



Financial Econometrics and
Volatility Models
Evaluating GARCH Forecasts
Using Value-at-Risk

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Empirical Application

•Mittnik, Kuester and Paoletta (2006). “Value-at-Risk Prediction: A Comparison of Alternative Strategies”, *Journal of Financial Econometrics*.

- Compares out-of-sample performance of several VaR forecasts using 30 years of daily data on NASDAQ composite index
- Computes VaR violations, tests for conditional and unconditional coverage based on rolling window predictions
- Finds GARCH model with fat-tailed distribution is best model

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- Long portfolio in the NASDAQ composite index
- Compute daily continuously compounded returns from daily close prices

- 2/8/1971 – 6/22/2001
- 7681 observations

Table 1 Summary statistics for NASDAQ returns.

Sample Size	Mean	Std. Dev.	Skewness	Kurtosis	Min	Max
7681	0.0392	1.1330	-0.4656	17.302	-12.048	13.255

Unconditional Models

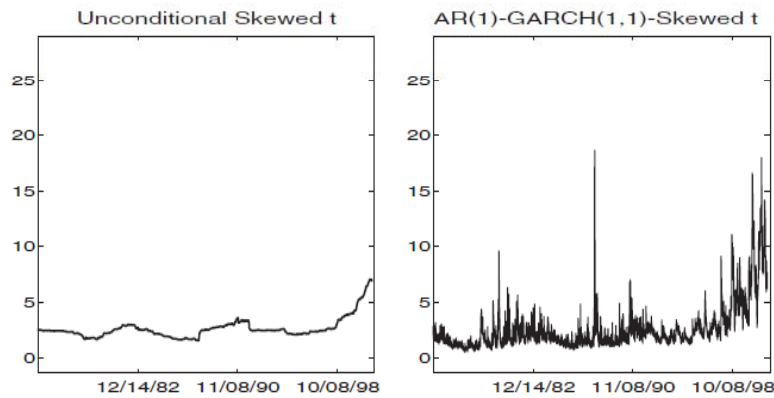
- Empirical quantile (HS)
- Normal quantile
- Student's t quantile
- Skewed-t quantile
- Extreme value distn quantile (EVT)

Models are estimated on 1000-day rolling windows incremented by 1 day

Conditional GARCH(1,1) Models

- Normal
- Student's t
- Skewed Student's t
- Mixture normal
- Mixture GED
- Normal + EVT
- Student's t + EVT

Rolling one-step ahead VaR^{0.01} predictions



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VaR Prediction Performance: unconditional models

Table 2 VaR prediction performance: unconditional models.^a

Model	100λ	% Viol.	LR _{uc}	LR _{ind}	LR _{cc}	DQ _{hit}	DQ _{VaR}	VaR
HS	1	1.30	0.02	0.00	0.00	0.00	0.00	2.65
	2.5	3.26	0.00	0.00	0.00	0.00	0.00	1.96
	5	6.00	0.00	0.00	0.00	0.00	0.00	1.43
Normal	1	2.80	0.00	0.00	0.00	0.00	0.00	2.06
	2.5	4.27	0.00	0.00	0.00	0.00	0.00	1.73
	5	6.18	0.00	0.00	0.00	0.00	0.00	1.44
<i>t</i>	1	2.10	0.00	0.00	0.00	0.00	0.00	2.30
	2.5	4.52	0.00	0.00	0.00	0.00	0.00	1.66
	5	7.74	0.00	0.00	0.00	0.00	0.00	1.25
Skewed <i>t</i>	1	1.30	0.02	0.00	0.00	0.00	0.00	2.64
	2.5	3.46	0.00	0.00	0.00	0.00	0.00	1.90
	5	6.17	0.00	0.00	0.00	0.00	0.00	1.41
EVT	1	1.29	0.02	0.00	0.00	0.00	0.00	2.65
	2.5	3.40	0.00	0.00	0.00	0.00	0.00	1.92
	5	6.03	0.00	0.00	0.00	0.00	0.00	1.43

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VaR prediction performance: AR(1)-GARCH(1,1)

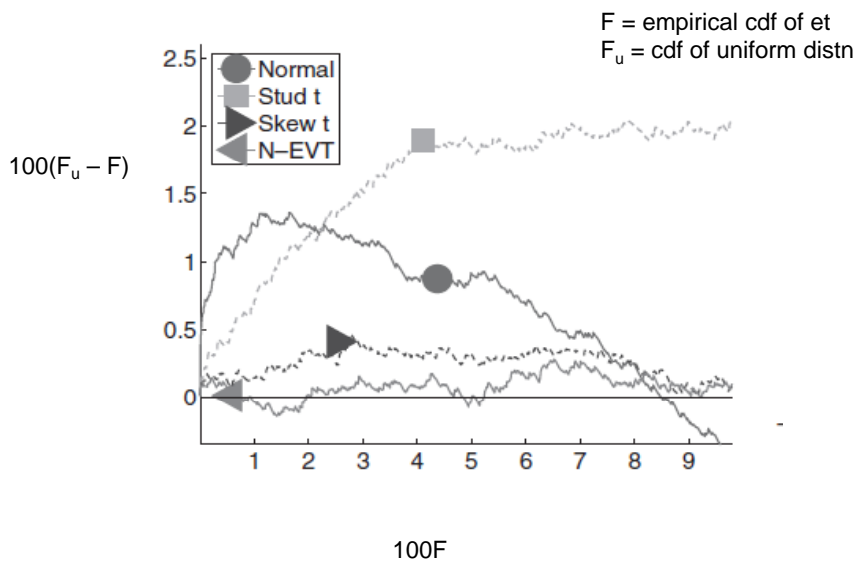
Table 3 VaR prediction performance: AR(1)-GARCH(1,1).^a

Model	100 λ	% Viol.	LR _{uc}	LR _{ind}	LR _{cc}	DQ _{Hit}	DQ _{VaR}	VaR
Normal	1.0	2.23	0.00	0.03	0.00	0.00	0.00	2.05
	2.5	3.92	0.00	0.04	0.00	0.00	0.00	1.72
	5.0	6.21	0.00	0.21	0.00	0.00	0.00	1.43
Student's <i>t</i>	1.0	1.81	0.00	0.01	0.00	0.00	0.00	2.19
	2.5	4.04	0.00	0.02	0.00	0.00	0.00	1.70
	5.0	6.89	0.00	0.06	0.00	0.00	0.00	1.34
Skewed- <i>t</i>	1.0	1.20	0.12	0.35	0.19	0.16	0.04	2.57
	2.5	2.72	0.25	0.00	0.00	0.00	0.00	2.01
	5.0	5.12	0.65	0.03	0.08	0.07	0.00	1.59
MixN(2,2)	1.0	0.91	0.47	0.59	0.67	0.16	0.18	2.53
	2.5	2.86	0.07	0.04	0.00	0.00	0.01	1.92
	5.0	5.78	0.00	0.02	0.00	0.00	0.00	1.45
MixGED(2,2)	1.0	1.06	0.61	0.79	0.85	0.04	0.03	2.53
	2.5	2.72	0.25	0.10	0.12	0.02	0.03	1.94
	5.0	5.37	0.17	0.05	0.05	0.00	0.00	1.50
N-EVT	1.0	0.97	0.82	0.16	0.37	0.12	0.08	2.61
	2.5	2.50	1.00	0.01	0.02	0.00	0.00	2.00
	5.0	5.33	0.22	0.07	0.09	0.05	0.08	1.54
ST-EVT	1.0	0.97	0.82	0.17	0.37	0.09	0.02	2.70
	2.5	2.47	0.87	0.00	0.00	0.00	0.00	2.07
	5.0	5.06	0.82	0.02	0.06	0.08	0.00	1.61

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Deviation probability plot for GARCH(1,1) models



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