**Non-causal modelling and forecasting**

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**Abstract**

Present status: The knowledge representation knows a massive (and a continuously increasing) set of techniques (like moving average, smoothing regression, expert/rule systems, fuzzy logic, neural network, staircase function, etc.) how models their learned knowledge (re)presents concerning the basic formula: Y=f(X1, …, Xi, …Xn). These types of modelling approaches deliver us these formulas and they let us use these formulas e.g., to simulate seemingly causal consequences (outputs) for (arbitrary) new input-constellations as if we call a function (f) in a programming language.

Goal/Task: The authors explored however a new form of knowledge representation where the function “f” is not existing in a trivial way. This new technique will be called as non-causal-modelling/forecasting (NCM or NCF).

Solution: The NCM has following logic: the problem should be described in form of an OAM (object-attribute-matrix), where the rows are the cases/objects/experiences. The columns are the attributes being existing in a parallel way. One of the attributes is the time as such (c.f. seconds, minutes, days, weeks, years numbered from an arbitrary starting point or numbered as ranking values from 1 to n). It is also necessary to define a time-interval (the number of the needed time units for forecasting). The calculations can be made in MS Excel, based on the Solver-Add-In. The calculation process is very simple: a set of statistical characteristics should be derived for the known past and also for the whole time-period (incl. expected future – with random initial-values for each row and column in this logical unit). A Solver-model needs an objective function or an error which can be minimized. The error definition is also very simple in the basic construct: the squared error of the differences between the statistical characteristics (like correlation, sum, modus, standard deviation, median, etc.) should be calculated for one or more characteristics. The fine-tuning of the basic concept can be realized through penalties or modification parameters of the targeted differences of the statistical characteristics for each attribute: the differences should not be zero at all because/if the past produce non-zero patterns too.

Already closed experiments: With other techniques (like similarity analysis where time-production-functions can be derived for quality assurance of the raw data), it is possible to optimize the needed/useful raw data. Parallel, the penalties (only for one single attribute and one single statistical characteristic) ensured also an objective better approximation concerning the known-future (test-data). The penalties could be estimated in an algorithmized form.

Argumentations – why this technique is robust (c.f. fast, scalable, flexible): The Solver-based solution produce “only” the estimated values for the future – not a time-production-function compared to other techniques like the similarity analysis for filtering bad and good data. The name of NCM means therefore: we do not have possibilities the extract the seemingly causal connection between the attributes (e.g. there is no ceteris paribus views – in a direct way, but of course – we have the possibility here too, to variate one single input in the past and to see, what kind of changes can be detected in case of one or more attribute(s) and one or more time-unit(s)). The statistical characteristics can be calculated for arbitrary amounts of cases and attributes in frame of an Excel worksheet. The Solver estimated future values always based on the same complexity (it means on the aggregated squared or even absolute differences), which can not cause the increasing the mathematical complexity through the volume of the raw data.

Future: This Solver-based technique can be involved into a VPN-like management system / running frame, where one or more local Solver-engine(s) work(s) under a kind of remote-control system supporting mobile users (c.f. C-URL). Further consistence-based fine-tuning can be realized through stepwise reduced data assets (c.f. histograms) and/or through specific (e.g., diagonal) patterns in the forecasting.

Demo: e.g., <https://miau.my-x.hu/miau/291/special_forecast5.xlsx>