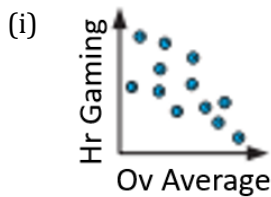
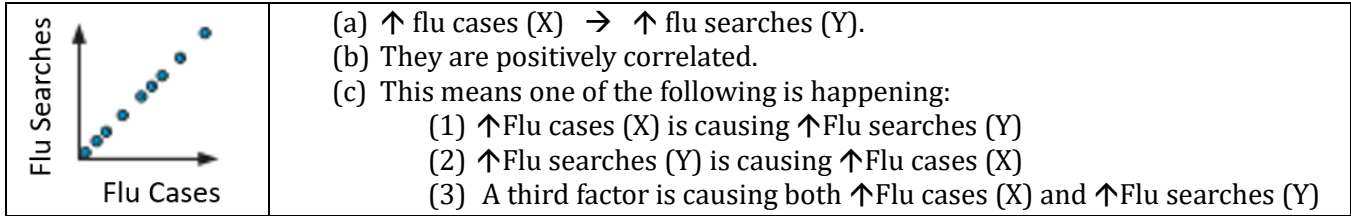


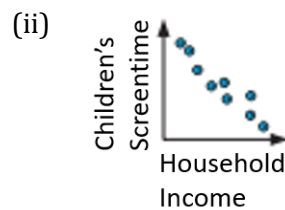
Causation vs Correlation Questions.

- For each of the following graphs,
 - Explain how the two variables are correlated.
 - Identify if the variables are positively or negatively correlated.
 - Explain, in terms of the variables, what 3 possible causation scenarios are occurring.

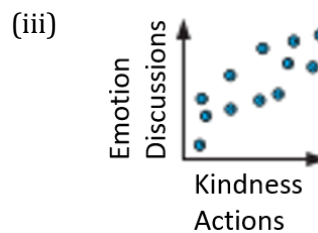
Below is an example:



Researchers investigated the number of hours that a student spend gaming and graphed that against their overall average in high school.



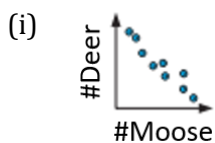
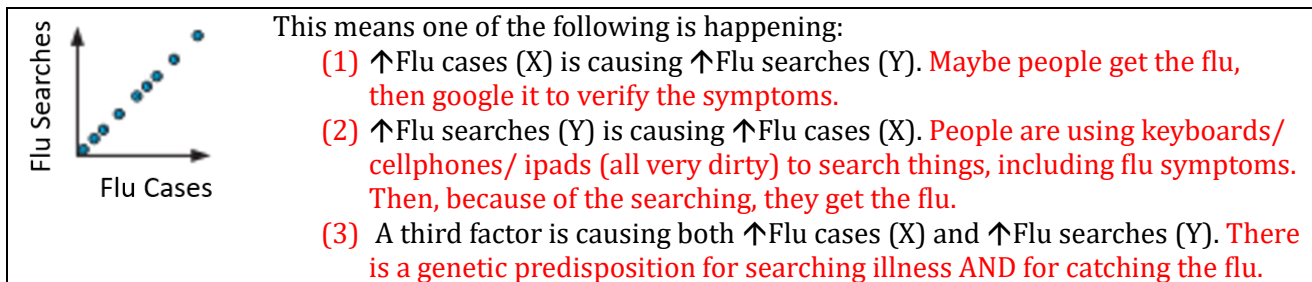
Researchers counted the average amount of time that children used devices and graphed that against the total household income.



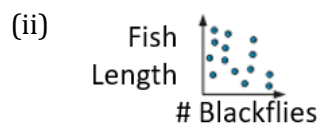
Researchers watched parents read their child a story. They recorded the number of discussions the parents had about the emotions of the characters with their children. Then, the child was invited to play without their parents. The researchers counted how many kind and helpful actions the child carried out.

- For each chart,
 - Explain, in terms of the variables, what 3 possible causation scenarios are occurring.
 - For each scenario, hypotheses (or wildly guess) why it might be true.

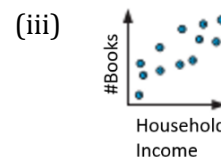
Below is in an example:



The number of deer in a 1km square region was graphed against the number of moose. (FYI: this is true – moose and deer don't live together)



The number of blackflies in a 1m square section of water was graphed against the average length of fish in the lake.



Researchers counted the number of books in a household and graphed that against the total household income.

3. In each of the following descriptions, discuss whether or not full causation or only correlation was established. Explain why (find replication, random assignment and effective sampling).
- (a) **Soap:** The manager of the Central Brampton public swimming pool wanted to compare the effectiveness of two laundry detergents: Soapy-suds and Squeaky-clean. For 5 days, in the month of April, 2019, as each dirty towel was turned in, it was placed into the only washing machine on the premises. When the washing machine contained 20 towels, a coin flip determined the detergent used for that load. The cleanliness of the load of towels was rated on a scale of 1 to 10 by an employee who did not know which detergent was used. The manager concluded that Soapy-suds is the best detergent on the market today.
- (b) **Headaches:** The University Hospital Network in Toronto has a research pool of thousands of people who wish to participate in their studies. They use a computer to generate random numbers to indicate positions on the list and then call those 50 people into their lab. All of the subjects are given a pill to take to help with their next headache. When the researchers called a week later, 84% of the subjects reported that after taking the pill their headaches disappeared.
- (c) **Fruit Loops:** Researchers in the University of Iowa wanted to know the impact of eating a diet that consisted only of the brightly coloured cereal Fruit Loops. They obtained 72 lab rats from their university lab and divided them into two groups by flipping a coin. One group had a normal lab rat diet and the other was fed only Fruit Loops. Researchers noticed that the Fruit Loop Rats seemed more nervous and that they had patchy fur as opposed to the regular rats.

Selected "Answers"

- 2a) It turns out that the number of deer in an area and the number of moose in an area are negatively correlated. If you have a lot of deer, you don't have a lot of moose. In reality, this is spuriousness. The deer carry a parasite that doesn't harm them at all. However, when moose catch this parasite from the deer, it burrows into their brain and kills them. So, if there are high numbers of deer in the area, they accidentally kill the moose living nearby.
- 2b) Blackflies are biting insects (they are awful) that are born in fast running water. Generally, fish prefer deeper pools where it is easier to hide. There is some correlation however, because fish do eat blackflies given the chance. As well, blackflies can live in polluted water. Fish generally do not like polluted water. These are the real-world reasons between the weak negative correlation.
- 2c) These factors are correlated. People have argued all 3 possibilities quite successfully (in my opinion). However, the research leans in the direction of books causing income. This argument goes: lots of books > early literacy > getting ahead in school > higher household incomes.
- 3a) Replication is weak on all fronts. Too few towels. Only one person judged how clean they were. Only one public swimming pool.
- 3b) Replication is weak: Too few people, Only in Toronto. Randomization is missing entirely.
- 3c) Replication is weak. Too few rats. Only in Iowa. Also: rats aren't people, just so you know.