

Index

- absolute returns volatility, 10–11
- actual volatility, 101
- ADC (asymmetric dynamic covariance) model, 65–6
- ARCH (autoregressive conditional heteroscedasticity) models, 7, 10, 17, 31, 37–44, 121, 122, 126
 - Engle (1982), 37–8
 - forecasting performance, 43–4
 - LM-ARCH, 51, 53
 - see also* GARCH
- autoregressive conditional heteroscedasticity models
 - see* ARCH models
- ARFIMA model, 34, 51, 53, 127
- ARIMA model, 34
- ARMA model, 7, 34
- Asian financial crisis, 9
- asymmetric dynamic covariance (ADC) model, 65–6
- at the money (ATM), 76
 - implied volatility, 101, 106, 107, 116–17
 - options, 87, 91, 106, 117, 119
- autocorrelation, 19
 - of absolute returns, 8
 - asset returns, 7
 - lack of, 7
- autocorrelation function, decay rate, 7
- autoregressive model, 126
- backtest, 132–3
 - three-zone approach to, 133–5
- backward induction, 86
- Bank for International Settlements (BIS), 129
- Barone-Adesi and Whaley quadratic approximation, 89–90, 92–5
- Basel Accords, 129–31
- Basel Committee, 129–31
- BEKK model, 66
- biased forecast, 29
- bid–ask bounce, 16, 90, 91, 117
- Black model, 127
- Black-Scholes model, 49–50, 71–95
 - binomial method, 80–6
 - matching volatility with u and d , 83–4
 - two-step binomial tree and American-style options, 85–6
 - dividend and early exercise premium, 88–90
 - dividend yield method, 88–9
 - Heston price and, 99–102
 - implied volatility smile, 74–7, 97
 - investor risk preference, 91–2
 - known and finite dividends, 88
 - measurement errors and bias, 90–2
 - no-arbitrage pricing, 77–80
 - stock price dynamics, 77
 - partial differential equation, 77–8
 - solving the partial differential equation, 79–80
 - option price, 97
 - for pricing American-style options, 72, 85–6
 - for pricing European call and put options, 71–7

- Black-Scholes model (*continued*)
 risk, 91
 testing option pricing model, 86–7
- Black-Scholes implied volatility (BSIV),
 49, 50, 73–4, 91, 100
- break model, 46
- Brownian motion, 18
- Capital Accord, 130
- CGARCH (component GARCH), 55
- Chicago Board of Exchange (CBOE), 2
- close-to-open squared return, 14
- component GARCH (CGARCH), 55
- conditional variance, 22
- conditional volatility, 10
- constant correlation model, 66
- deep-in-the-money call option, 76
- deep-out-of-the-money call option, 76
- delta, 89, 90
- Diebold and Mariano asymptotic test, 25,
 26–7
- Diebold and Mariano sign test, 25, 27
- Diebold and Mariano Wilcoxon sign-rank
 test, 27
- discrete price observations, 15
- EGARCH, 34, 41, 43, 121, 122
- equal accuracy in forecasting models,
 tests for, 25
- error statistics, 25
- EVT-GARCH method, 135
- EWMA (exponentially weighted moving
 average), 31, 33, 40, 44
- explained variability, proportion of,
 29–30
- exponential GARCH (EGARCH), 34, 41,
 43, 121, 122
- exponential smoothing method, 33
- exponentially weighted moving average
 (EWMA), 31, 33, 40, 44
- extreme value method *see* high-low
 method
- factor ARCH (FARCH) model, 66
- FARCH (factor ARCH) model, 66
- fat tails 7
- FIEGARCH, 50–1, 52–4
- FIGARCH, 50, 51–2, 53, 122
- financial market stylized facts, 3–9
- forecast biasedness, 117–19
- forecast error, 24
- forecasting volatility, 16–17
- fractionally integrated model, 46, 50–4
 positive drift in fractional integrated
 series, 52–3
- forecasting performance, 53–4
see also FIGARCH; FIEGARCH
- fractionally integrated series, 54
- GARCH, 18, 34, 38–9, 121, 122, 126
 component GARCH (CGARCH), 55
- EVT-GARCH, 135
- exponential (EGARCH), 34, 41, 43,
 121, 122
- GARCH(1,1) model, 12, 17, 38,
 40, 46
- GARCH(1,1) with occasional break
 model, 55
- GARCH- t , 135
- GJR-GARCH, 41–2, 43, 44, 122
- integrated (IGARCH), 39–40, 45
- quadratic (QGARCH), 42
- regime switching (RSGARCH), 57–8,
 122
- smooth transition (STGARCH), 58
- TGARCH, 42
- generalized ARCH *see* GARCH
- generalized method of moments (GMM),
 60
- generalized Pareto distribution, 137
- Gibbs sampling, 61
- GJR-GARCH, 41–2, 43, 44, 46, 122
- Gram–Charlier class of distributions, 12
- Heath-Jarrow-Morton model, 127
- Heston formula, 99, 102
- Heston stochastic volatility option
 pricing model, 98–9
 assessment, 102–4
 zero correlation, 103
 nonzero correlation, 103–4
- Black-Scholes implied and, 99–102
- market price of volatility risk, 107–13
 case of stochastic volatility, 107–8
 constructing the risk-free strategy,
 108–10
- correlated processes, 110–11
- Ito's lemma for stochastic variables,
 107
- market price of risk, 111–13
- volatility forecast using, 105–7
- heteroscedasticity-adjusted Mean Square
 Error (HMSE), 23–4

- high-low method (*H-L*), 12–14, 17, 21
 historical average method, 33
 historical volatility models, 31–5
 forecasting performance, 35
 modelling issues, 31–2
 regime switching, 34–5
 single-state, 32–4
 transition exponential smoothing, 34–5
 types, 32–5
 HISVOL, 121, 122
- implied standard deviation (ISD), 116, 121, 122
 implied volatility method, 30, 91, 101
 at the money, 101, 106, 107
 Black-Scholes (BSIV), 49, 50, 73–4, 91, 100
 implied volatility smile, 74–7, 97
 importance sampling, 60
 independent and identically distributed returns (*iid*), 16, 136
 in-sample forecasts, 30
 integrated cumulative sums of squares (ICSS), 55
 integrated GARCH (IGARCH), 39–40, 45
 integrated volatility, 14, 39, 40
 interest rate, level effect of, 58
 in-the-money (ITM) option, 87
 intraday periodic volatility patterns, 15–16
 inverted chi-squared distribution, 62
 IOSCO (International Organization of Securities Commissions), 130
 Ito's lemma, 77, 107, 108, 110
- Jensen inequality, 11
- kurtosis, 4, 17
- large numbers, treatment of, 17–19
 Legal & General, 4
 level effect in interest rates, 58
 leverage effect (volatility asymmetry), 8, 37, 56, 148
 likelihood ratio statistic, 139
 LINEX, 24
 liquidity-weighted assets, 130
 LM-ARCH model, 51, 53
 log-ARFIMA, 51, 53, 127
 lognormal distribution, 2
- long memory effect of volatility, 7
 long memory SV models, 60
- market risk, 130
 Markov chain, 60
 maximum likelihood method, 11
 MCMC (Monte Carlo Markov chain), 59
 MDH (mixture of distribution hypothesis), 148
 mean 2
 Mean Absolute Error (MAE), 23, 44
 Mean Absolute Percent Error (MAPE), 23, 44
 Mean Error (ME), 23
 Mean Logarithm of Absolute Errors (MLAE), 24
 Mean Square Error (MSE), 23
 MedSE (median standard error), 44
 mixture of distribution hypothesis (MDH), 148
 Monte Carlo Markov chain (MCMC), 59, 60–3
 parameter w , 62–3
 volatility vector H , 61–2
 moving average method, 33
 multivariate volatility, 65–9
 applications, 68–9
 bivariate example, 67
- nearest-to-the-money (NTM), 116–17
 near-the-money (NTM), 76, 106
 negative risk premium, 102
 nonsynchronous trading, 15
 normal distribution, 2
- operational risk, 131
 option forecasting power, 115–19
 option implied standard deviation, 115–16
 option pricing errors, 30
 stochastic volatility (SV) option pricing model, 97–113
 Ornstein-Uhlenbeck (OU) process, 108
 orthogonality test, 28–30
 outliers, removal of, volatility persistence and, 18–19
 out-of-sample forecasts, 30
 out-of-the-money (OTM) put option, 76, 87, 92, 119
 out-of-the money (OTM) implied volatility, 101

- quadratic GARCH (QGARCH), 42
quadratic variation, 14–15
quasi-maximum likelihood estimation (QMLE), 60, 136
- random walk (RW) model, 32–3, 44, 126
range-based method, 12, 17
realized bipower variation, 15
realized volatility, 14–16
recursive scheme, 25
regime-switching GARCH (RSGARCH), 57–8, 122
regime-switching model, 19, 46
regression-based forecast efficiency, 28–30
- risk 1
risk management, volatility models in, 129–41
risk-neutral long-run level of volatility, 98
risk-neutral price distribution, 101
risk-neutral probability measure, 83, 85
risk-neutral reverting parameter, 98
risk-neutrality, 49
risk-weighted assets, 130
rolling scheme, 25
Root Mean Square Error (RMSE), 23, 44
RSGARCH, 57–8, 122
- serial correlation, 28
Sharpe ratio, 1–2
sign test, 25
simple regression method, 33–4
skewness, 4
smile effect, 75
smirk, 75
smooth transition GARCH (STGARCH), 58
smooth transition exponential smoothing, 34–5
squared percentage error, 24
squared returns models, 11
Standard and Poor market index (S&P100), 4
standard deviation as volatility measure, 1, 2
STGARCH 58
stochastic volatility (SV), 31, 59–63, 121
forecasting performance, 63
innovation, 59–60
- MCMC approach, 60–3
parameter w , 62–3
volatility vector H , 61–2
option pricing model, 97–113
stock market crash, October, 1987 18
- strict white noise, 16
strike price effect, 101
Student- t distribution, 17
switching regime model, 54
- tail event, 135, 136
TAR model, 34, 43, 58
Taylor effect, 8, 46
TGARCH, 42
Theil- U statistic, 24
threshold autoregressive model (TAR), 34, 43, 58
time series, 4–7
trading volume weighted, 117
trimming rule, 18
- UK Index for Small Capitalisation Stocks (Small Cap Index), 4
unbiased forecast, 29
unconditional volatility, 10
- value-at-risk (VaR), 129, 131–5
10-day VaR, 137–8
evaluation of, 139–41
extreme value theory and, 135–9
model, 136–7
multivariate analysis, 138–9
variance as volatility measure, 1
variance-covariance matrix, 65
VAR-RV model, 51, 53
VDAX, 126
VECH model, 66
vega, 89, 90
vega weighted, 117
VIX (volatility index), 126
new definition, 143–4
old version (VXO), 144–5
reason for change, 146
volatility asymmetry *see* leverage effect
volatility breaks model, 54–5
volatility clustering, 7, 147
volatility component model, 46, 54
volatility dynamic, 132
volatility estimation, 9–17
realized volatility, quadratic variation and jumps, 14–16

- scaling and actual volatility, 16–17
- using high–low measure, 12–14
- using squared returns, 11–12
- volatility forecasting records, 121–8
 - getting the right conditional variance and forecast with the ‘wrong’ models, 123–4
 - predictability across different assets, 124–8
 - exchange rate, 126–7
 - individual stocks, 124–5
 - other assets, 127–8
 - stock market index, 125–6
 - which model?, 121–3
- volatility forecasts, 21–30
 - comparing forecast errors of different models, 24–8
 - error statistics and form of ε_t , 23–4
 - form of X_t , 21–2
 - see also* volatility forecasting records
- volatility historical average, 126
- volatility index *see*, VIX
- volatility long memory
 - break process, 54–5
 - competing models for, 54–8
 - components model, 55–7
 - definition, 45–6
 - evidence and impact, 46–50
 - forecasting performance, 58
 - regime-switching model (RS-GARCH), 57–8
- volatility persistence, 17–19, 45, 136
- volatility risk premium, 119
- volatility skew, 76, 116
- volatility smile, 101, 116
- volatility spillover relationships, 65
- volume-volatility, 147–8
- weighted implied, 116–17
- weighted least squares, 117
- Wilcoxon single-rank test, 25
- wildcard option, 91
- yen–sterling exchange rate, 4

Index compiled by Annette Musker

