Medical Statistics, Informatics and Telemedicine

Lecture 8
Reasoning and Reasoning Fallacies
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Gergely Agócs

EBM: Evidence-Based Medicine

A series of conscientious, unambiguous, and logical decisions based on evidences available at the time, which serve the treatment of the given patient.

Known statistical results

Personal knowledge, experience

„Common sense"

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Reasoning – Logic, „Common Sense"

One argues for the decision based on the data

... is the reasoning indeed correct?
One should be able to notice when not!

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Reasoning – Logic, „Common Sense"

One argues for the decision based on the data

... is the reasoning indeed correct?
One should be able to notice when not!

Linda is a talented, independent, 31-year-old woman who studied philosophy. She is very sensitive to social injustice. As a student she also took part on anti-nuclear demonstrations. Please number the below statements according to their validity in your opinion (make 1 the most probable):

a) Linda is a teacher in a primary school;
b) Linda works for a book shop and takes part in a yoga course;
c) Linda is a member of National Woman Suffrage Association;
d) Linda is a bank employee;
e) Linda is an insurance agent;
f) Linda is a bank employee and a feminist.

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Statements of an Arguement

premises (evidences) ⟶ conclusions (decisions)

„false" argumentation?

we suppose that the premises are true

whether we committed a fallacy depends
also on the circumstances

Inductive Argumentation

premises (evidences) ⟶ conclusions (decisions)

deductive argumentation:
the truth of the premises confirms the conclusion with 100%
certainty

positive PCR CoViD test
and typical symptoms ⟶ CoViD infected („legally")

inductive argumentation:
the truth of the premises makes the conclusion only probable –
this is the typical case in real life

positive PCR CoViD test
and typical symptoms ⟶ CoViD infected („biologically")

Argumentation Fallacies
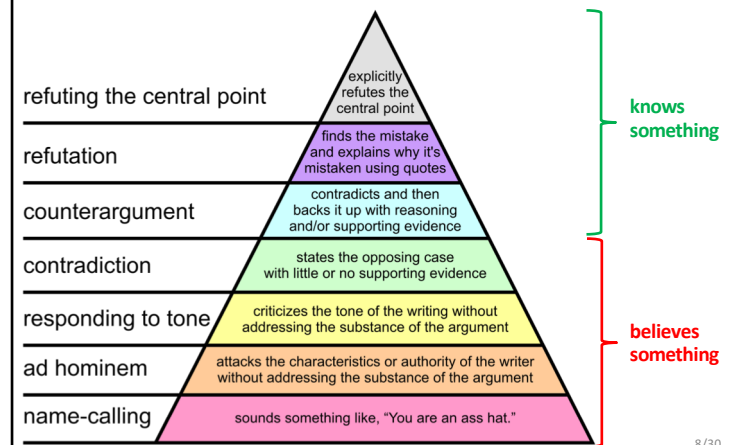
premises (evidences) ⟶ conclusions (decisions)

TRUE   ???   WRONG or TRUE

no (direct) consequence

Argumentation Fallacies:
Graham's Hierarchy of Disagreement

refuting the central point — explicitly refutes the central point

refutation — finds the mistake and explains why it's mistaken using quotes

counterargument — contradicts and then backs it up with reasoning and/or supporting evidence

} knows something

contradiction — states the opposing case with little or no supporting evidence

responding to tone — criticizes the tone of the writing without addressing the substance of the argument

ad hominem — attacks the characteristics or authority of the writer without addressing the substance of the argument

name-calling — sounds something like, "You are an ass hat."

} believes something

Fallacies of Relevance:
ad hominem (Going Personal)

1) Coursing

2) Tu quoque (you too)

Person 1:
„You should drink less."
Person 2:
„But you yourself drink a lot!"

I drink alcohol. ❌ My argument against drinking alcohol is invalid.

INGO OHNE FLAMINGO

Fallacies of Relevance:
ad hominem (Going Personal)

3) Attacking credibility: He said it. I think he is not credible. Therefore the statement is wrong.

A patient says to an other patient pointing to a physician: „Look, how fat he is, he cannot be good obesitologist!"

This physician is himself overweight. ❌ This physician cannot help overweight patients.

Fallacies of Relevance:
ad verecundiam (Appeal to Authority)

s/he is a professional or respected person, so the statement is true

„Nietzsche said: God is dead. So God must be dead"

Nietzsche said something. ❌ It is true.

Fallacies of Relevance:
Red Herring (Distracting Clue)

1) Strawman-argument:

The topic of the discussion is changed

Person 1: „I don't think we should allow the children to play next to a street with heavy traffic."
Person 2: „But we can't just lock them up in their room all the time."

Children should not play next to a street with heavy traffic. ❌ Children should always stay at home.
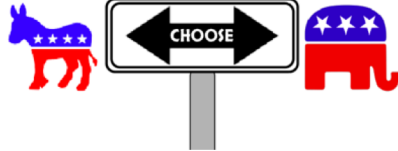
Fallacies of Relevance: Red Herring (Distracting Clue)

2) False dilemma

imply to have only two choice when there are actually more.

„either you are with us or against us!"

You are not with us. ❌ You are against us.

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Fallacies of Relevance: Missing the Point

The reasoning is not directed toward the statement but toward something else (which may or may not be related).

Discussion between politicians: „The number of type 2 diabetes patients is increasing, so we should increase the financing of antidiabetic drugs."

The number of diabetes cases increases. ❌ More money should be sent on diabetics (though that won't necessarily lead to decreasing case numbers)
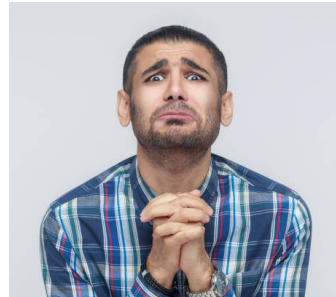
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Fallacies of Relevance: *ad passiones* (Appeal to Emotions) #1

1) *ad misericordiam* (pity)

s/he is unlucky, so s/he is right

Student in the exam: „Dear Professor, my grandmother is sick, please don't fail me"

Grandmother is sick ❌ 2 ≤ exam grade (independently from knowledge)

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Fallacies of Relevance: *ad passiones* (Appeal to Emotions) #2

2) *ad baculum* (force)
when you don't agree, you will suffer from bad consequences

„God exists, because if you don't believe in God, you will go to hell."

the Last Judgement in the Sistine Chapel

If you don't believe in the existence of God, you will go to hell ❌ God exists

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Fallacies of Relevance:
ad passiones (Appeal to Emotions) #3

3) *ad metum* (fear)

it is frightening so it cannot be true

„Riding a motorcycle may be lethal. It is not a senseful way of transportation.

Riding a motorcycle may be lethal. Death is frightening. ❌ Motorcycling is not a senseful way of transportation.

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Fallacies of Relevance:
ad passiones (Appeal to Emotions) #4

4) *ad absurdo* (mockery)

it is ridiculous, so it cannot be true

„It would be ridiculous to let a railway line run by children. So there is noithing like that in real."

The Budapest Children's Railway

It would be ridiculous to let a railway line be run by children. ❌ So etwas gibt es deshalb nicht.

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Fallacies of Relevance:
ad consequentiam (Appeal to Consequences)

if it is true it will have unacceptable consequences so it must be wrong.

Student in the exam: „Dear Professor, if I fail, I will have to repeat the whole year! Please let me pass!"

If I fail the exam, I have to repeat the whole year ❌ $2 \leq$ exam grade (independently from my knowledge)

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Fallacies of Relevance:
ad populum (Appeal to Popularity)

many believe it's true so it's true

„This product is the market leader, so it is the best product."

Most people choose this product. ❌ The product has the best quality.

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Fallacies:
Causation Arguments

1) *Post hoc ergo propter hoc* = <u>after</u> this, therefore because of this

Patient at the doctor's: „After my
CoViD vaccination I got a thrombosis,
so the CoViD vaccination caused the
thrombosis."

Thrombosis <u>after</u>
CoViD vaccination ❌ Thrombosis <u>due to</u>
CoViD vaccination

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Fallacies:
Causation Arguments

2) **Correlation –> Causation (<u>*cum* hoc ergo propter hoc</u> = <u>with</u> this, therefore because of this)**

Where more pineapples are consumed,
the number of cancer cases is higher.

More pineapples consumed ⟶ More cancer cases

http://www.fastcodesign.com/3030529/infographic-of-the-day/hilarious-graphs-prove-that-correlation-isnt-causation

3) **Arbitrary setting of the direction of causation.**

Healthy people more often
have lice than sick ones. ❌ The lack of lice
causes diseases.

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Fallacies:
secundum quid (Excessive Generalization)

1) **happened to me so it will happen to everyone**

Grandma to her friends: „This herbal tea helped me a lot.
You should also try it, it is effective!"

The tea helped
one person. ❌ The tea will help
everyone

Mozart died at the age of 35, Schubert at 31, Mendelssohn
at 38. All the greatest composers die young!

2) **happened once (or a couple of times) so it will happen every time**

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Fallacies:
Part-Whole Equivalence

1) **Fallacy of composition: inferring that something is true for the whole because it is true for a part of the whole.**

A student in a group could not answer the professor's question. The professor said: „Why cannot ever anyone answer my question in this group!"

A student did not
know the answer. ❌ Noone can ever answer
a question in the group.

2) **Fallacy of division: inferring that something is true for the whole because it is true for a part of the whole.**

Cardiovascular diseases are very widespread in Hungary. Peter is Hungarian, so he has a cardiovascular disease.

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Fallacies:
ad ignorantiam (appeal to ignorance)

It asserts that a proposition is true because it has not yet been proven false. It goes against "the burden of proof rests on who asserts, not on who denies" (*onus probandi*) principle.

The manufacturer sais (but no one has ever proven) that this homeopatic remedy will help me to loose weight. → I will take this remedy and loose weight

During hypothesis testing I did not reject the null hypothesis. → I rejected the alternative hypothesis.

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Fallacies:
Neglecting Variability

Note: the truth of the premises only makes the conclusion likely but not sure

1. individual VARIABILITY – we cannot conclude about „individuals" for sure.

This antihypertension drug decreases the hypertension **in average** by 10 mmHg. → It will decrease **Uncle Sam's** hypertension by 10 mmHg as well.

2. sampling VARIABILITY – we cannot conclude based on „samples" for sure.

The difference between the average weight losses of the control and the treatment **groups** is 12 kg. → The difference between the average weight losses of the control and the treatment **populations** is 12 kg.
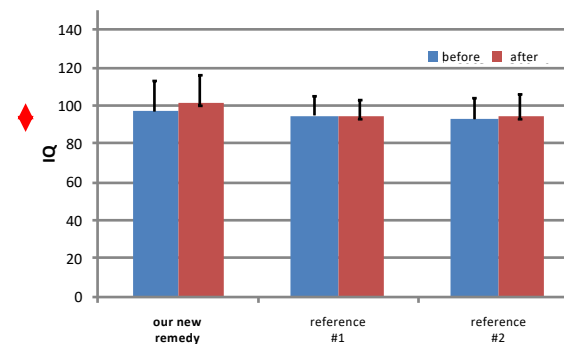
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Fallacies:
Neglecting Variability (using images)
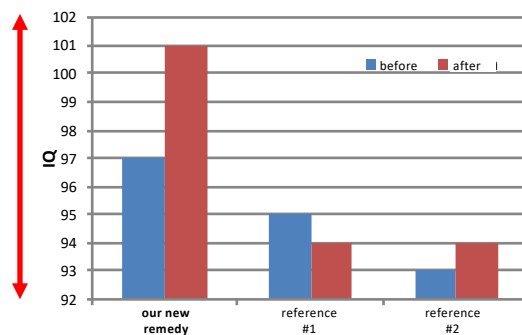
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Fallacies:
Neglecting Variability (using images)

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Fallacies:
Additional or Missing Premises

In this case, the conclusions of the reasoning are wrong not due to the process of reasoning but due to missing premises.

Greater body height ⟶ More frequent sleep disturbance

According to parents:
more infections during
childhood ⟶ The probability of cancer is higher