

## CIRCULATORY ANALYSIS:

### A NEW PROBABILITY-TYPE CATEGORY FOR APPLICATIONS II

*Presentation at:* Category Theory Seminar, 2010, 14h00-15h30  
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An index of temporal irreversibility of time series, called the **circulation**,  $C$ , proposed by W. McCausland in his article ‘Time reversibility of stationary regular finite-state Markov chains’, *Journal of Econometrics*, 136, 303-318, 2007, may be used to measure the degree of longitudinal asymmetry of the data. This index can be extended to circulation functions in more general settings, see R. Tymkiv ‘Temporal irreversibility of time series: circulation and economic applications’, *preprint*.

This more general circulatory analysis, based on the cumulative circulation function,  $IC$ , that parallels and, in a way, generalizes the probability theory, manipulates the degrees of temporal reversibility, so that we can measure and compare the asymmetry of stochastic processes, verify the exactness of models, discover the inner laws governing the time series.

A category theoretical approach to this theory gives an overall view of the foundations and properties of circulation. In this talk, starting with general definitions, we proceed to some basic results and important special cases of discrete and continuous state spaces, and to some examples of utilization of the circulation in economics, like so called ‘steepness’ or ‘sharpness’ effects describing the geometry of time series.

Finally, we present sample properties and convergence results for the circulation functions. They allow to easily apply the general theory in practice and to use the computational and simulation methods to the real world data. Further research directions are also proposed.

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