

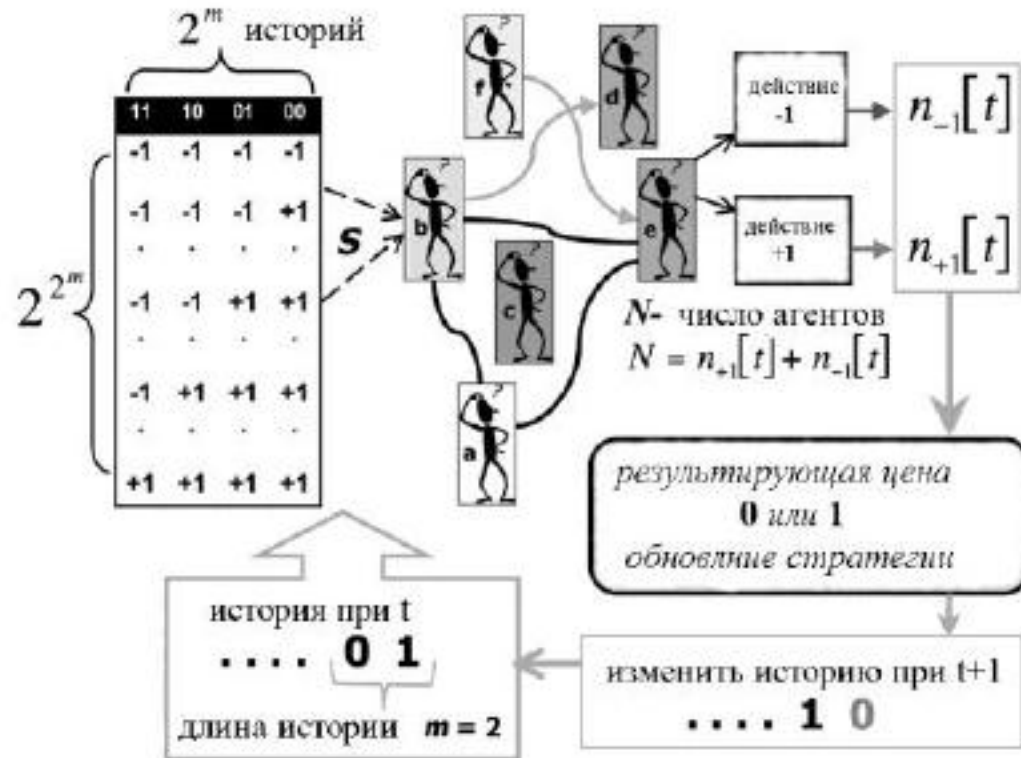
P-adic theory of fractal agents based model of stock market

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Microscopic approach

Scheme of Minority Game : Agent Base Modelling



Mathematical model of agents based stock market

- Each trader may be in the following states:
- $|0\rangle$ - shell state
- $|\uparrow\rangle$ - trader buys shares
- $|\downarrow\rangle$ - trader sells shares
- $|2\rangle$ trader holds shares

- This states is the bases for Hubbard model !

Hubbard model as model for ensemble of traders

Hubbard model As a Square Root of Spin Glass Model

$$\sum_{\mathbf{r}} U X_{\mathbf{r}}^2 + \sum_{A,C,\mathbf{r},\mathbf{r}'} t_{-AC}(\mathbf{r} - \mathbf{r}') X_{\mathbf{r}}^{-A} X_{\mathbf{r}'}^C$$

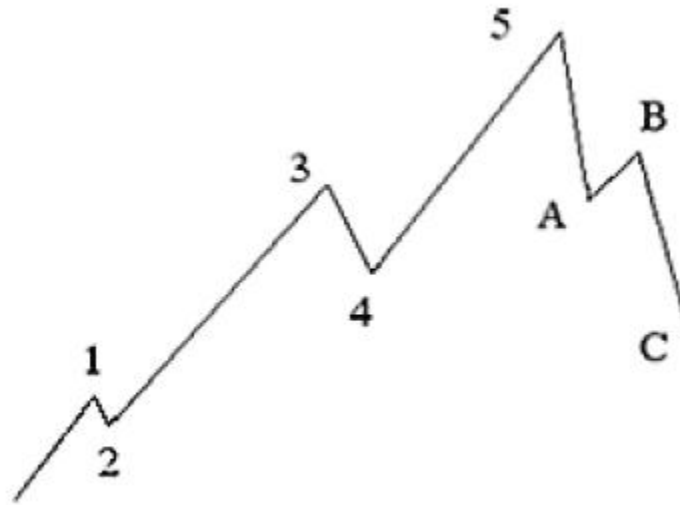
Minority game as second order perturbation of Hubbard model

Heisenberg model and Spin Glass Model

$$\sum_{\mu} (A^{\mu})^2 = \frac{1}{2} + \frac{1}{N} \left[\sum_i h_i s_i + \frac{1}{2} \sum_{ij} J_{ij} s_i s_j \right]$$

Elliott wave theory

VERY PRACTICAL APPROACH BUT UNKNOWN MATHEMATICAL BASES



P-adic description of prices

- p-adic numbers and functions describes a price
- Why real numbers are bad. Answer: heavy tails
- If you have heavy tails, you are dealing with p-adic numbers!

We consider such function
p – base of number fields,
b – fractal dimension

$$f_b^p(r) = \sum_0^N a_k p^{bk}; \quad a_k = (0, 1, \dots, p-1); k \in Z.$$

$$r = \sum_0^N a_k p^k; \quad a_k = (0, 1, \dots, p-1); k \in Z.$$

Comparison of p-adic function and real data. If you use Elliott wave you use p-adic numbers !

Main procedure:

Mapping:

$$a_n \rightarrow (a_n)^D$$

D is fractal dimension

Real Data

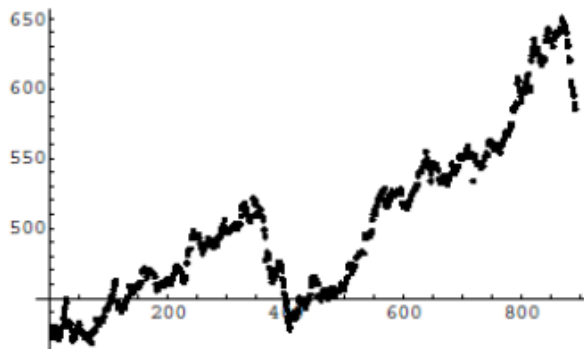


Fig 2. *Russian stock Index*

Mapping of P-adic straight line

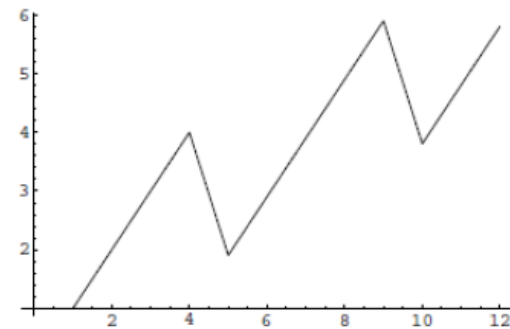


Fig.3. *Subcritical wave (First Level of Fractal) for $D > 1$, $p = 3$*

Two type of p-adic function (Elliott waves): subcritical and supercritical

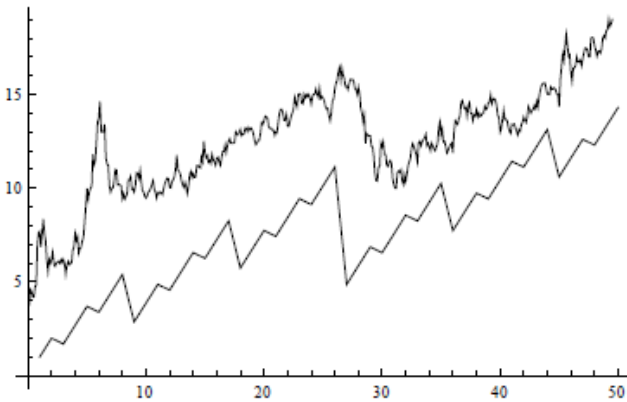
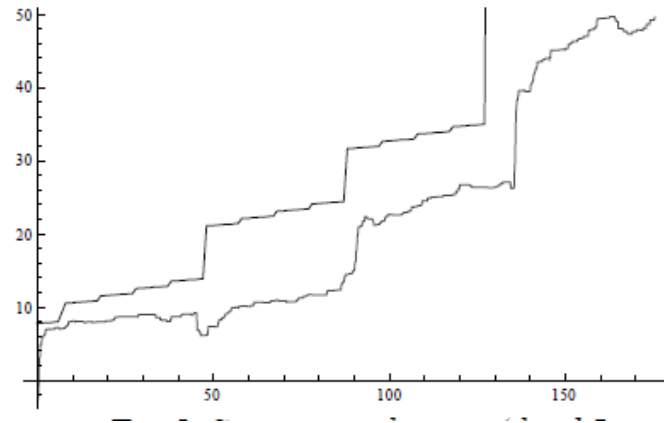
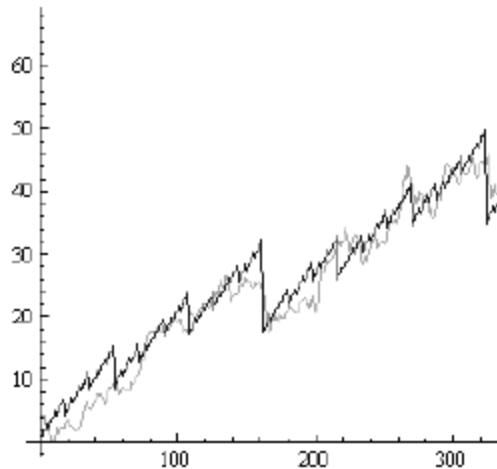
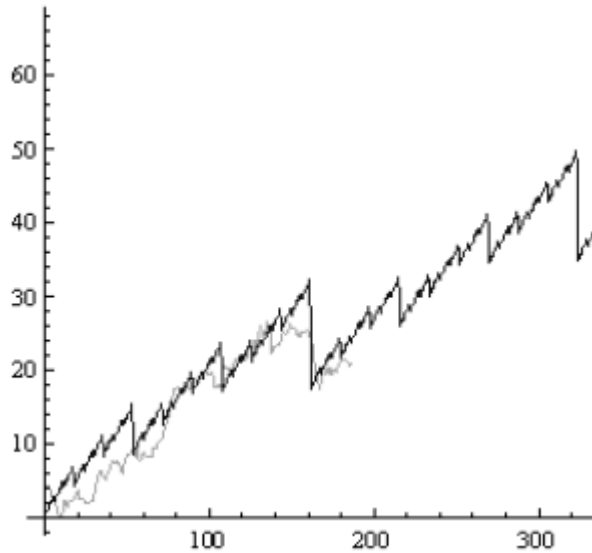


Fig 4. Subcritical wave (Third Level of Fractal) for $D > 1$, $p = 3$ The second curve shows the real data.



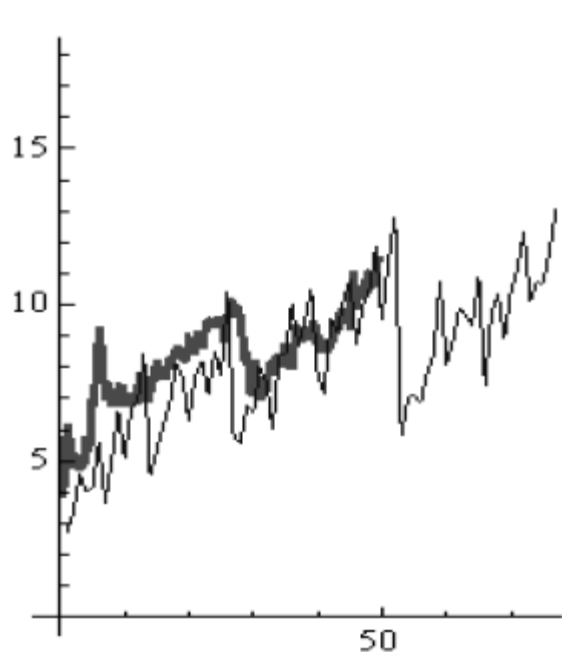
*Fig 5. Supercritical wave (third Level of Fractal) for $D < 1$, $p = 3$
This type of wave is not presented in the Elliott theory.*

P-adic interpolation and extrapolation as Forecast procedure

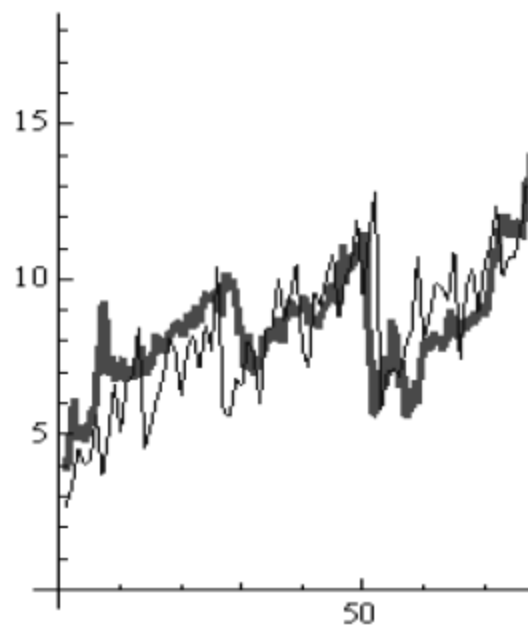


01.07.2006-01.04.2007 *IBM Year timeframe* 01.07.2006-01.07.2008

Forecast of Gazprom



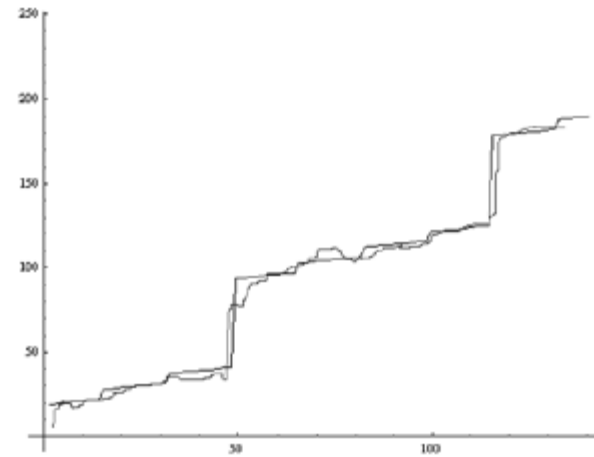
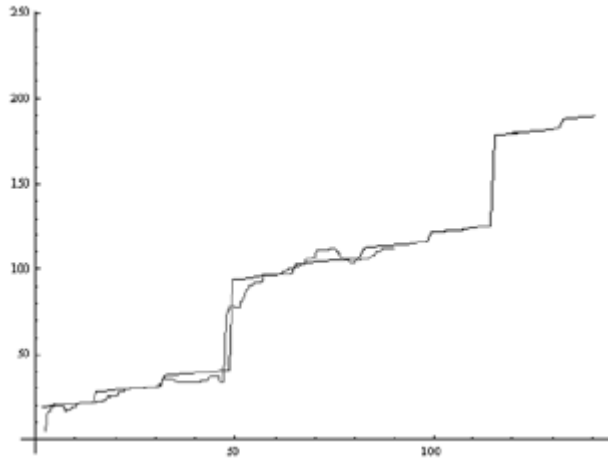
01.06.2009



01.06.2009-02.06.2009

Gazprom Daily time frame

Forecast: RTS Index



RTS index Weekly time frame

27.05.2009-30.05.2009

27.05.2009-1.06.2009

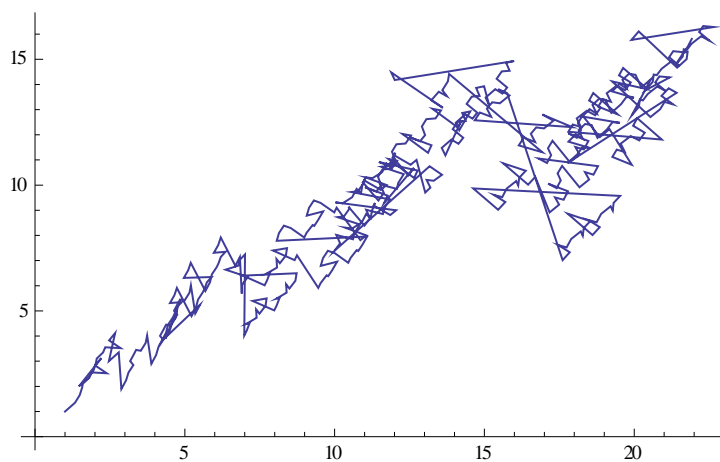
P-adic price configuration

Hubbard model – the only agent-based model,
which gives a p-adic behavior of prices

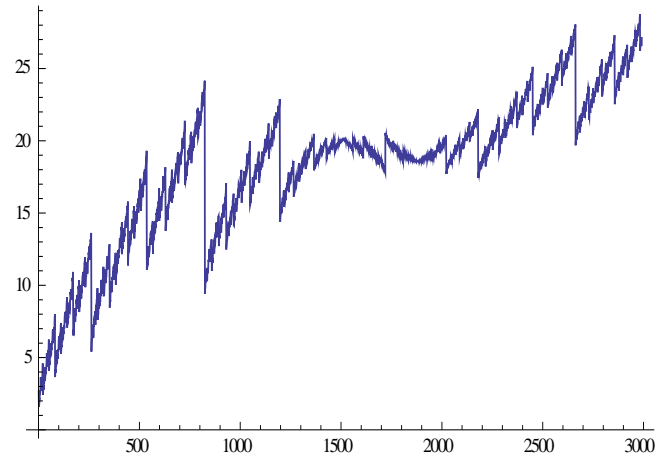
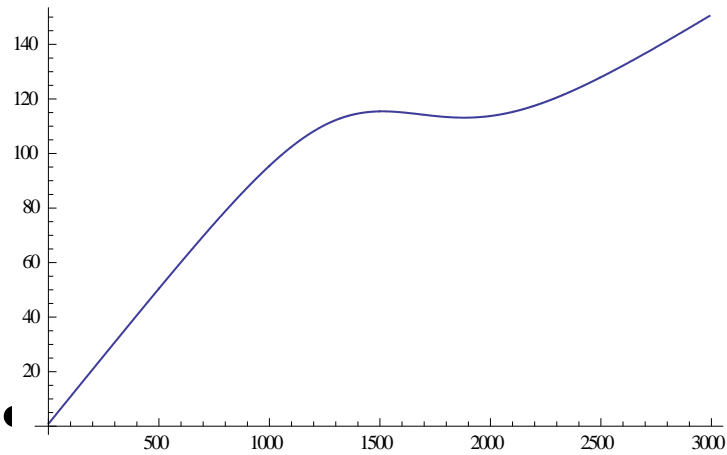
Our goal – to give mathematical formulation of
Elliott theory

Results on p-adic patterns as construction of
elements of Elliott theory !

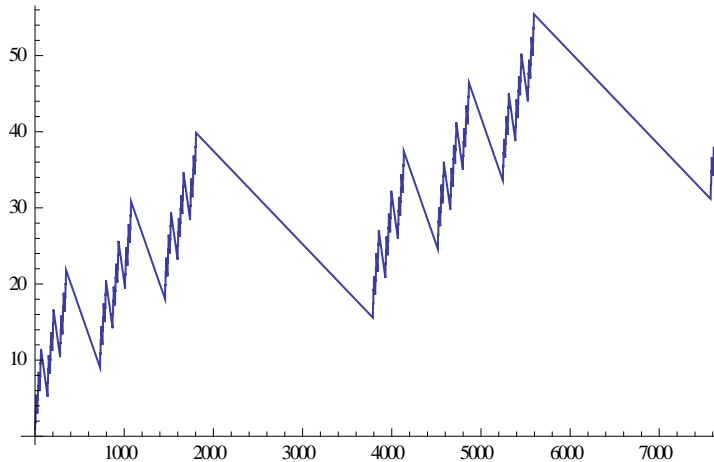
P-adic stochastic configuration



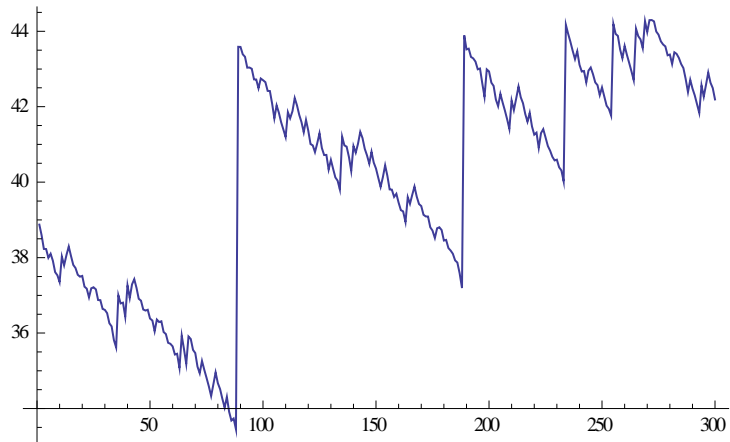
Continuous function (Left) and its fractal image (Right)



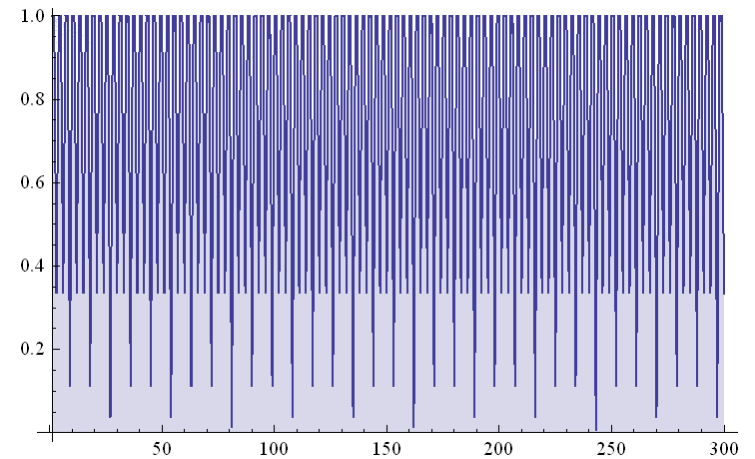
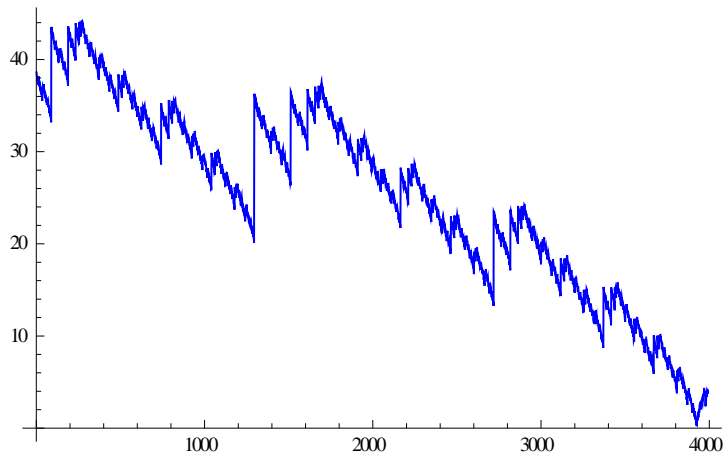
Horizontal - fractal argument, vertically
- fractal function. Corrections - not
vertical. Usual for Elliott Wave.



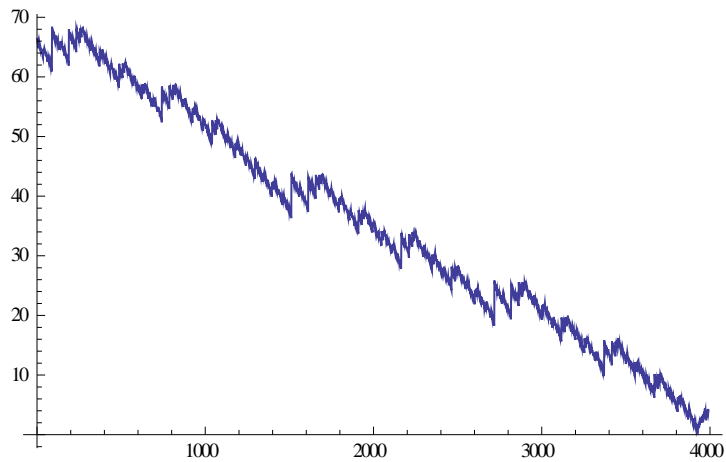
The triangular configuration of the Elliott theory (End configuration for Fluctuation of Price)



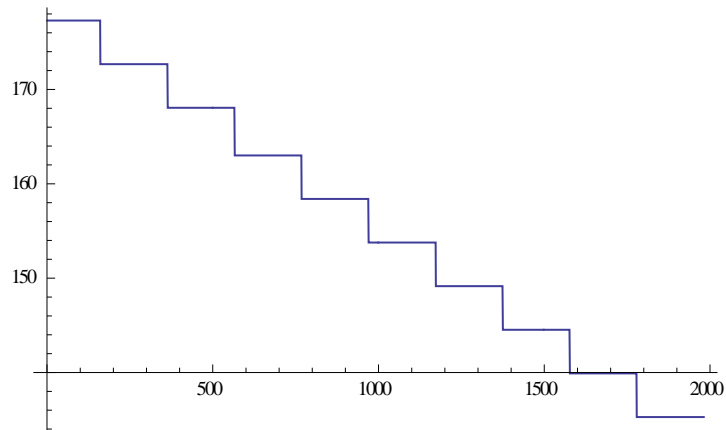
Left: Correction with a triangle. Right:
modulus of p adic function = volume
of shares traded!



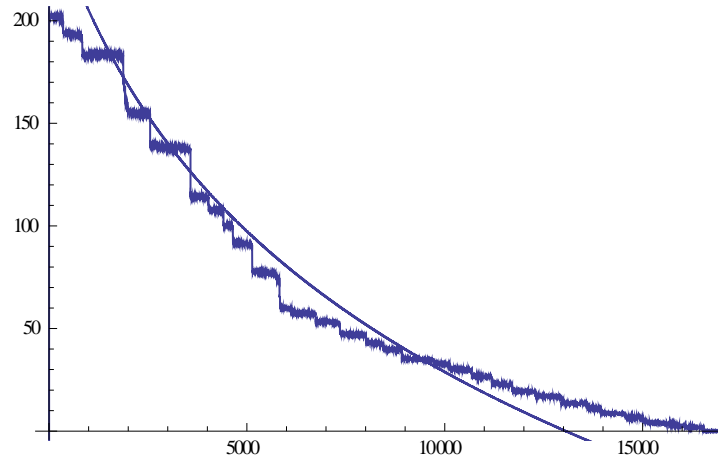
Stretched correction from Elliott theory



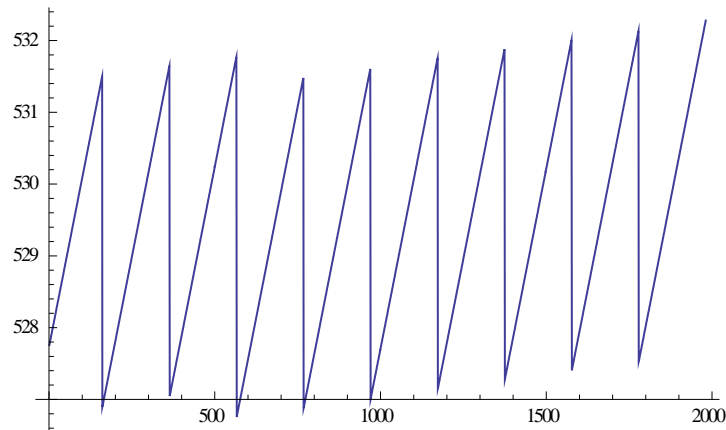
Simple configuration with steps



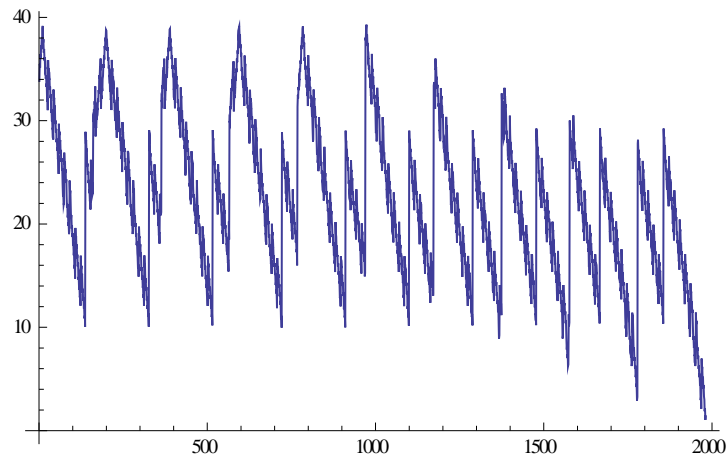
Fractal envelope of a continuous function



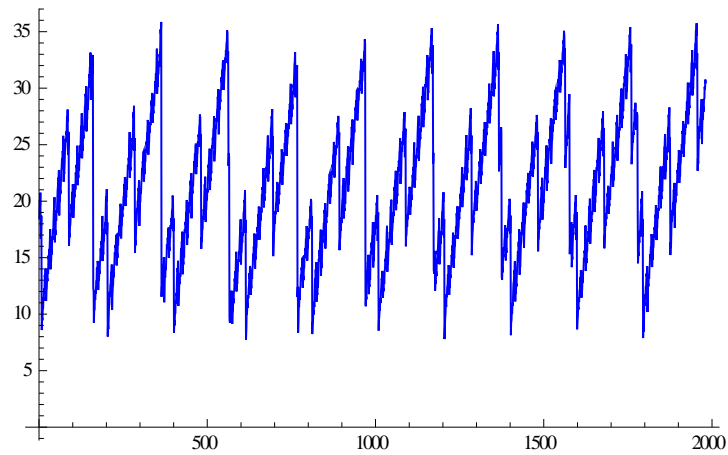
Simple configuration of the teeth (triangle with many teeth)



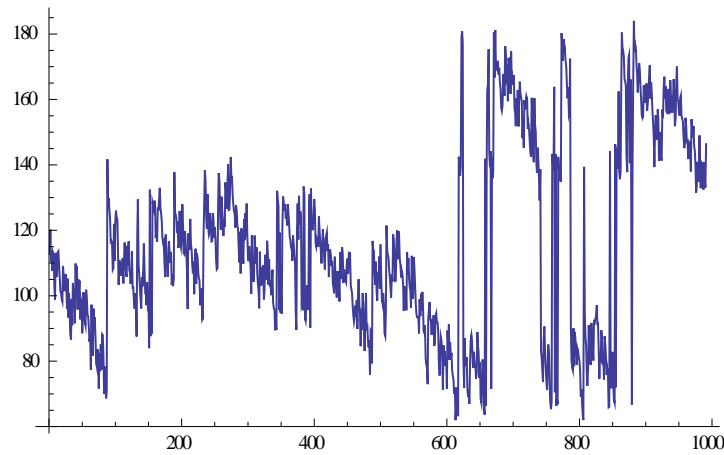
Double (complex) configuration of the teeth



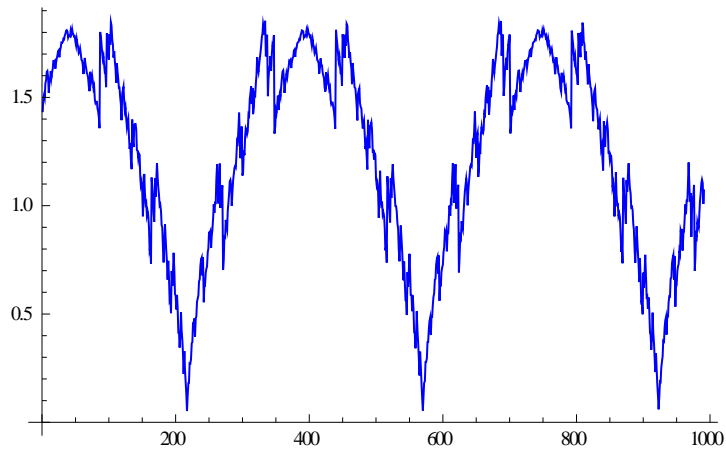
Triple (complex) configuration of the teeth



Not deterministic configuration. P-adic description.



Fractal function of the cosine



Goodbye.

- This is the beginning of p-adic technical analysis

