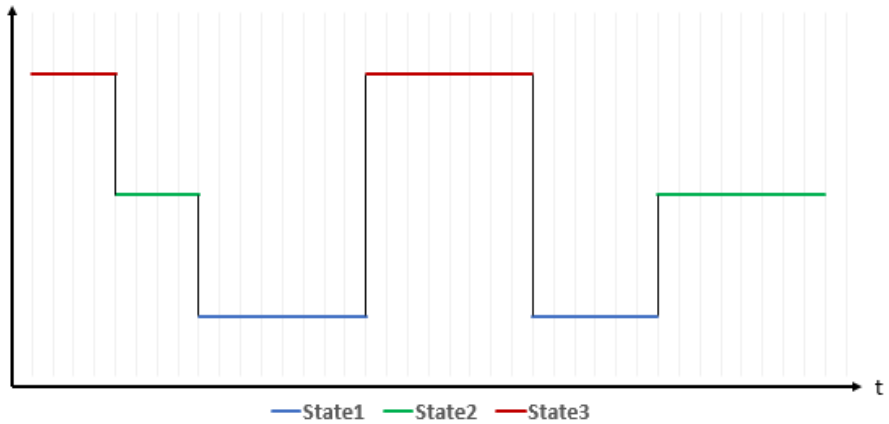
Apply machine learning to Performance trend analysis

Araya Eamrurksiri

Overview

Markov switching model

- A technique uses for describing the evolution of the process at different period of time
- Model involves multiple structures that can characterize the time series behaviors in different states
- The switching mechanism (back and forth) between the states is assumed to be an unobserved Markov chain - a stochastic process which contains the probability of transition from one state to any other state



Markov switching model

Assuming that S_t denote an unobservable state variable

$$y_t = X_t{}'\beta_{S_t} + \varepsilon_t, \quad \varepsilon_t \sim N(0, \sigma^2_{S_t})$$

y_t is the observed value of time series at time t
X_t are the predictor variables of time series at time t
β_{S_t} are the coefficients in state S_t, where $S_t = 1, 2, ..., k$

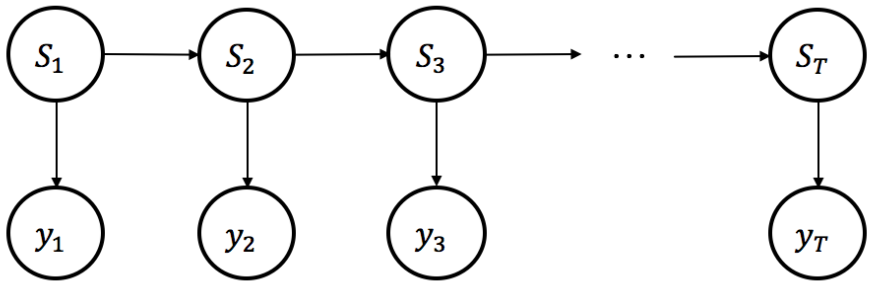


Figure: Model structure

Markov switching model

Given dataset,

- y_t is *CPU utilization*
- X_t are some components from the *EventsPerSec* which have an impact on the *CPU utilization* (e.g., *RrcConnectionSetupComplete, Paging, X2HandoverRequest*) and test environment
- Assume there are three states ($k = 3$): normal, good, bad

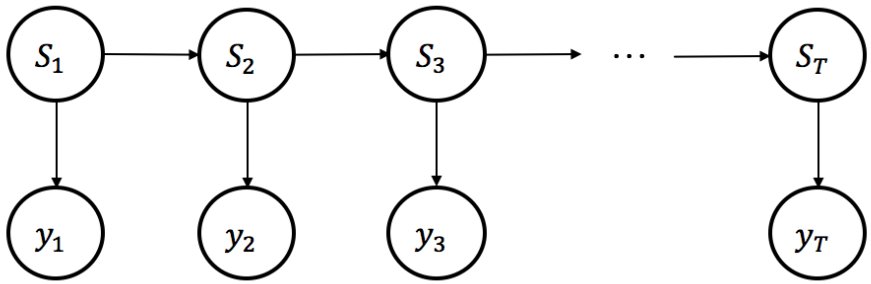


Figure: Model structure

Markov autoregression switching model

The observation are drawn from the first order autoregressive model, AR(1), that is it depends on the past observation and the current state.

$$y_t = X_t{}'\beta_{S_t} + \phi_{1,S_t} y_{t-1} + \varepsilon_t$$

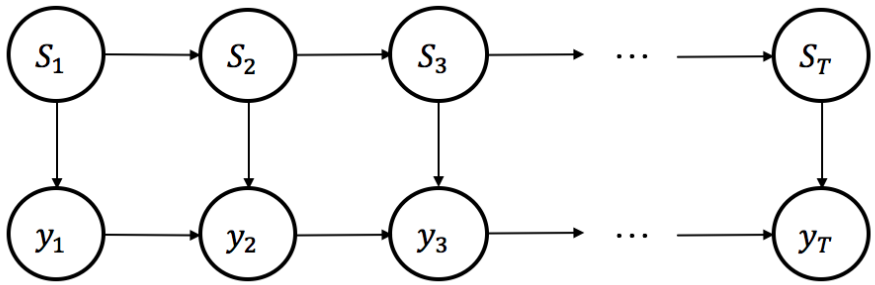


Figure: Model with additional dependencies at observation level

What has been done?

- Study and review source code in the R package in detail
  - MSwM: An univariate autoregressive Markov switching models for linear and generalized models
- Implement and modify algorithm to fit with the problem and given dataset
  - Categorical variables
  - NAs coefficients
- Solve computational problems
  - Invertible Hessian

Next step

- Model Selection
  - Compare several models (e.g., number of states, parameter which has switching effect)
  - Select the most suitable model for a given set of data based on the quality of model (e.g., AIC, BIC)
- State Prediction
  - Training model using the set of parameters from the model in previous step
  - Find the most probable state for the new observation
- State Inference