Course description:
This course covers advanced topics in time series analysis. Topics will include vector autoregression models, vector error correction models, state-space models, dynamic factor models, Bayesian vector autoregression models, count time series, Markov-switching and change-point models, and forecast evaluation.

This course is intended for those who have taken the four-week workshop on *Time Series Analysis*, the one-week workshop on *Time Series Analysis: An Introduction*, or the equivalent.

A sound background in time series fundamentals is assumed. The course will make use of basic matrix algebra. The lab component of this course will employ both STATA and (less frequently) R. Familiarity with both software packages is assumed, but a STATA crash course will be provided outside the lecture on day two. If you are unfamiliar with STATA or R, we suggest that you attend one of the many tutorial sessions or lectures offered as part of the Summer Program.

Making Contact:
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Assignments and Grading:
Assignments will be given in this course. Assignments will either be daily or every-other-day. The goal of the assignments is to solidify the concepts of each lecture with hands-on work in the lab.
Course outline:

**Day 1.**
Introduction to the course and review of time series fundamentals
- Notation and terminology
- Autoregression, autocorrelation and serial correlation
- Stationarity
- Exogeneity
- Weak dependence
- Trending, cycling and structural breaks
- Instability and integration

Readings:

**Day 2.**
Vector Autoregression (VAR) Models – a review of the basics
- The reduced form VAR
- Lag-length selection
- Interpretation
- Robustness checks
- Granger causality

Readings:
**Day 3.**
Vector Autoregression (VAR) Models – an extension
- Vector Moving Average representation (VMA)
- Impulse response functions (IRF)
- The Cholesky decomposition
- Orthogonalised impulse response functions (OIRF)
- Forecast-error variance decomposition (FEVD)
- Dynamic multiplier functions

**Readings:**

**Day 4.**
Vector Error Correction Models (VECM) – Part one
- A reminder about cointegration and error correction models
- Applying the logic of cointegration to (VAR) models

**Readings:**

STATA documentation on VECMs – to be provided

**Day 5.**
Vector Error Correction Models (VECM) – Part two
- Lag-length selection
- Rank selection
- VECM identification
- Interpretation
- Robustness checks

**Readings:**

Day 6.
Structural Equation Models
- What are structural equation models?
- Structural Vector Autoregression (SVAR)
- Identifying restrictions
- Structural impulse response functions (SIRF)

Readings:


Day 7.
The State-Space approach to structural models
- The linear state-space model
- Some classical time series models in state-space form
- Controlling for measurement error
- Modelling I(1) processes
- Modelling other non-stationary processes

Readings:

Day 8.
More on the State Space approach
- Estimating state-space models
- The Kalman filter
- Predicting, filtering and smoothing with state-space models

Readings:

STATA documentation on state-space models in STATA – to be provided.
**Day 9.**
Advanced time series models in state-space form
- Dynamic-factor models
- Vector autoregressive moving average models (VARMA) – if time permits

**Readings:**


**Day 10.**
Thinking as a Bayesian
- The intuition to Bayesian state-space models
- Two examples: Time varying coefficients models and Bias Estimation models

**Readings:**

**Day 11.**
The importance of equation balance: Re-thinking the GECM
- When is the GECM an appropriate model?
- Must there be cointegration to use the GECM?

**Readings:**
Read the entire Symposium in *Political Analysis* 24(1) on error correction methods.


**Day 12.**
Fractional integration models
- What can we do if our data are not I(1) or I(0)?

**Readings:**

**Day 13.**
An alternative to FI: The PSS method of bounds

- What can we do when we don’t know if the regressors are stationary?

**Readings:**


**Day 14.**
Dynamic Conditional Correlation models

- Time-varying parameter models in the presence of volatility

**Readings:**


**Day 15.**
The resurgence of waves

- Are there regular, periodic cycles in political data?

**Readings:**

**Day 16.**
Measurement of Dynamic Latent Concepts

- Analogs to Dynamic Factor Analysis (with missing data)

**Readings:**


**Day 17.**
Structural Breaks and Regime Changes, part 1
- How to detect a single structural break

**Readings:**

**Day 18.**
Structural Breaks and Regime Changes, part 2
- Multiple structural breaks, and non-frequentist interpretations

**Readings:**

**Day 19.**
Temporal aggregation
- What is the natural metric of a time series?
- How does the aggregation mechanism affect our inferences?

**Readings:**

**Day 20.**  
Individual meetings

**Readings:**  
NA