

Time Series Prediction

WEEK 5

FORECASTING BASICS WITH TRENDS:
GARCH + COPULA
MODELS

- **Organizational Matters:**

- **Projects**

- **Session 5:**

- **GARCH**

- **DCC-GARCH**

- **COPULA**

- **COPULA-GARCH**

SESSION 5:

THE GARCH-MODEL:

KEY TAKEAWAYS:

- Generalized Autoregressive Conditional Heteroskedasticity, or GARCH, is a model that incorporates a moving average component together with the autoregressive component.
- Specifically, the model includes lag variance terms together with lag residual errors from a mean process.
- The introduction of a moving average component allows the model to both model the conditional change in variance over time as well as changes in the time-dependent variance.
- As such, the model uses two parameters "p" and "q" that describes the number of lag variance terms:
 - **p**: The number of lag variances to include in the GARCH model.
 - **q**: The number of lag residual errors to include in the GARCH model.
- A generally accepted notation for a GARCH model is to specify the GARCH() function with the p and q parameters GARCH(p , q); for example GARCH(1, 1) would be a first order GARCH model.

THE DCC-GARCH-MODEL:

KEY TAKEAWAYS:

- Generalizes the volatility and variance terms to multivariate setting
- Think about it as a nested approach by decomposing each individual component properly
 - CCC – Constant-Conditional-Correlation
 - DCC – Dynamic-Conditional-Correlation
- Use your favorite GARCH-model for estimating the individual time series parameters

COPULA:

KEY TAKEAWAYS:

- Sklar's Theorem is the foundation of Copula Theory
- Represent multivariate distributions via their dependence structure and marginals
 - Pearson correlation (potentially flawed)
 - Spearman correlation (ranks)
 - Kendall's Tau (pairs)
- Parametric families i.e. Gauss-Copula or mixtures are possible
- Archimedean copulas as a nested approach
- Vine-copula as a graph-like approach

COPULA-GARCH:

KEY TAKEAWAYS:

- It's just a more advanced approach for studying time series
- Don't take the math too serious - try to apply the tools to real datasets

TASKS UNTIL NEXT WEEK

- Completion of the learning material of week 4: watch the GARCH+Copula-Videos
- Complete/prepare the IPython-Notebooks:
 - i.e. Fourier-Transform: Energy
 - i.e. Kalman Filtering: Finance-1
 - i.e. Wavelets: Environment
 - i.e. Smoothing-Techniques: Finance2
- Check out the GitHub-Repos:
 - <https://github.com/kboroz/TimeSeriesPredictionWS2023>
 - <https://github.com/Apress/advanced-forecasting-python>
- Bring questions!