Forecasting number of natural gas consumers and their total consumption with R

Ondřej Konár, Marek Brabec, Ivan Kasanický,
Marek Malý, Emil Pelikán

Czech Technical University in Prague
Czech Institute of Informatics, Robotics, and Cybernetics

Academy of Sciences of the Czech Republic
Institute of Computer Science

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Motivation

- Total consumption and price per unit are essential inputs for forecasting the revenues from delivered energy.
- Energy retail prices can differ for various tariffs.
- Larger customers get usually lower price and vice versa.
- The tariffs can be assigned automatically based on historical consumption.

Goal of our research

We wanted to develop a prediction model with the following properties:

1. we forecast customer counts and their total consumption within each tariff class
2. tariffs are assigned to customers based on their consumption level
3. forecasts are based on regular invoicing data
4. forecast is conditioned by a long-term normal temperature
5. model should be implemented in a user-friendly way and run on standard PC

Challenges

Factors that make reaching the goal difficult

- Forecast variables are not independent:
  1. total consumptions (naturally) depends on the customer count
  2. customers can switch between tariffs (as a result of consumption level variability)

  Result: covariance structure should be considered
- Invoicing periods differ between various customers

  Result: data need to be transformed

Package structure

1. Data preprocessing – conversion of invoicing data to input data
2. Parameter estimation
3. Forecasting

Standardized load profiles

- Model for disaggregation of consumption
- Makes daily consumptions from time aggregates, e.g. annual
- GAM with temperature and calendar as explanatory variables
- Brabec et. al (2015). *Statistical Models for Disaggregation and Reaggregation of Natural Gas Consumption Data*. Journal of Applied Statistics 42(5)

Prediction model construction

Basic ideas I

1. Two-level model – customer counts forecast (incl. tariff switches) as the first level, consumption totals forecast as the second
2. Transition from the forecast time series to a new one – time series of tariff assignment for a particular customer
3. Forecasting based on Markov property

$$\hat{p}_{t+1} = p_t P_t$$

Prediction model construction

Basic ideas II

1. Probability can be estimated using relative frequency

$$\hat{p}_{ct} = N_{ct}/N_{\bullet t}$$

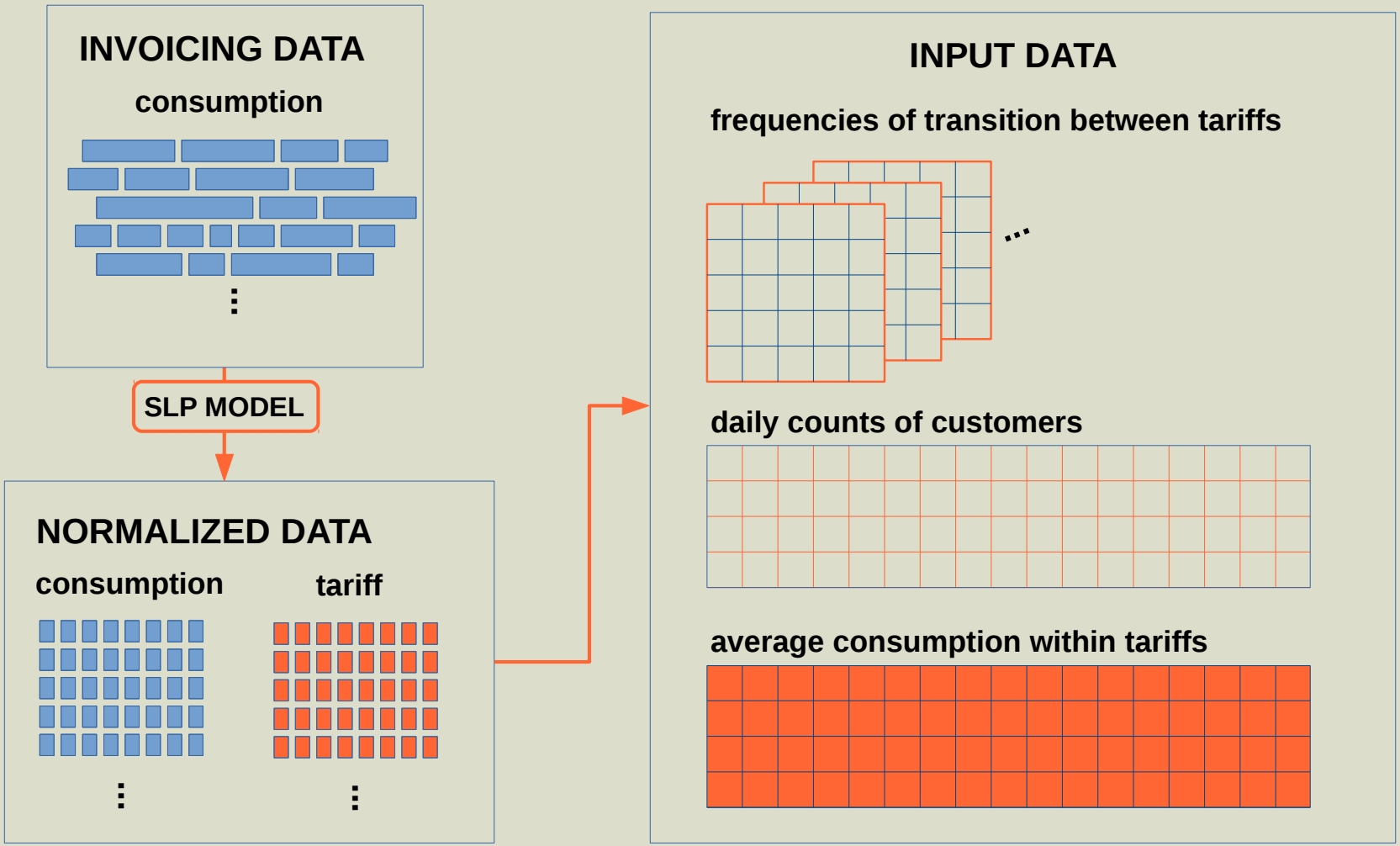
we can invert the procedure and work with

$$\hat{N}_{ct} = p_{ct}N_{\bullet t}$$

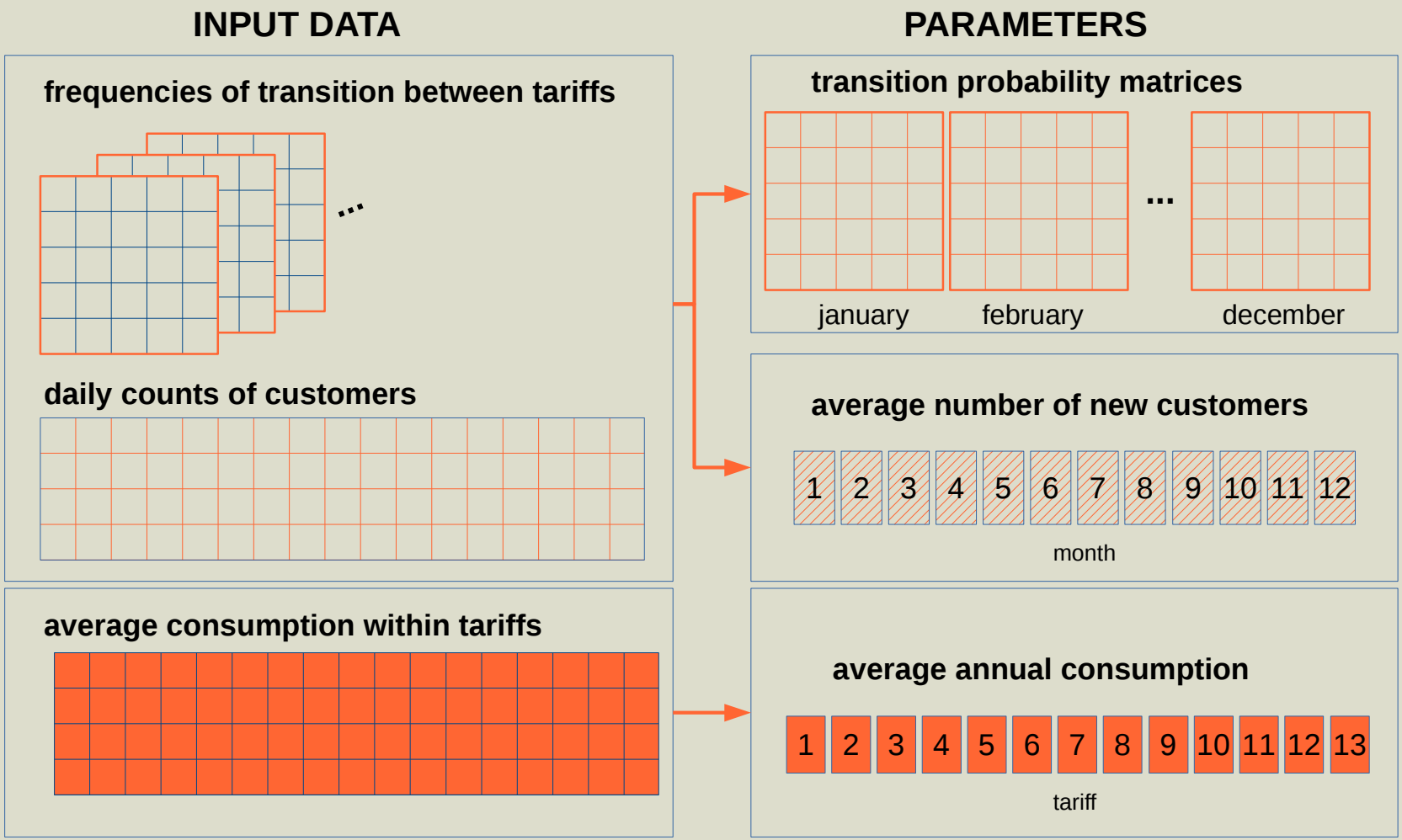
2. Number of new customers forecast as a separate module

3. Customer counts forecasts are multiplied by average consumption forecasts

Data preprocessing

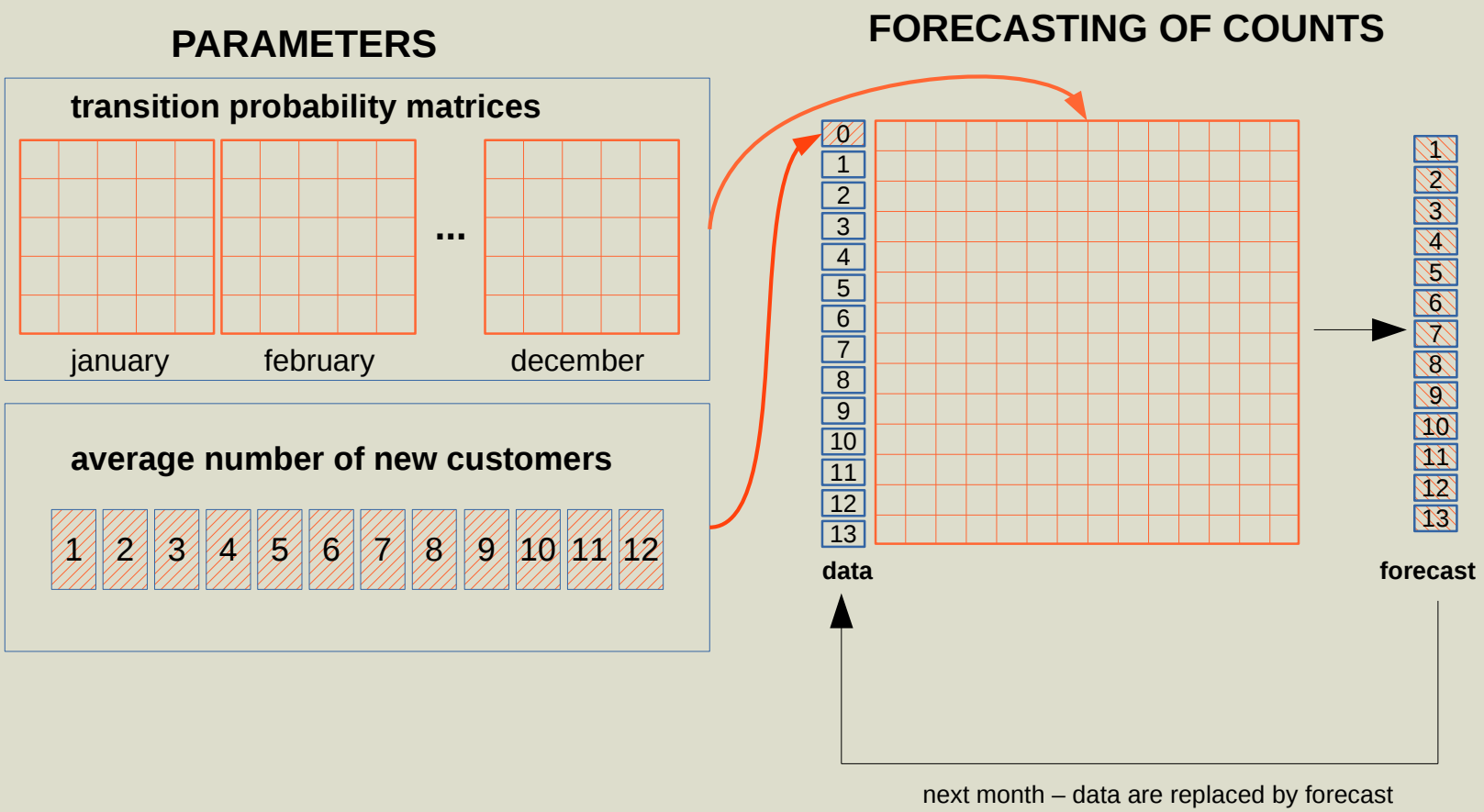


Estimation of parameters



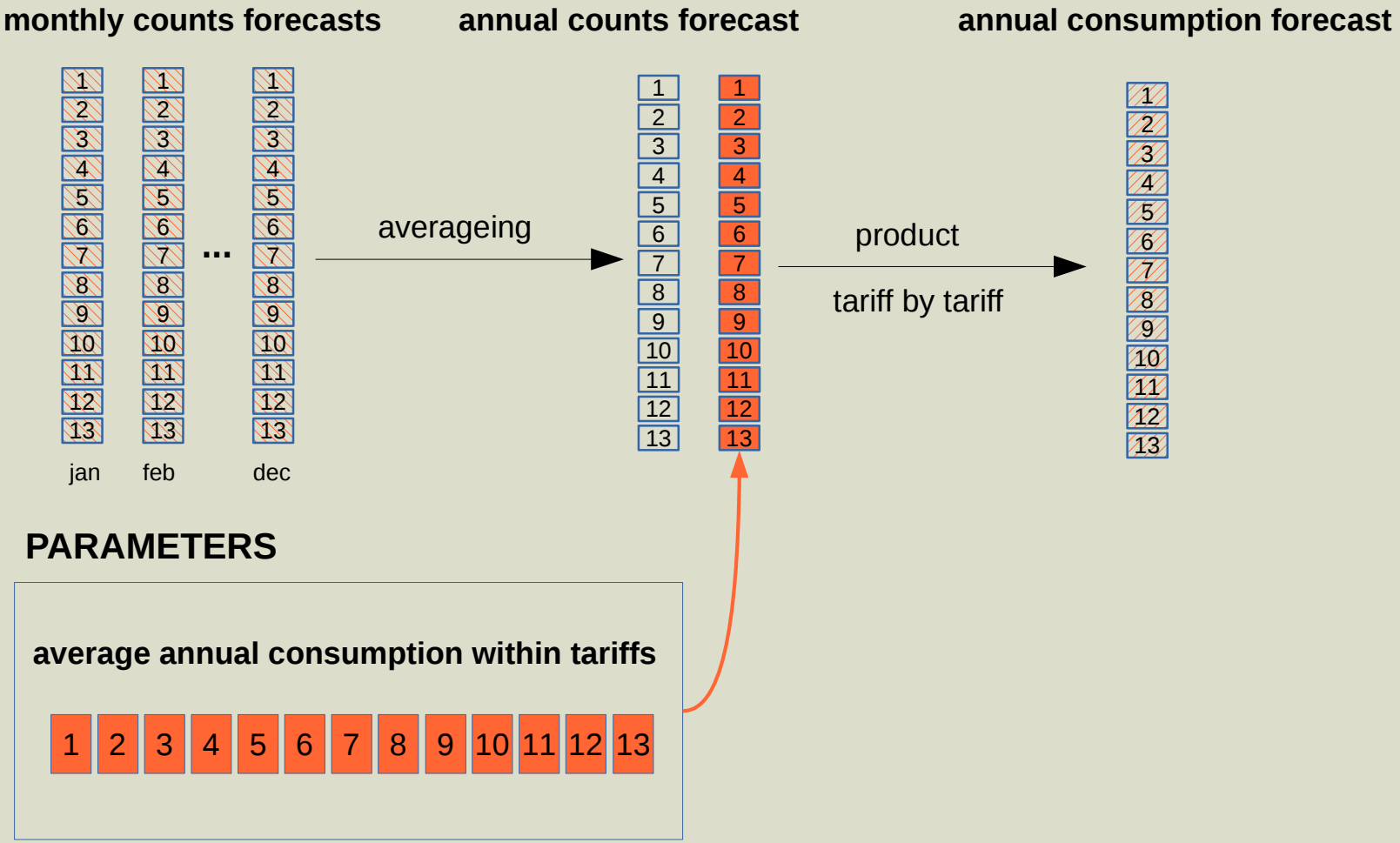
Forecasting

Level 1



Forecasting

Level 2



Thank you for your attention.