

Solutions

1. Which of the following is not a leading question?

- A We have recently upgraded SurveyMakers to become a first-class tool. What are your thoughts on this first-class site?
- B Should the mayor fix the dirty, potholed streets in the city?
- C As a good patriotic citizen, do you think you should buy an imported car?
- D How important is health care compared to other social issues?

A) Using "first-class" is leading

B) "Dirty, potholed streets" is leading

C) "Patriotic citizen" is leading

D) Is not a leading question

2. Identify the type of bias and suggest how the same data could be researched without bias.
- a) Your teacher asks you to raise your hand if you understood the lesson.
 - b) City council conducts a survey about the police force by asking everyone who comes to the next council meeting.
 - c) The local news posts a poll on its website asking if climate change is real.
 - d) An application to join a gym asks how much you like exercising.
 - e) A store that sells hunting gear petitions to lower the cost of registering a gun.
- a) Response bias - You may feel pressured to raise your hand even if you didn't understand the lesson. To research without bias there could be an anonymous vote on paper.
- b) Non-Response and sampling bias - People who attend city council meetings often have extreme opinions. Also many people are unable to attend these meetings. To research without bias there would need to be a few open public meetings so that a more accurate opinion can be gathered.
- c) Sampling bias - Only people who watch that news station are going to vote. This is unlikely to be a representative sample. To research without bias the poll needs to be carried out in other ways (eg not just people who watch the station).
- d) Response bias - You may feel pressured to make a good impression and say more than you really do. To research without bias the question should ask how often do they exercise.
- e) Sampling bias - You are likely to only ask those who already have a gun, or are interested in getting a gun, so they will most likely be in favour. To research without bias the poll needs to be carried out in other ways (eg, not in a hunting store).

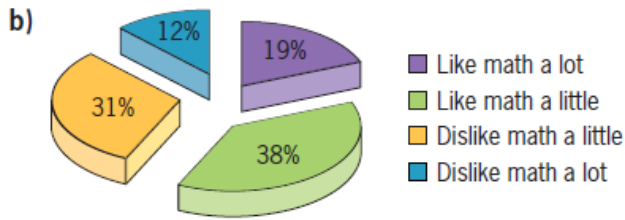
4. Identify the problem with the graph or situation.

- a) A drug company states that in its clinical trials, patients had 20% fewer headaches.

Were there any other potential factors as to why there were fewer headaches? (weather, hydration levels, diet).

How many headaches did they usually have to start with?

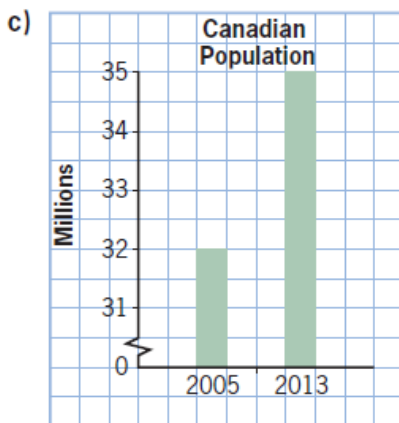
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We don't know how many people responded.

The way the graph is portrayed, the positive responses look bigger than the negative responses.

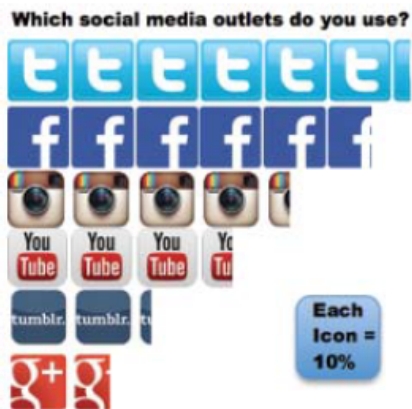
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There is a break in the numbers on the y-axis which makes the differential between the two columns look bigger than there actually is. It looks like the population has more than doubled, where as its only gone up by 3 million (under 10%).

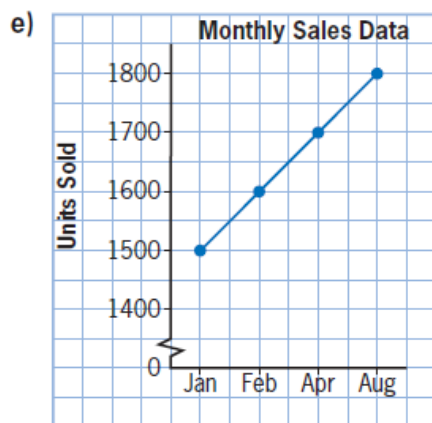
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- d) Teens were surveyed to see which social media sites they use. The following results were given:



It is difficult to estimate the true values from the size of the fractions of the icons.

4. Identify the problem with the graph or situation.



Again, there is a break in the numbers on the y-axis which makes the growth rate look bigger than it actually is. The x-axis has some months missing (no break indicated) as well which helps to exaggerate the growth rate.

6. Determine if the number is significant.
- Canada Post delivers 9.8 billion pieces of mail each year.
 - Over 70 billion hours of video are watched on YouTube each year.
 - Clayton Kershaw earns \$30 000 000 a year to play baseball.
 - In 2013, the Canadian national debt was over \$650 billion.

a) There are about 12.4 million households in Canada. That means each household gets $9.8 \text{ billion} \div 12.4 \text{ million} = 790$ pieces of mail per year.

$790 \div (52 \times 5) = 3$ pieces per day (which seems reasonable). So no, the number is not significant.

b) Youtube has about 2 billion users per month, so 24 billion per year.

That means each user watches $70 \text{ billion} \div 24 \text{ billion} = 2.90$ hours of video per year.

So no, the number is not significant.

Sidenote: the actual viewing is 5 billion videos **per day**

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c) An annual wage of \$30 million is a significant number. This is vastly more than the rest of the world gets paid.

d) The national debt is how much money the government owes to its creditors and includes its pension obligations. The figure for 2012 was \$602 billion.

So there has been an increase of $(650-602)/602 \times 100 = 8\%$. The number is significant.

Sidenote: the actual Canadian national debt in 2019 had risen to \$768 billion.

7. *Maclean's* magazine published an infographic about solar energy.
- What makes this infographic appealing?
 - How does Canada rank as a solar-energy producing nation? Why might this be?
 - How does the way the data are displayed visually connect them to the topic of solar power?
 - What do you think the editors are trying to convey with the statement in the centre of the circle: "The top 15 solar energy producers per capita (... and Canada)."

a) The bright colours and design in the shape of the sun make this appealing.

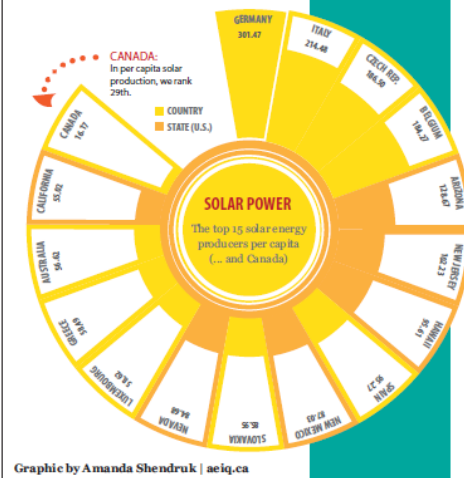
b) Canada ranks 29th overall. This could be due to lack of federal spending, the attitude of the public, and other energy generating forms be cheaper as well as more established.

c) The use of sun-like colours and the shape of the infographic help to connect to the topic.

New Solar Power Record Set

On April 15, Germany set a new record for solar power production by reaching peak power output of approximately 22.68 gigawatts.

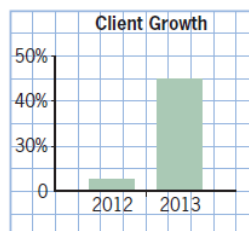
How does everyone else compare?
Top Solar Energy Producers, per Capita (2011)
 (Amounts are in Watts per Capita)*



- d) The editors are trying to convey the message that Canada is not doing very well when it comes to generating and using solar energy.

12. An agricultural research firm conducts a survey of local farmers.
- One of the questions on the survey asks, "The use of high-tech farming methods increases yields by up to 20%. How important is it for you to use high-tech farming methods?" What type of bias does this question have? Rewrite it so it is free of bias.

- b) The brochure includes this graph. Why do you think the firm presents the information this way?



a) Measurement bias - It is a leading question. To make it neutral take out the initial statement about increased yields.

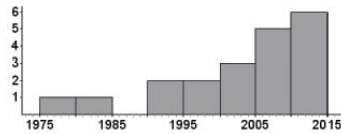
It is important for you to use high-tech farming methods.

Strongly agree Agree Don't know Disagree Strongly disagree

b) The firm are trying to give the impression of rapid growth and therefore convince potential clients that they should join up. The scale on the y-axis is not correct and accentuates this impression. It doesn't even signify that there is a break. Very sneaky!

13. The table shows the all-time North American box office Top 20 up to 2013.

- a) What is surprising about the data?
- b) The graph shows the movies organized by the year of their release. What does it say about the fairness of this comparison?

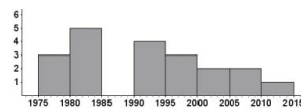


a) Most of the movies in this list involve sci-fi, fantasy, and/or superheroes.

b) Most of the movies in the list were released after 2010 so had an advantage in that ticket prices cost more than movies released earlier than 2010, which had cheaper prices.

Rank	Released	Film Name	Total Box Office
1	2009	Avatar	\$760 507 625
2	1997	Titanic	\$658 672 302
3	2012	Marvel's The Avengers	\$623 279 547
4	2008	The Dark Knight	\$533 345 358
5	1999	Star Wars Ep. I: The Phantom Menace	\$474 544 677
6	1977	Star Wars Ep. IV: A New Hope	\$460 998 007
7	2012	The Dark Knight Rises	\$448 139 099
8	2004	Shrek 2	\$441 226 247
9	1982	ET: The Extra-Terrestrial	\$435 110 554
10	2006	Pirates of the Caribbean: Dead Man's Chest	\$423 315 812
11	1994	The Lion King	\$422 780 140
12	2010	Toy Story 3	\$415 004 880
13	2013	Iron Man 3	\$408 992 272
14	2012	The Hunger Games	\$408 010 692
15	2002	Spider-Man	\$403 706 375
16	2009	Transformers: Revenge of the Fallen	\$402 111 870
17	1993	Jurassic Park	\$395 708 305
18	2011	Harry Potter and the Deathly Hallows: Part II	\$381 011 219
19	2003	Finding Nemo	\$380 529 370
20	2005	Star Wars Ep. III: Revenge of the Sith	\$380 270 577

c) This graph is adjusted for inflation. How is it different? Why does it make more sense?



d) Your teacher will provide you with a file called Top20Movies.csv. It contains both the adjusted for inflation and non-adjusted Top 20 movies. How does the list change when comparing the unadjusted to the adjusted movies?

Literacy Link

Inflation is an increase in prices over time. When comparing dollar amounts from different time periods, it is important to adjust for inflation.

c) This graph looks almost the opposite of the original. It makes more sense because there is a more even spread of the number of movies in each year.

Top 20 Inflation NOT Adjusted				Top 20 Inflation Adjusted			
Rank	Year	Film	Total Box Office (\$)	Rank	Year	Film Name	Total Box Office(\$)
1	2009	Avatar	760,507,625	1	1977	Star Wars Ep. IV: A New Hope	1,284,600,464
2	1997	Titanic	659,672,302	2	1997	Titanic	1,110,601,196
3	2012	Marvel's The Avengers	623,279,547	3	1982	ET: The Extra-Terrestrial	1,060,155,772
4	2008	The Dark Knight	533,345,358	4	2009	Avatar	805,469,145
5	1999	Star Wars Ep. I: The Phantom Menace	474,544,677	5	1980	Star Wars Ep. V: The Empire Strikes Back	761,835,156
6	1977	Star Wars Ep. IV: A New Hope	460,998,007	6	1994	The Lion King	737,246,722
7	2012	The Dark Knight Rises	448,139,099	7	1999	Star Wars Ep. I: The Phantom Menace	736,934,284
8	2004	Shrek 2	441,226,247	8	1993	Indiana Jones and the Temple of Doom	736,267,832
9	1982	ET: The Extra-Terrestrial	435,110,554	9	1983	Star Wars Ep. VI: The Return of the Jedi	733,585,163
10	2006	Pirates of the Caribbean: Dead Man's Chest	423,315,812	10	1981	Raiders of the Lost Ark	685,705,118
11	1994	The Lion King	422,780,140	11	2012	Marvel's The Avengers	638,939,832
12	2010	Toy Story 3	415,004,880	12	1994	Forrest Gump	637,327,355
13	2013	Iron Man 3	408,992,272	13	1977	Close Encounters of the Third Kind	587,327,355
14	2012	The Hunger Games	408,010,692	14	2008	The Dark Knight	585,975,751
15	2002	Spider-Man	403,706,375	15	1978	Grease	583,630,724
16	2009	Transformers: Revenge of the Fallen	402,111,870	16	2004	Shrek 2	554,550,157
17	1993	Jurassic Park	395,708,305	17	2002	Spider-Man	548,234,646
18	2011	Harry Potter and the Deathly Hallows: Part II	381,011,219	18	1996	Independence Day	546,452,224
19	2003	Finding Nemo	380,529,370	19	1984	Beverly Hills Cop	521,554,398
20	2005	Star Wars Ep. III: Revenge of the Sith	380,270,577	20	1990	Home Alone	519,397,359

d) 11 movies made both lists, so 9 drop out of the all time list once adjusting for inflation. Once adjusting for inflation there are only 5 movies released after 2000. The top movie drops to number 4 once adjusting for inflation.

Sidenote: A fairer comparison would just be based upon tickets sold. That way we wouldn't have to adjust for inflation, although the producers wouldn't like that as it would be much tougher to make grand claims about smashing box office records, which you now know are misleading at best.