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Religio. 2015, vol. 23, iss. 2, pp. [203]-206

ISSN 1210-3640 (print); ISSN 2336-4475 (online)

Stable URL (handle): https://hdl.handle.net/11222.digilib/135117
Access Date: 07. 12. 2024
Version: 20220831

Workshop "Bridging the Gaps: (Ancient) History from the Perspective of Mathematical and Computational Modelling and Network Analysis"

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As any historian will attest, there is no such thing as a complete account of past events. All the available sources are, by definition, filtered through the conditions in which they were, either by human hands or natural processes, produced. The historian is therefore tasked with bridging the gaps in the available data and the consequent construction of a coherent narrative, which does justice to, at least the vast majority, of the available sources. Recently, several projects have emerged which break away from traditional, more speculative methods to tackle this problem and instead strive towards the implementation of methodologies derived from the exact sciences. Although the implementation of these approaches in the social sciences can at times be problematic, they hold the promise of great advances in our current understanding of historical events. One of these projects, GEHIR (Generative Historiography of Religion), established at Masaryk University in Brno, hosted its first workshop on the 13th and 14th of November 2015 on "History from the Perspective of Mathematical and Computational Modelling and Network Analysis".

The workshop aimed to address some of the key theoretical issues in the field and to introduce the GEHIR project to a wider audience. Consequently, the workshop had a predominantly exploratory character and much of the in-depth mathematics have remained untouched. Nevertheless, and perhaps because of this reluctance to discuss the mathematical underpinnings of the methodology, certain issues have been raised which are of vital importance to the emerging research field and may have serious consequences for historiography in general.

Three key issues emerged over two days of presentations and discussions: data and data interpretation, mathematical models and their effectiveness in narrative formation and validation, and the interaction between models and data (i.e. modelling without data, on data or against data). Despite the somewhat rudimentary nature of these issues, the real value of the workshop, to my opinion, lies in the key insights that it yielded concerning these issues and the consequent questions these insights raise about

the commonly accepted methods of historical research in particular and research in the social sciences in general.

The discussion on data and the interpretation of data started with a presentation by Dr Andreas Duering. Duering argued that, the physical remains of past populations (grave sites, artefacts etc.) do not necessarily lead up to unambiguous conclusions about the cultures that produced them. This has to do with the fact that many different populations can produce similar datasets. Duering illustrated this by pointing out some of the major problems with data derived from grave sites. He argued that we can derive far less information from cemeteries than most scholars believe because they do not (directly) correspond to once living populations. This problem derives from the fact that cemetery populations are cumulative (they build up over time) whereas living populations are an intersection of the population at a given time. The presence of a certain disease in a cemetery population does, for instance, not correlate directly its presence in the contemporary living population. After all, infected people die sooner and thus fill up the cemetery sooner.

The body of the workshop was aimed at the second issue: mathematical, computer generated models and their effectiveness in narrative formation and validation. The main problem with computer generated models or, for that matter, any other model is, as Justin Lane argued, that they concentrate on some characteristics and leave out others. As such computer generated models are simplistic and de-contextualized. Especially in the social sciences it is often hard, if not impossible, to determine which factors were instrumental to a certain development and which were not. On the other hand, Dr István Czachesz pointed out that the more details and parameters (i.e. realism and complexity) we add to a model, the less useful it becomes. The opposition between realism and usefulness which is inherent to models thus limits the potential of the discourse.

Overall the consensus amongst the participants was, that computer modelling serves, beyond anything else, as a means through which the validity of competing theories can be tested. Dr Ken Kahn illustrated this potential of computer modelling in his analysis of the Spanish flu epidemic which ravaged Europe during the later years of the First World War and which claimed 50-100 million lives worldwide. Historians have identified two possible places of origin: Camp Funston in Kansas and Étaples in France. Although both theories initially seemed equally valid, Kahn's computer model has shown that Étaples as the location of the initial outbreak would infer that the disease lingered in and around the camp for a considerable time before spreading. If on the other hand, the point of origin is sought in Camp Funston, the disease would have spread more gradually and, in line with expected patterns. Kahn however emphasised that

his model did not falsify the Étaples hypothesis. It merely added weight to the Camp Funston theory.

Of course, it must be recognized that the above mentioned example follows the spread of an infectious disease which, if one is well informed about how it spreads and who it is likely to be infected, can be predicted with far more certainty than the spread of cultural materials. Ideas and concepts might spread from person to person, much like infectious diseases, but the amount of variables involved in their spread, or lack thereof, is many times greater. A similar approach in the study of culture and the diffusion of ideas thus becomes a lot more complicated.

Tomáš Hampejs, of the GEHIR project, introduced three possible angles from which to approach this problem: modelling without data, on data and against data. Without explicitly expressing preference it became clear from his presentation and the presentations by subsequent GEHIR members that the research team prefers the latter two approaches. Especially modelling against the data deserves special mention here. In this approach, explained its most fervent supporter Vojtěch Kaše, models are generated first and then tested against the available data. This way, a host of possible scenarios is generated of which more might fit the available data. The generation of models thus explores which scenarios are most likely within the scope of natural and cultural restraints, and account for the available data.

The workshop was concluded with a general discussion which mostly revolved around the question how this novel research field can be validated within the larger frame of historical research. As pointed out above, computer modelling comes, despite its enormous potential, with some serious limitations. In addition, it has proven hard to convince mainstream historians of the need for detached mathematical methodologies to make sense of past events. In part this has to do the fact that computer based models are developed on the basis of complex mathematics which few historians understand thoroughly. As Tomáš Hampejs pointed out: it is both virtually impossible and moreover undesirable for a historian who wishes to employ computer modelling techniques in historical research either to know both the historical details and be an expert on the mathematics behind the methodology (which he aptly dubbed the ‘Da Vinci Approach’) or to remain oblivious of the underlying mathematics and hire a mathematician to run the analysis for him (less aptly dubbed the ‘Slaver Approach’). A proper understanding of the mathematics behind computer modelling is paramount for interpreting its outcomes. This is directly, to my opinion the reason why, despite its potential, computer modelling still has a long way to go before being accepted as a valid and fruitful tool in historical research. Human society is, most of us like to believe, far too

complex to be boiled down to a mathematical model and incorporating such an approach means that one needs to accept that, at least in theory, human behaviour can be reduced to the outcomes of abstract mathematical equations.