**Index**

**Bold number refers to definition**

**A**

adjust position, 230  
ADR. See American Depository  
Receipt (ADR)  
all or nothing (AON), 271  
alpha, 87  
as function of call delta, 888  
as function of underlying price, 87  
American Depository Receipt (ADR), 128, 271  
American option, 271  
Black-Scholes-Merton (BSM) model, 63, 68  
“Butterfly” relationship, 32  
calls with different expirations, 34–35  
calls with different strikes, 29–30  
European option vs., 23, 28, 31, 39  
exercise style, 10  
implied volatility curve, 138  
intrinsic value of, 28  
nondividend paying stocks, 38  
options, early exercise of, 243  
option strategies, 92  
put call parity, 36  
short option position, 26  
Anscombe’s Quartet, 267  
AON. See all or nothing (AON)  
arbitrage, defined, 271  
arbitrage, structured product, 13–14  
arbitrage bounds for option prices  
boxes, 38–39  
the “butterfly” relationship, 32  
call option, maximum value of a, 25–26  
call option, minimum value for a, 26–27  
calls with different expirations, 34  
calls with different strikes, 29–30  
calls with different strikes, 29–30  
calls with different strikes, 33  
options, American compared to  
European, 25  
option values, 21–24  
portfolio 1, 36  
portfolio 2: no exercise, 37  
pseudoarbitrage, 24–25  
put, maximum value of a, 26  
put call parity, 35–38  
put call parity relationship, 35  
put option, minimum value for a, 27–29  
puts with different expirations, 34–35  
puts with different strikes, 30–31, 31  
summary, 39–40  
values, absolute maximum and  
minimum, 25–39
arbitrage relationships
about, xiii, xvi, 23
dependent variables, 43
implied volatility surface, 183
put call parity, 35
Asian option, 271, 275
asset, underlying, 10
“Asset Allocation” (Sharpe), 117
asymptotic solution of Whalley and Wilmott, 198–200
at-the-money (ATM) call
call, 205
call delta vs. time to expiration, 68–69
call options, 49, 63, 66, 75
defined, 271
delta of the, 68, 71, 74
implied volatility, 147
implied volatility curve, 151, 187
implied volatility curve as a function of expiration, 145
option, with volatility will lower the gamma, 199
options, gamma is maximized for short-dated, 88
options, out-of-the-money options relative to, 140
options, theta is maximized for short-dated, 88
options, value of, 66–67, 71
options, vega is short, 111
options, volatility value of, 77
option with high gamma, 72, 74, 75, 80
put options, 63, 66
straddle, 150
strike, 77, 104, 109, 186, 220, 229
strike, upside strikes trade at premium vs., 140
strike, volatility of, 142–43
strike price below, 138
volatility curve, 138
volatility index of CBOE, model-free implied, 147
at-the-money (ATM) call
delta as a function of time until expiry parameters are those in figure 5.6, 69
as a function of time until expiry, 66
at-the-money (ATM) forward, 271
at-the-money (ATM) put
delta as a function of time until expiry parameters are the same as those for figure 5.6, 70
as a function of time until expiry, 66
auction, pre-opening, 167–69
automatic exercise, 271
B
back months, 271
back office, 233, 271
back spread, 271
backwardation, 271
bad things happen, 135–36
Barings Bank, 233
basis point, 84, 271
basis risk, 242, 272
basket option, 240, 272, 275
Bayes’s theorem, 177–81
bear, 272
Bermudan option, 10, 272
bias, 123
efficiency and, 123–25
bid and ask
implied volatility for Google
February option December 21, 2009, 186
spread in practice, varying the, 179–80
bid/ask spread, 59, 123, 228, 272
binomial model, 48–55
about, 42, 272, 282
binomial tree
European call option, pricing of, 55
one-step, evolution of the stock price in, 49
Index

single node, pricing of a call option at, 54
three-step, evolution of the stock price in, 53
Black-Scholes-Merton (BSM) model about, xi, xv–xvi, 5, 42–43, 55–61, 63–67, 272
alpha, 87
alpha as a function of the underlying price, 87
alpha as function of the call delta, 88
ATM call as a function of time until expiry, 66
ATM call delta as function of time until expiry parameters are those in figure 5.6, 69
ATM put as a function of time until expiry, 66
ATM put delta as function of time until expiry parameters are those for figure 5.6, 70
breakeven, concept of, 78–80
call delta as a function of the underlying price, 68
call rho as a function of the underlying price, 83
call theta as a function of the underlying price, 77
call value as a function of the underlying price, 65, 68
carry rho, 83–84
DdeIT, 85–86
DdeIV, 85
DdeIV as function of the underlying price, 85
DdeIT for calls as function of the underlying price, 86
delta, 67–71
gamma, 72–76
gamma as a function of the underlying price, 73
gamma as a function of time until expiry for an out-of-the-money option, 74, 75
 Greeks, second-order, 84
put delta as function of the underlying price, 69
put value as function of the underlying price, 65
rho, 82–83
summary, 88
theta, 76–78
vega, 80–82
vega as function of the underlying price, 81
vega as function of time and expiry for an at-the-moment option, 81
block trade, 272
Boston Options Exchange, Inc. (BOX), 15
boxes, 38–40, 272
option, 59
breakeven, concept of, 78–80
brokerage firm, xii, 15–18, 272
BSM model. See Black-Scholes-Merton (BSM) model
bucket shop, 4, 272
Buffett, Warren, 1
bull, 272
butterfly, 93, 272
calendar spread, 24, 115, 272, 282
condor vs., 113
call as a hedge, 12–13
call as a hedge, 12–13
condor vs., 113
iron, 111–12, 277
long, 110–11, 201
with missing wing, 114–15
no-arbitrage condition, 144
relationship, 32
short straddle vs., 219
static hedging and, 201
buying
buy-in risk, 242–43
buy-in risk, 242–43
C

C
INDEX

call
delta as function of the underlying price, 68
don a future, exercising a, 246
rho as a function of the underlying price, 83
on a stock, exercising a, 246–47
theta as function of the underlying price, 77
value as function of the underlying price, 65, 68
call-around market, 16, 272
call option(s)
American vs. European, 25
with different strikes, 29–30, 33
expiations, relationship between different, 34
maximum value of, 25–26
minimum value for, 26–27
values, 21–24
values, absolute maximum and minimum, 25–39
call spread, 29–31, 38, 40, 95, 103–6, 272, 277
carry rho, 83–84
cash settlement, 273
Cauchy distribution, 259
CBOE. See Chicago Board Options Exchange (CBOE)
CBOT. See Chicago Board of Trade (CBOT)
center, quantifying the, 254
CFTC. See Commodity Futures Trading Commission (CFTC)
Chicago Board of Trade (CBOT), 273
Chicago Board Options Exchange (CBOE), 5, 15–16, 118, 147, 273, 275–77, 283
Chicago Mercantile Exchange (CME), 273, 276
Christmas tree, 273, 282
clearinghouse, 16–17, 273, 279
close-to-close estimator, 128
closing price, 7, 118, 120, 123, 126–29, 133, 269, 273
closing trade, 273
CME. See Chicago Mercantile Exchange (CME)
COMEX, 273
commodity, 60, 273
markets, 271
option expirations, 240
products, 109
trader, 154
Commodity Futures Trading Commission (CFTC), 273
commodity trading advisor, 273
contango, 273
contingent order, 273, 278
contract month, 273, 276
contract size, 274
contract unit, 10–11
convergence, 54, 124, 274
conversion, 113, 121, 221, 243, 272, 274
correlation, 240–41
Anscombe's Quartet, 267–69
correlation does not tell us "things are moving together," 266
correlation is not causation, 265
correlation measures degree of linear association, 266
data that has a clear relationship and a low correlation, 266
fitted regression line, 264
highly correlated, divergent series, 266
for a population, 263
positively correlated returns and negatively correlated volatilities, 267
scatter graph of two variables, 264
Simpson's Paradox, 270
coupon, 14, 242–43, 274
covered call, 19, 100, 274
credit risk, 4, 17, 274
critical strike for put exercise as a function of time, 245
Index

D

day order, 274
DdeIT, 85–86
for calls as a function of the underlying price, 86
DdeIV, 85
as a function of the underlying price, 85
deep (in-the-money), 28, 38, 42, 64, 74, 221, 246–47, 274
delivery date, 274
delivery options, 274
delivery price, 274
delta, 67–71, 234
delta neutral, 75, 192–93, 229, 274
dependent variables, 45–48
designated primary market maker (DPM), 275
diagonal spread, 274
direct method, 197
dispersion, 204, 274
dispersion trading, 240, 274
distribution of returns, 60–61
distributions
Cauchy distribution, 259
center, quantifying the, 254
distribution A, 261
distribution B, 261
distribution of height, corresponding, 255
histogram of random numbers drawn from a uniform distribution, 260
histogram of random numbers from a normal distribution, 258
kurtosis, 260–61
mean absolute deviation (MAD), 257
measured heights of 11 professional athletes, 255
moments and the “shape” of distributions, 254–62
normal distribution, 253–54
robustness of efficiency, 260
skewness, 256
tails, quantifying, 260–62

variance (of a sample), 257
width, quantifying the, 256–61

dividend changes, 47–48

dividends
absence of, 59–60
buy-in risk and, 242–43
dividend spread, 247–48
dividend yield
ATM call as function of time until expiry, 66
Black-Scholes-Merton (BSM) model, 64–65
call delta as function of the underlying price, 68
call value as function of the underlying price, 65
carry rates and, 83
defined, 39, 47, 59–60, 64, 275
dividend changes and, 47
dividends, absence of, 59–60
gamma as function of the underlying price, 73
gamma as function of time until expiry for out-of-the-money option, 74
interest rates and, 39
normal, 243
par value as function of underlying price, 65
repro rates and forward prices, 84
vega as a function of time until expiry for at-the-money option, 81
do nothing, 229
double-asymptotic method of Zakamouline, 200–201
DPM. See designated primary market maker (DPM)
dynamic hedge, 223, 275

E

ECN. See electronic communication network (ECN)
edge, 154–56
efficiency, 123
bias and, 123–25
EFT. See exchange-traded fund (ETF)
Eisenhower, General Dwight D., 227
elasticity, 275
electronic communication network (ECN), 275
electronic exchange, 15, 114, 184, 275, 279
estimator, close-to-close, 128
EUREX, 275
European call option, 55
European option, 275
American option vs., 10, 25, 28, 39, 243, 272
Bermudan option vs., 272
Black-Scholes-Merton (BSM) model, 63
boxes and, 39
BSM partial differential equation, 42
call option, minimum value for, 27–28
convergence and, 54
option nomenclature, 92
options, early exercise of, 243
puts with different expirations, 35
wrong options, exercising, 222
exchange-traded fund (ETF), 275
exercise and assignment, 17–18
expiration date, 10
expiration trading
forward risk, 221
Google price on October 16, 2009, 218
Greens, irrelevance of the, 223–25
implied volatility on expiration day for Google, October 16, 2009, 218
nonexpiration days in American stocks, 216
option value as we approach expiry, 224
pinning, 215–19
pinning in American stocks, 216
pin risk, 219–21
summary, 225
theta as we approach expiry, 224
wrong options, exercising the, 221–23
exponential utility function, 195

F
fast market, 275
FIFO. See first-in, first-out (FIFO)
fill or kill (FOK), 275
final settlement price, 276
first-in, first-out (FIFO), 181, 275
fitted regression line, 264
flipping, 183–85
FOK. See fill or kill (FOK)
forward risk, 221
FXI, 7, 8
FXP, 7, 8

gambler’s ruin, 158–62
gamma, 72–76, 234–38
   as a function of the underlying price, 73
   as a function of time until expiry for an out-of-the-money option, 74, 75
general principles of trading and hedging
about, 153–54
edge, 154–56
gambler’s ruin, 158–62
hedging, 156–58
Kelly sizing, example of, 162–63
probability distribution of result of St. Petersburg game, 160
probability of going bankrupt with 55 percent chance of winning and betting our entire bankroll, 159
scalability and breadth, 163–64
scalability within products, 163–64
summary, 164
trade sizing and leverage, 158–63
Index

Google price on October 16, 2009, 218

Greeks
- irrelevance of the, 223–25
- second-order, 84

H
- Halmos, Paul, 227
- hedge frequency, 206
- hedging, 156–58, 192–93
- based on underlying price changes, 194
- to a delta band, 194
- error as a function of the number of rebalances, distribution of the, 207
- a long position with a put, 11–12
- in practice, 193–203
- at regular time intervals, 193
- static, 201–3
- strategy for the one-year option, realizations of the, 204
- volatility, choosing a, 208–13
- hedging bands
  - as functions of the BSM delta which is shown as a dashed line, optimal, 196
  - long call, 196
  - short call, 196
  - from the WW Asymptotic method as functions of the BSM delta, 199
  - from the Zakamouline Asymptotic method as functions of the BSM delta, 202
- histogram
  - of random numbers drawn from a uniform distribution, 260
  - of random numbers from a normal distribution, 258

I
- ICE. See International Commodities Exchange (ICE)
- implied method, 198
- implied volatility
  - about, 137
  - bid and ask, for the Google February option expiration at 2 p.m. on December 21, 2009, 186
  - curve, 236
  - dynamic hedging, 141
  - dynamics, 146–51
  - expiration day
    - for Google, October 16, 2009, 218
  - implied correlation, 141–42
  - implied volatility curve, 138–42
    - for an index, typical, 139
    - as function of expiration, 145–46
    - parameterizing and measuring the, 142–45
    - for a stock, typical, 139
    - implied volatility dynamics, 146–51
    - model misspecification, 138
    - raw and scaled, of the QQQQ Options as a function of the out-of-the-money delta September 13, 2007, 143
  - summary, 151
  - supply and demand, 140–41
  - surface, trading correlated assets, 185–88
  - VIX and the S&P 500, 150
  - VIX implied volatility index, 148
  - VIX volatility of the, 148
  - volatility curves
    - that differ by a shift in the level, two, 146
    - that differ by a twist, two, 146
    - that differ in convexity, two, 147
  - volatility curves that differ by a shift in the level, two, 146
  - volatility curves that differ by a twist, two, 146
  - volatility curves that differ in convexity, two, 147
  - initial risk slide, 239
INDEX

interest rate
changes, dependence on the, 46–47
existence of a single constant, 59
International Commodities Exchange
(ICE), 276
inventory, 232–34
inventory-based market-making,
172–76
*I Want to be a Mathematician*
(Halmos), 227

K
Kelly sizing, 162–63
kurtosis, 260–61

L
LEAP. See long-term equity
anticipation product (LEAP)
leverage and trade sizing, 158–63
LIFFE. See London International
Financial Futures Exchange
(LIFFE)
log returns, why use?, 119–23
London International Financial
Futures Exchange (LIFFE), 277
long call hedging bands, 196, 202
long calls (puts), 19
long stock (covered call)
short calls, 19
long-term equity anticipation product
(LEAP), 277

M
Maginn, John L, 117
Managing Investment Portfolios: A
Dynamic Process (Maginn and
Tuttle), 117
margin, strategy-based, 18–19
market
depth for QQQQ at 12:52 CST on
February 25, 2009, 170
execution, 15–16

order-driven, 166–67
structure, 14–19, 166–69
market maker
profit and loss distribution for the,
174
profit and loss distribution when
orders are unbalanced, 175
simulation, underlying price paths in
our, 173
market-making, inventory-based,
172–76
market making techniques
about, 165–66
auction, pre-opening, 167–69
Bayes’s theorem, 177–81
bid and ask implied volatility for the
Google February option
expiration at 2 p.m. on
December 21, 2009, 186
bid and ask spread in practice,
varying the, 179–80
flipping, 183–85
inventory-based market-making,
172–76
market, order-driven, 166–67
market depth for QQQQ at 12:52
CST on February 25, 2009,
170
market making, 169–76
market-making, information-based,
176
market structure, 166–69
mimicry: the ultimate method,
180–81
order book, pre-open, 168
order book for QQQQ at 12:52 CST
on February 24, 2009, 167
order book immediately after the
open, 169
price paths in our market maker
simulation, underlying, 173
profit and loss distribution for the
market maker, 174
profit and loss distribution for the
market maker when orders are
unbalanced, 175
Index

profit as a function for the market maker, 174
“ratio” trade, 181–83
stop hunting, 185
summary, 189
supply and demand curves implied by the pre-open order book, 168
trading based on order-book information, 181–89
trading correlated assets: the implied volatility surface, 185–88
trading day, 169
trading game, practicing, 188–89
mathematics, role of, xiv–xvi
mean absolute deviation (MAD), 257
measured heights of 11 professional athletes, 255
median of the deviations from the median MAD, 257
mimicry, 180–81
modeling principles, 42–43
MSFT prices and returns, 121

N

The New York Mercantile Exchange (NYMEX), 273, 278
The New York Stock Exchange (NYSE), 13, 278
Nixon, Richard, 227
nonexpiration days in American stocks, 216
normal distribution, 253–54
NYMEX. See The New York Mercantile Exchange (NYMEX)
NYSE. See The New York Stock Exchange (NYSE)

O

OCC. See Option Clearing Corporation (OCC)
OCO. See one cancels other (OCO)
one cancels other (OCO), 278

OPM. See “Other people’s money” (OPM)
Option Clearing Corporation (OCC), 14, 16–18, 278
option contract, specifications for an, 9–11
option order, 14–15
option position, 235
options about, 9
buying a call as a hedge, 12–13
buying a put (call) to speculate on a fall (rise), 12
clearing and the Option Clearing Corporation (OCC), 16–17
contract unit, 10–11
evolve exercise of, 243–48
exercise and assignment, 17–18
exercising wrong, 221–23
expiration date, 10
FXI and FXP, 8
hedging a long position with a put, 11–12
long calls (puts), 19
margin, 18
market execution, 15–16
market structure, 14–19
option contract, specifications for an, 9–11
option order, 14–15
option type, 9
over-the-counter trading (OTC), 17
portfolio margin, 19
short calls (puts), 19
short calls and long stock (covered call), 19
strategy-based margin, 18–19
strike price, 10
structured product arbitrage, 13–14
structured products, creation of, 13
summary, 20
trading costs, 18
underlying asset, 10
uses of, 11–14
volatility trading, 13
INDEX

option strategies
bearish underlying forecast, 90
bullish underlying forecast, 89
calendar spread, 115
call spread, 103–5
conversions and reversals, 115–16
dependence of the straddle value on time, 109
forecasting and strategy selection, 89–91
implied volatility, decreasing, 91
implied volatility, increasing, 90
iron butterfly, 111–12
ladder, 114–15
long butterfly, 110–11
long call, 96–98
long condor, 112–13
long put, 102–3
long straddle, 108–9
long strangle, 109–10
neutral underlying forecast, 90
neutral volatility, 91
option nomenclature, 91–93
payoff of a short call position, 99
profit and loss of the 95 105 strangle, 110
profit and loss of the 100 105 110 call ladder, 114
profit and loss of the 100 105 one by two call spread, 113
profit and loss of the 100 straddle, 108
profit and loss of the 105 put spread, 106
ratio spread, 113–14
realized volatility, decreasing, 90–91
realized volatility, increasing, 90
risk reversal, 106–8
risk tolerance, 91
short call, 98–100
short put, 100–102
strategies, 93–115
summary, 116
theta of the 95 105 call spread, 104
underlying price, 97
value of a call spread position as it approaches expiry, 105
vega of the 95 105 call spread, 105
volatility forecast, 90
option trading
conclusion, 249–51
history, 1–6
stock options, total annual volume in U.S., 5
option type, 9
option value
as we approach expiry, 224
order book
immediately after the open, 169
pre-open, 168
for QQQQ at 12:52 CST on February 24, 2009, 167
supply and demand curves implied by the pre-open, 168
order-driven market, 166–67
OTC. See over-the-counter (OTC)
"Other people's money" (OPM), 279
over-the-counter (OTC), 17, 279
Index

P

Parkinson estimator, 129
Parkinson variance, sampling error in, 127
Path 1, 204
Path 2, 205
pinning, 215–19
  in American stocks, 216
pin risk, 219–21
population variance as function of sample size, convergence of variance to true, 124
portfolio 1, 36
portfolio 2: no exercise, 37
portfolio margin, 19
position repair, 228–32
pre-opening auction, 167–69
price paths in our market maker simulation, underlying, 173
pricing models about, 41–42
  binomial model, 48–55
  Black-Scholes-Merton (BSM) model, 55–61
dependent variables, choice of, 45–48
distribution of returns, assumption about, 60–61
dividend changes, dependence on the, 47–48
dividends, absence of, 59–60
European call option in the binomial tree, pricing of, 55
interest rate, existence of a single constant, 59
interest-rate changes, dependence on the, 46–47
modeling principles, general, 42–43
one-step binomial tree, evolution of the stock price in, 49
pricing variables, other, 48
results, interpretation of, 44
short the underlying, ability to, 60
  single node in the binomial tree, pricing of a call option at, 54
  strike, dependence on the, 45–46
summary, 61
three-step binomial tree, evolution of the stock price in, 53
time changes, dependence on the, 47
tools, choosing the, 43
tradable underlying, existence of a, 59
underlying, dependence on the, 45
variable, choosing suitable, 43–44
volatility, dependence on the, 47
  volatility is constant, 60
pricing variables, other, 48
primary risks, 231
probability
distribution of result of the St. Petersburg game, 160
of going bankrupt with 55 percent chance of winning and betting our entire bankroll, 159
professional trading, xii–xiv
profit as a function for the market maker, 174
  as a function of time for a short position hedged at the realized volatility, 211
  as a function of time for a short position hedged at implied volatility, 212
profit and loss (P/L) distribution for $1,000 vega of initially at-the-money options when hedged once a day, 207
for $1,000 vega of initially at-the-money options when hedged once a week, 206
of hedged option positions, 203–13
for the market maker, 174
for the market maker when orders are unbalanced, 175
pseudoarbitrage, 24–25
INDEX

put
delta as a function of the underlying price, 69
on a stock, exercising a, 244–46
value as a function of the underlying price, 65
put call parity, 35–38
relationship, 35
put exercise as a function of time, critical strike for, 245
put option(s)
with different expirations, relationships between, 34–35
with different strikes, 30–31
maximum value of a, 26
minimum value for a, 27–29

R
“ratio” trade, 181–83
results, interpretation of, 44
returns and MSFT prices, 121
rho, 82–83, 242
risk-aversion parameter, 197
risk management
about, 227–28
adjust position, 230
Barings Bank example, 233
call on a future, exercising a, 246
call on a stock, exercising a, 246–47
correlation, 240–41
critical strike for put exercise as a function of time, 245
delta, 234
dividend spread, 247–48
do nothing, 229
exit the trade, 230
gamma, 234–38
implied volatility curve for the example, 236
initial risk slide, 239
inventory, 232–34
option position, 235
options, early exercise of, 243–48
position repair, example of, 228–32
primary risks, 231
put on a stock, exercising a, 244–46
rho, 242
risk side, 235
risk side after buying 10 80 puts, 237
risk side after selling 200 shares, 237
risk side when using a floating implied volatility, 236
roll the position, completely, 229
secondary risks, 231
Société Générale example, 233
stock risk: dividends and buy-in risk, 242–43
Sumitomo example, 233
summary, 248
tertiary risks, 231
vega, 238–40
risks
buy-in, 242–43
forward, 221
pin, 219–21
primary, 231
secondary, 231
stock, 242–43
tertiary, 231
risk side, 235
after buying 10 80 puts, 237
after selling 200 shares, 237
when using a floating implied volatility, 236
robustness of efficiency, 260
roll the position, 229

S
scalability, 163–64
scatter graph of two variables, 264
SEC. See Securities and Exchange Commission (SEC)
secondary risks, 231
Securities and Exchange Commission (SEC), 154, 280
Sharpe, William, 117
short call hedging bands, 196, 202
Index

short calls (puts), 19
long stock (covered call), 19
short covering, 281
short interest, 281
short selling, 281
short squeeze, 281
short the underlying, ability to, 60
Simpson’s Paradox, 270
skewness, 256
Société Générale, 233
S&P volatility, 130
static hedging, 201–3
stock options
total annual volume in U.S., 5
stock price
in three-step binomial tree, 53
stock risk: dividends and buy-in risk, 242–43
stop hunting, 185
strategy-based margin, 18–19
strike, dependence on the, 45–46
strike price, 10
strip in Europe, 281
structured product arbitrage, 13–14
structured products, creation of, 13
Sumitomo, 233

T

tails, quantifying, 260–62
tertiary risks, 231
theta, 76–78
as we approach expiry, 224
time changes, dependence on the, 47
tools, choosing the, 43
tradable underlying, existence of, 59
trade sizing, 158–63
trading
based on order-book information, 181–89
correlated assets, 185–88
day, 169
game, 188–89
trading, volatility, 13
trading costs, 18
Tuttle, Donald L., 117

U
underlying, dependence on the, 45
underlying asset, 10
utility-based methods, 194–97

V
variable, choosing suitable, 43–44
variance (of a sample), 257
variance convergence to true population variance as function of sample size, 124
vega, 80–82, 238–40
as a function of the underlying price, 81
as a function of time and expiry for an at-the-moment option, 81
volatility cone for MSFT, from two years of closing prices ending December 31, 2008, 133, 134
constant, 60
in context, 132–35
dependence on the, 47
for different option positions as a function of market direction, 209
estimator, “quick and dirty,” 125–29
forecasting, 129–32
S&P, 130
for True Religion Apparel, Inc., 131, 132
two price paths with identical, 209
volatility estimation about, 117–19
bad things happen, 135–36
bias, 123
bias and efficiency, 123–25
close-to-close estimator, 128
convergence of variance to true population variance, 124
efficiency, 123
log returns, why use?, 119–23
INDEX

298

volatility estimation (Continued)
MSFT prices and returns, 121
Parkinson estimator, 129
Parkinson variance, sampling error in, 127
S&P volatility, 130
summary, 136
volatility, forecasting, 129–32
volatility cone for MSFT, from two years of closing prices ending December 31, 2008, 133, 134
volatility estimator, “quick and dirty,” 125–29
volatility for True Religion Apparel, Inc., 30-day moving window close-to-close, 131
volatility for True Religion Apparel, Inc., 30-day moving window “jump excluded” close-to-close volatility and EWMA, 132
volatility in context, 132–35
volatility trading
about, 70, 80, 145, 181, 250, 283
asymptotic solution of Whalley and Wilmott, 198–200
direct method, 197
double-asymptotic method of Zakamouline, 200–201
exponential utility function, 195
hedge frequency, 206
hedging, 192–93
hedging at regular time intervals, 193
hedging bands, long call, 196, 202
hedging bands from the WW Asymptotic method as functions of the BSM delta, approximate, 199
hedging bands from the Zakamouline Asymptotic method as functions of the BSM delta, 202
hedging based on underlying price changes, 194
hedging error as function of a number of rebalances, 207
hedging in practice, 193–203
hedging strategy for one-year option, 204
hedging to a delta band, 194
hedging volatility, choosing a, 208–13
implied method, 198
optimal hedging bands as functions of BSM delta, 196
Path 1, 204
Path 2, 205
P/L distribution for $1,000 vega of initially ATM options when hedged once a day, 207
P/L distribution for $1,000 vega of initially ATM options when hedged once a week, 206
P/L distribution of hedged option positions, 203–13
profit as a function of time for a short position hedged at the realized volatility, 211
profit as a function of time for a short position hedged at implied volatility, 212
risk-aversion parameter, choosing, 197
short call hedging bands, 196, 202
static hedging, 201–3
summary, 213
utility-based methods, 194–97
volatility, two price paths with identical, 209
volatility as a function of market direction, 209

W

width, quantifying the, 256–61
“with a tick,” 283
wrong options, exercising the, 221–23

Z

Zakamouline’s double-asymptotic method, 200–201