200 day moving average  170-174
Abu-Mostafa, Yaser  319
account:
  growth  17
  size  52
accuracy
  classification  302, 352
  general  182, 249
ada boost  320-321, 358
AIG bankruptcy  225
Albert, Jim  388
AmiBroker:
  custom objective function  186
  databases  80-89
  development platform  203-266
  environment  77-89
  Introduction book, free  78
  Mean Reversion book  78
  Quantitative Trading Systems
  book  78
  trial, free  78-80
  TSDP  78
AmiQuote:
  AmiBroker data manager  82
  free data  82-85
Anaconda  92
Anderson, Edgar  293
anticipate signals  175-176
  indicator-based  261-266
  precompute  176
anti-Martingale  see Martingale
auxiliary data  23, 188
backtest:
  change  16
  historical  187-189
  indicator-based  246-248
  procedure  187-189
bad stuff happens  49
bad tick  315
Bandy, Howard
  Introduction to AmiBroker
  book  78
  Mean Reversion Trading Systems
  book  78, 161, 215, 217, 318
  Modeling Trading System
  Performance book  30, 54, 58,
  167, 395
  Quantitative Trading Systems
  book  78, 224
Bayes, machine learning algorithm:
  Gaussian  330-331
  multinomial  332-333
Bayesian:  388, 395, 420
  change  16
  position size  31
best estimate  18, 54, 146, 198, 362-
  363, 374-375, 381
bet sequencing  388-390
bias:
  stationary  26
  confidence  34
bankable equity  47
binning data  164-165
black swan  55, 138
blackjack  34, 389, 421
Bollinger band 25
bonds 15, 23
Box, George 38
breakdown 17
California, Univ at Irvine 293
CAR25:
characteristics 187
universal objective function 186
use 306
Carroll, Lewis 35
casino 35
catastrophic forgetting 397
central limit theorem 224, 411
certainty 52-54
chart pattern 16, 19
Chenoweth, Mark 118
class membership 350
classification:
category 28, 91, 184, 292-293, 301, 306
costs 350
example 320-349
target 284, 363-364
classifier 393
cognitive dissonance 31
commission 188
commodities 15
competition 37
components of trading:
development see development
flowchart 18
management see management
compound annual rate of return (CAR):
calculate 127
define 62, 138
metric 62, 134
objective function 138
position size 141
computer:
language see language
confidence:
drawdown 41
faith 33
goal 16
position size 387
quantifiable 34
risk as limitation 16
subjective 200
validation 33
confusion matrix:
AmiBroker 351
change 16
objective function 184
Continuum Analytics Anaconda 92
csi 112
cumulative distribution function (CDF):
inverse 56
risk tolerance 53, 55
currencies 15
curve-fit 182
cycle frequency 229
data driven 16
data series:
alignment 21, 23
auxiliary 23
backtest 188
bars 22
bid-ask 22
close, as last price 22
daily 22
end-of-day 22
high, unknown order 22
historical 16
in-sample 28
intra-day 22
low, unknown order 22
master dates 23
mining 28
missing 23, 188
non-price 23
not interchangeable 27
open, high, low, close 22
open, as first price 22
out-of-sample 28
patterns 16
price 22
primary 21-23, 187, 201, 237-238, 243, 250, 263, 272, 314, 355-356, 374, 393
synchronization 26
tick 22
time series 22, 26
transformation 21
variation required 16
volume 22
data:
bar types 159-160
characteristics:
desirable 107
mandatory 107
fundamental 108-110
mining 124
number of points 196
over-the-counter 110
read and write:
    AmiBroker 114-115
    Python 116-122
simulated 108
sources, development 109
sources, free:
    Google 85, 112
    Interactive Brokers 113
    msn 85, 113
    nasdaq 113
    quandl 85
    US Treasury 113
    Yahoo 85, 87, 114
sources, subscription:
    csi 112
dtn.iq 112
eoddata 112
eSignal 112
Norgate 88, 113
quandl 88
sources, trading 109
surrogate 108
visual inspection 297
date alignment 23, 188
date, pivot 359
decision tree 322-323:
    AmiBroker 351
    change 16
decisions 35
derman, Emmanuel 23
deterministic 16
development
    backtest 18
    best estimate 18
data 18
    issue selection 18
    iterative process 29
    objective function 28
    model 18
    validation 18
difficult 15, 35-38, 155
dimensionality 189-192, 357-359
distribution:
    see also Cumulative Distribution Function
    change 16
drawdown 67
    final equity 62
    next day return 52
    no assumptions 23
    price changes 385
tail 55
    trade results:
        position size 20
double down 229-230
downey, Allen 92
drawdown 17, 19, 29
    account growth 53
    defined 40
    depth 42
    holding period 53, 129-143
    issue selection 126-152
    length 42
    maximum risk 52
    multi-day 42
    not symmetric 41
    objective function 187
    position size 53, 58-59
    reasons: 32-33
        broken system 33
        out of sync 33
        position size wrong 33
    recovery time 40
    system broken 53
    system health 42
    synchronization 42
    trade accuracy 130-152
extended trading 176
faith 41
false positive 353, 398
feature selection 358
feedback 36
Fibonacci 175
filters 170
Fisher, Ronald 293
fitting 182-184
fixed fraction 54
Flach, Peter 319
flash crash 315
flowchart:
  trading components 18
forecast horizon 52-54, 64, 125-127, 147-152, 363, 397, 405-414
FOREX 15
Frean 397
frequency of action 41
frequentist 16, 165, 388, 420
full fraction 57
futures 15
Galileo 16, 157
gambling 388-390, 420
generalization 183
genie 385, 418
global optimum 191
goal 15, 16
Google:
  data 85
  Python 92, 104-106
gradient boost 324-325
handicap 37
Hanson 192
Harrington, Peter 319
health, system:
  drawdown 27
  monitoring 19, 29
synchronization 27
holding period 34
drawdown 129-143
minimum 42
objective function 187
position size 53
trade accuracy 129-143
horizon see forecast horizon
Hubble 16
hyper-parameters 319
idea driven 16
impossible things 35
impulse signals 52, 168-170, 283-289
independent 156
event 389-390
variable 230-231, 263, 291
indicator: 16, 19
based development 22, 153, 203-266
see also model development
Bollinger band 25
Elliott wave 175
Fibonacci 175
fuzzy 162-163
ideal 161-162
initialization 188
interchangability 161
realistic 163-165
threshold 353
z-score 25
zig-zag 175
inefficiency 36
information content:
direction 23
distribution of trades 23, 24
list of trades 23, 24
mean 23
moments of distribution 23, 24
reality 23, 24
set of trades 23, 24
information theory 388
in-sample:
confusion matrix 354
data mining 28
define 28
fit always good 195
length of period 35
results always good 37
results of little value 195
short as practical 195
stationarity 193-196, 386
intra-day:
data 22
drawdown 47
signal 176
Interactive Brokers 113
invisible prices 43, 45
iris data 293, 302
issue selection 123-152
accuracy 125-152
detectable patterns 124
holding period 125-152
profit potential 123
risk 123, 124-143
iterative search 54
Janeczko, Tomasz 207
Japkowicz, Nathalie 312
joblib 362
judgement 77, 309, 398
Kahneman, Daniel 154
Kelly criteria 58
Kohavi, Ron 304
kurtosis:
define 25
landings are manditory 201
language:
computer:
general purpose 20
Python 20
learning:
classification 28
data requirement 28
estimation 28
generalization 27
in-sample 28
out-of-sample 28
patterns 27
system 16, 17
learning repository 293
leverage ETF 61, 143
libraries, function:
    numpy 20
    Pandas 20
    scikit-learn 20
    scipy 20
linear discriminant analysis 326-327, 358
linear regression 163
liquidity 135
local optimum 191
logistic regression 328-329
Lopes 388
lost opportunity 363, 398
machine learning: 16
    based development 22, 153, 267-3xxx
    see also model development
environment 77
management:
    best estimate 18
    measurement 49
    objective function 20
    parameter 20
    position size 18, 19
    process 15
    risk 18, 19
market-on-close (MOC) 44
market-on-open (MOO) 43
market research 123-124
markets, efficient 17
mark-to-market:
    adverse excursion 45
    equivalence 51-52, 64-66
    impulse signals 52
    issue selection 125
    number data points 52
    serial correlation 66
    state signals 52
    subjective decisions 52
    test period distortion 52, 169-170
Martingale 389-390
mathematics:
    increasingly important 155, 157
    required skill 77
matplotlib 91
model development 267
maximum adverse excursion 43
    accumulated 48
    drawdown 48
    multi-day trade 45
    risk 43
    series of trades 46-47
maximum favorable excursion:
    mark-to-market 48
    metric 25
McKinney, Wes 90, 92, 93
mean:
    define 25
measurement:
    management 49
    process 15
membership bias 224-225
    Norgate Premium Data 225
memorization 183
memory 389
meta-parameters 319
metric, performance 15, 19
    baseline 19
    CAR25 134
    single valued 20
misclassification 350
missing data 23, 188
model:
    all are wrong 38
    data alignment 21
    data preparation 21
    entry 18
    exit 18
    goal 157
    indicators 22
    input 22
    metrics 19
    output 22
    parameters 16
    pattern recognition 19
    performance 22
position sizing 22
rules 16
signals 16, 21
simplifications 23
synchronization 26
trading system 16
trend following 34
transformation 22
validation 19
verify 16
model airplanes 200-201
model development:
indicator-based 203-266
  AmiBroker 203-266
  anticipating signals 261-266
  backtesting 246-248
  indicators 203
    chart patterns 228-229
    data series 212
    detrended price oscillator 222-224
    diffusion index 224-228
    highpass filter 222
    lookback length 212, 213
    oscillator 212
    oversold depth 212
    percent rank 219
    position in range 219-221
    RSI 215-217
    selection 213-229
    stochastic 219
    Williams %R 219
    z-score 217-219
entries 230-231
exits 231-246
in-sample 249
Janeczko, Tomasz 207
long / flat 212-213
mean reversion 204
membership bias 224-225
objective function 205-211
  accurate trading 207
  bars held 206
  CAR25 206
  consecutive losers 206
  custom backtester 207
  decathlon scoring 207
  frequent trading 207
  gain per trade 206
  holding period 207
  losing trades 206, 207
  maximum drawdown 206
  percent winners 206
  trades per year 206
  optimization 248-249
  out-of-sample 249-251
  program template 203
  rules 203
  short / flat 213
  tradable systems 255-256
  validated systems 256-259
  walk forward 251-255
  z-score 205
machine learning 267-384
  “A” array 309-312
  accuracy 302, 308
  algorithms 319-349
    ada boost 320-321
    decision tree 322-323
    gradient boost 324-325
    linear discriminant analysis 326-327
    logistic regression 328-329
    naive Bayes—Gaussian 330-331
    naive Bayes—multinomial 332-333
    nearest neighbor 334-335
    passive aggressive 336-337
    perceptron 338-339
    quadratic discriminant analysis 340-341
    random forests 342-343
    support vector machine—
      linear kernel 344-345
    support vector machine—
      polynomial kernel 346-347
    support vector machine—
      radial basis kernel 349-350
  AmiBroker 267
  balancing class membership 350-351
  classification 292
  class weight 351
  confusion matrix 306-312, 350
  cost matrix 309-312, 350-351
  cross validation 302-306
  data and dates 268-272
  data independence 290-292
data mining  290
data preparation  314-318
date alignment  315
diagonal  308-312
domain knowledge  309
element independence  314-315
false negative  307-312
false positive  307-312
future leak  315
generalities  290-292
in-sample  310
interpolation  315
iris example  293-349
lagged values  291
linear scaling  317
linearly separable  302
logistic transformation  317-318
matrix algebra  309
misclassification costs  350-351
missing data  315
model evaluation  312
model fitting  310-312
model prediction  311
Murphy, Kevin  267
neural network  317
normalization  317
off-diagonal  308-312
outliers  315-318
out-of-sample  311
positive class  306-312
percent rank  317
precision  308
prediction  306-312
predictor variables  291, 298
Python  267-
regression  292
replacement  312-313
sample weight  351
scikit-learn  316
sequential covering  301
signals  272-274, 283-289
sliding window  316-318
softmax  317-318
standardization  316
stratified cross validation  304-306
stratified shuffle split  310-314
supervised  290-292
support vector machine  316
target variable  290, 316
trading  355-357

transformation  316-318
train / test split  310
true negative  307-312
true positive  307-312
TSDP coordination  382-383
TSDP translation  274-283
trading  351-3xxx
trading system simulator  278-283
Type I-IV errors  307-308
unbalanced classes  302
unsupervised  290
weight parameter  351
Winzorize  315
preliminaries  153-202
best estimate  154
constraints  176-182
entries and exits  165-168
indicators  161-165
learning  154
pattern recognition  158
perfect bottoms  165-168
prediction  183
purpose  183
simplification  157
two paths  154
two processes  155-156
trading system  156
trading management  156
validation  154

manifold learning  358
Margineantu  308
metaparameter  356
model examples:
   200 day moving average  170-174
   moving average cross  176-182
monitor:
   performance  16
Monte Carlo analysis:
   best estimate  67
   change  16
   compare single value  20
distributions  20
drawdown forecast  54
dynamic position sizing  67, 395-418
issue selection  125-152
performance  30
position size 31
risk management 67
moving horizon 388
msn:
  data 85, 113
Murphy, Kevin 267
mutual funds 15
naive Bayes:
  Gaussian 330-331
  multinomial 332-333
nasdaq 113
nearest neighbor 334-335
next day return 52
no guarantee 66
noise 27, 35, 157-158, 183
non-linear 16
Norgate Premium Data: 113, 225
  AmiBroker 81
  membership bias 225
normalization 356
numpy:
  library 20, 91
  model development 267
objective 16
objective function:
  CAR25 186
  define 28, 184-187
  construction 28
  custom 186
  development 29
  rank alternatives 29
  subjectivity 28, 29
  trader psychology 30
  trading management 29
  use 28
  universal 138, 186
offline 17
open market 15
optimum 191
optimization 189-192
  alternatives 189
  indicator-based 248-249
order placement 175
Ostermeier 192
outlier 315-317, 406-407
out-of-sample:
  confusion matrix 354
  define 28
  length of period 35, 195
  poor results 33, 195
  results important 37
  stationarity 193-196
  validation 28, 194-196
overfit 182
p greater than n 357-358
passive aggressive 336-337
Pandas:
  book 90
  dataframe 296, 356, 401
  library 20, 91
  McKinney 90
  model development 267
particle learning 388
patriotic 41
patterns:
  importance 26
  persistent 17
  precede trades 16, 22
  profitable 17
  recognize 16, 17
  signals 17
percentile 54
perceptron 338-339
perfection 192
performance:
  best estimate set of trades 30
  distribution 29
  estimates 29
  monitor 17
  Monte Carlo 30
  profit potential 29
  risk 29
  system health 29
pickle 362
pipeline 361
pivot date 359
population: distinguish 23
portfolio 143-144
position size:
  ballast funds 12
  Bayesian analysis 31
  CAR25 relationship 141
  computing 17, 19
  drawdown 19, 31, 58-59
  dynamic see dynamic position sizing
  fixed fraction 54
  fixed ratio 58
  fixed size 20, 58
  importance 16, 19, 31
  Kelly 58
  maximum safe 15
  model 19
  Monte Carlo 31
  not fixed size 31
  not stationary 31, 128, 156
  profit 19
  safe-f:
    defined 58-
    single contract 58
    synchronization 27
    trade-by-trade 17
    trading management 18, 19, 385-418
  posterior distribution 388
precision:
  classification 308, 352
  general 182, 249
  precompute 176
prediction:
  change 16
  purpose of system 16, 22, 183
  predictor variable 356
price 15
principal component 358
prior distribution 388, 419, 420
probabilistic 16
probability density function (pdf):
  defined 24
  histogram 55
  risk 55
process:
  control 388
  designing system 15
  modeling 16
  monitoring system 15
profit:
  oriented 16
  potential 124-144
  risk relationship 16
  synchronization 27
programming:
  environments 77-106
  required skill 77, 157
  machine learning 90-106
  Python 77, 90-106
  trading system development platform (TSDP) 77-89
prospecting 124
psychology:
  cognitive dissonance 31
  objective function 30, 187
  trader 30
p-value 16, 34
pyramiding 229-230
Pyle, Dorian 314
Python:
  see also model development
  Anaconda Spyder 267
  books 92
  environment 77, 90-106,
    267-xxxxxx
  file directories 294-295
  library stack 91
  trading system 365-373
  tutorial 91, 106
quadratic discriminant analysis 340-341
quality control 388
Quandl 88, 113, 365-366
quantify subjectivity 185
quantitative techniques:
  technical analysis 15
random forests 342-343, 358
Rawlings, James 388
reaction 16
recall:
  classification 308, 352-355, 373
recognize patterns 17, 22
regularization 358
repainting 174-175
reward:
  tradeoff 15, 16
rewards high 37
Richert, Willi 319
risk:
  acceptable 16, 17
  account growth 39
  accuracy 40
  control 42
  drawdown 39
  dynamic position sizing 39
  entries 39
  estimating 19
  exits 39
  holding period 40
  inherent in data 31
  issue selection 39, 40
  intra-trade 40
  limitation 16
  management 39
  maximum adverse excursion 43, 48
  measurement 39, 40
  normalized: 15
    best and worst trades 71-73
  oriented 16
  personal tolerance 39
  position sizing 39
  statement: 40
    account size 52
    CDF 53
    certainty 52
    example 52
    forecast horizon 52
    maximum drawdown 52
    personal 67
  synchronization 39
  system design 39
tolerance 16, 17, 31, 39-76, 385
  issue selection 125-152
  tradeoff 15, 16
  trade selection 39
  trading account 39
risk free:
  alternative 16
robust 192, 255, 361, 366, 406
Robins 397
Rogers, Will 49
root finding 176
roulette 35, 389-390, 420
safe-f:
  CAR25 relationship 141
    define 59, 135
  issue selection 124, 135
  mark-to-market 64
  risk tolerance 59
  trade-by-trade 59
  trading management 31
sample:
  distinguish 23
  estimate 24
  subset 24
scikit-learn:
  classification 20
  library 20, 91
  model development 267
  pattern recognition 20
  transformation 316-317
scipy:
  library 20, 91
  model development 267
search:
  evolutionary operation 192
  exhaustive 191
  non-exhaustive 191-192
  space 189-192
self deception 154
sensitivity 308, 407
sequential covering 301, 363
sequential learning 388, 395
shadow trades 395-406
Shah, Mohak 313
Sharpe ratio 25, 187
Shigezumi 388
short positions 44
risk 132-134

signals:
anticipate 175-176
generated 16
impulse 52
noise 27, 35, 157-158
precede trades 16, 157
patterns 17
state 52

Silver, Nate 27, 158

skewness:
define 25
stationary 16

slippage 188
softmax 317-318

Sortino ratio 187

SPY 50
Spyder:
Anaconda Python 101-103

standard deviation:
define 25

standardization 356

state signals 52, 168-170, 283-289
mark-to-market 168
test period boundary 169

stationary:
assumption of 26
bias 26
correlations are not 144
define 26
machine learning 359-360
nothing is 194
position size is not 128, 156
synchronization 193-196
theorems require 26
time series is not 26, 35, 193
trading difficulty 35, 193
walk forward 200

statistical significance 53
Statisticat 388
stay the course 386

stocks 15
stop trading, reasons 31-33
stratified K fold 373-374
stratified shuffle split 373-374
subjective 16, 125
quantifying 185

support vector machine 344-350, 358

synchronization:
data and model 26
drawdown 42
importance 26
position size 27
profit 27
stationarity 193-196
system health 27

system, trading:
auxiliary data 21
breakdown 17, 49, 67
confidence 16
health see health indicators 22
intermarket data 21
long / flat 125
managing 15
model + data 21
monitoring 15
objective function 28
parameters 16, 20-22
performance 15
prediction 16
profitable 16
purpose 16
requirements 16
rules 16
signals 16
single issue 125

table limit 389-390
tail risk 55, 57, 61, 138, 406, 408
takeoffs are optional 201
technical analysis:
charts 77
quantitative 77

terminal wealth relative (TWR):
CAR, related 127
define 60
metric 61
objective function 187
position size 60
Vince, Ralph 60
threshold 353
time series data:
different 36
not stationary 26, 36
toxic trades 187, 363--365
tradeoff, risk reward 15
trade quality:
best trades 67
buy and hold 67
risk-normalized 71-73
sweet spot 129-137
worst trades 70
trading management: 385-418
dynamic position sizing 31, 67
integrated approach 15, 16
Monte Carlo 67
overview 31
safe-f 31
stop trading 31-33
trading system:
development:
integrated approach 15
platform (TSDP) 16, 203-266, 382-383
model 16
RSI2 example 67-73
equity 68
listing 75
safe-f 70
statistics 69
trades 70
trades:
independence 20
train / test 373-375
transformation, data 21
trend following 34, 36, 160
triangular weighting 397, 404, 411
TSDP see trading system
UCI learning repository 293
uncertainty 35
US Treasury data 113
utility of money 52
validation 197-200
best estimate trades 198
machine learning 357-361, 373
walk forward 197-200
van Rossum, Guido 90
variance:
define 25
verify:
learning 16
Vince, Ralph 60
visible prices 43, 45
volatility:
maximum allowed 16
minimum required 16
volume 15
walk forward:
best estimate trades 198
confidence 34
define 197-200
gold standard 197
indicator-based 251-255
weights:
diffusion index 224
moving window 396-397
objective function 184
White queen 35
Winzorize 315
Yahoo:
data 85, 114
z-score 25
zig-zag 175