Switching Models in Econometrics

Part II: Threshold Switching Models

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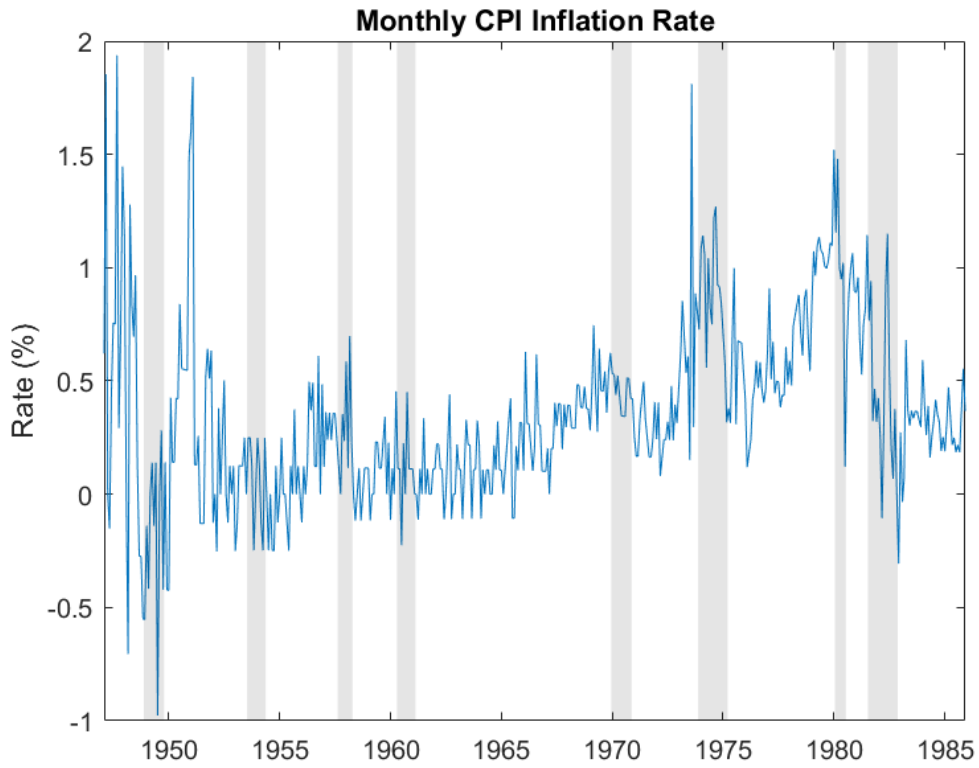
Data Triggers

The level of an observable economic variable can **trigger** a change of state when it crosses above or below certain threshold levels

For example, the behavior of time series such as an exchange rate or an inflation rate will exhibit regime shifts when the series moves outside of a “normal” regime, triggering government intervention.

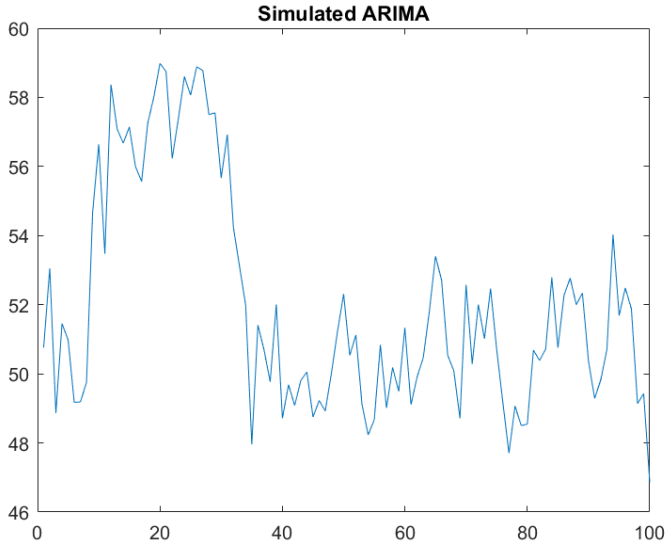


Live Script: Data Triggers

Submodels

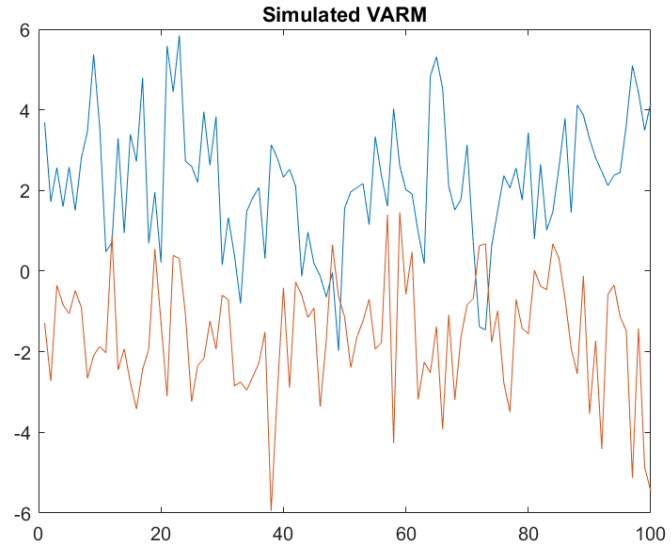
Univariate Series

```
% ARIMA submodel constructor:
mdl1 = arima('Constant',C1,'AR',AR1,'Variance',v1);
```



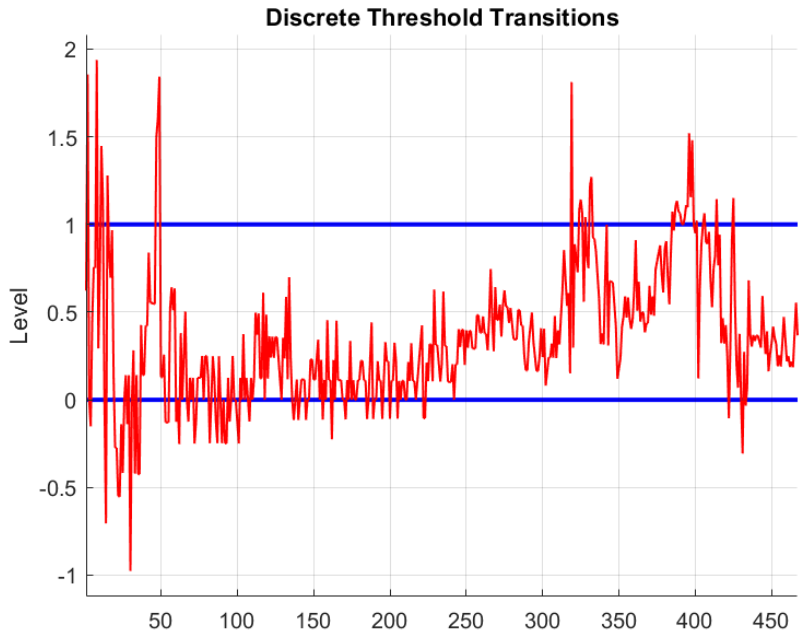
Multivariate Series

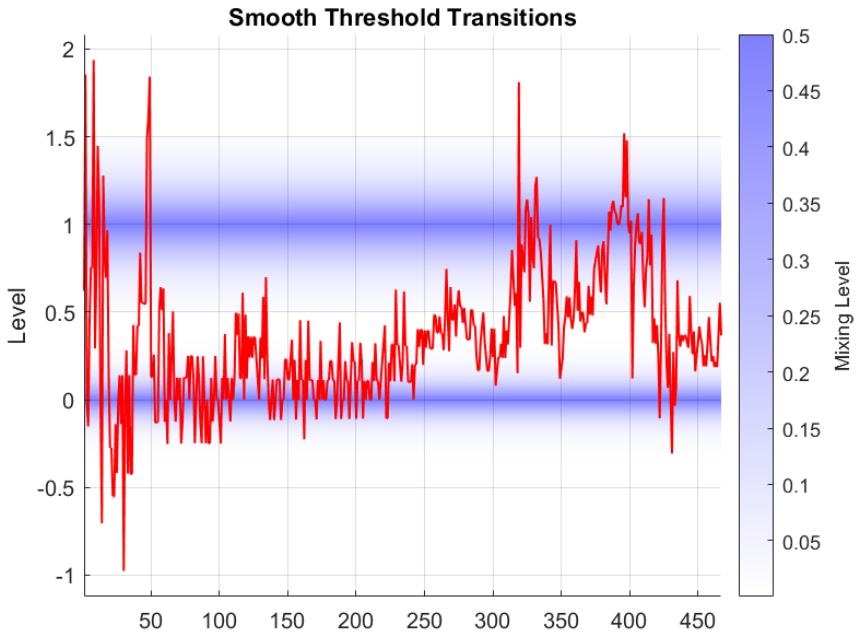
```
% VARM submodel constructor:
mdl2 = varm('Constant',C2,'AR',AR2,'Covariance',Sigma2);
```



Deterministic Switching: Threshold Transitions

Switching occurs when the value of a predetermined *threshold variable* crosses distinct *threshold levels*





Live Script: Threshold Transitions

Threshold Variables: Exogenous and Endogenous

- **Threshold variables activate** threshold switching models
- They are independent of model specification and construction
- They may be a variable from outside the model (**exogenous**)
- They may be a lagged variable from within the model (**endogenous**)
- Threshold variables must be specified when estimating, simulating or forecasting threshold switching models

Submodels + Switch = Switching Model

To construct a threshold transition switching model:

1. Create a vector of ARIMA or VARM submodels (@ARIMA, @VARM)
2. Create a threshold transition switching mechanism (@threshold)
3. Assemble the switching model with the tsVAR constructor (@tsVAR)

Live Script: Threshold Switching Model

Estimation, Simulation, Forecasting

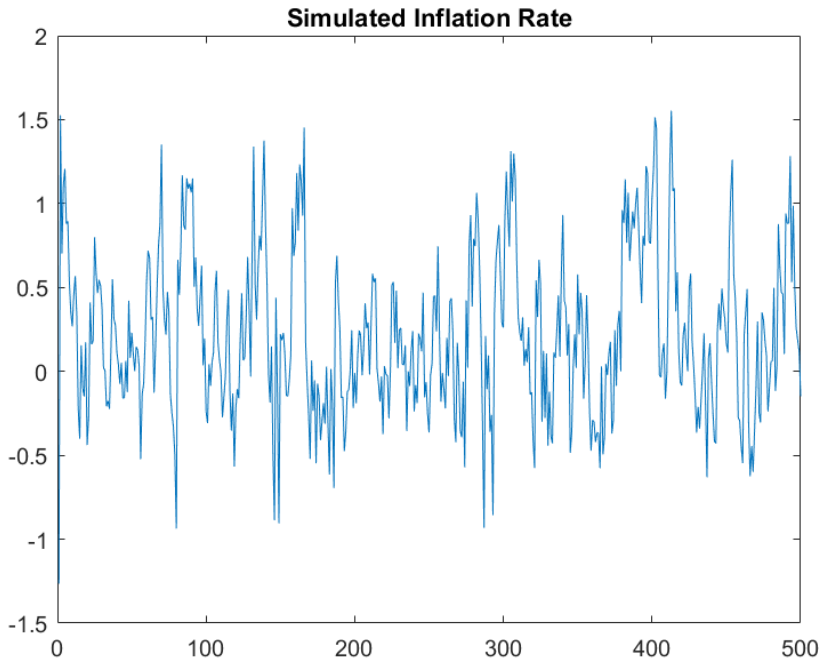
Each modeling framework in Econometrics Toolbox (ARIMA, VARM, tsVAR, etc.) has methods for:

- **Estimating** model parameters from data
- **Simulating** specified models over multiple paths
- **Forecasting** model means from current data

Live Script: Estimation

Live Script: Simulation

Live Script: Forecasting



Documentation

https://www.mathworks.com/help/econ

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forecast

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Plot the simulated response data, forecasts, and 95% forecast intervals using the Monte Carlo estimates.

```
figure
hold on
plot(idx0,y0,'b');
h = plot(idx1,y1,'b--');
h1 = plot(idx1,yf1,'r');
h2 = plot(idx1,yf2,'m');
ciu = yf2 + 1.96*sqrt(estVar); % Upper 95% confidence level
cil = yf2 - 1.96*sqrt(estVar); % Lower 95% confidence level
plot(idx1,ciu,'m-.');
plot(idx1,cil,'m-.');
yfill = [ylim,fliplr(ylim)];
xfill = [idx0(end) idx0(end) idx1(end) idx1(end)];
fill(xfill,yfill,'k','FaceAlpha',0.05)
legend([h h1 h2],["Actual" "Optimal" "Estimated"],...
    'Location',"NorthWest")
title("Point and Interval Forecasts")
hold off
```