Change point detection in mobile advertising

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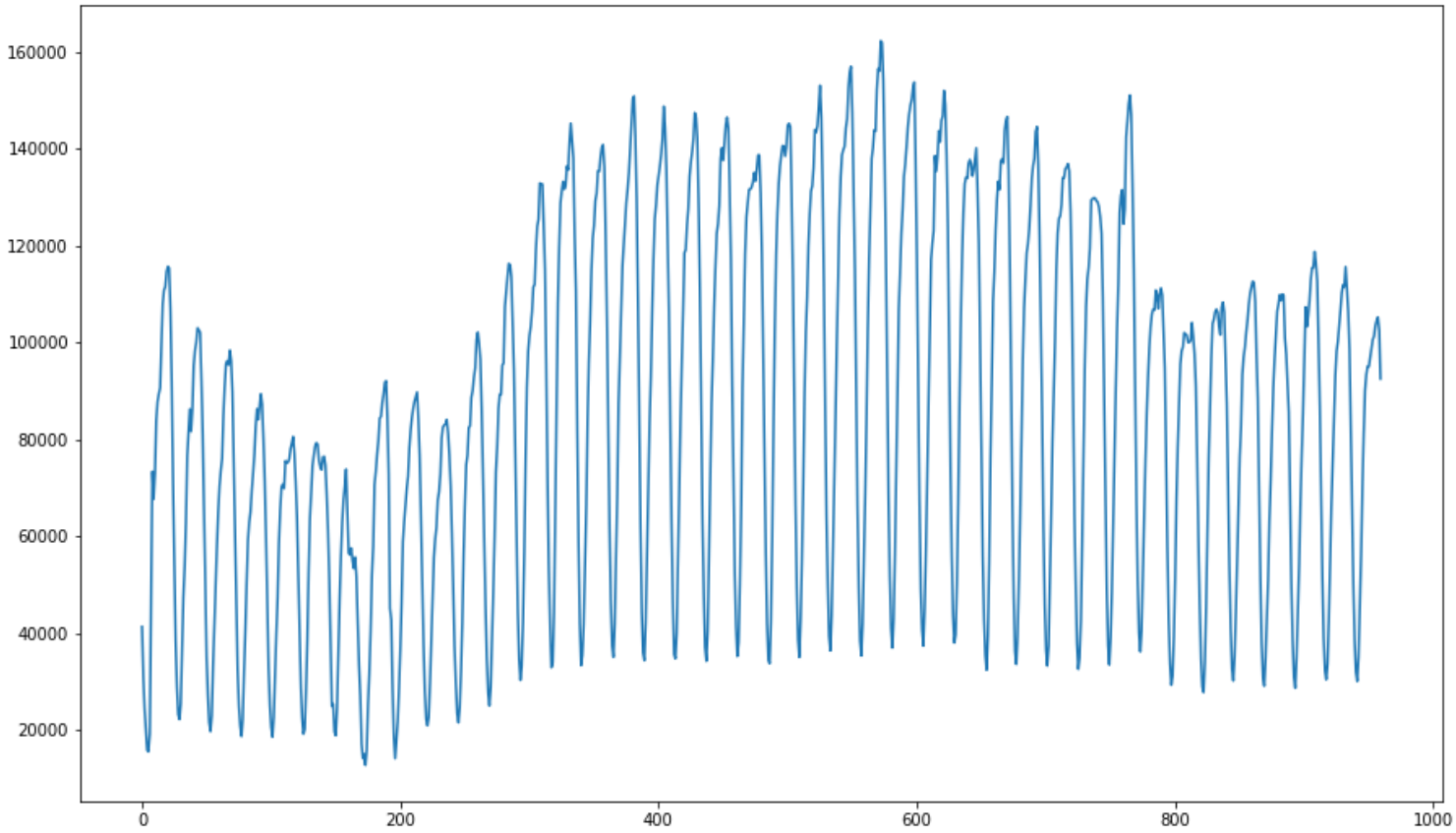
What is change point detection?

- Change point — point in time series where some significant change occurred
- Change point detection — group of methods to find change points in time series

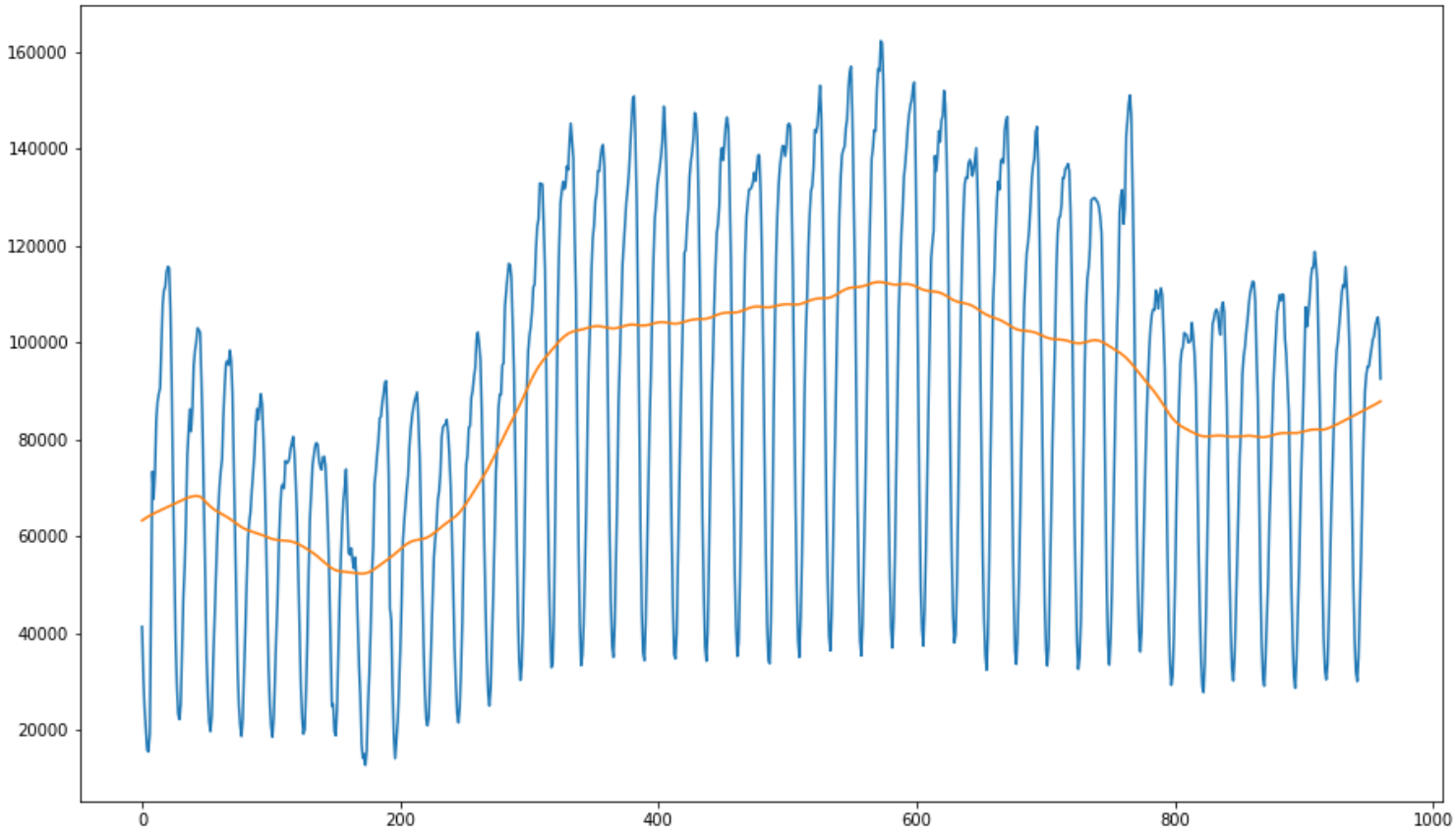
Types of change points

- Trend change
- Mean change
- Variance change
- Single point change
- Period change
- Structure change

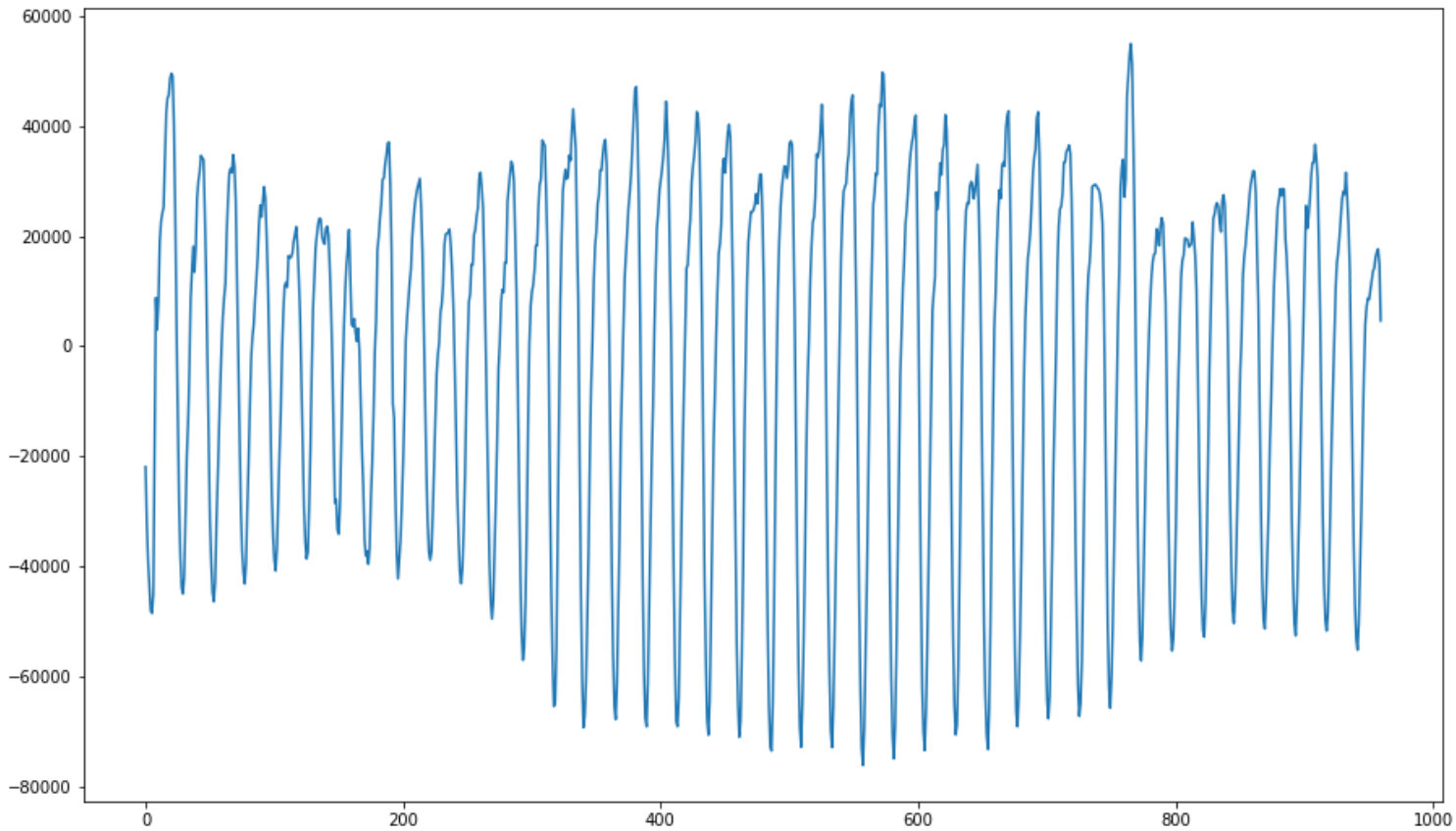
Common graph



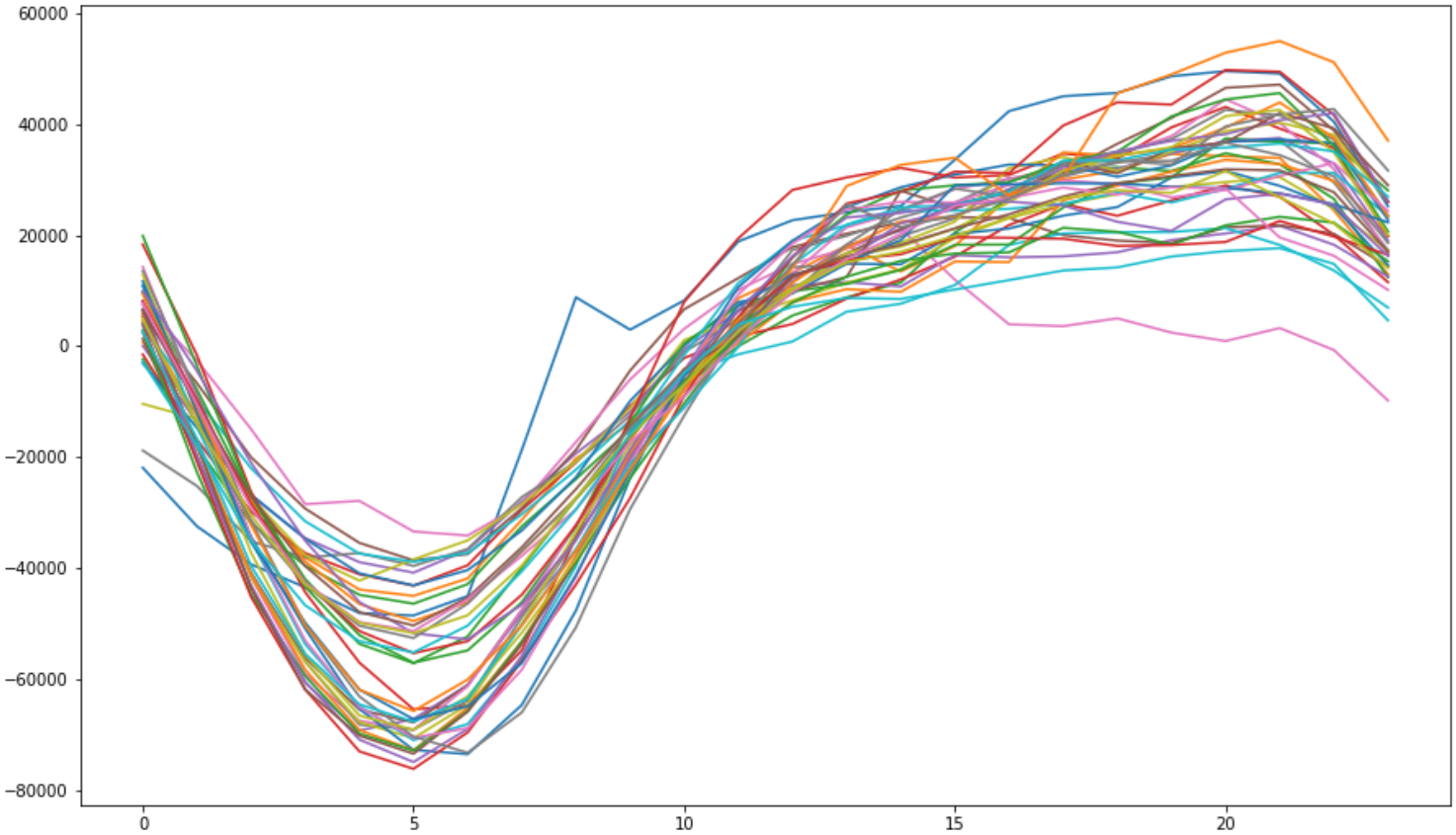
Common graph with trend



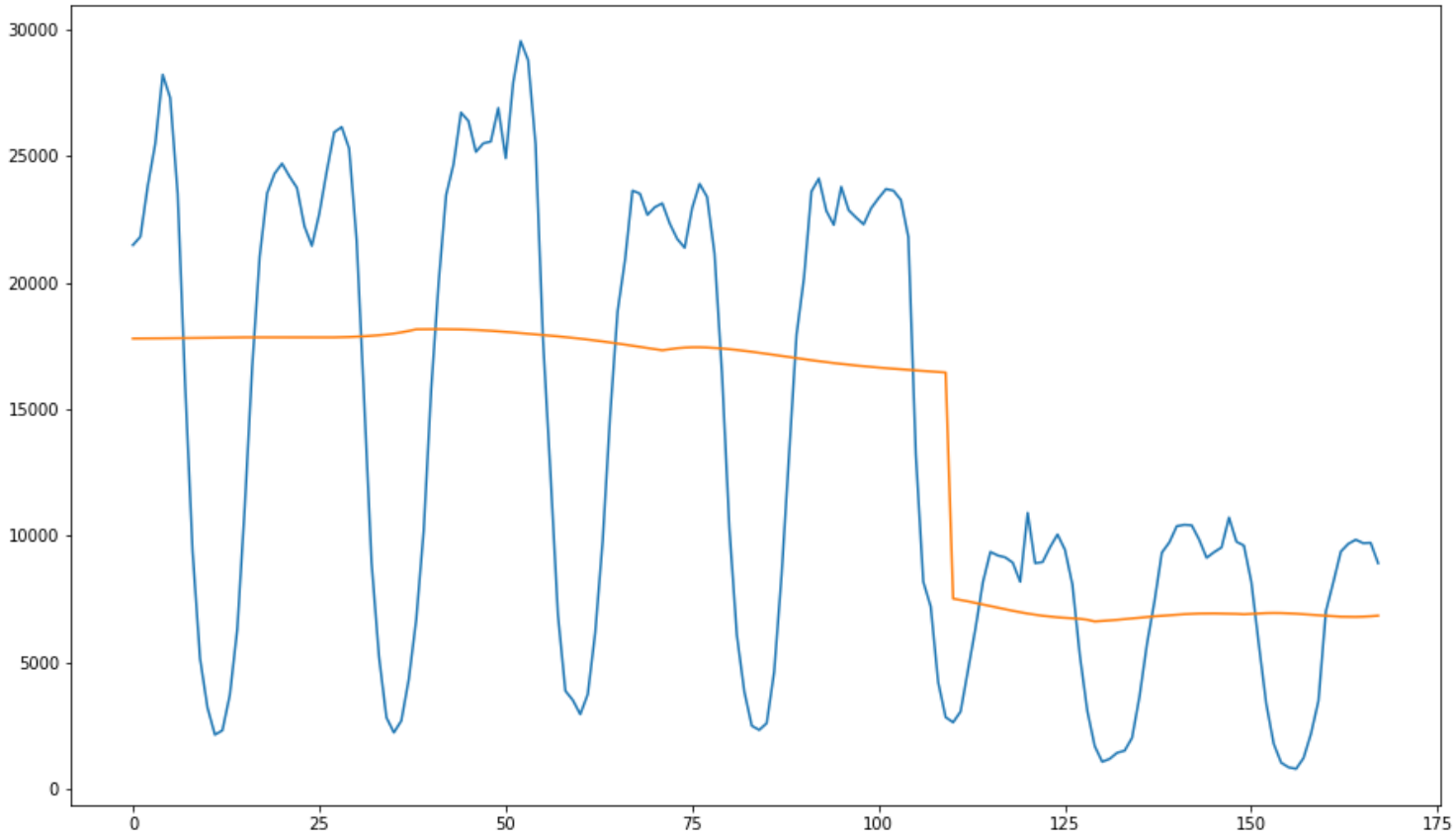
Common graph without trend



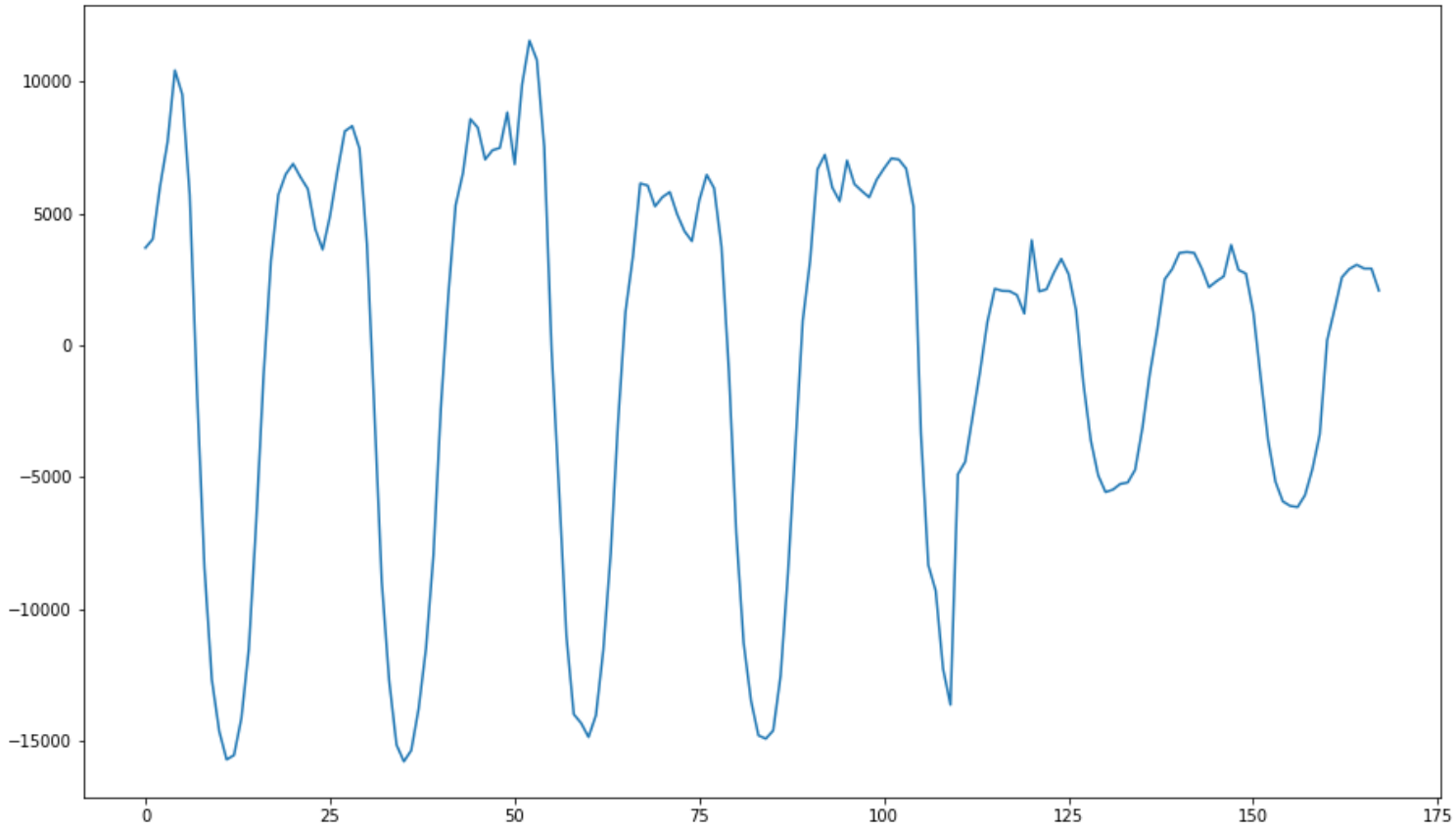
Common graph periodic frequency



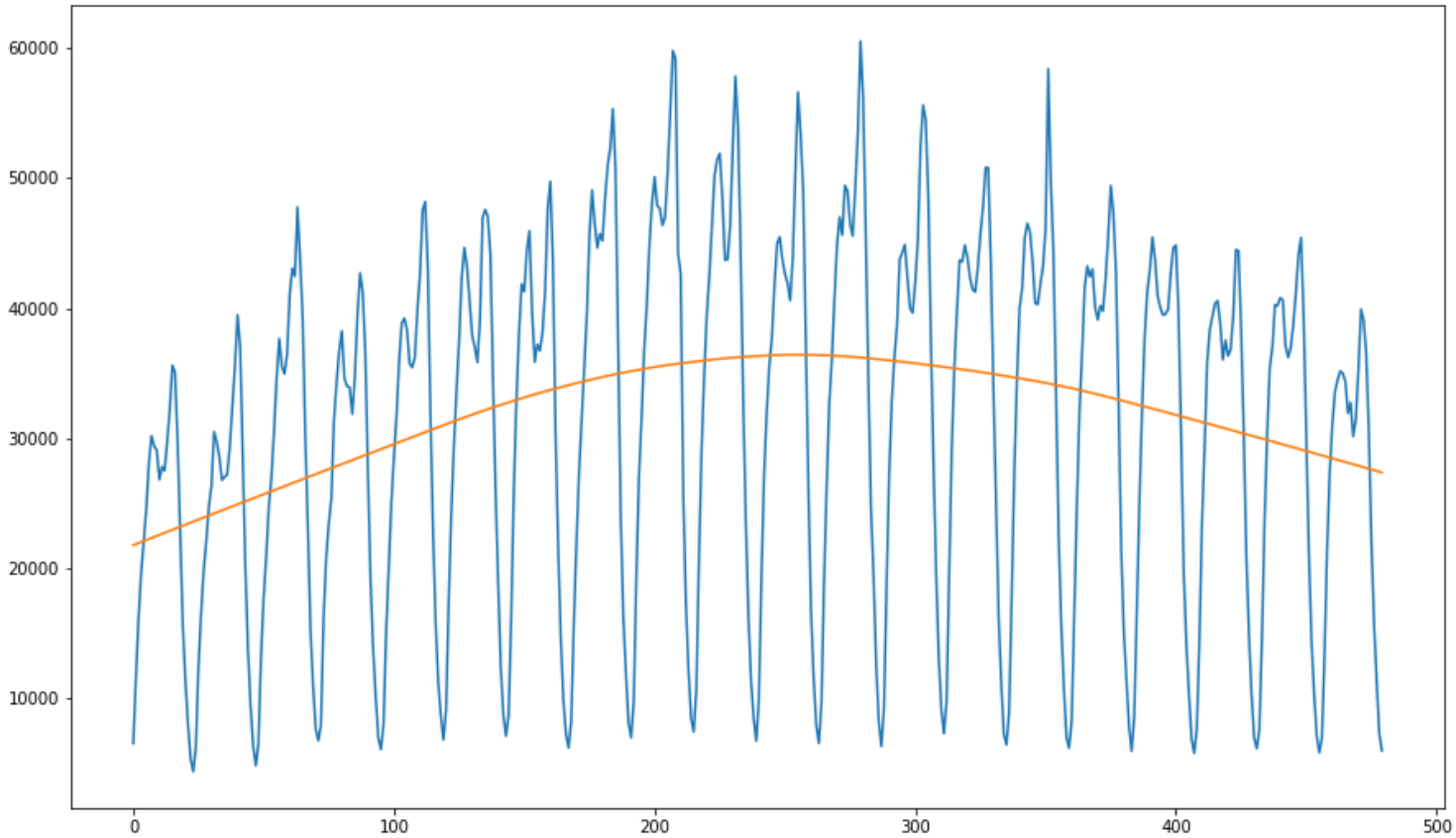
Mean change



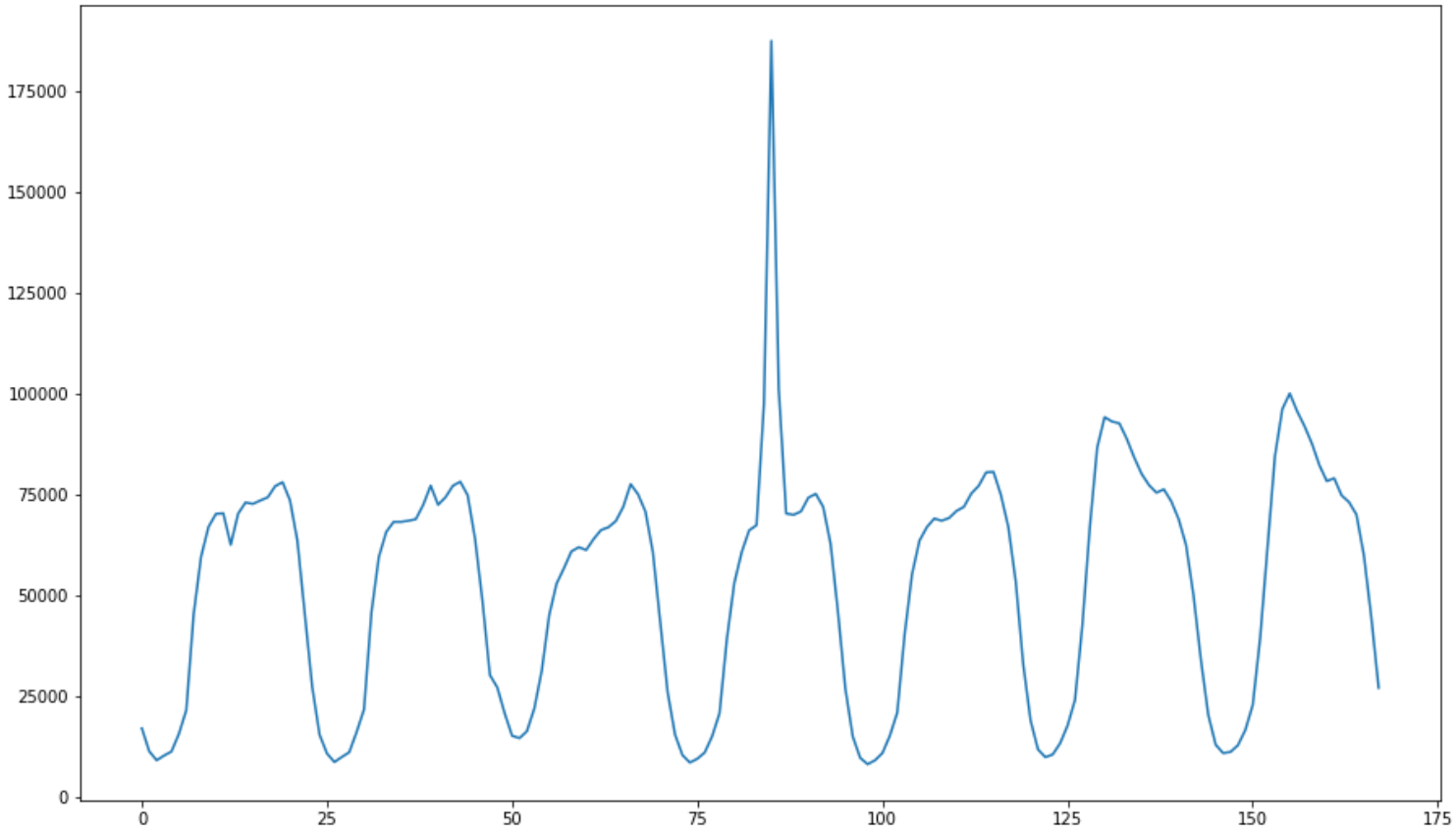
Variance change



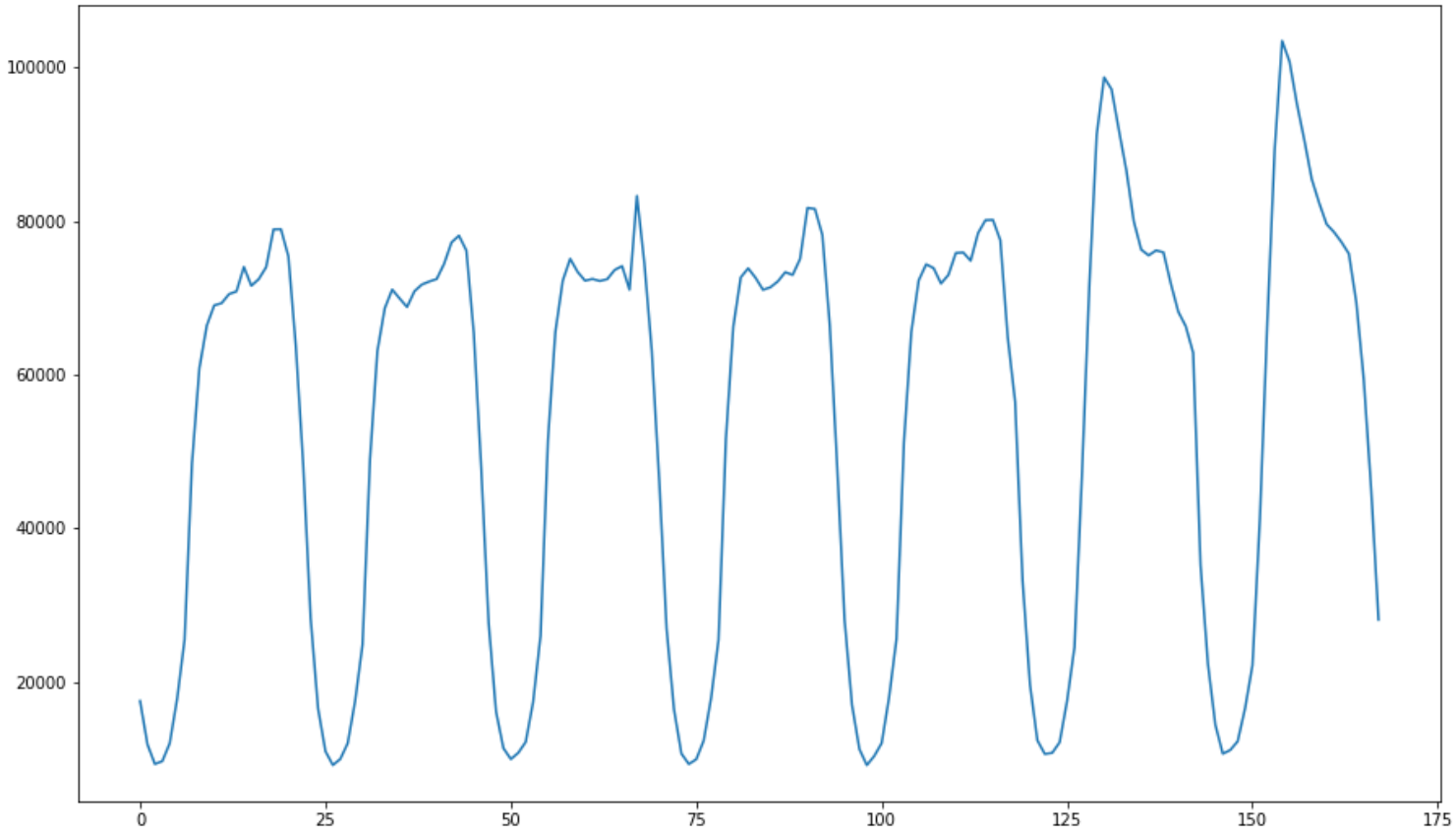
Trend change



Point change



Structure change



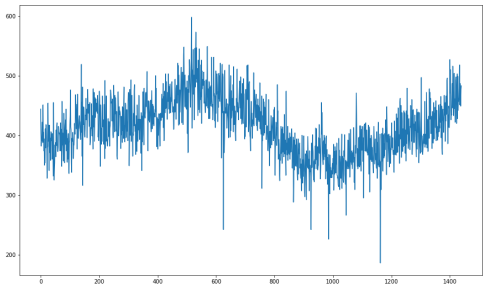
Reasons to detect change points

- Searching issues in historical data
- Reacting on changes quickly
- Extracting trend more accurately

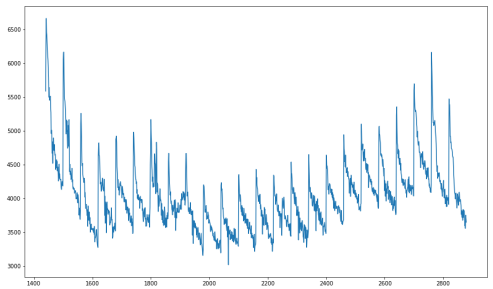
Airpush cases. Fraud elimination

- Apps minutely requests data
- Red flag: strong pattern.
- Can be a automated bots behind pattern

Clean application



Fraud application



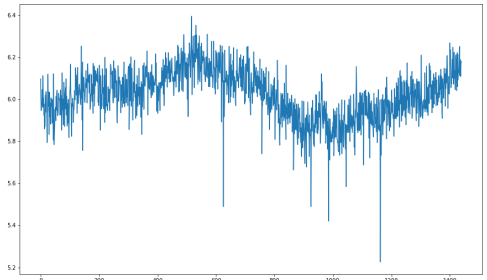
Airpush cases. Fraud elimination

- Goal: to be able to find such apps automatically
- We can reach this goal using frequency analysis

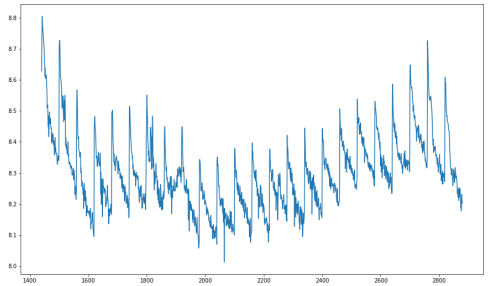
The framework can be described as follows:

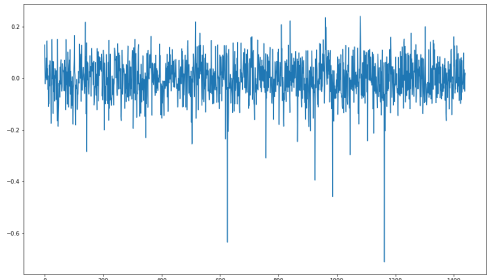
1. Apply logarithm to time series to stabilyze amplitude
2. Remove trend (low frequent part) from time series
3. Apply Fourier transform to time series
4. Estimate the distribution of periodogram values
5. Compare distributions of each application with a distribution of white noise (which is exponential) using Kullback–Leibler divergence
6. If divergence $>$ threshold, then application is marked as suspicious

Clean application



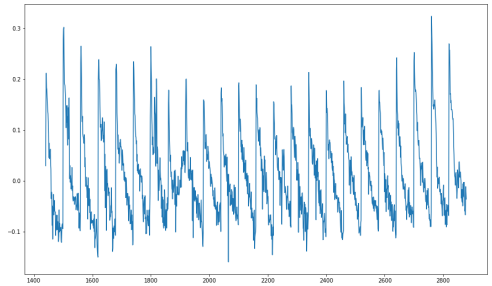
Fraud application



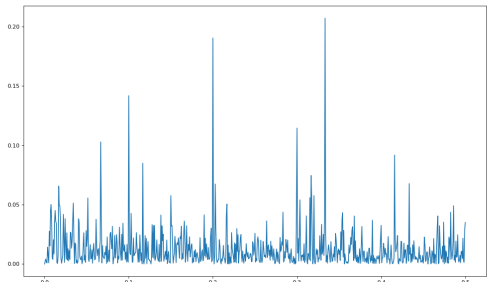


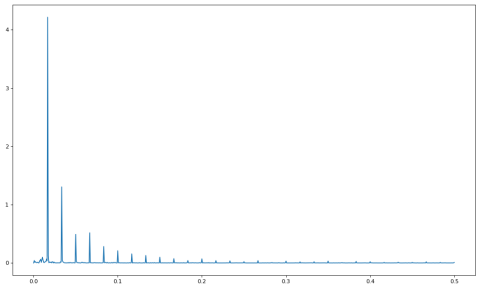
Clean application

Fraud application



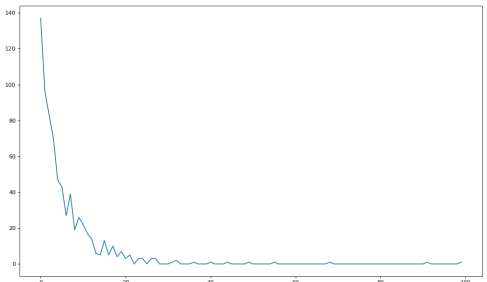
Clean application



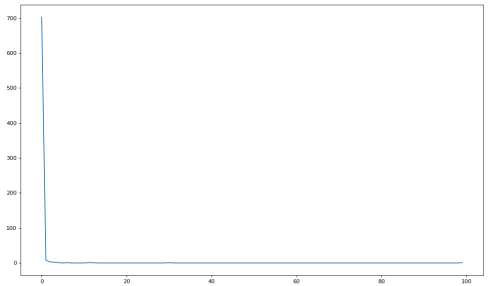


Fraud application

Clean application



Fraud application



- Clean app score: 0.09
- Fraud app score: 1.87