# New Algorithm for Weak Changes Detection with Application to Financial Data

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*ntroduction:* Detecting weak changes in time series is crucial in many fields, particularly in finance and economics, where subtle structural shifts may precede major market events. Traditional methods often fail to identify these small yet impactful changes. This work proposes a novel statistical procedure capable of detecting such weak changes, even when masked by noise, and precisely estimating their occurrence times.

*Piece-wise stationary CHARN models:* The proposed model is a piece-wise stationary CHARN model that accounts for k potential change points in a time series of n observations. The model formulation includes stationary and ergodic processes, with a change detection framework based on likelihood ratio tests. The mathematical formulation ensures flexibility and robustness even when model parameters are unknown.

*Power of the Test:* The asymptotic power of the proposed test is derived under general conditions and includes an explicit formulation for practical implementation. This allows the detection method to be both theoretically sound and computationally feasible for real-world data.

*Automatic Detection Algorithm:* An automatic algorithm is developed for sequentially detecting weak changes. It involves comparing intervals within the time series and applying statistical tests for identifying change points. The method is efficient, adaptive, and suitable for real-time applications.

*Application to Financial Data:* The algorithm was applied to financial time series such as the FTSE 100 and S&P 500 indices. Detected change points align with significant historical events including the 2008 financial crisis, the Russian financial crisis, and U.S. monetary policy shifts. These case studies demonstrate the practical relevance of the algorithm.

*Highlights of the Algorithm:* The algorithm is efficient, robust to noise, and provides interpretable outputs including estimated change points and the associated test powers. These features make it highly valuable for monitoring and analysis of large-scale or streaming time series data.

Index Terms—Radical Protest, Climate Justice Movements, Disruption, Socio-Ecological Transformation