional
- Departures are permitted but require extra effort from reader → so use sparingly!

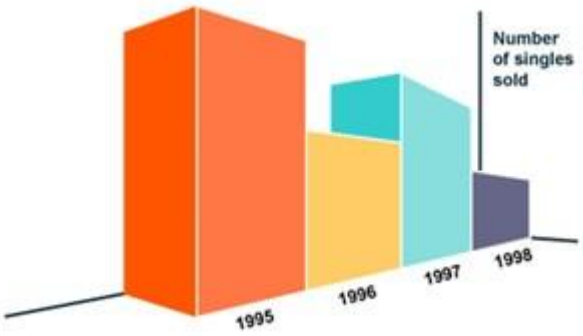


vs.

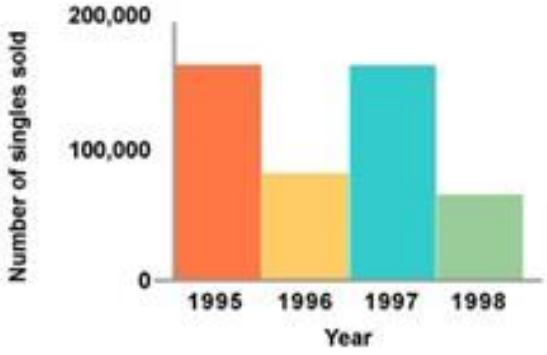


Guidelines for Good Charts (5 of 7)

- Avoid ambiguity
  - Show coordinate axes
    - at right angles
  - Show origin
    - usually at (0,0)
  - Identify individual curves and bars
    - With key/legend or label
  - Do not plot multiple variables on same chart
    - Single y-axis



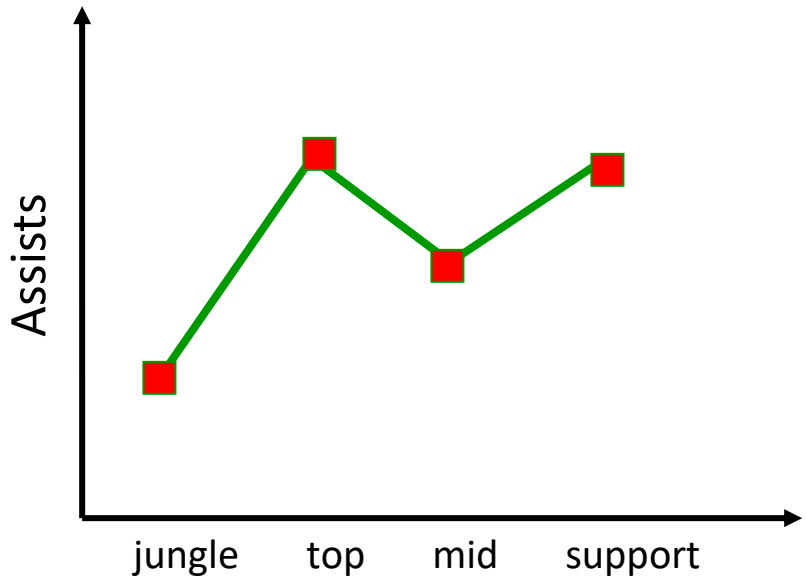
vs.



http://www.carltonassociatesinc.com/images/confusion-new.jpg

Guidelines for Good Charts (6 of 7)

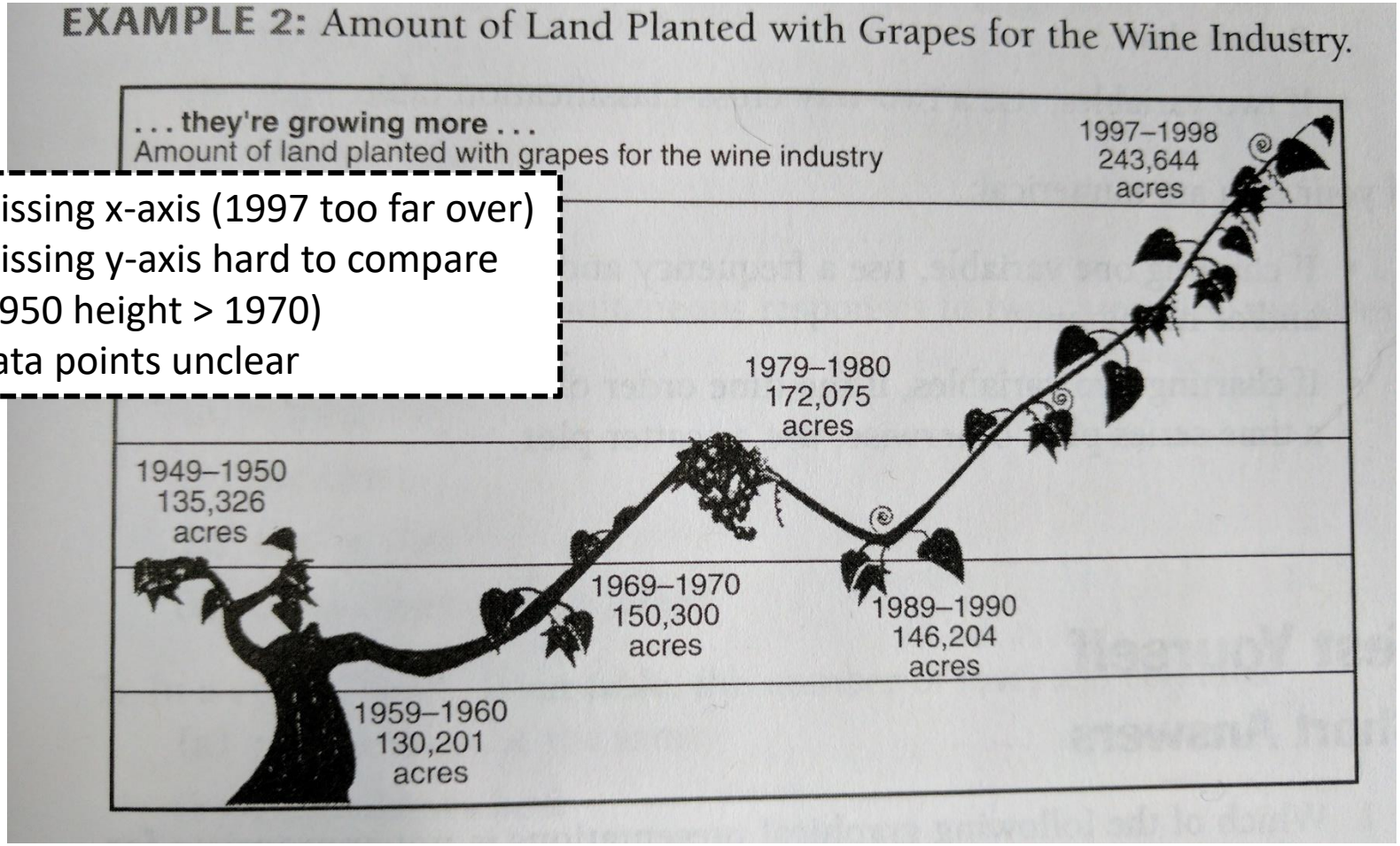
- Don’t connect categorical data with lines
  - Lines joining successive points signify that they can be approximately interpolated
  - If don’t have meaning, should not use line chart



- No linear relationship between champion types
- Instead, use column chart
- Don’t connect with lines

Guidelines for Good Charts (6 of 7)

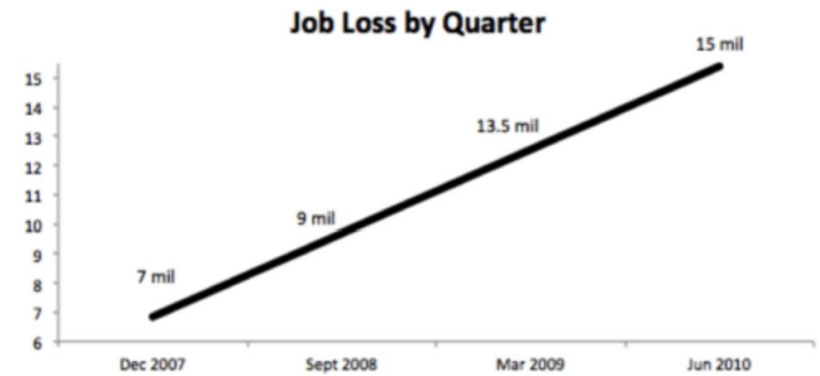
- Can deceive as easily as can convey meaning



- Missing x-axis (1997 too far over)
- Missing y-axis hard to compare (1950 height > 1970)
- Data points unclear

Groupwork
Improving Bad Charts

1. Work Solo: Study chart. Identify improvements. Write down.
2. Work as a Team: Compare lists. Discuss.
3. Write down combined.



[Figure7]

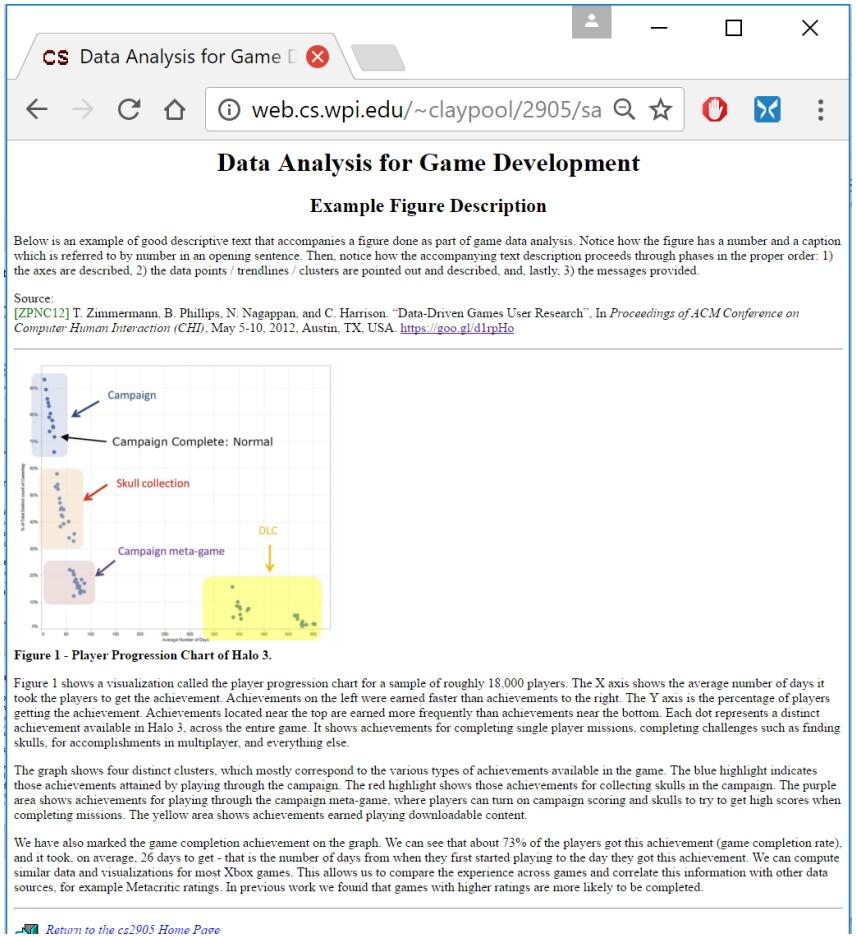
https://web.cs.wpi.edu/~imgd2905/d22/groupwork/2-bad-charts/handout.html

Checklist for Good Charts

- Axes
  - Are both axes labeled?
  - Are the axis labels self-explanatory and concise?
  - Are the scale and divisions shown on both axes?
  - Are the min and max ranges appropriate?
  - Are the units indicated?
- Lines/Curves/Points
  - Is the number of lines/curves reasonably small?
  - Are curves labeled?
  - Are all symbols clearly distinguishable?
  - Is a concise, clear legend provided?
  - Does the legend obscure any data?
- Information
  - If the y-axis is variable, is an indication of spread (error bars) shown?
  - Are grid lines required to read data (if not, then remove)?
- Scale
  - Are units increasing left to right (x-axis) and bottom to top (y-axis)?
  - Do all charts use the same scale?
  - Are the scales contiguous?
  - Is bar chart order systematic?
  - Are bars appropriate width, spacing?
- Overall
  - Does the whole chart add information to reader?
  - Are there no curves/symbols/text that can be removed and still have the same information?
  - Does the chart have a title or caption (not both)?
  - Is the chart self-explanatory and concise?
  - Do the variables plotted give more information than alternatives?
  - Is chart referenced and discussed in any accompanying report?

Describing Chart in Report & Presentation

- "Formula"
  - Describe all axes
    - E.g., "The x-axis is time since game began, in seconds"
  - Describe data sets/trendlines
    - E.g., "The blue dots are the average maze completion time"
  - **Then** provide message
    - E.g., "Notice how the red bar is higher than the blue, indicating that …"
- Example on Web page



Data Analysis for Game Development

Example Figure Description

Below is an example of good descriptive text that accompanies a figure done as part of game data analysis. Notice how the figure has a number and a caption which is referred to by number in an opening sentence. Then, notice how the accompanying text description proceeds through phases in the proper order: 1) the axes are described, 2) the data points / trendlines / clusters are pointed out and described, and, lastly, 3) the messages provided.

Source:
[ZPNC12] T. Zimmermann, B. Phillips, N. Nagappan, and C. Harrison, "Data-Driven Games User Research", In *Proceedings of ACM Conference on Computer Human Interaction (CHI)*, May 5-10, 2012, Austin, TX, USA. https://goo.gl/d1rpHo

Figure 1 - Player Progression Chart of Halo 3.

Figure 1 shows a visualization called the player progression chart for a sample of roughly 18,000 players. The X axis shows the average number of days it took the players to get the achievement. Achievements on the left were earned faster than achievements to the right. The Y axis is the percentage of players getting the achievement. Achievements located near the top are earned more frequently than achievements near the bottom. Each dot represents a distinct achievement available in Halo 3, across the entire game. It shows achievements for completing single player missions, completing challenges such as finding skulls, for accomplishments in multiplayer, and everything else.

The graph shows four distinct clusters, which mostly correspond to the various types of achievements available in the game. The blue highlight indicates those achievements attained by playing through the campaign. The red highlight shows those achievements for collecting skulls in the campaign. The purple area shows achievements for playing through the campaign meta-game, where players can turn on campaign scoring and skulls to try to get high scores when completing missions. The yellow area shows achievements earned playing downloadable content.

We have also marked the game completion achievement on the graph. We can see that about 73% of the players got this achievement (game completion rate), and it took, on average, 26 days to get - that is the number of days from when they first started playing to the day they got this achievement. We can compute similar data and visualizations for most Xbox games. This allows us to compare the experience across games and correlate this information with other data sources, for example Metacritic ratings. In previous work we found that games with higher ratings are more likely to be completed.

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http://web.cs.wpi.edu/~imgd2905/d20/samples/analysis-example.html

Guidelines for Good Charts (Summary)

- For each chart, go over "checklist"
- The more "yes" answers, the better
  - Remember, while guidelines, art and not science
  - So, may consciously decide not to follow these guidelines if better without them → but have *good* reason!
- In practice, takes several trials before arriving at "best" chart
- Want to present message the most: accurately, simply, concisely, logically
- Accompany with description! Text or verbal
  - Remember, audience/reader has *not* seen! – Make sure to introduce