accenture

i4C Analytics

Now part of
Accenture Analytics

Control forecasting performance over time through Sequential Schemes:

An application to the energy sector

High performance. Delivered.

AGENDA

ITALIAN ENERGY SECTOR
Network & Needs

METHODOLOGY
Standardizing Data and choosing Charts

ONE SINGLE PROCESS ON DAILY CONSUMPTIONS
GAS & POWER Sectors

24 PROCESSES ON HOURLY CONSUMPTIONS
POWER Sector

NEXT STEPS
Improvements: business and statistical points of view

ITALIAN ENERGY SECTOR

Network & Needs

EXAMPLE:
GAS NETWORK

Distributors
Anagrafical and consumption data

SNAM (TSO)
Natural Gas supply

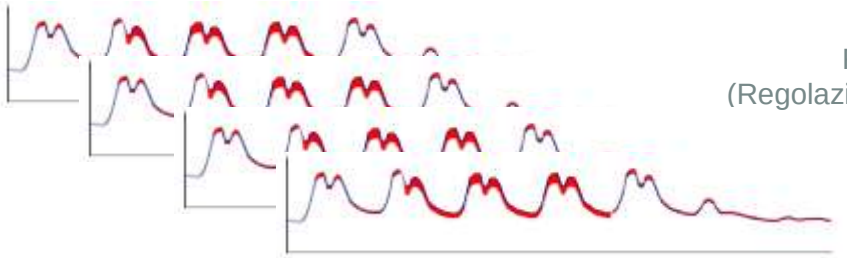
STORAGE
Storage contracts

Meteo Provider
Weather data (temperature, solar irradiation, humidity)

Forecasting

Energy Scheduling

Market Operator

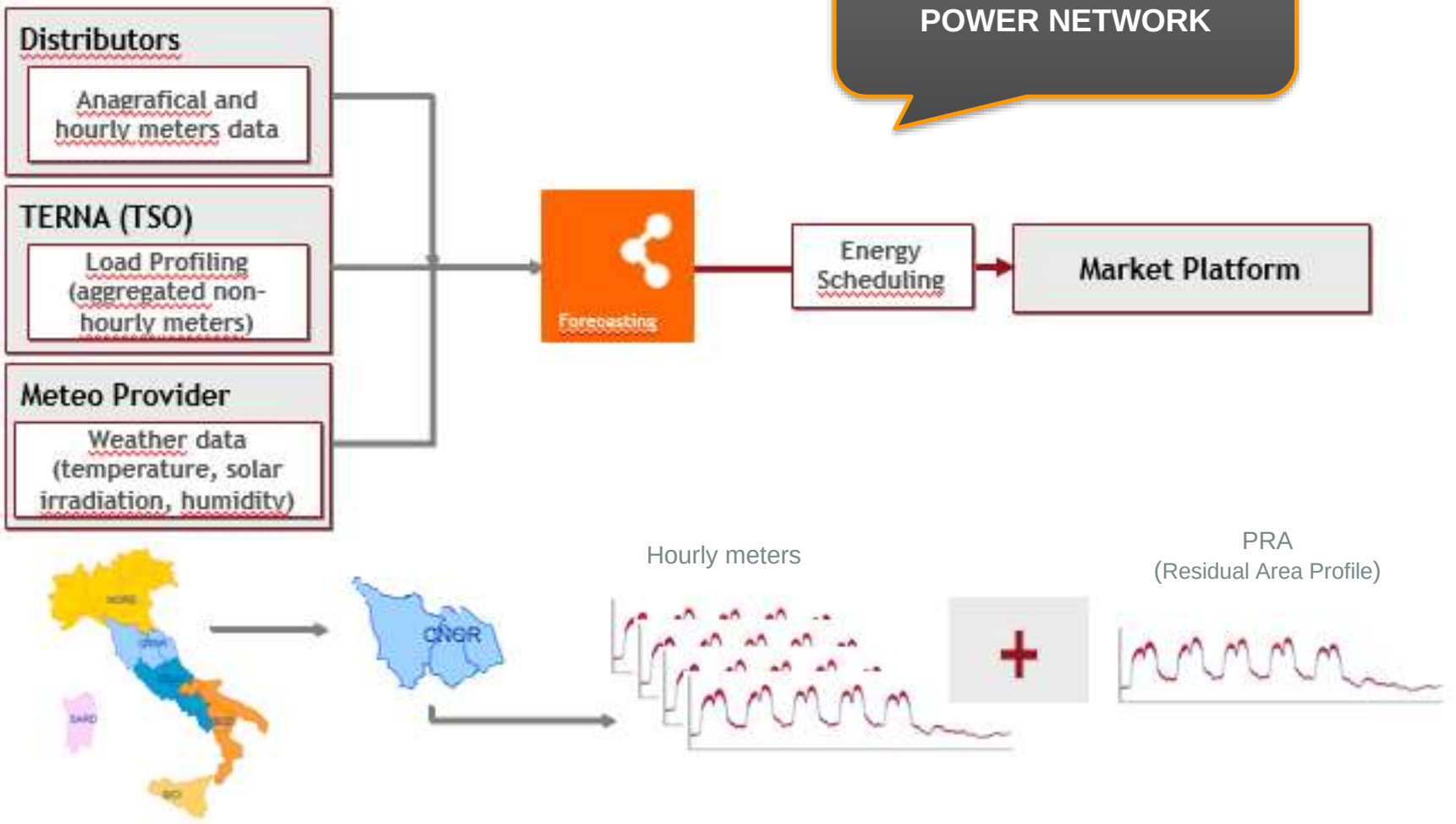


REMI
(Regolazione e Misura)

ITALIAN ENERGY SECTOR

Network & Needs

EXAMPLE:
POWER NETWORK



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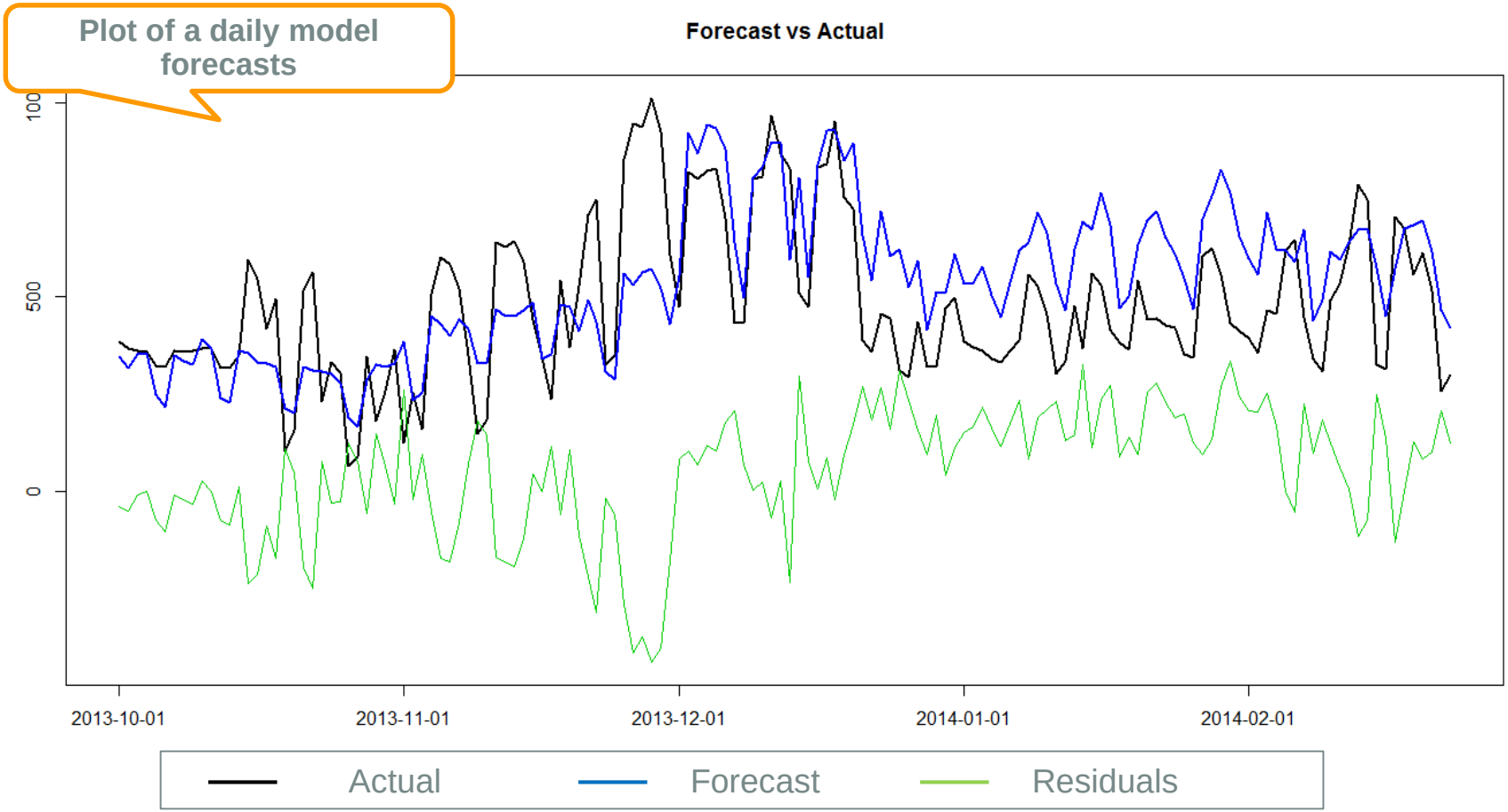
METHODOLOGY

Standardizing Data and choosing Charts

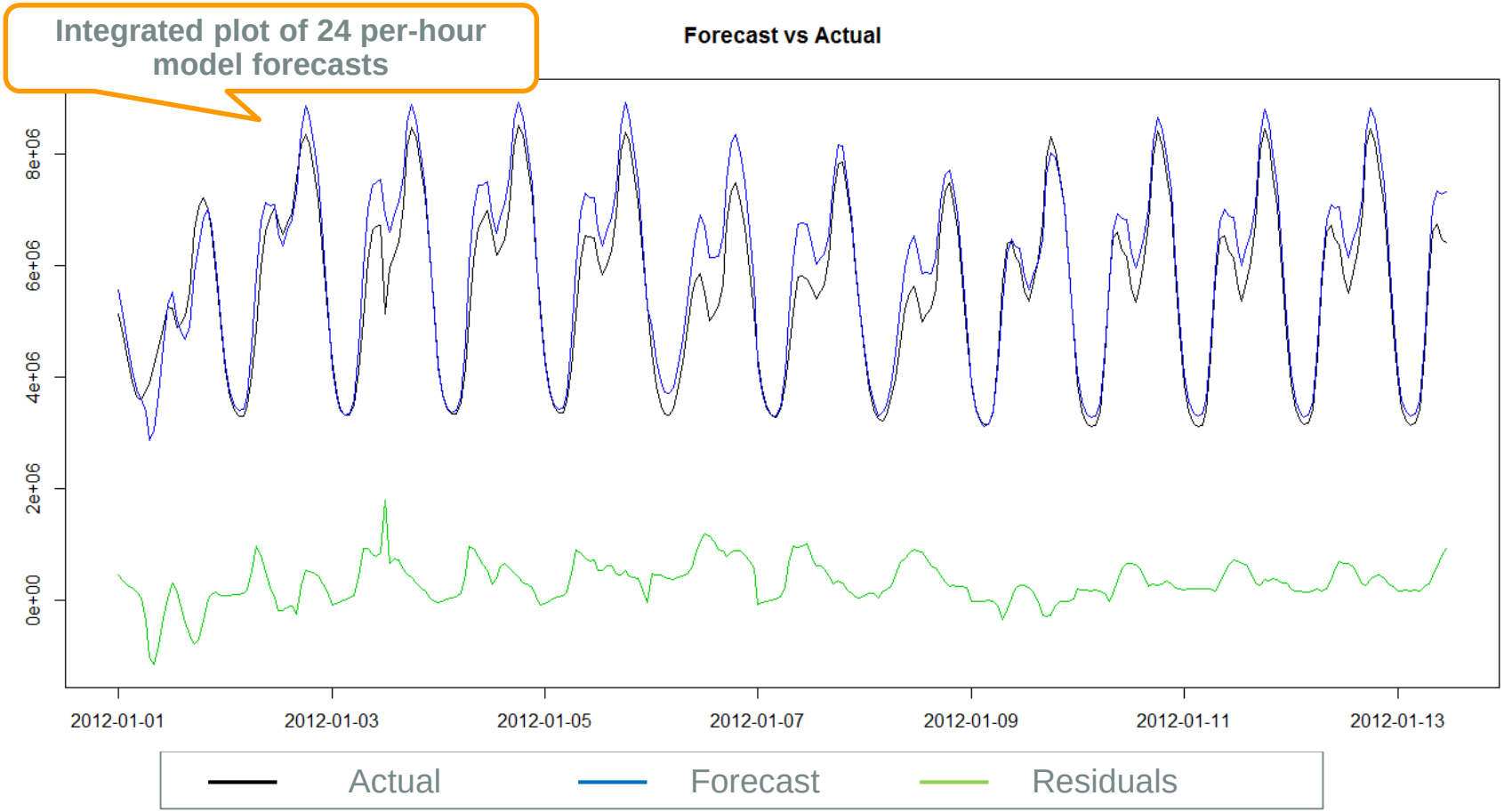
- Focus on Residuals of consumption forecasts : Gas example



METHODOLOGY

Standardizing Data and choosing Charts

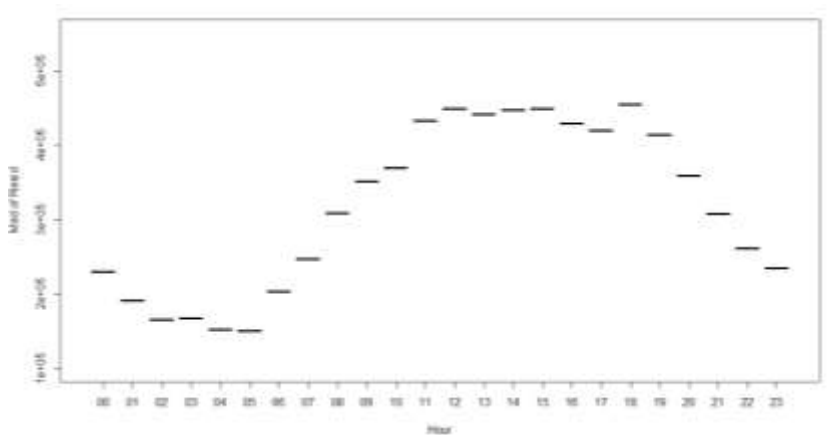
- Focus on Residuals of consumption forecasts : Power example

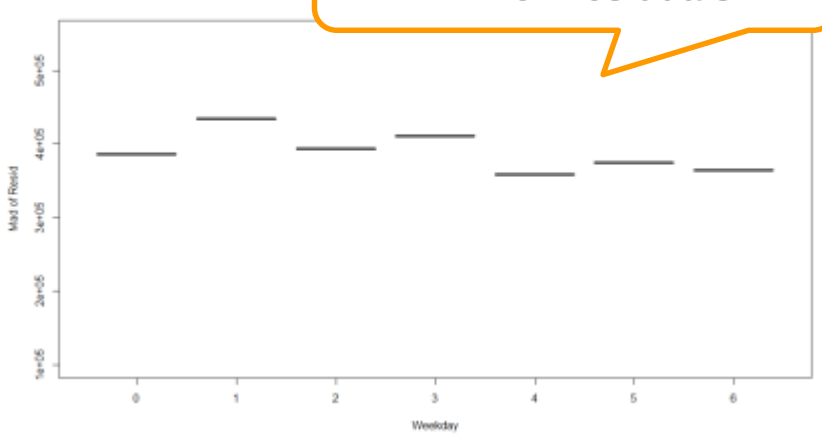


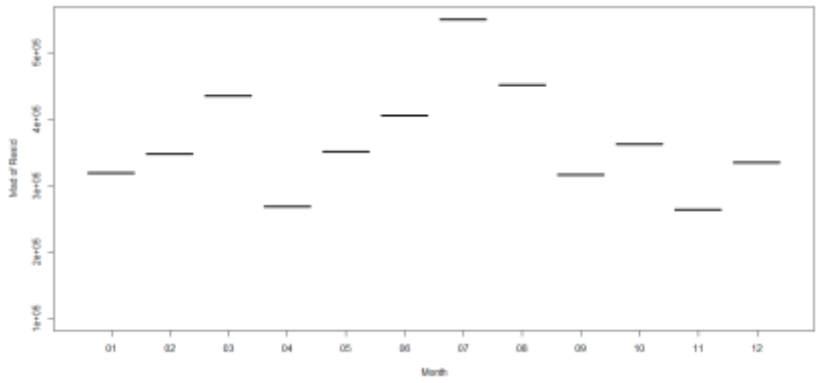
METHODOLOGY

Standardizing Data and choosing Charts

- Energy consumption forecasting process has got well-known easy or difficult hours, weekdays and months







Complexity in forecasting: MAD of Residuals

Hour

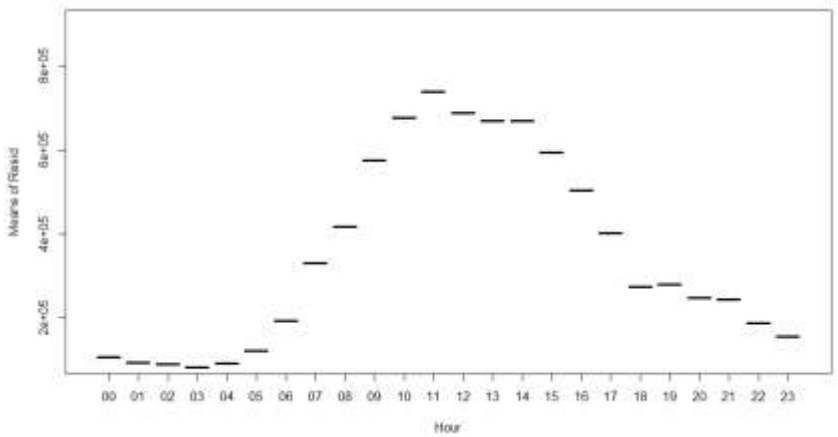
Weekday

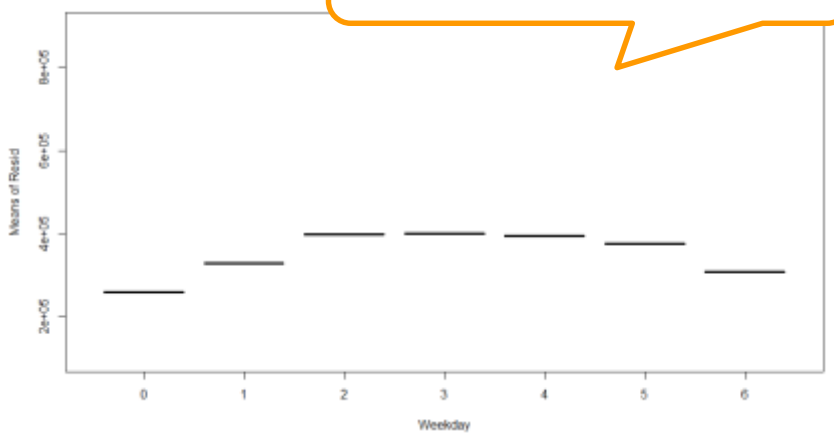
Month

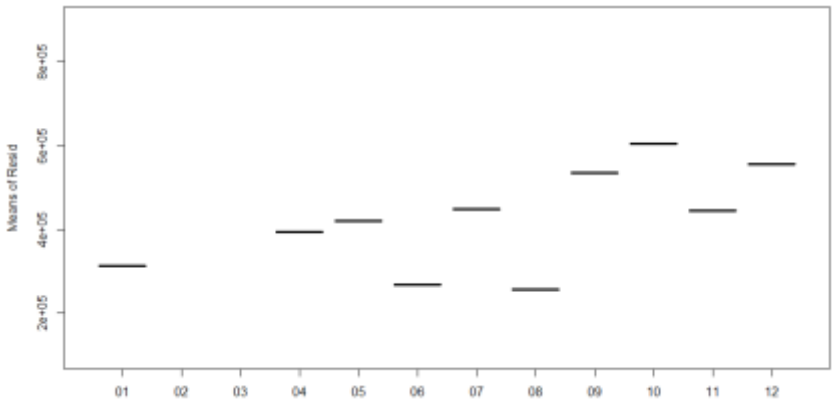
METHODOLOGY

Standardizing Data and choosing Charts

- Energy consumption forecasting process has got well-known either easy or difficult hours, weekdays and months







Complexity in forecasting: means of Residuals

Hour

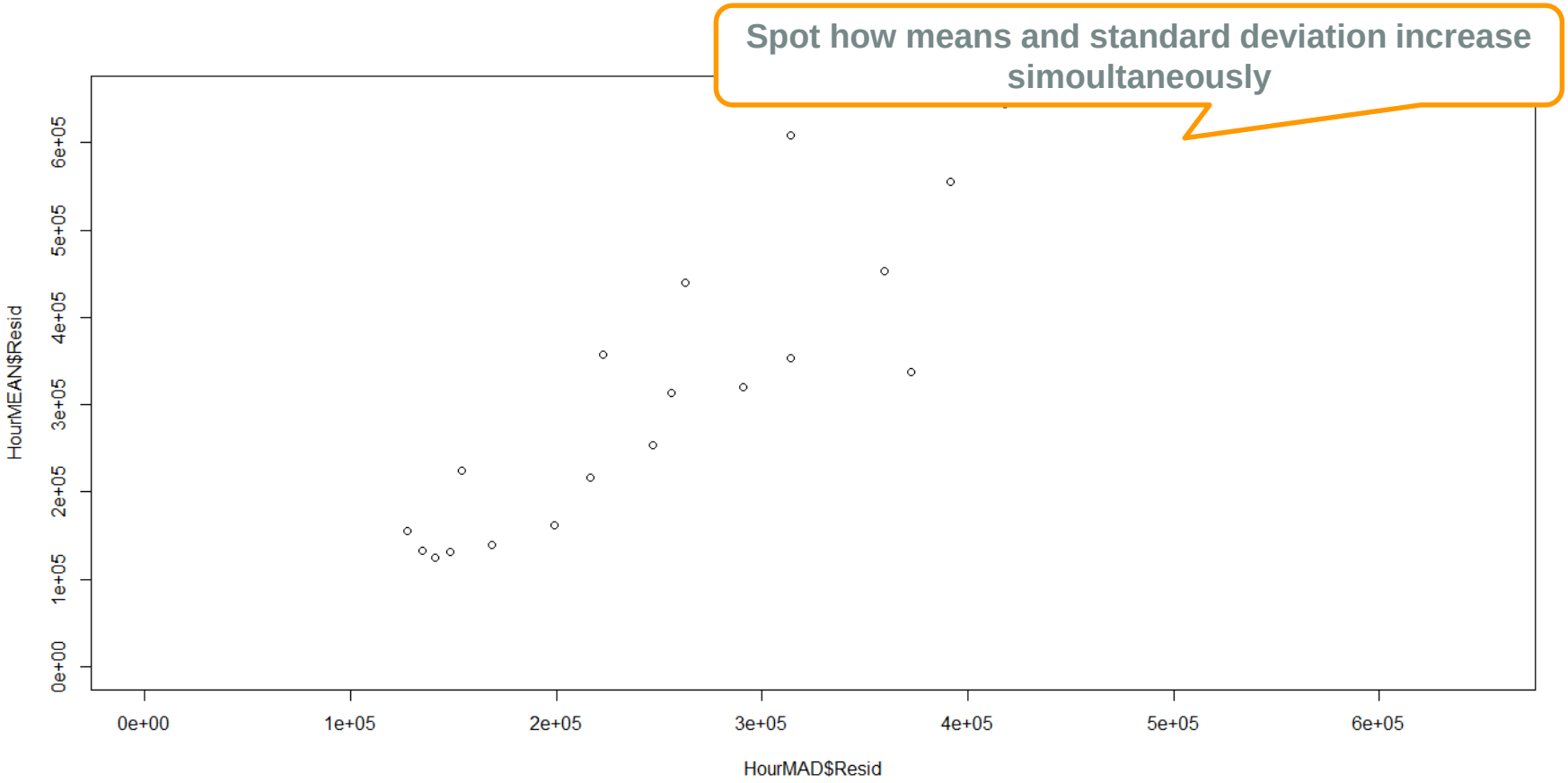
Weekday

Month

METHODOLOGY

Standardizing Data and choosing Charts

- Standard deviation and means of Residuals for this group shows a similar behaviour



METHODOLOGY

Standardizing Data and choosing Charts

- In order not to relay on few figures for this standardization, homogeneity tests have been carried out:
  - **Fligner test** for homogeneity of **standard deviation** within groups of hours/weekdays/months
  - **Kruskal test** for homogeneity of **means** within groups of hours/weekdays/months

- Results in the previous slide are used to support the following simplification.
  - groups for **standardization** are made only **on Kruskal test results**, avoiding the use of both kruskal and fligner's.

Standardize by hour, weekdays and month

METHODOLOGY

Main R instruments

- **Packages**
  - **agricolae**

    Felipe de Mendiburu (2014). agricolae: Statistical Procedures for Agricultural Research. R package version 1.2-0. http://CRAN.R-project.org/package=agricolae
  - **qcc**

    Scrucca, L. (2004). qcc: an R package for quality control charting and statistical process control. R News 4/1, 11-17.
    - qcc()
    - mqcc()
- **Sequential Schemes**
  - X-bar chart

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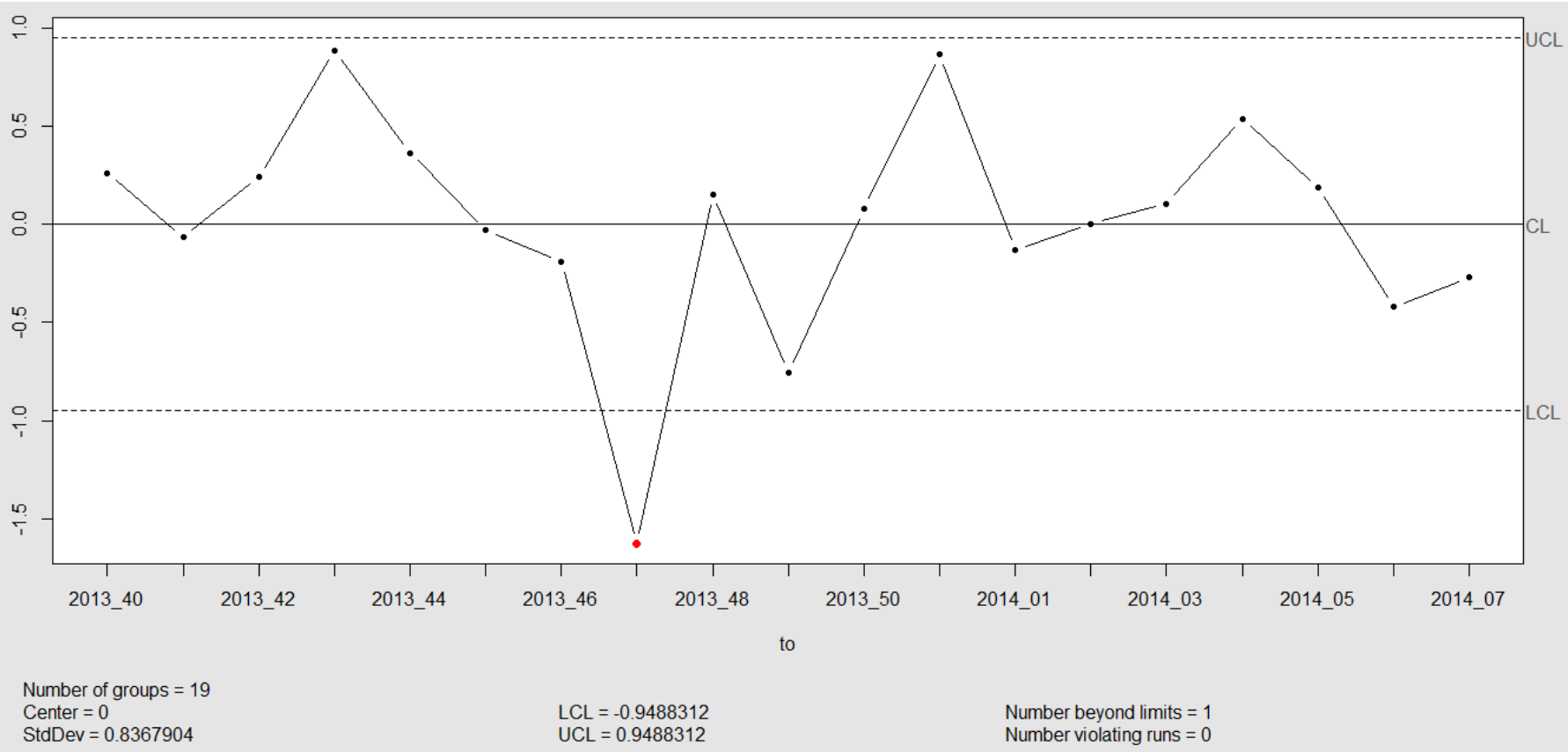
NEXT STEPS
Improvements: business and statistical points of view

ONE SINGLE PROCESS ON DAILY CONSUMPTIONS

GAS sector

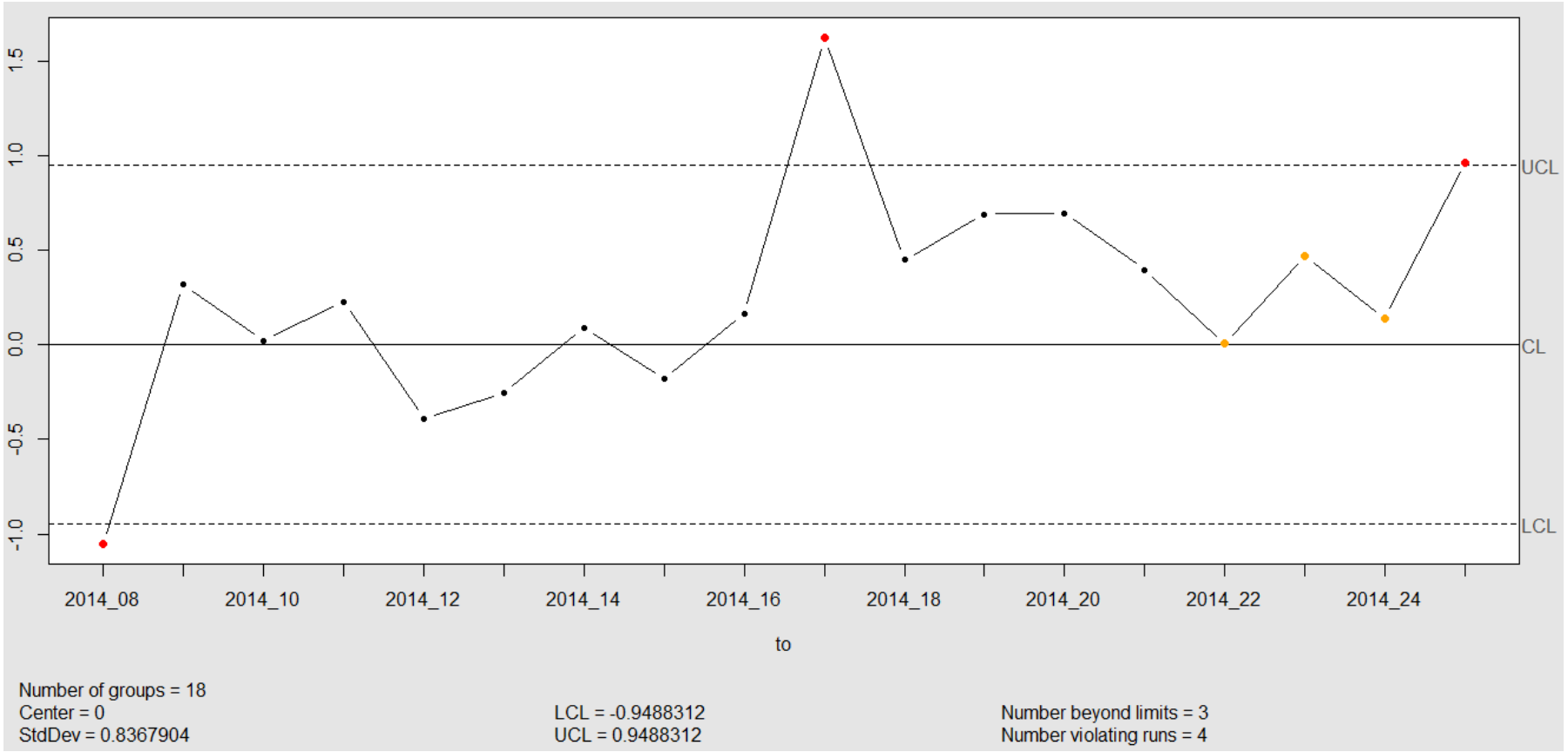
- Process Data on std Residuals



ONE SINGLE PROCESS ON DAILY CONSUMPTIONS

GAS sector

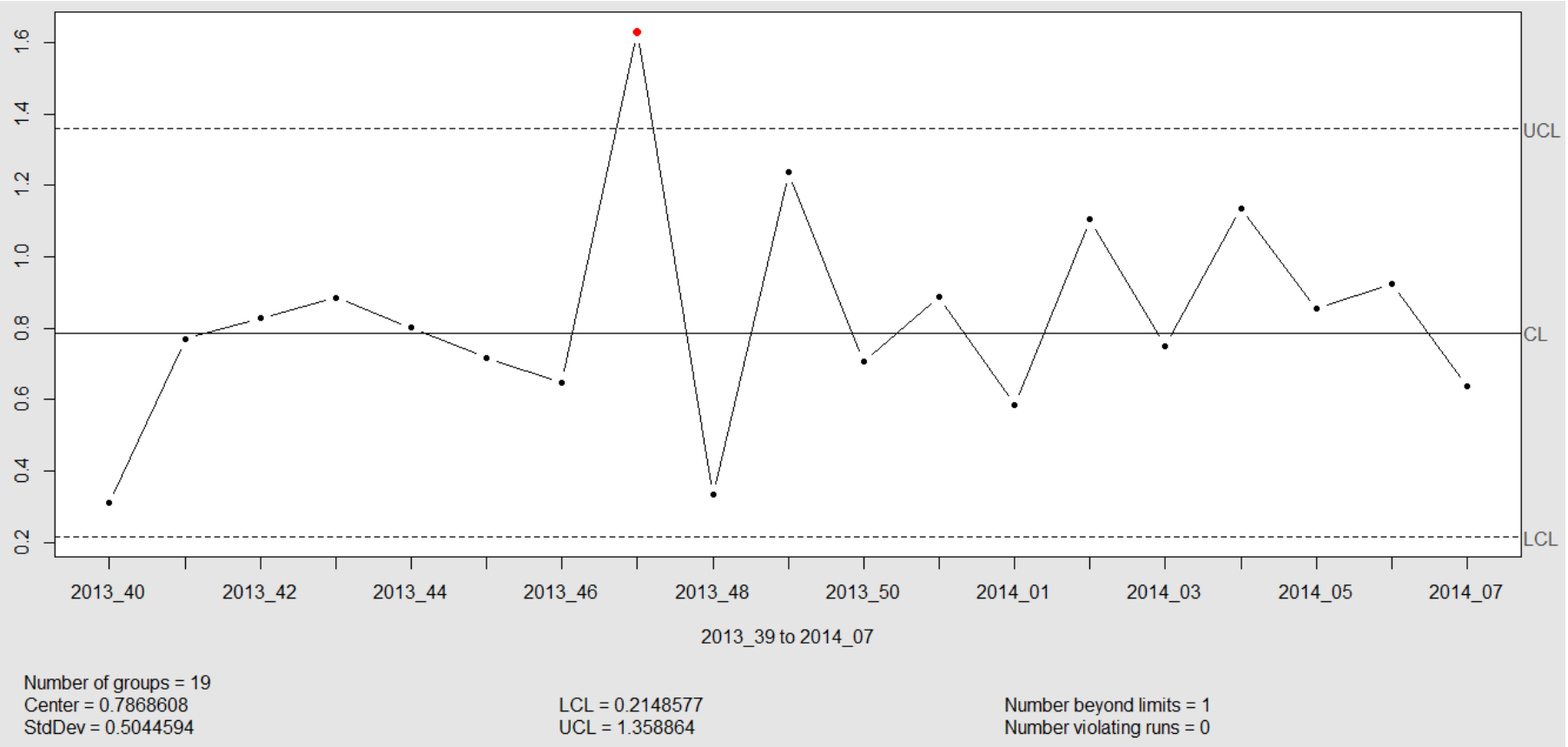
- Control Data on std Residuals



ONE SINGLE PROCESS ON DAILY CONSUMPTIONS

GAS sector

- Process Data on absolute std Residuals



ONE SINGLE PROCESS ON DAILY CONSUMPTIONS

GAS sector

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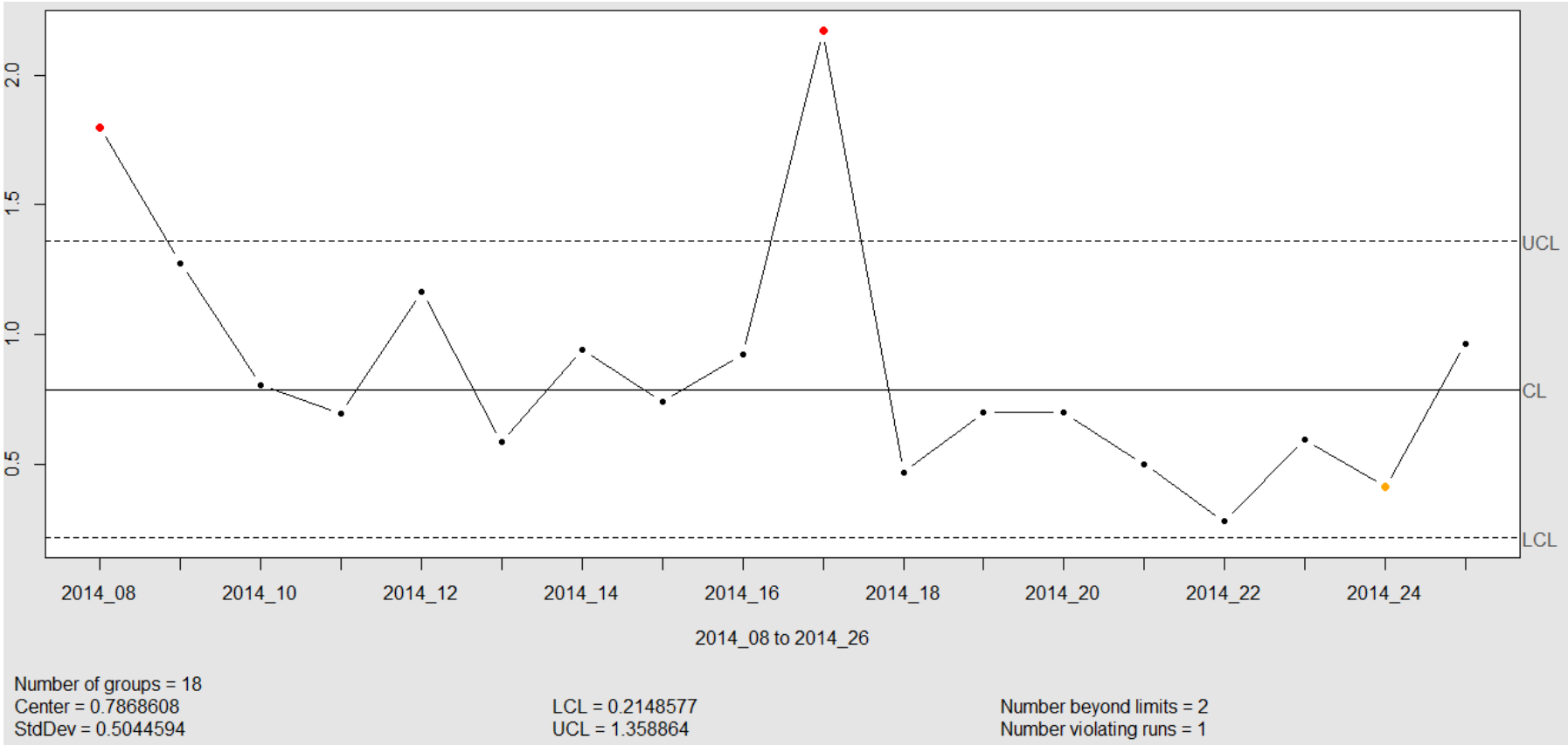

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ONE SINGLE PROCESS ON HOURLY CONSUMPTIONS

POWER sector

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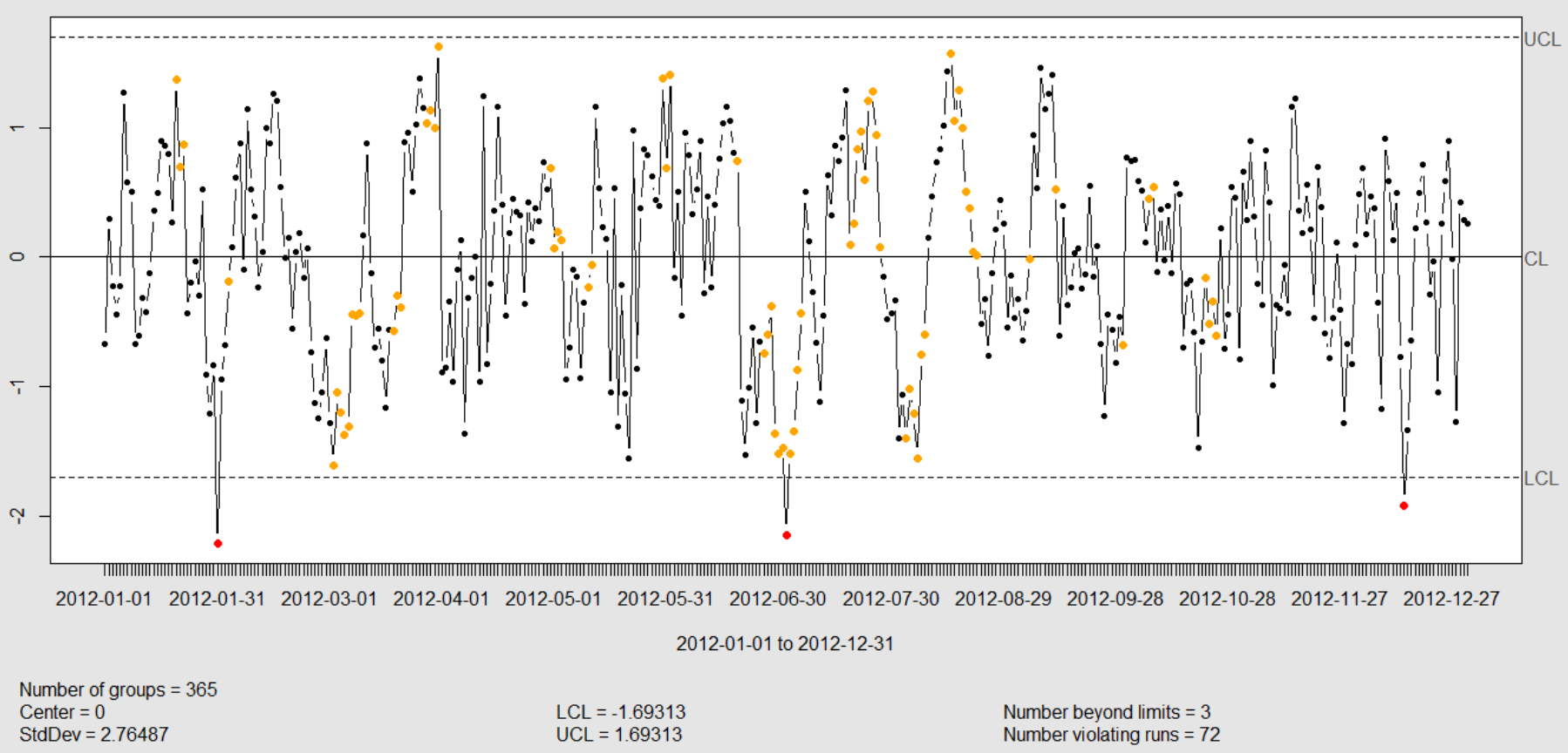

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POWER sector

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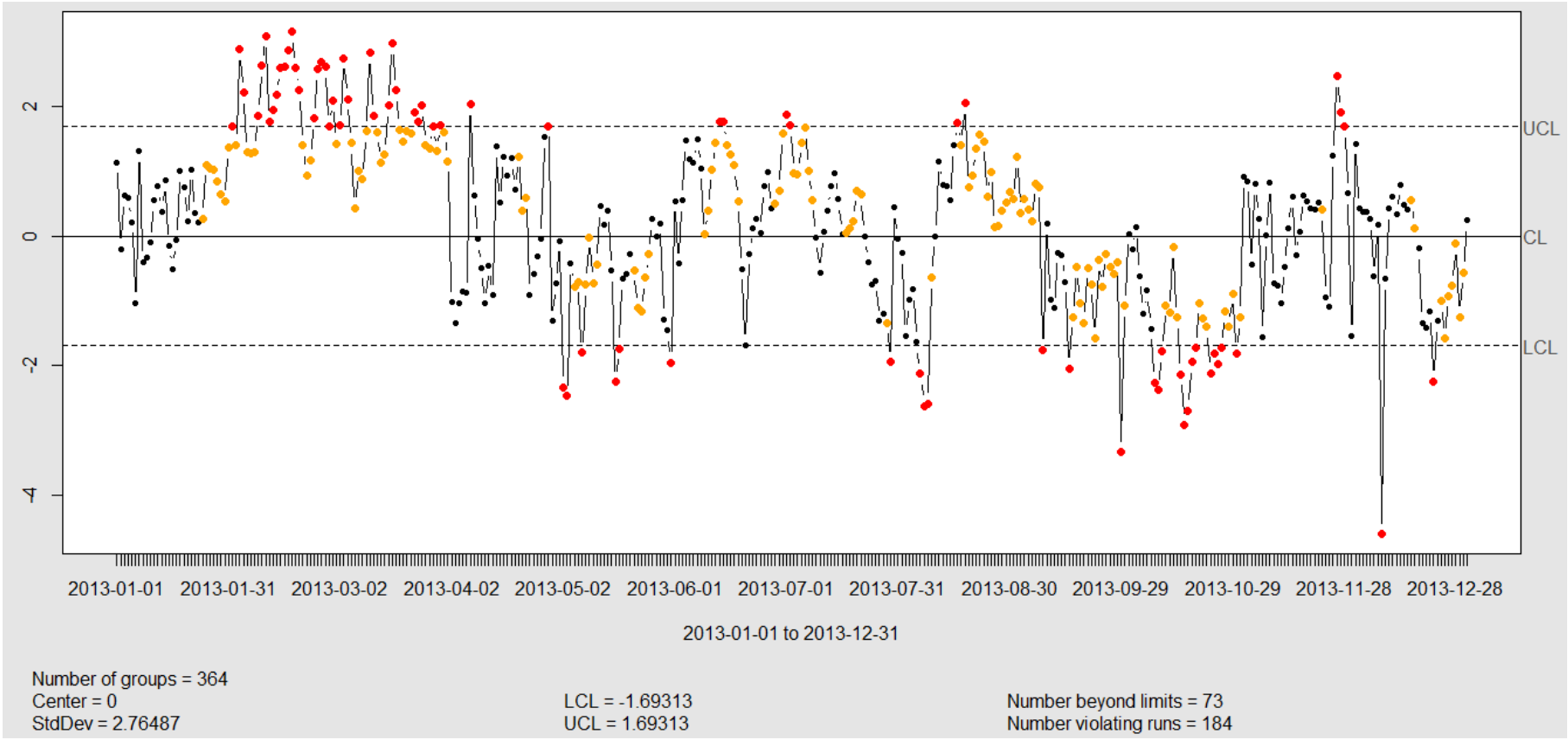

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POWER sector

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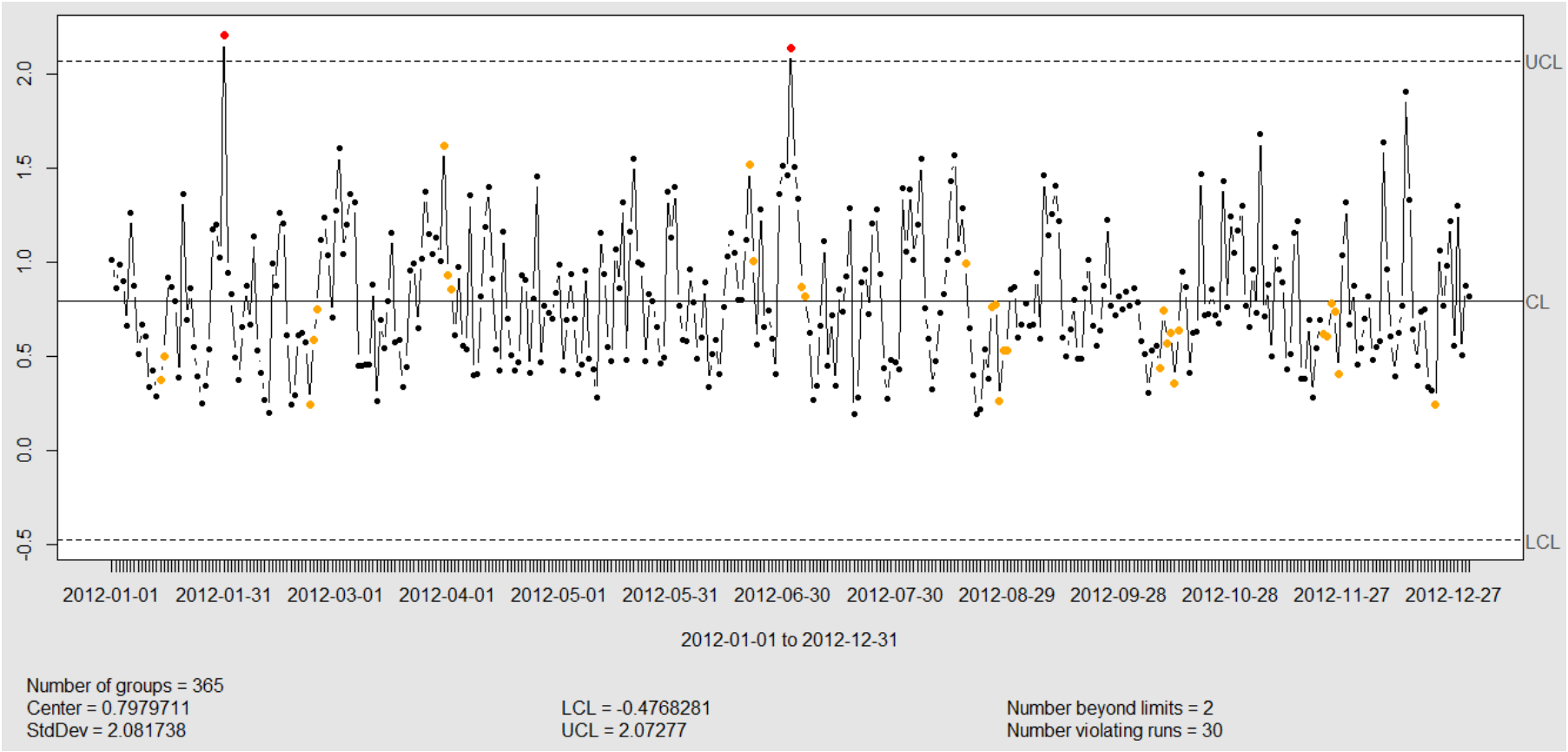

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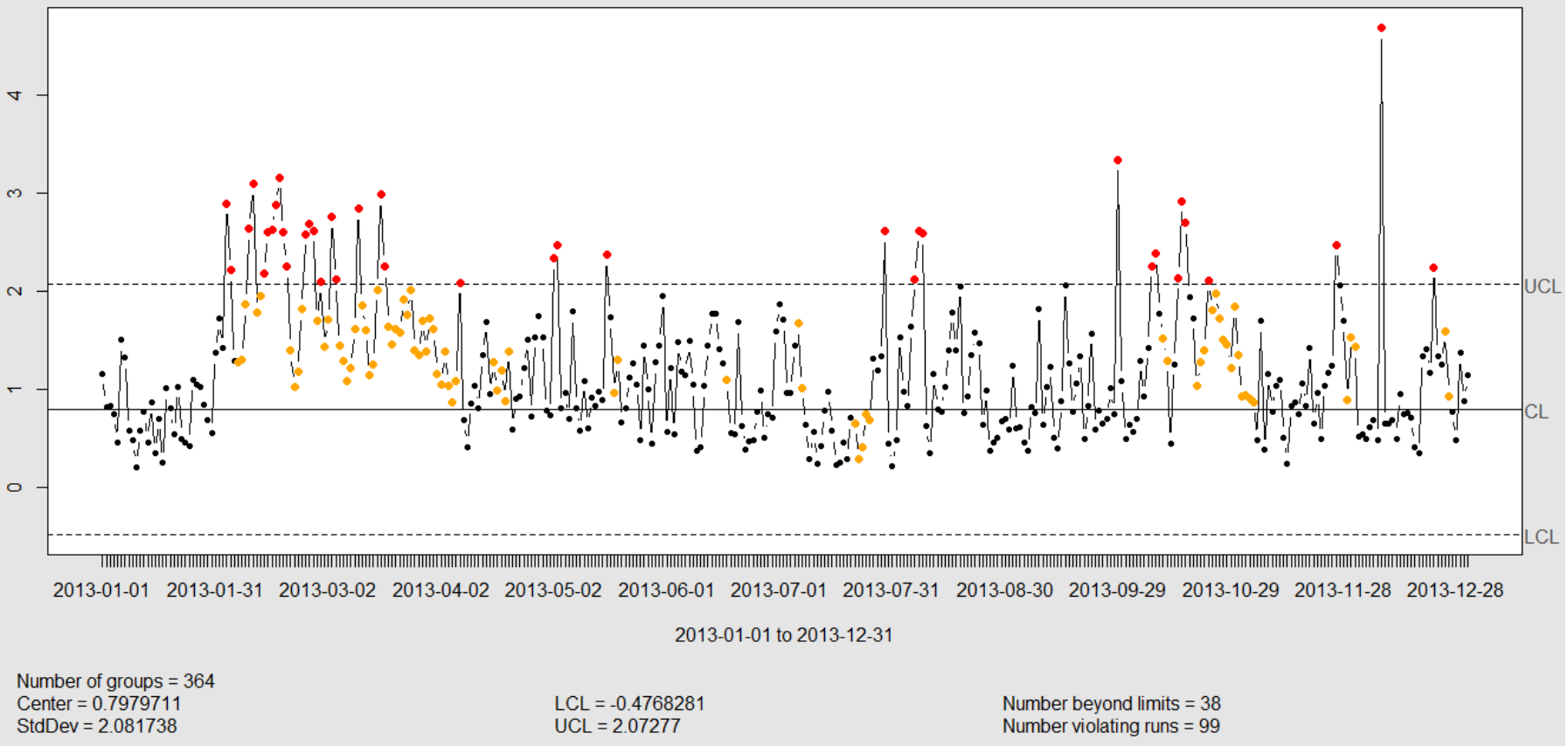

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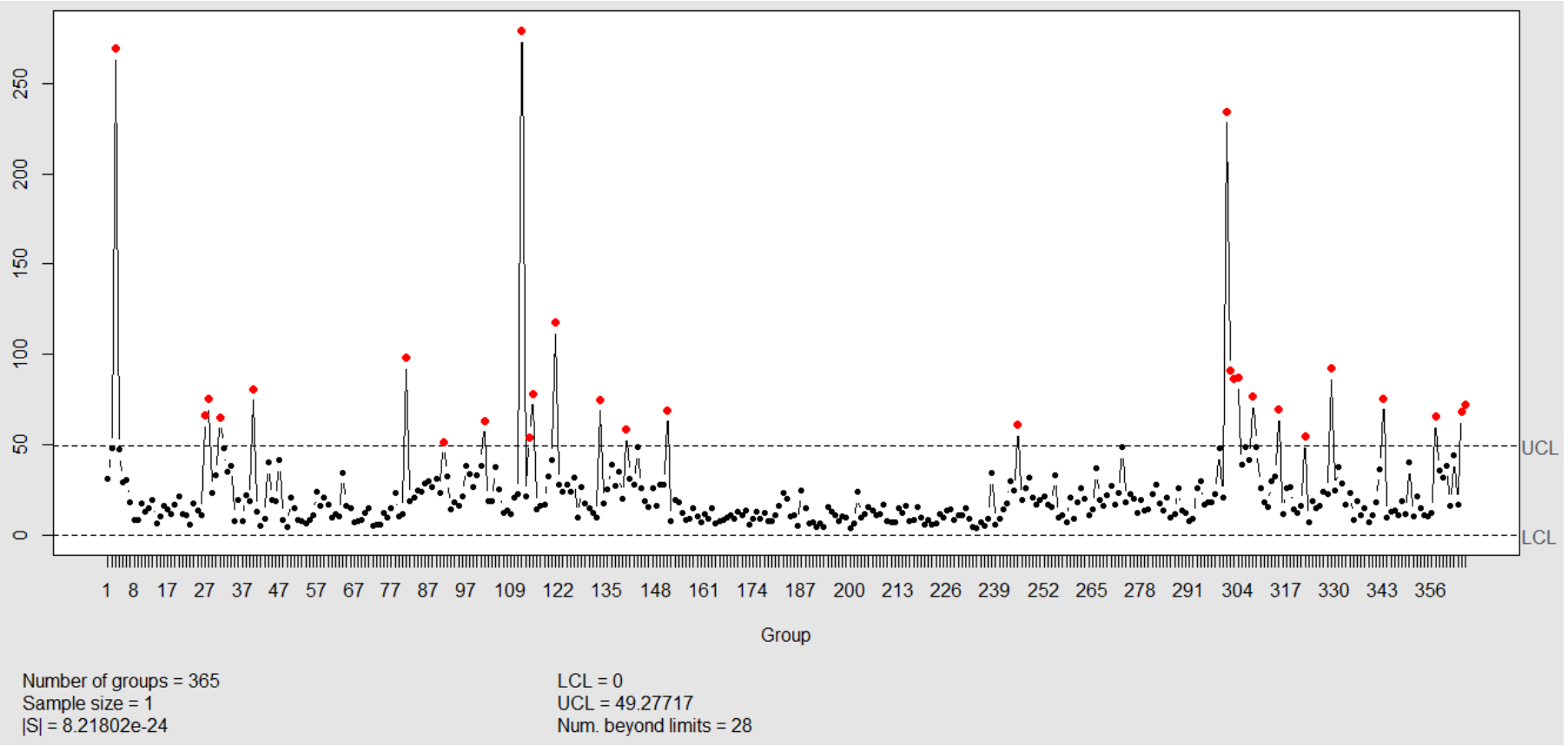

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POWER sector

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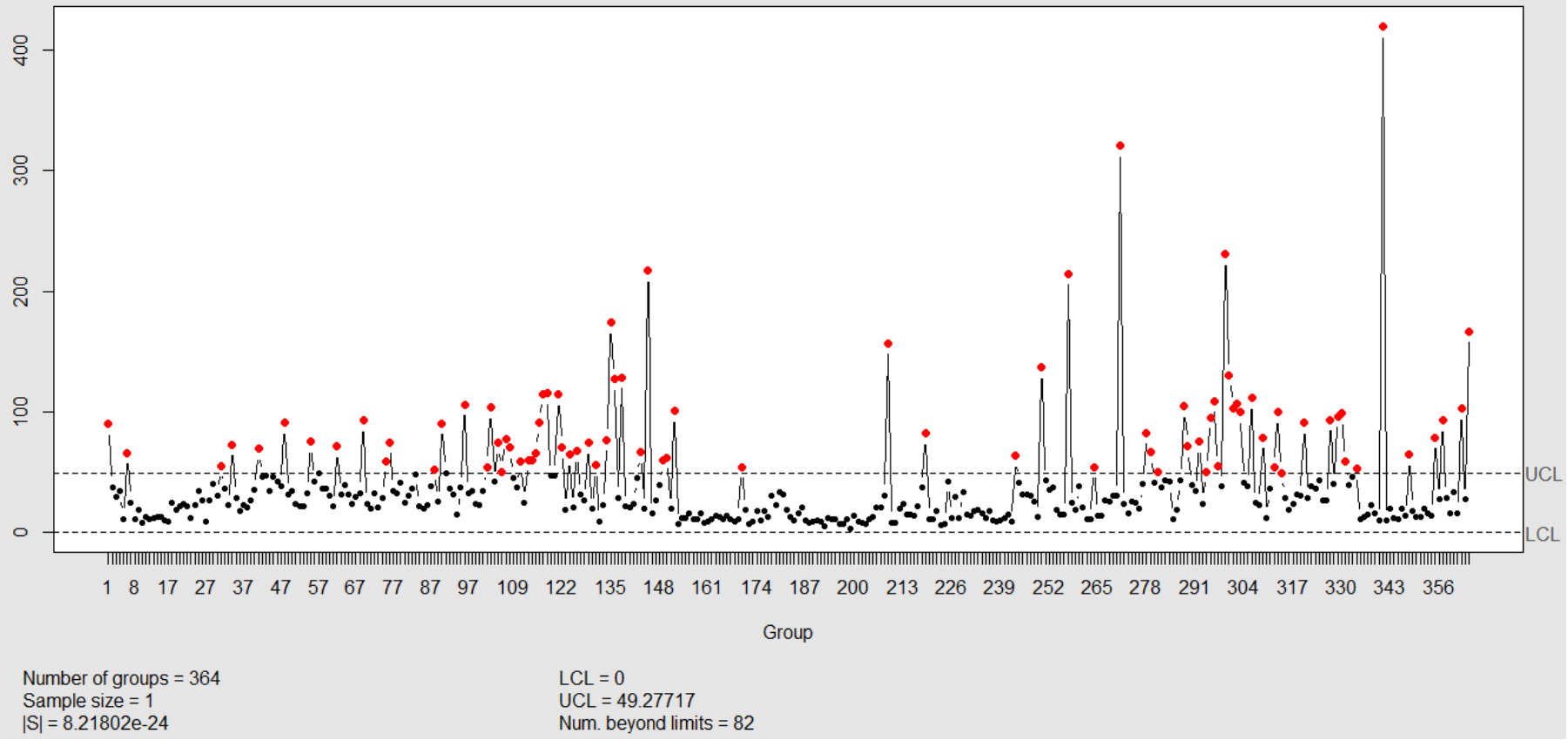

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NEXT STEPS

Improvements: business and statistical points of view

- Statistical Point of view
  - Standardizing data by mad of residuals and not only by means
  - Using various kind of charts

- Business Point of View
  - Define different aggregation level for monitoring the process (1 series x 1 model, all series with the same model)
  - Define clusters where to show either std Residual charts or absolute std Residuals

Q&A

Contact information

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Thank you for your attention