Critical Thinking

Session Six

Fallacies IV: Statistics and Causes

The Monty Hall Problem

Questions

What do you think is the probability that we can find at least one pair of people in this group who share a birthday?

How many people would need to be in the class before we can expect a roughly even (fifty-fifty) chance that there will be at least one shared birthday?

The probability that no two birthdays are on the same day (assuming that nobody was born on 29 February) is given by:

$$\frac{365 \times 364 \times 363 \times \ldots \times (365-r+1)}{365^r}$$ (where 'r' stands for the number of people in the group)

Upshots?

In a group of a hundred, the chance that no two people share a birthday is 0.00000031.

There only need to be 23 people in a group before we can expect a roughly even chance of a shared birthday:

If there are 23 in the group, the chance that no two people share a birthday is just under a half: 0.493.

Example 1

John was assaulted by a man who had an excellent right hook. Now we know that 90% of ex-professional boxers have an excellent right hook and only 2% of men who are non-ex-professional boxers have excellent right hooks. It seems probable, then, that John was assaulted by an ex-professional boxer.

Example 2

I met a man in the supermarket who knew all about the kinds of rocks you get on the moon. The people who know the most about such things are mostly geologists, astronomers and astronauts, so I reckon he must have been one of them.

Base Rate Fallacy (a version of the Fallacy of Suppressed Evidence)

An argument whose premises assert that a member of a certain sub-group within a population is more likely to have a certain feature than a member of the remainder of the population and which concludes that something/somebody with that feature is a member of that sub-group. The argument is fallacious because the premises do not say how big the sub-group is relative to the population.

Suppressed Evidence in Statistical Contexts

An opinion poll conducted in July 2004 found that 28% of New Zealanders wanted the death penalty reinstated.

One Network News reported this as follows:

"The death penalty was abolished nearly 45 years ago; but now a One News Colmar Brunton Poll shows nearly 1 in 3 New Zealanders wants it back."

Notice:

1. The poll result does not support TVNZ's "1 in every 3" claim. 28% is closer to 1 in 4 than it is to 1 in 3.

2. The poll result does not support the theory that support for the death penalty has risen.

3. In fact support for the death penalty had dropped. A few years ago, it was nearly two thirds in favour.

4. Criminology Professor John Pratt (Victoria University) said that 28% was the lowest figure in favour of death penalty he had heard in New Zealand's history.

5. What effect would the news have had if it had been reported as:

"72% of New Zealanders do not support reinstating the death penalty!"

or

"Nearly 3/4 of New Zealanders do not support reinstating the death penalty!"

6. All of this assumes that the poll sample accurately represents the New Zealand population.

Ambiguous claims involving Percentages

You (let us say) earn $50,000 a year.

The company needs to cut your salary by 20%.

But, they promise to increase your salary by 20% next year.

When you lose 20% of your current salary (50,000), you will earn $40,000.

Next year, 20% will be added to your salary, but 20% of what?

20% of your original salary? If so, you will be back with $50,000.

20% of your new salary? Then, you will be on $48,000.

In this context, '20% of your salary' is ambiguous: it might mean '20% of your old salary' <u>or</u> '20% of your new salary'.

At least 3 Meanings of 'Typical' or 'Average'

1. <u>Mean</u>: add up all the individual instances of a measure and then divide by the total number of instances.

2. <u>Median</u>: middle instance of a list of the instances in numerical order.

3. <u>Mode</u>: most frequently occurring instance.

Seven Students with Student Loans

Ivan owes $10,000, Jade owes $20,000, Kate owes $25,000, Ella owes $45,000, Emma owes $100,000, Ennia owes $5,000 and Otis owes $5,000.

Mean:

$$\frac{(\$5,000+\$5,000+\$10,000+\$20,000+\$25,000+\$45,000+\$100,000)}{7}$$

$$= \$30,000$$

Median:

(middle value of)

$5,000, \$5,000, \$10,000, \$20,000, \$25,000, \$45,000, \$10,0000$

$$= \$20,000$$

Mode:

$$= \$5,000$$

Student loans aren't that much of a problem; the typical student only owes $5,000 (mode).

Student loans are a problem – the typical student owes $20,000 (median).

Student loans are a terrible problem – the typical student owes $30,000 (mean).

Rules for Statistical Samples

The larger the sample, the more likely it is that data from the sample will reflect the corresponding facts about the population.

The more representative a sample is of different subgroups, the more likely it is to reflect the population.

The more closely the variation in the sample proportionately reflects variation in the population, the more likely it is that the sample will reflect the population.
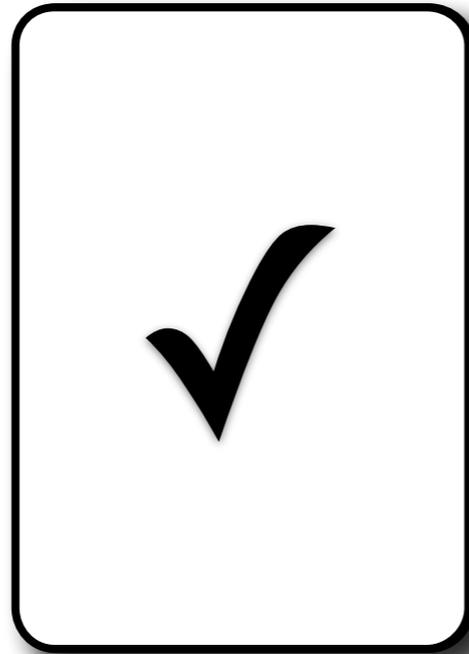
The closer the selection of sample members is to a random selection, the more likely it is that the sampled data will reflect the corresponding facts about the population
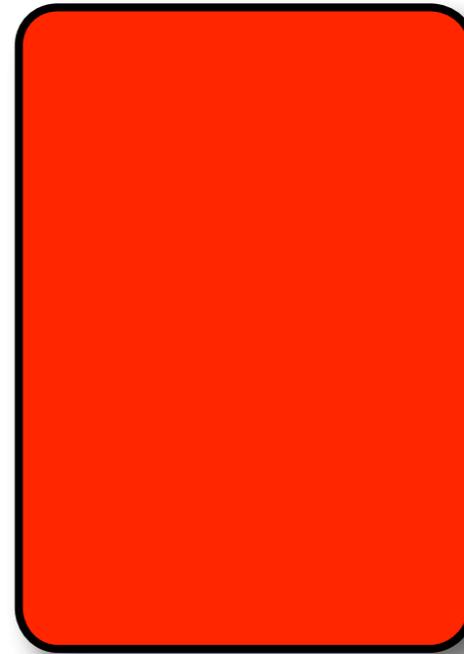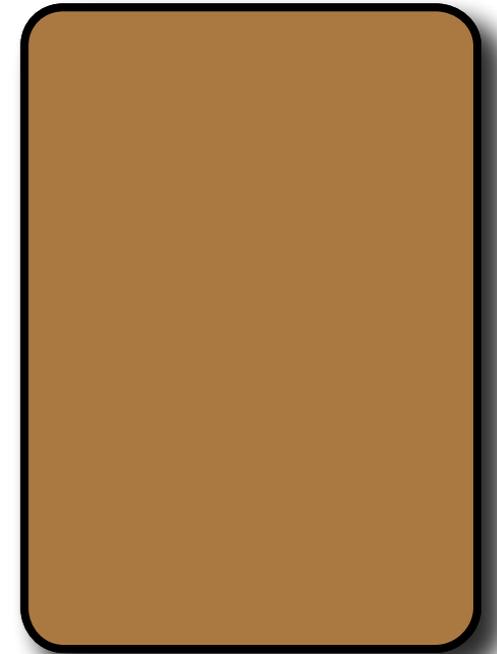
The Wason Selection Test

Card I — 3

Card II — ✓

Card III — (red)

Card IV — (brown)
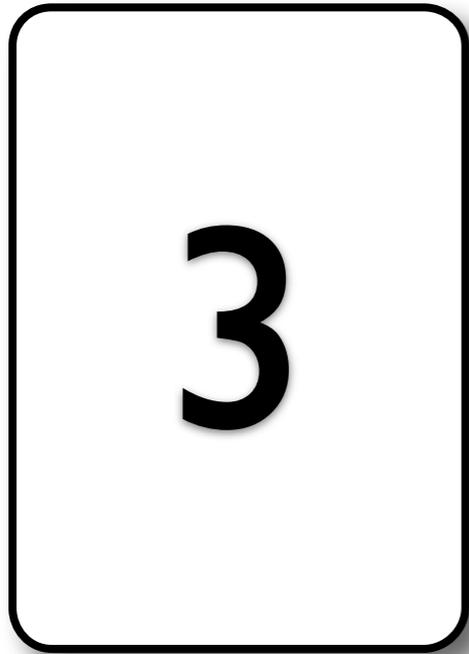
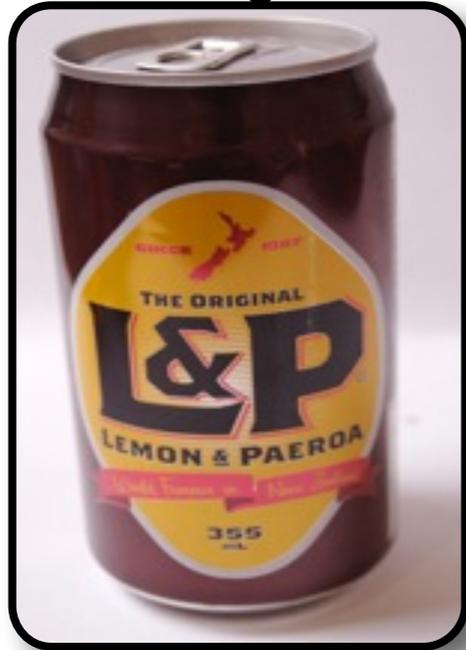Which card or cards must you turn over to check that all four cards obey the rule:

If a card has an even number on one face, then its opposite face will show a primary colour.

Answer: The second and fourth card...

You are a bouncer in a bar and 4 customers are brought to your attention. Here is what you know about each.

Person I

-drinking soda

Person II

-drinking beer

Person III

-age thirty-three

Person IV

-age seventeen

Which customer or customers must you investigate to check that all four people obey the rule:

If a person is drinking alcohol, then that person must be at least 18 years old.

Definition

A condition C is <u>necessary</u> for the holding of some other condition or state of affairs E if C must hold whenever E holds.

Example

The availability of oxygen is necessary for human life.

We can express this fact in a number of other ways.

If there is no oxygen available, then there is no human life.

or

Humans are only going to be alive if oxygen is available.

or

If there is a living human, then oxygen is available.

Definition

A condition *C* is <u>sufficient</u> for the holding of some other condition or state of affairs *E* if *C* is enough to guarantee *E*.

Example

The availability of ginger beer is sufficient for quenching my thirst.

We can express this fact in a number of other ways.

If I have had ginger beer, then my thirst is quenched.

or

If my thirst is not quenched, then I do not have ginger beer.

A condition can be *necessary* for some state of affairs without being *sufficient* for that state of affairs.

Example

The availability of oxygen is necessary for human life, but it is not sufficient: there are other conditions that must be fulfilled if there is to be human life.

A condition can be *sufficient* for some state of affairs without being *necessary* for that state of affairs.

Example

Cheesecake is sufficient to stave off my hunger, but it is not necessary.

It is possible for a condition to be both necessary and sufficient for a single state of affairs.
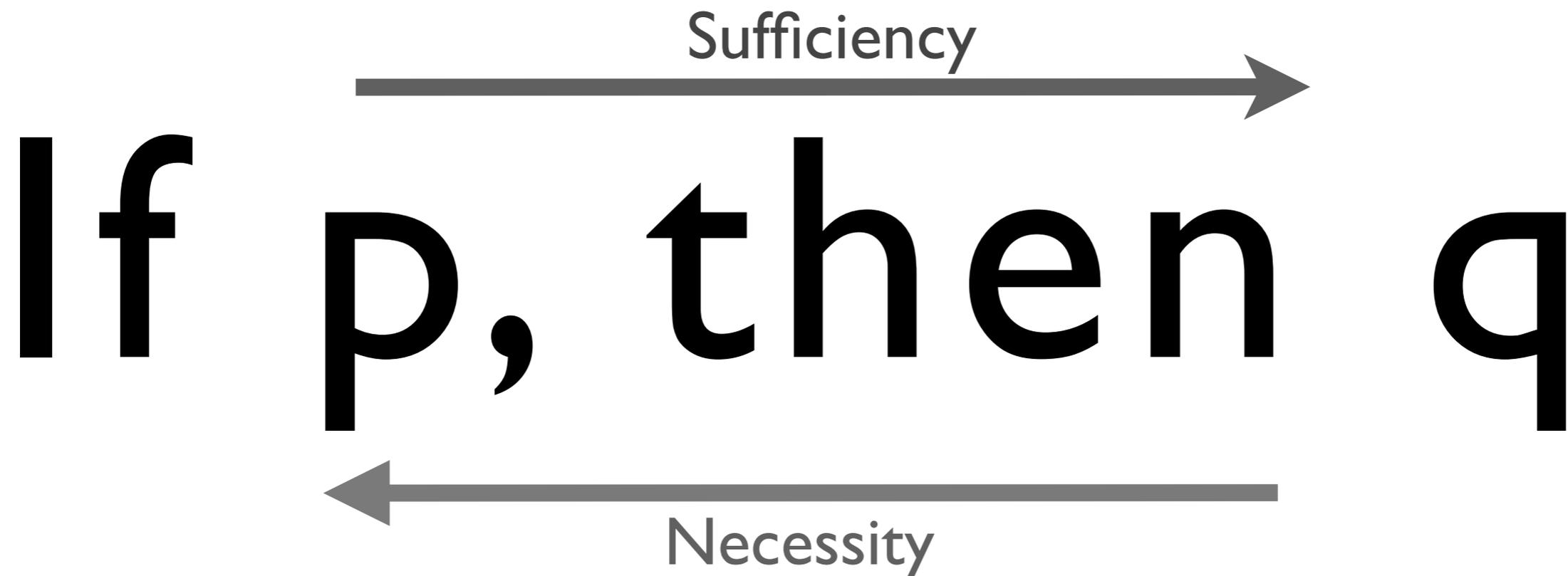
Example

Being a three-sided plane figure with angles of equal size is both necessary and sufficient for being an equilateral triangle.

Any conditional proposition expresses both necessity and sufficiency.

If p, then q

says that p is sufficient for q and that q is necessary for p.

Sufficiency
→

If p, then q

←
Necessity

Slippery Slope Fallacy

P1. If the youth of 2014 continue to text each other at the present rate, texting will become second nature to them.

P2. If texting becomes second nature, then it will become an automatic reflex.

P3. If texting becomes an automatic reflex, then it will be as natural a form of communication as speech itself.

P4. If texting becomes as natural a form of communication as speech itself, it won't be long before our pre-teens are texting in their sleep.

P5. If our pre-teens text in their sleep, we cannot predict who they will talk to, what they will say and what sort of a bill they will be running up.

P6. We don't want our pre-teens texting in their sleep.

   Therefore,

C2. We must restrict cellphone use by our pre-teens.

How to show that a Slippery Slope argument is bad

Identify the first condition that conclusion claims ought not to be allowed to hold, then;

Identify the final condition in the chain, and finally;

Show that this final condition need not hold(/follow), even if the first condition holds(/we accept as true).

Slippery slope fallacies are sometimes very persuasive. Why? Well...

i. Such 'chain' arguments are always valid; and

ii. Each premise of the chain argument can be plausible even though the conclusion of the chain argument is not that plausible. Suppose the premise that says:

'If condition 1 holds, then condition 2 holds' has 80% chance of being true.

And suppose that the premise which says:

'If condition 2 holds, then condition 3 holds' also has 80% chance of being true.

You are committed to believing something which has only 64% chance of being true.

Legitimate Slippery Slope Argument

A slippery slope argument in which, at each step in the chain, good reasons are given for thinking that the alleged consequence will follow.

Example

If you buy one of those 4-wheel drive monstrosities, then you will have to enlarge your existing Ponsonby Villa's garage. If you want to enlarge your garage, then you will have to knock out the wall dividing the garage and the bathroom, and make the bathroom smaller. If you make the bathroom smaller, you'll find it very hard to sell your house. So you shouldn't buy one of those 4-wheel drive monstrosities.

Two Slippery Slope Arguments with Opposing Conclusions

Immediate steps should be taken to outlaw pornography once and for all. The continued manufacture and sale of pornographic material will almost certainly lead to an increase in sex-related crimes such as rape and incest. This in turn will gradually erode the moral fabric of society and result in an increase of crimes of all sorts. Eventually a complete disintegration of law and order will occur, leading in the end to the total collapse of civilisation.

Attempts to outlaw pornography threaten basic civil rights and should be abandoned. If pornography is censored, censorship of newspapers and news magazines is only a short step away. Then there will be censorship of textbooks, political speeches, and the content of university lectures. Complete mind control by the central government will be the inevitable result.

Imagine...

You have walked into a room. The window, which overlooks the backyard, is broken. Sitting in the middle of a bowl of fruit is a cricket ball. Beneath the window, on the couch, is a brick. A rather hefty piece of two by four is leaning up against one of the walls.

Definition

A <u>cause</u> of an event E, is, roughly, any condition or event which helps to bring about E.

Example

Brian's eating over a kilogram of red meat per day was a cause of his contracting bowel cancer.

Brian's sitting down to a meal everyday was also a cause of his contracting bowel cancer.

Maybe the Big Bang is also a cause of Brian's contracting bowel cancer.

Example

Eating over a kilogram of red meat a day causes bowel cancer.

This doesn't mean:

Eating over a kilogram of red meat a day is sufficient for contracting bowel cancer.

And we don't mean:

Eating over a kilogram of red meat a day is necessary for contracting bowel cancer.

All we mean is that:

Given the lives that most people live, eating over a kilogram of red meat a day significantly raises the probability that the average person will contract bowel cancer.

What do we mean by 'the cause?'

There are four different things people could mean:

1. The special condition which, given the laws of nature and standard background circumstances, brings about a type of event.

Examples

What makes a plane fly?

Why hasn't a race of giant, super-intelligent ants taken over the world?

2. The condition whose presence enables a suitably placed, suitably resourced person to bring about an event of a particular type.

Examples

What makes a plane fly?

What could I do to create a race of giant, super-intelligent ants?

3. The condition which a normal observer could remove from a situation in order to prevent an event of a certain type.

Examples

How do we prevent a repeat of last winter's power crisis?

How do we prevent domestic gas explosions?

How do we prevent Matthew from taking over the world with his race of giant super-intelligent ants?

4. The condition in virtue of which we hold somebody responsible for the occurrence of an event.

Examples

Who is accountable (or should pay out, or should be blamed/praised) for the explosion?

Whose fault was last winter's power crisis?

Who left the taps on in the bathroom?

Who is to blame for creating a race of giant, super-intelligent ants who wish to take over the world?

Correlation

Two types of event (or situation, or state of affairs) are:

Perfectly (positively) correlated if and only if an event of the first type occurs when and only when an event of the second type occurs.

or:

Highly (positively) correlated if and only if, for the most part, an event of the first type occurs when and only when an event of the second type occurs.

Here are five ways to account for the fact that two types of event are perfectly correlated:

1. Events of the first type cause events of the second type.

   Pressing the light switch happens just before the light comes on.

2. Events of the second type cause events of the first.

   When the street lights come on, the sun goes down.

3. Sometimes events of the first type cause events of the second type and sometimes it is the other way round.

When my partner gets angry, I get angry.

4. Events of both types are among the causal results of some third type of event.

People in Wellington start getting out of bed at the same time that people in Auckland start getting out of bed.

5. Coincidence

You get superstitious causal claims, especially when the probability of an interesting event is low or the event happens infrequently.

The Fallacy of Questionable Cause

An argument where a correlation is assumed to be a cause.

The premises of the argument assert that a correlation holds between two events, A and B.

The conclusion asserts that, therefore, A-type events cause B-type events.

The argument ignores the four other possible explanations of the correlation between A and B.

Two special types of Questionable Cause Fallacy

i. Post hoc ergo propter hoc: ('after that, this, therefore, this, because of that)

Two separate events occur one after the other and it is concluded that the first caused the second.

Example 1

Widespread disorder in the South Island on Saturday night had the police dealing with over 700 separate incidents. What do you expect when the Crusaders lose the Super 14 Finals!

ii. Mistaking correlation for cause: taking two types of event which are correlated and concluding that they are causally connected.

Example 2

Hot Chocolate prevents crime! When sales of hot chocolate go up, street crime comes down!

The Fallacy of Inverting Cause and Effect

This occurs when one moves from the premise that A causes B to the conclusion that an absence of A causes (leads to) an absence of B.

Example

If you don't give your Mother a present for her birthday then she will not be very happy. Thus, by giving your Mother presents for her birthday you can guarantee that she will be very happy.

What have we learnt?

Arguments come in a variety of strengths.

Controversial claims need arguments to support them.

Knowing when to assign the burden of proof is important.

Appeals to Authority need to be both legitimate and cannot be used against someone else's argument.

Never attack someone's character, only their argument, unless it is a case of testimony.

Testimony can be unreliable.

Being a critical thinker is hard but not impossible.

Online resources

Lecture slides and additional materials can be found here:

http://all-embracing.episto.org/courses/critical2014/

You can contact me by e-mail at:

m.dentith@episto.org

Getting the Conspiracy Theory Theorist to Miami By Matthew R. X. Dentith

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My name is Matthew R. X. Dentith, and I am a conspiracy theory theorist who needs your help to get to Miami in March of next year.

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