

## AP Statistics Handout Key: Lesson 1.1

Topics: quantitative and categorical data, misleading graphs

### Lesson 1.1 Guided Notes

#### Quantitative vs. Categorical Data

Quantitative data: Data that is **numerical** (think ‘quantities’). The values have an inherent **order**.

List several examples of quantitative data: # of AP classes, SAT score, blood pressure, income, yards per catch, etc. **Tip**: One way to tell if a variable is quantitative is to see if it makes sense to average it. For example, it makes sense to find the average SAT score. So, SAT score is quantitative.

Categorical data: Data where values are categories or group labels, which often **don’t have an inherent order**.

List several examples of categorical data: eye color, ethnicity, favorite sports team, relationship status, etc. **Tip**: It often doesn’t make sense to find the average of categorical variables. For example, what is the average of “single” and “married”? It doesn’t work. So, relationships status is categorical.

Student	Height (in)	Dominant Hand	Final Exam Score	Home Zip Code
Bill	72	Left	77	68494
Julius	64	Right	83	68492
Yesenia	67	Right	91	68490

1. Label each of the variables (height, favorite color, final exam score, home zip code) as either quantitative or categorical. For each, explain your reasoning.

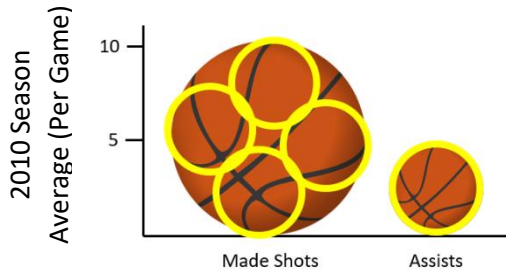
- **Height: Quantitative.** Has an inherent order (taller/shorter), and it makes sense to find the average height.
- **Dominant Hand: Categorical.** No inherent order (left isn’t “higher” than right), and it doesn’t really make sense to find the “average” of left and right.
- **Final Exam Score: Quantitative.** Has an inherent order (higher/lower score), and it makes sense to find the average exam score.
- **Home Zip Code: Categorical.** No inherent order (is one zip code really “higher” than another?), and it doesn’t make sense to average (if we average a bunch of zip codes, result is meaningless).

#### Data Visualization & Misleading Graphs

How to spot a misleading graphic:

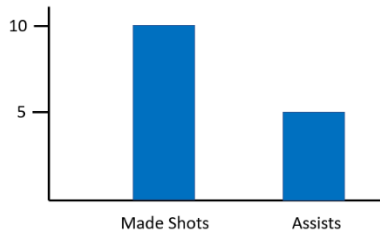
1. It may not have axis labels or **scale**.
2. It may **cut off** the x or y axis, or start at a weird place.
3. It may use **pictures** for bar graphs (called a ‘pictograph’).

**Example 1: “Kobe was a ball hog”**

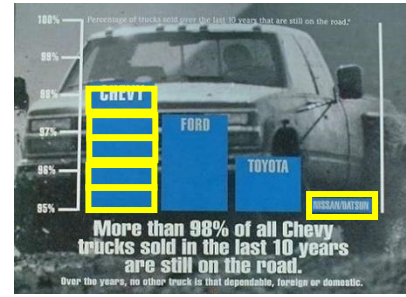


**Example 1:** The number of ‘made shots’ is double the ‘assists’ per game, but the two-dimensional ball figure makes the made shots appear several times as big.

**Adjusted:**



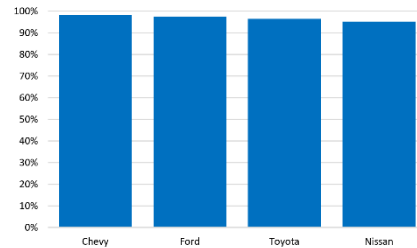
**Example 2: “Chevy builds the most dependable trucks”**



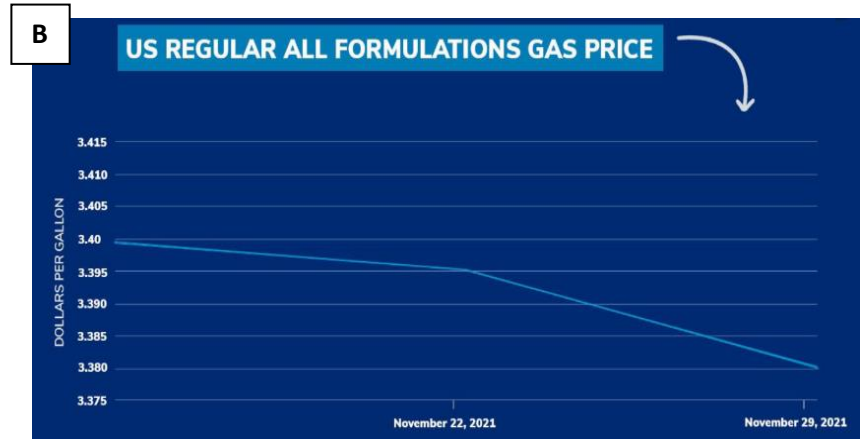
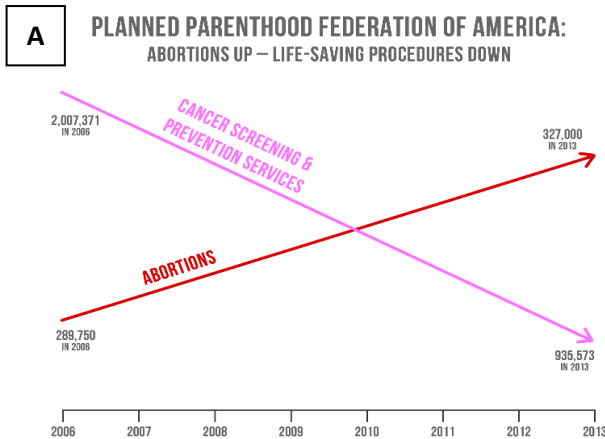
Example from TED-Ed: [“How to spot a misleading graph”](#)

**Example 1:** The y-axis is “zoomed in” and starts at 95%, making a 3 percentage point increase appear like a several-fold increase.

**Adjusted:**



**Lesson 1.1 Discussion**



**Discussion Question:** Graph A was presented by a Republican Congressman during a hearing. Graph B was tweeted by a Democratic House political committee (the DCCC), with the caption: “Thanks, @JoeBiden.” Why might each graph be misleading? Explain.

**Graph A:** The distorted y-scale (not labeled) makes the 1 million decrease in cancer screenings have the same magnitude of y-axis change as the 40k increase in abortions. As a result, the abortions line ends above cancer screenings, even though there are actually more cancer screenings than abortions. When using a proper y-axis, the change in abortions is much flatter (see adjusted graph, on next page).

**Graph B:** The y-axis is really zoomed in, making a 2-cent decline in gas prices seem unusually large. In addition, this small decline occurred after a much larger run-up of gas prices under the Biden

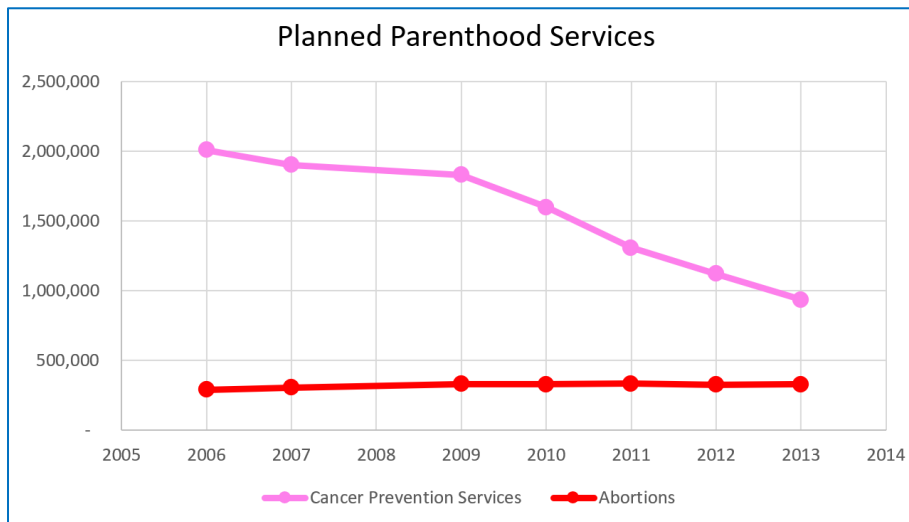


Administration (see adjusted graph below). Gas prices are not controlled by the President, but the tweet (“Thanks, @JoBiden”) seems to make such a claim.

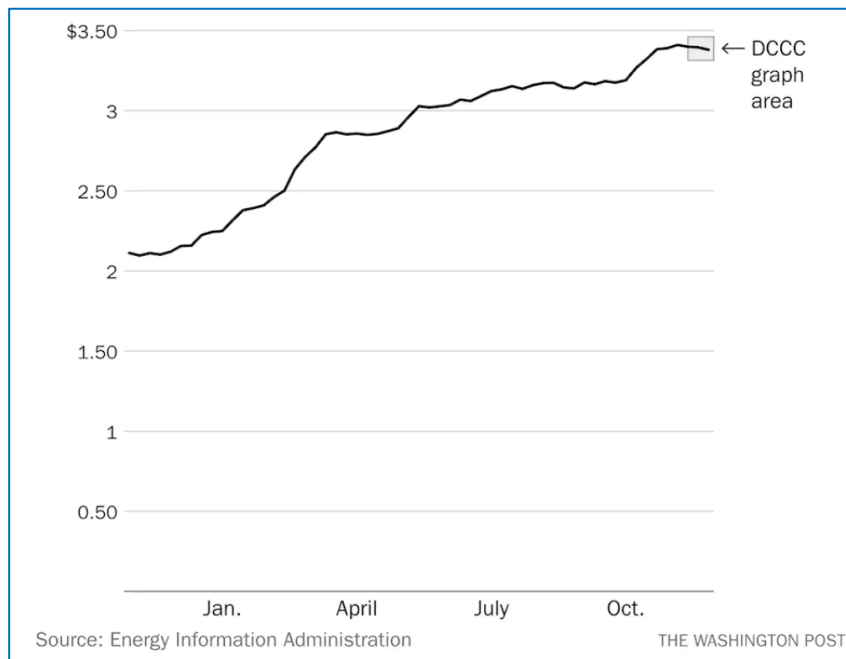
**Teacher Note:** Students may not know the context of the large run up of gas prices earlier in 2021, so they may not be able to give the complete response shown above. Still, students should be able to see that the drop in gas prices was only 2-cents and, because of the scale, the drop seems unusually large.

**Recommended discussion norms**  
[skewthescript.org/discussion-norms](http://skewthescript.org/discussion-norms)

### Graph A, Adjusted (Courtesy of Politifact)



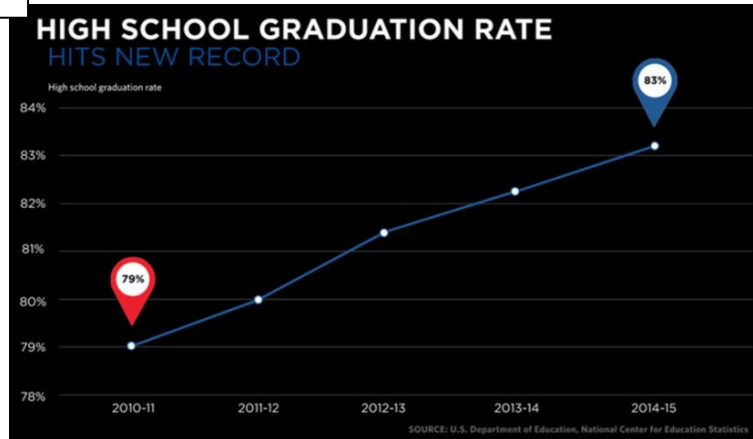
### Graph B, Adjusted (Courtesy of Washington Post)



## Lesson 1.1 Practice

Please complete all exercises *before turning to the next page!*

C



Source link: <https://obamawhitehouse.archives.gov/blog/2016/10/17/graduation-rate-reaches-new-high-one-student-shares-his-story>

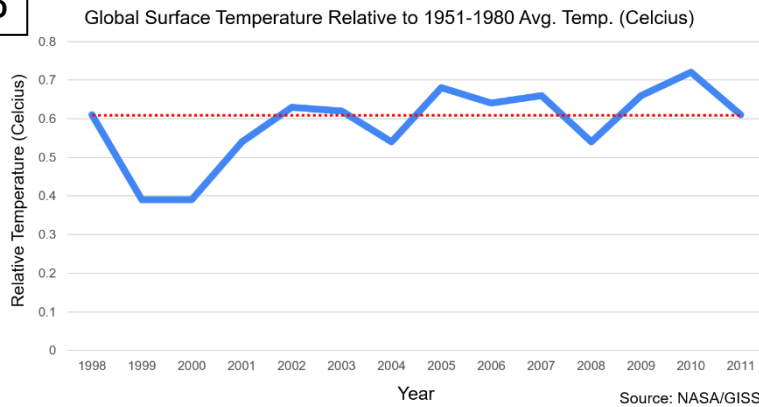
**Graphic 'C'** was published on the White House's official blog during the Obama Administration. It uses national school data prepared by the Department of Education.

**Graphic 'D'** was presented at summit of climate change skeptics. It uses global land-ocean temperature data from NASA's Goddard Institute for Space Studies.

**Graphic 'E'** was shared on Twitter and has an unknown origin.

For each graph, answer the following questions: Is the visual misleading? Why or why not? If it is misleading, how would you change it?

D



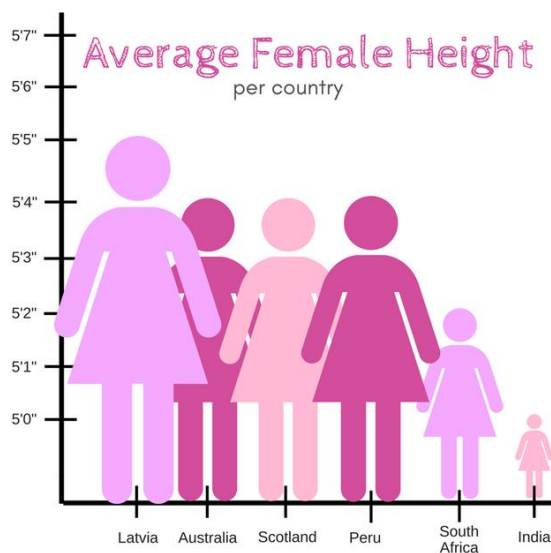
**Graph C:** Y axis does not start at 0. This small y-axis makes the small differences in values appear very large

**Graph D:** Only uses 29 years of data (and a very convenient selection of those 29 years) to show a flat trend. A wider timeline shows growth in temperatures

**Teacher Note:** Graph D is the most subtle of the misleading graphics. It has a well-labeled x/y axis and a credible data source. Students may not realize why it's misleading until they see the next page. Encourage them to think about the context of measuring climate – that may get a few students to realize that climate must be studied over a longer period of time in order to see meaningful trends.

**Graph E:** The y-axis doesn't start at 0, exaggerating the differences. Also, the two-dimensional nature of the pictograph overemphasizes the differences, making women from Latvia *giants* compared to women from India.

E



Graphic found by Sabah Ibrahim on [twitter](#)

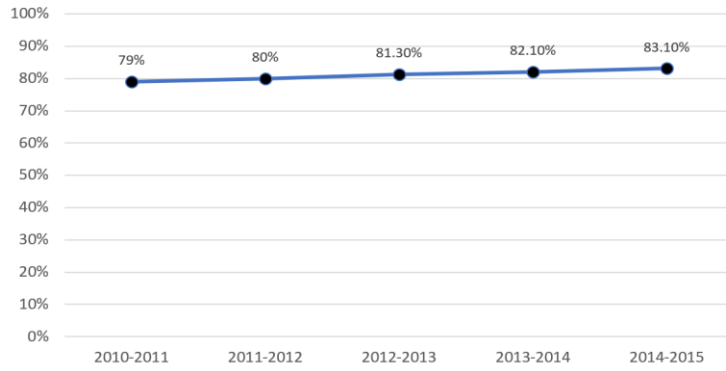


Material adapted from the Skew The Script curriculum ([skewthescript.org](http://skewthescript.org))

Skew The  
Script

C

U.S. High School Graduation Rates

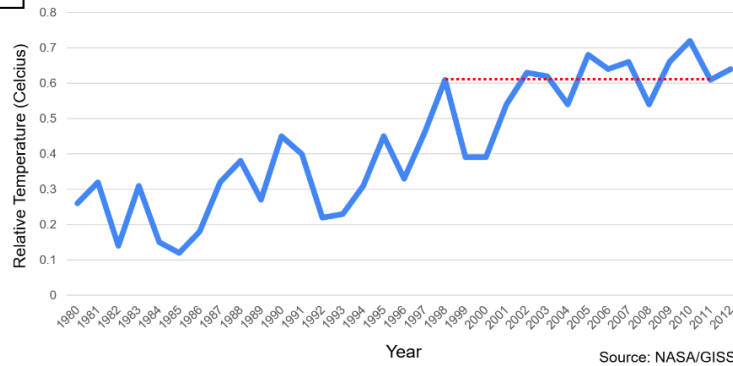


This page presents the **same data**, but with **adjusted graphs**. For each graph, answer the following question: What makes this version of the graph less misleading? Explain.

**Graph C:** Now, the y-axis begins at 0% and ends at 100%, which is the full scale that percentage values may take. So, we can see that a 4% increase is still a positive change, but not a several-fold change in graduation rates.

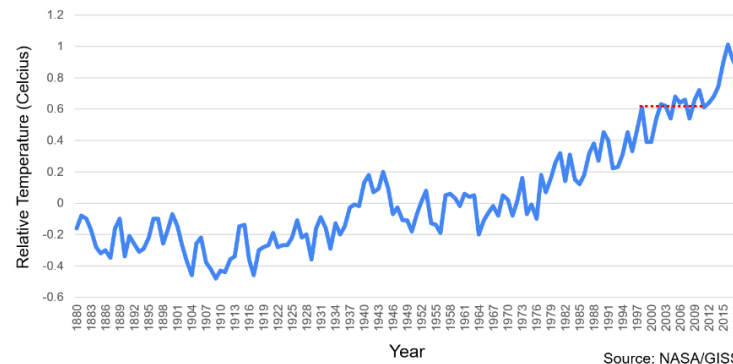
D

Global Surface Temperature Relative to 1951-1980 Avg. Temp. (Celcius)



**Graph D:** These graphs show a fuller range of the data. It looks like the graphic on the previous page starts at 1998, an unusually warm year, which made the overall trend appear flat. This fuller context allows us to see that 1998 was an outlier year and that the overall trend is warming over time.

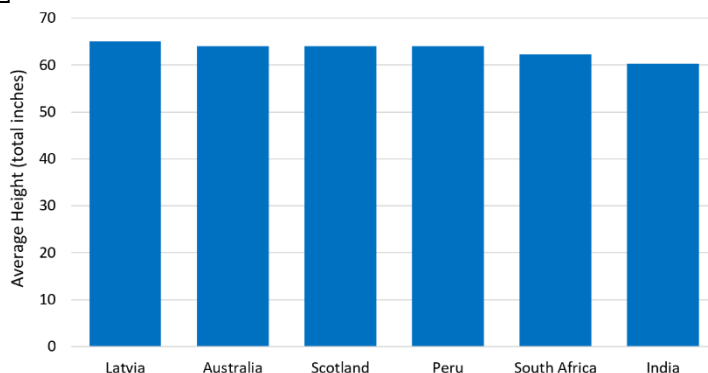
**Teacher Note:** Of course, we can go back even further and see how the Earth's temp has changed up and down over millennia. This strategy also shows an unusual rate of warming in last 150 years. See: <https://xkcd.com/1732/>



**Graph E:** By replacing the pictographs with bars, only the height dimension varies. So, we no longer see a distortion of area. In addition, the y-axis now starts at zero, showing a more representative picture of the total average heights in all the nations.

E

Average Height Among Women in Different Countries



## Further Practice

Teachers: We recommend providing additional practice exercises from your AP Stats textbook or from prior AP Stats exams. The following textbook sections and AP exam questions are aligned to the content covered in this lesson.

- [The Practice of Statistics](#), 4th-6th editions: introduction and section 1.1
- [Stats: Modeling the World](#), 4th & 5th editions: chapters 1-2, 3rd edition: chapters 2-3
- [Statistics: Learning from Data](#), 2nd edition: sections 2.1 & 2.5-2.6
- [Advanced High School Statistics](#), sections 1.1 – 1.2
- [AP Exam Free Response Questions \(FRQs\)](#): 2016 Q6 (parts a, c, e)

