Correlation is not a causation – medicine students awareness about basics statistical physics concepts

Daniel DZIOB, Bartosz LISOWSKI, Grzegorz TATON, Tomasz ROK, Michal SWIATEK

Jagiellonian University Medical College, Department of Biophysics, sw. Lazarza 16, 31-530, Krakow, Poland

Daniel DZIOB

Jagiellonian University, Smoluchowski Institute of Physics, Lojasiewicza 11, 30-348 Krakow, Poland

Abstract. Correlation may or may not imply causation. Distinguish between both of them could be crucial in a medical profession, for example when observed pathological symptom and its possible source. We prepared a tonometry exercise which deal with this problem and have implemented during the biophysics laboratories for undergraduate medical students. Students awareness about causation and correlation were tested before and after the laboratories with specially designed test. Results of both tests as well as students opinion will be presented during the presentation.

1 Motivation

These days everybody knows that correlation does not imply causation. When asked, medical professionals are aware that one cannot lightly judge if there is a link between an observed pathological symptom and its possible source. Nor they do not claim experimental therapy a success, before knowing the mechanism of drug action. The problem is that human beings are not necessarily good correlation finders, not to mention causation judges. This has been described in a beautiful paper by Redelmeier and Tversky [1]. Despite that there is no causal link between barometric pressure and arthritis pain, patients that suffer from the latter tend to keep this belief. When presented with two time series, human beings not always estimate the right degree of correlation, and the situation worsens when they think those time series *should* be correlated. It may happen that we will find causation even when there is no correlation.

2 Tonometry laboratories

We hypothesised that biophysics lab creates an opportunity to improve medical students' intuition and help them to correctly estimate Pearson correlation coefficient of two time series, e.g. blood pressure and body temperature. First we have performed a test of students ability to find correlation. Then, during obligatory course of biophysics we've introduced an intervention (an exercise devoted to time series and correlation analysis) and once again performed the test to see if this intervention helped students to become better judges of correlation coefficient.

A specially designed test consists of graphs with two time-dependent variables on each. Students had to decide about the correlation between both sequences and provide a causation link or decide, that there is any. Data given for students were divided into three subgroups:

1) non-scientific parameters with various correlations (e.g. number of pizzerias and weather);
2) medical data about pain and atmospheric pressure correlation for different patients;
3) medical data with correlations identical like in (2), but with different variables.

Test was given to students at the beginning on the semester before the laboratories and after 10 weeks at the end of the laboratories (tonometry was one of the activities). The

implementation process, together with the results of both tests, will be shown and discuss during the presentation.

As for the intervention, students‘ task was divided into two parts. First they were asked to measure the pressure inside the mechanical model of an eye using ocular air puff tonometer and then analyze and visualize the obtained data. Students were also given another time series, which described hypothetical changes in the same model, only measured a week earlier. Those two sequences vere correlated, every time with a different Pearson coefficient.

The leading question students were trying to ask was: are the pressures measure inside the model by the students and a week before were correlated? In other words, could they guess guess how the pressure in the hypothetical eye changes in a given time interval, given the results of previous measurements?

During the talk we will present the details of the intervention and the results of both, pre-test and post-test.

References

[1] D.A. Redelmeier and A. Tversky, On the belief that arthritis pain is related to the weather, *PNAS* **93** (1995) 2895-2896.