When a few data points are not enough

DATALAB special

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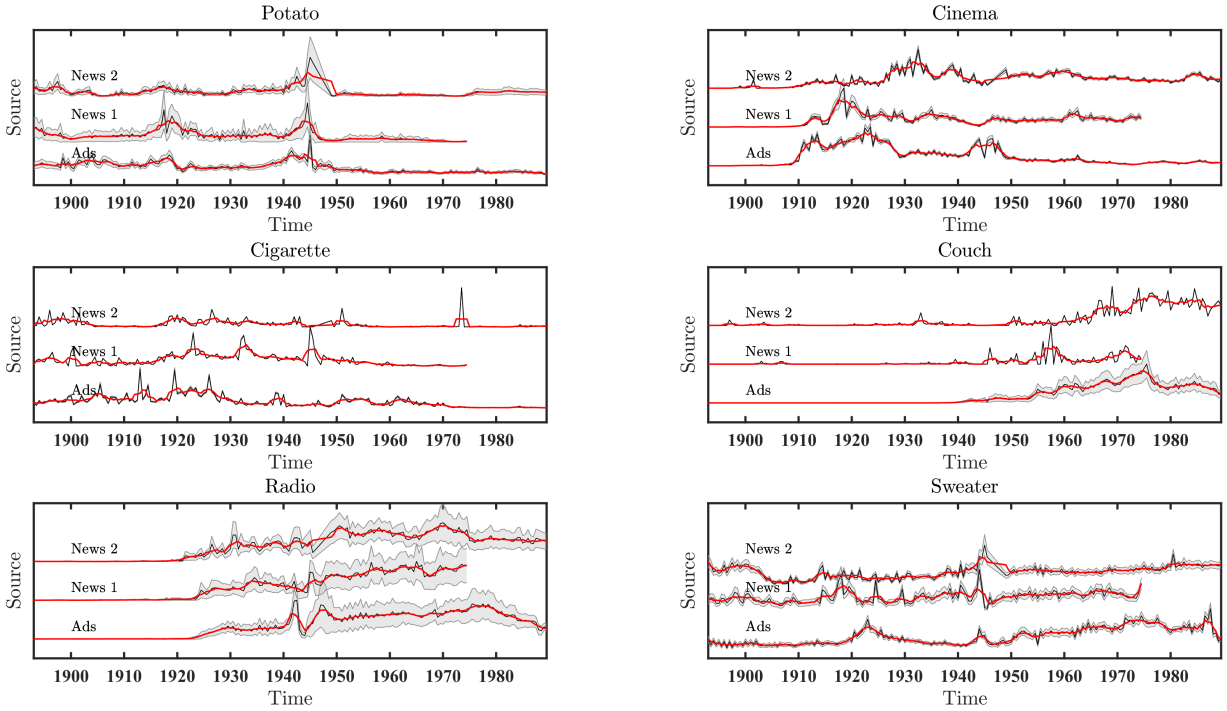
Outline

Effects of advertisements



Articles and advertisements from *De Tijd* (1890-1974) and *De Telegraaf* 1893-1989, $N \simeq 30E^6$.

Wevers, M., J. Gao, K.L. Nielbo (2019) Tracking the Consumption Junction, arXiv:1903.11461 [cs.IR]

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Shaping or reflecting

We test for X *Granger cause* Y, by comparing the performance of the nested 'newspaper discourse only' model:

$$y_t = \beta_0 + \beta_1 y_{t-1} + \ldots + \beta_k y_{t-k} + \epsilon$$

with the full 'newspaper and advertisement discourses' model:

$$y_t = \beta_0 + \beta_1 y_{t-1} + \ldots + \beta_k y_{t-k} + \alpha_1 x_{t-1} + \ldots + \alpha_m x_{t-m} + \epsilon$$

to identify which one does the better job at explaining y_t based on the residuals. The zero-model for the hypothesis then is $H_0 : \alpha_i = 0$ for each i of the element $[1, m]$ with the alternative hypothesis being $H_1 : \alpha_i \neq 0$ for at least one i of the element $[1, m]$. We applied the test bi-directionally such that a shaping relation finds support if we can confirm that 'X *Granger cause* Y' and reject that 'Y *Granger cause* X' in case of a reflecting relationship (the inverse of shaping). Finally, if both 'X *Granger cause* Y' and 'Y *Granger cause* X' find support this is viewed as support for a more complex relationship between the two time series.

Shaping: *advertisements* $\rightarrow$ *articles*

Reflecting: *articles* $\rightarrow$ *advertisements*

Complex: *advertisements* $\leftrightarrow$ *articles*

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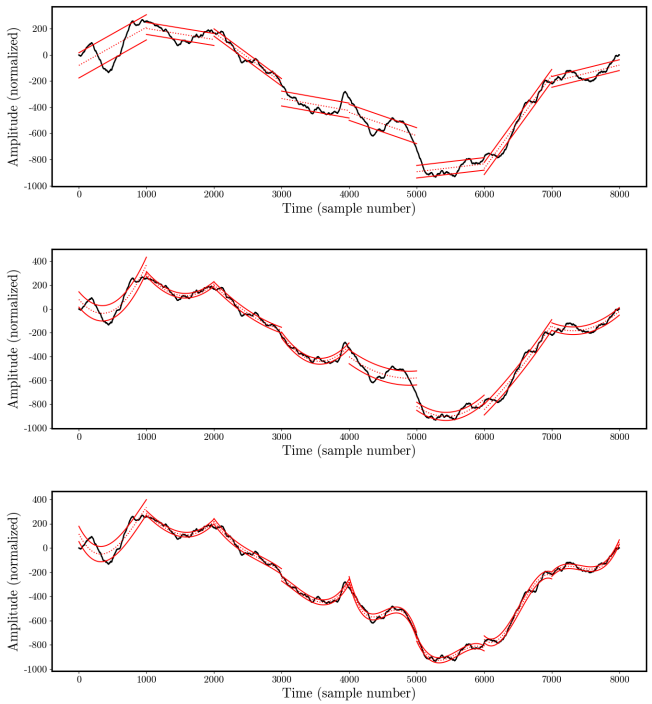
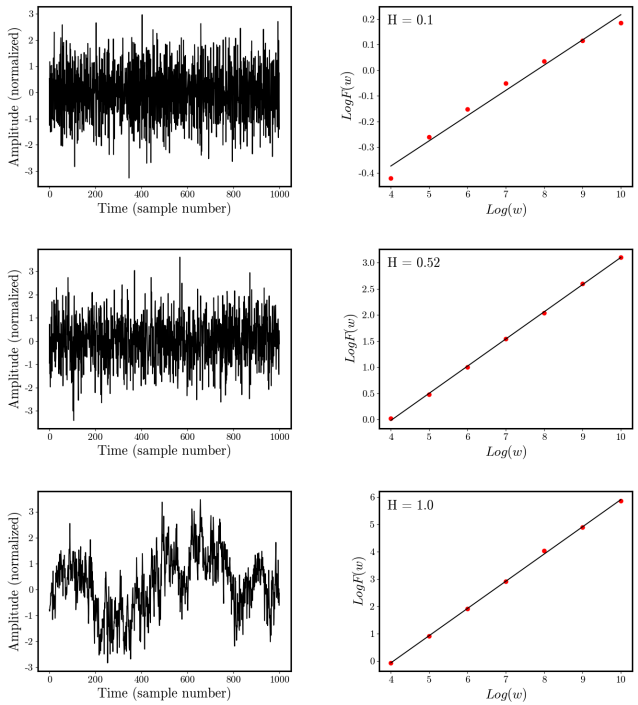
Long-range dependencies



Computation of local fluctuations around linear, quadratic, and cubic trends



Estimation of Hurst parameter using Adaptive Fractal Analysis

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K. L. Nielbo, K. F. Baunvig, B. Liu, and J. Gao, "A curious case of entropic decay: Persistent complexity in textual cultural heritage," Digital Scholarship in the Humanities, 2018.

Software library: `https://github.com/knielbo/saffine`

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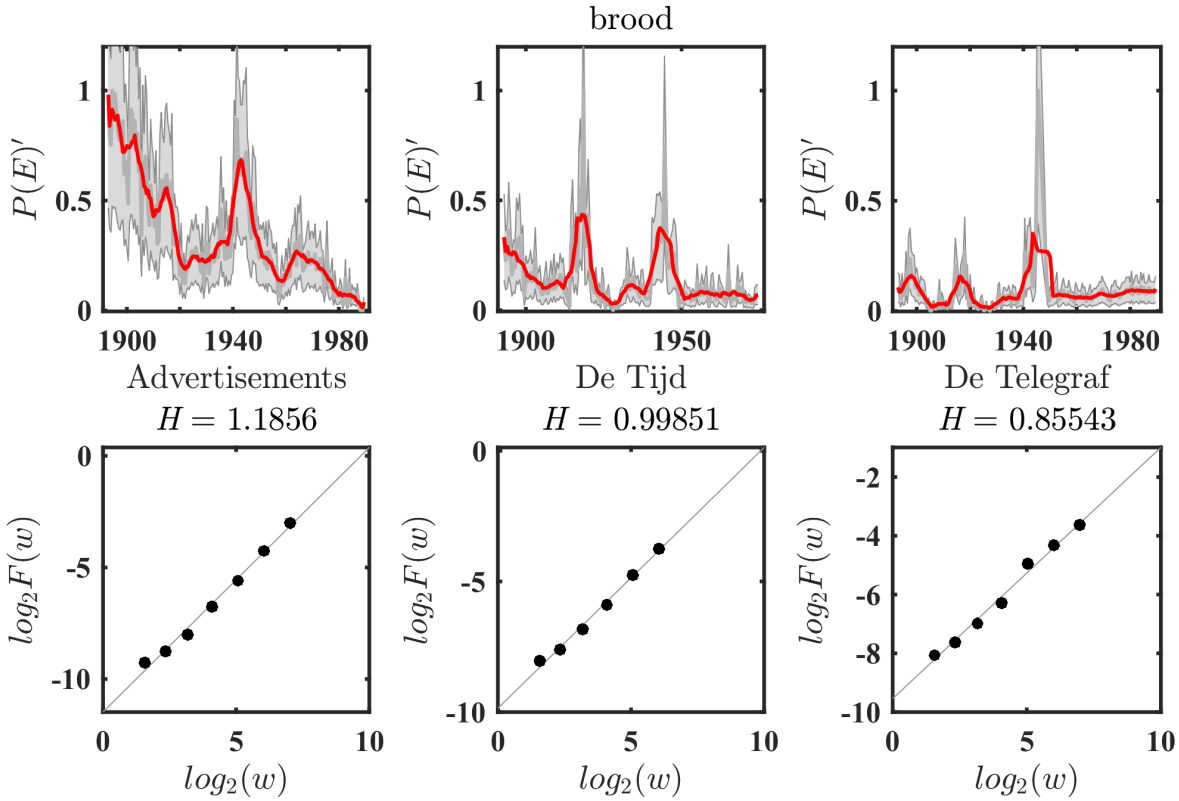
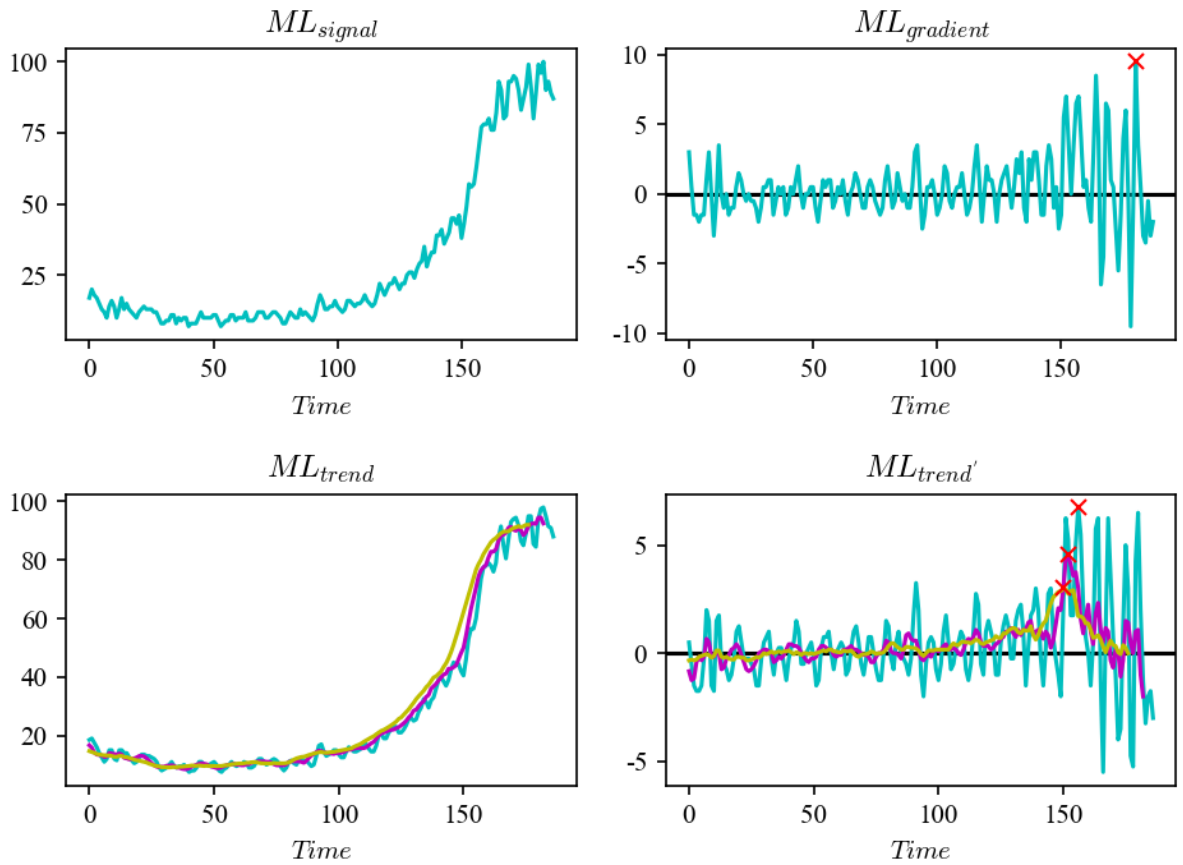


Adaptive Fractal Analysis to estimate Hurst exponent: *antipersistent correlations*: $0 < H < \frac{1}{2}$, *memoryless*: $H = \frac{1}{2}$, *persistent correlations*: $\frac{1}{2} < H < 1$



Trend detection in social media is modeled on natural catastrophes and epidemics → point-like events.

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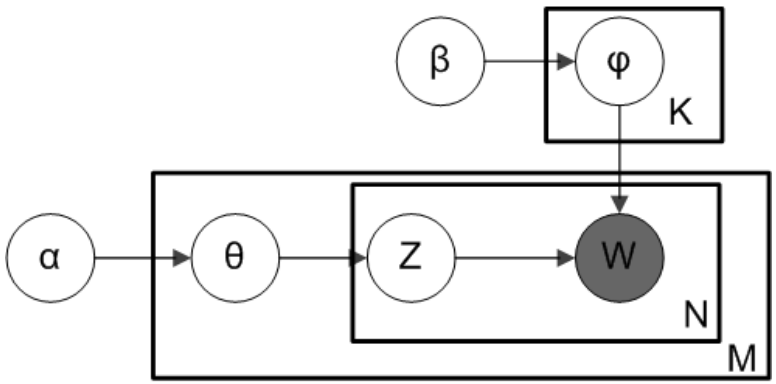
Resonant information



$\mathbb{N}$ovelty over window w:

$$\mathbb{N}_w(j) = \frac{1}{w} \sum_{d=1}^{w} D_{KL}(s^{(j)} \mid s^{(j-d)})$$

with $\mathbb{T}$ransience:

$$\mathbb{T}_w(j) = \frac{1}{w} \sum_{d=1}^{w} D_{KL}(s^{(j)} \mid s^{(j+d)})$$

for $\mathbb{R}$esonance

$$\mathbb{R}_w(j) = \mathbb{N}_w(j) - \mathbb{T}_w(j)$$

Nielbo, K., M.L. Perner, C. Larsen, J. Nielsen, D. Laursen (2019) Automated Compositional Change Detection in Saxo Grammaticus' Gesta Danorum. (hal-02084682)

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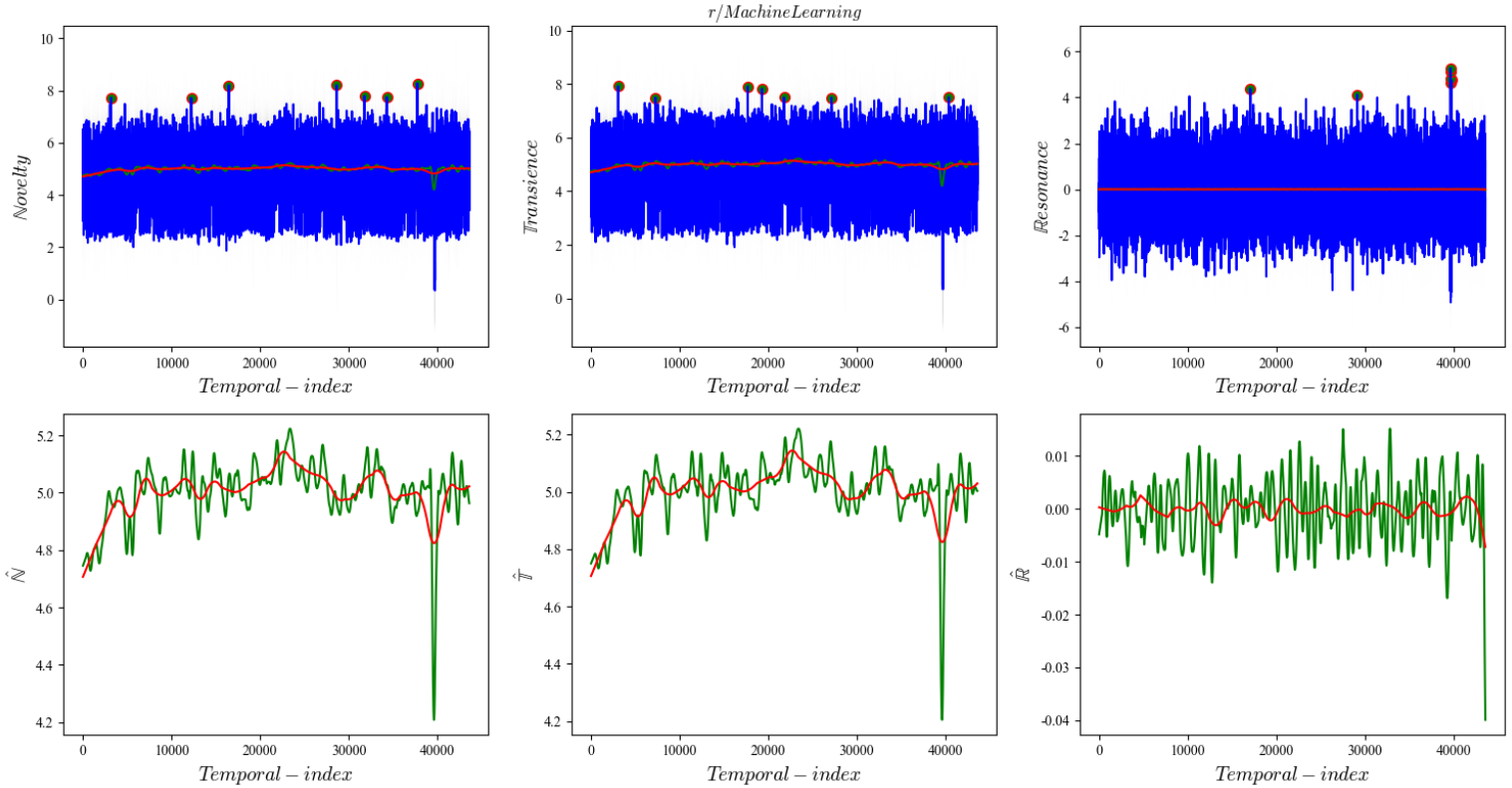
Resonant subreddits



Trend detection for social media works well for point-like events (e.g., natural catastrophes and epidemics), but what are the signature(-s) of social trends? Analyzing 7TB+ data from `reddit.com`, we find that in certain `subreddits`, novelty ressonates more with the future and that content display long-term memory at short and intermediary time-scales.

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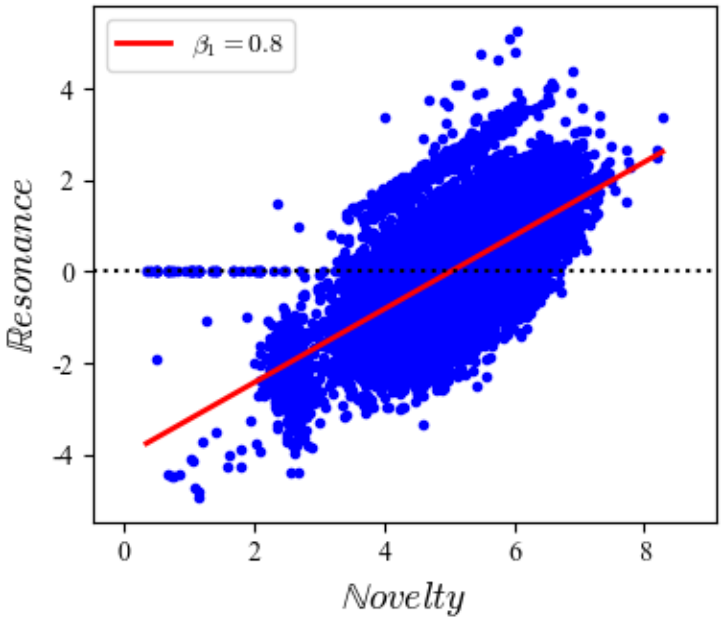
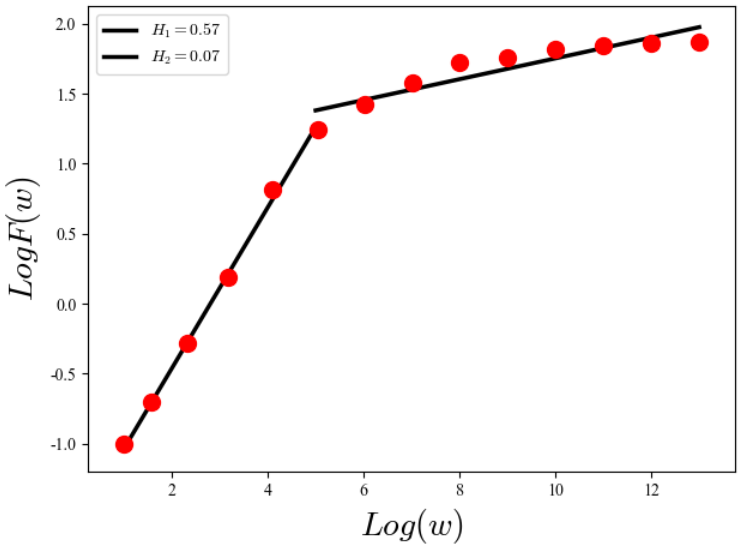
Innovation indicators





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Thank you for your attention

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slides: http://knielbo.github.io/files/datalab_special.pdf