Karlsruher Institut für Technologie

Problem Set 2
Modeling of Equity Returns

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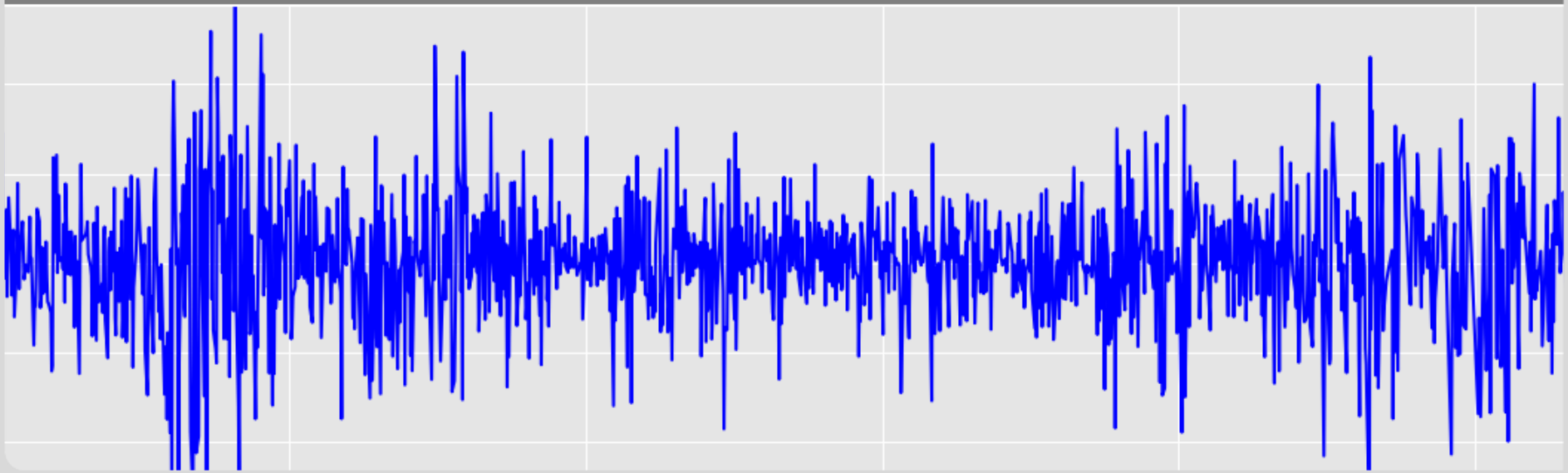
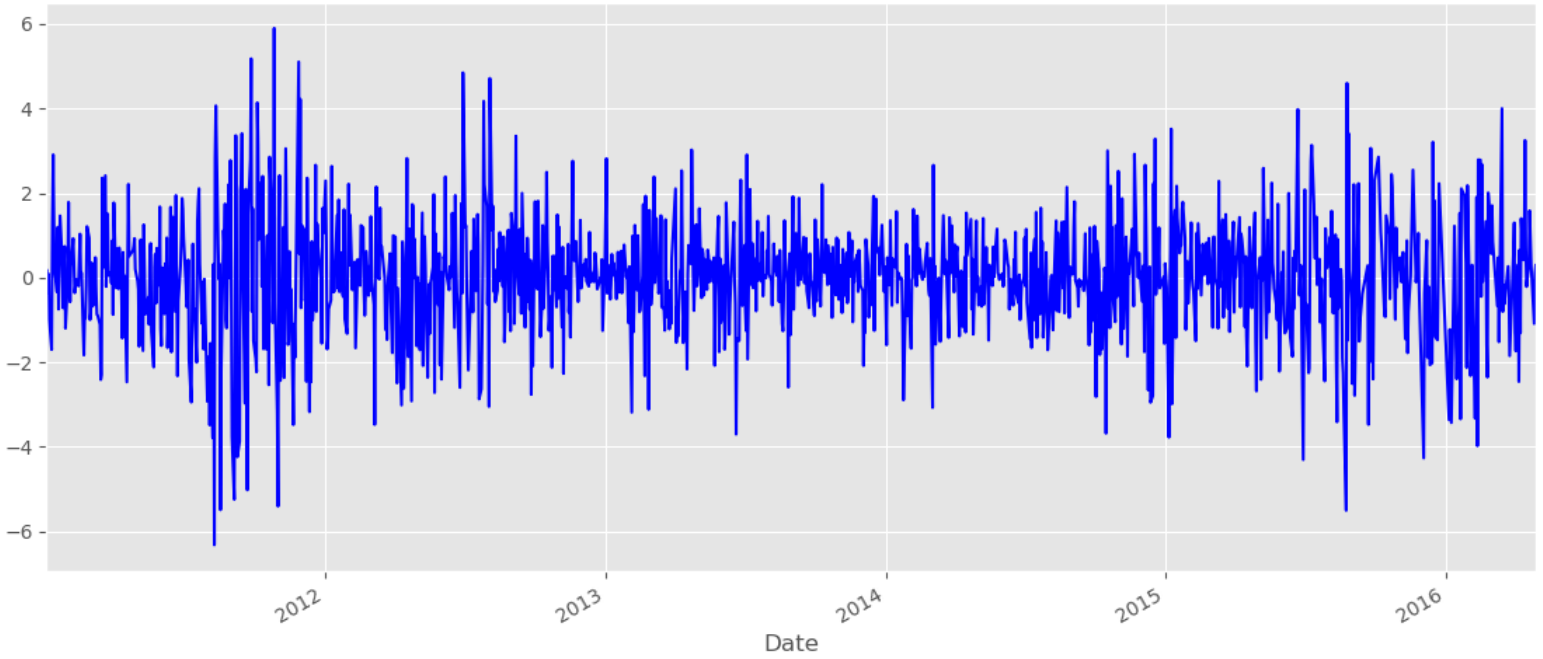
CRAM-Programming Lab WS 2017/18

FBV, Chair of Financial Economics and Risk Management

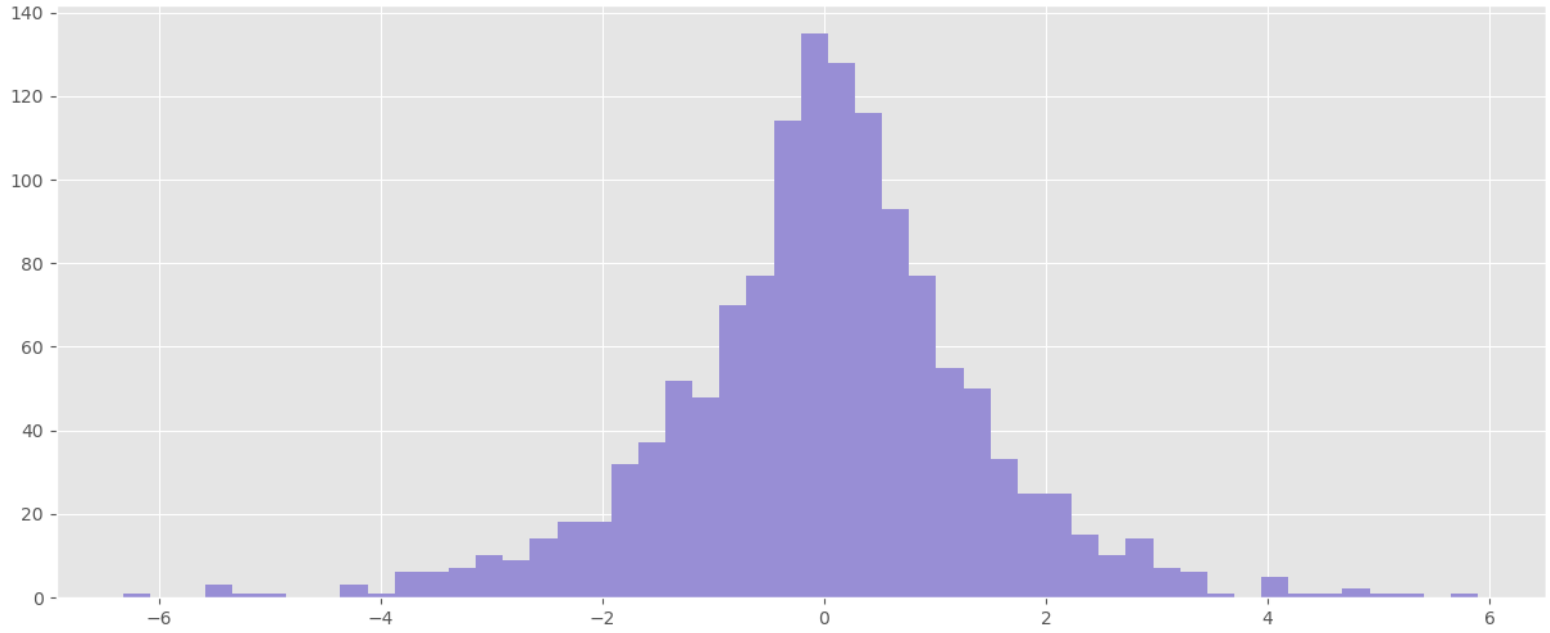


Question 1a: Equity Index Returns



- The volatility varies over time: it is higher in the period of late 2011 and 2015/16 than during the remaining periods
- Therefore we characterize the return series as ‚heteroscedastic‘

Question 1a: Equity Index Returns



- The returns are leftskewed and show more weight in the tails than a normal distribution
- This leads to the assumption that the Gaussian distribution is not a good choice for modeling financial returns

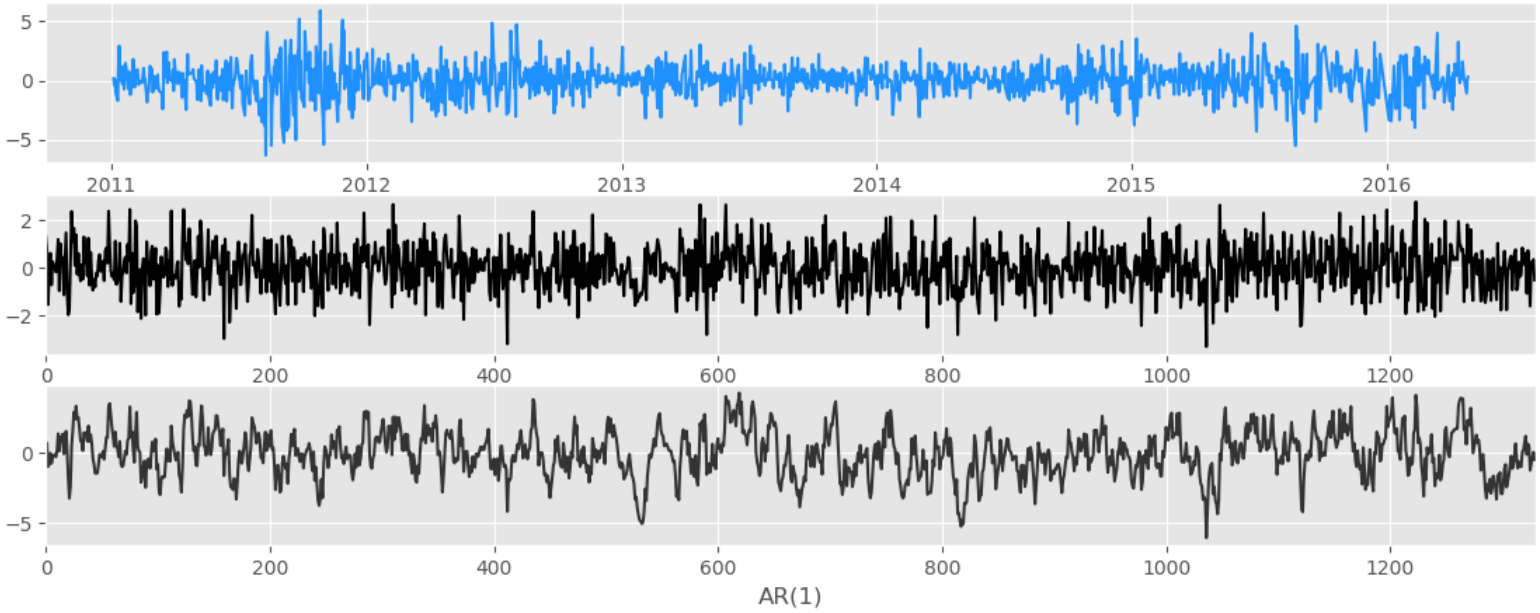
Question 1b: Jarque-Bera Test

- Skewness = -0.16
- Excess kurtosis = 1.83

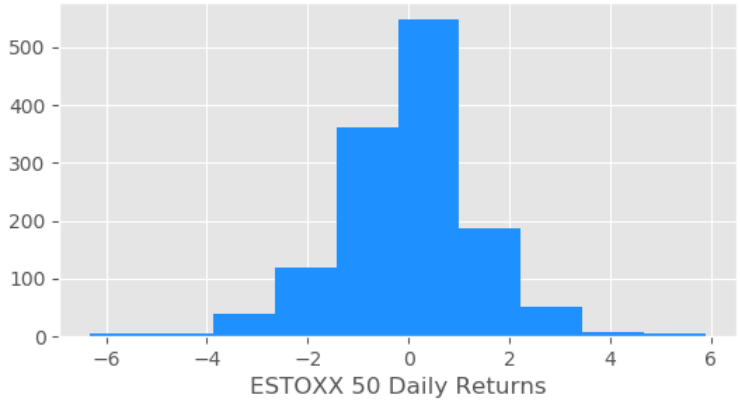
- Jarque-Bera test
  - Test statistic = 191.32
  - P-value = 2.86e-42

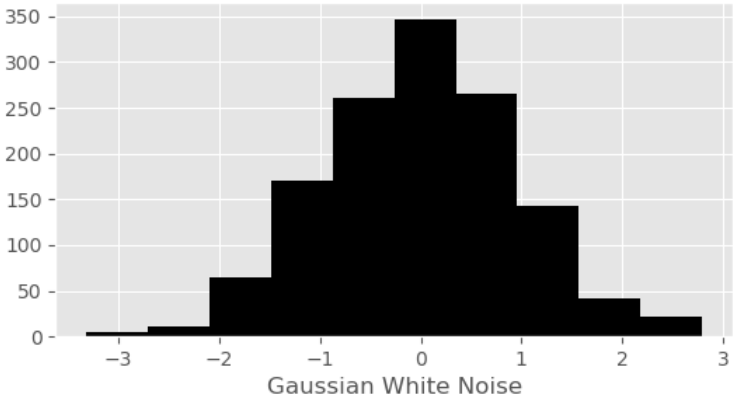
- The data has negative skewness and excess kurtosis. The null hypothesis (data is normally distributed) of the Jarque-Bera test is rejected if a significance level of alpha > 2.86e-42 is chosen.
- Therefore, the returns are not Gaussian.

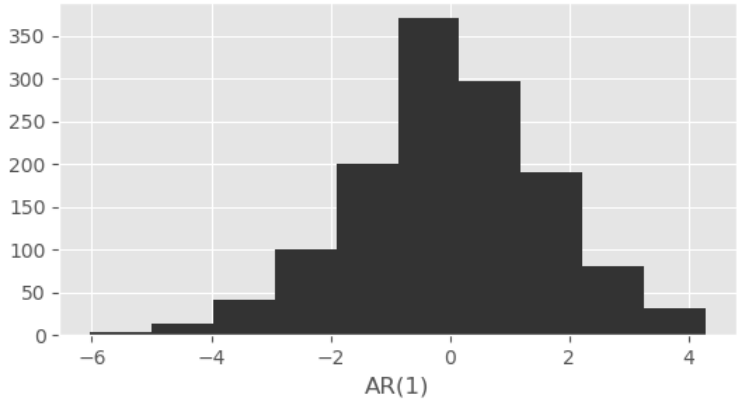
Question 1c: Simulating Returns



Question 1c: Simulating Returns







Question 1c: Simulating Returns

	Skewness	Kurtosis
ESTOXX 50	-0.16	1.83
GWN	-0.02	3.05
AR(1)	-0.18	3.20

Higher moments of ESTOXX 50, GWN and AR(1)

Question 1c: Simulating Returns

	Test statistic	P-value
GWN	0.21	0.90
AR(1)	9.52	0.01

Results of Jarque-Bera test for GWN and AR(1)

- GWN
  - H0 is not rejected unless alpha >0.90 (= p-value)
  - Non-Gaussianity cannot be shown
- AR(1)
  - H0 is rejected for any alpha >0.01
  - Non-Gaussianity can be shown

Question 1d: Ordinary Least Squares (OLS)

- See code

Question 1e: Estimate AR(1)

	ESTOXX 50	GWN	AR(1)
Beta[0]	0.0072	-0.0024	-0.0023
Beta[1]	0.0062	-0.0014	0.8067
T-statistic[0]	0.1882	-0.0911	-0.0885
T-statistic[1]	0.2251	-0.0504	49.7143
Adj. R^2	-0.0007	-0.0008	0.6504

ESTOXX 50 (1), Gaussian White Noise (2), AR(1) (3)

Question 1e: Estimate AR(1)

- ESTOXX 50 & GWN
  - Both regressions have a negative adj. R^2 -> they don‘t explain anything
- AR(1)
  - Adj. R^2 = 65.04%: 65.04% of the variation is captured by this model
  - Beta[1] = 0.8067 and highly significant: if the previous return is increased by 1%, the return increases by 0.8%.
  - -> AR-approach seems more suitable than GWN / return

Question 1f: Forecasting

	1-step ahead	2-step ahead
Forecast	-0.3726	-0.3029
Uncertainty	0.9174	1.5144

Forecasting for AR(1)