Index

σ-algebra, 169
p-quantile, 60
complement rule, 171
adapted process, 124
adjusted close price, 52
aggregate claim amount, 42
Ali-Mikhail-Haq copula, 221
annuity
   numéraire, 136
Area Under the Curve (AUC), 163
AUC, 163
autocovariance, 11
backtesting, 24
Bank for International Settlements, 135
Basel II, 144
Bayes formula, 152
Bernoulli distribution, 182
binomial
   distribution, 182
binomial logistic regression, 158
BIS, 135
bivariate exponential, 104
bivariate Gaussian, 91
Black-Cox model, 111, 116
bond
   defaultable, 127
   pricing PDE, 230
Borel-Cantelli Lemma, 172
business risk, v
catastrophe risk, v
Cauchy
   distribution, 179
causal, 4
causation, 89
CDO, 139
CDS, 135
characteristic
   function, 194
cohert risk measure, 54
cointegration, 22
collateralized debt obligation, 139
complex unit circle, 11, 203
compound Poisson
   process, 36
conditional
   expectation, 71, 187, 196
   probability, 173
   survival probability, 121
Conditional Tail Expectation, 71
Conditional tail expectation
   Gaussian, 73
conditioning, 173
Consumer Price Index, 51
contract
   credit default, 119
copula, 103
   Ali-Mikhail-Haq, 221
   exponential, 104
   survival, 105
correlation, 89
counterparty risk, v
counting process, 29, 31
covariance, 11
Cox process, 33
Cramér-Lundberg model, 44
credit default
   reduced-form approach, 121
   structural approach, 107
credit default contract, 119
credit default swap, 135, 137
credit valuation, 135
adjustment, 147

cross-covariance, 11

CTE
  Gaussian, 73
cumulant, 42
cumulative distribution function, 55, 178
  joint, 180
cVA, 147
defaultable bonds, 130
default rate, 123
density
  function, 177
  marginal, 181
dickey-Fuller test, 13
discrete distribution, 182
discretization index, 32
distorted risk measure, 75
distortion function, 55, 75
distribution
  Bernoulli, 182
  binomial, 182
  bivariate exponential, 104
  Cauchy, 179
  discrete, 182
  exponential, 178
gamma, 179
  Gaussian, 178
  geometric, 182
  Gumbel bivariate, 104
  lognormal, 179
  marginal, 190
  negative binomial, 183
  Pareto, 66, 209
  Pascal, 183
  Poisson, 183
  uniform, 178
diversification, 55
domino effect, 114
domino effect, 114

enlarge processes, 36
enlargement of filtration, 127
equity holder, 108
event, 169
event risk, v
expectation, 184
  conditional, 71, 187, 196
expected shortfall, 74
exponential
distribution, 123
exponential distribution, 34, 178
failure rate, 122
False Positive Rate, 162

Fatou’s lemma, 172
filtration
  enlargement of, 127
financial risk, v
formula
  Bayes, 152
FPR, 162
gamma
  distribution, 179
  function, 179
Gaussian
  bivariate, 91
  distribution, 178
  random variable, 195
Gaussian conditional tail expectation, 73
Gaussian Value at Risk, 64
generalized inverse, 60
generating function, 194
geometric
distribution, 182
gross market value, 135
Guaranteed maturity benefits, 54
Gumbel bivariate logistic distribution, 104
hedge ratio, 21
historical measure, 107
HJM
  model, 126
independence, 71, 173, 175, 177, 181, 183, 188, 195, 199
indicator function, 175
infimum, 183
insolvency, 60
Internal Ratings-Based formula, 144
investment risk, v
IRB formula, 144
Japan/U.S. Foreign Exchange Rate, 51
joint
  cumulative distribution function, 180
  probability density function, 180
key lemma, 126
KPSS test, 15
lag operator, 2, 3, 6
law
  of total expectation, 190
  of total probability, 171, 174, 190
least square regression, 20
liability, 53
likelihood ratio, 154
logistic regression, 158
logit, 159
Notes on Financial Risk

lognormal
distribution, 179

macro-economic shock, 105
marginal
density, 181
distribution, 190
Marshall-Olkin bivariate exponential, 104
mean-square distance, 198
measure
historical, 107
physical, 107
model
Cramér-Lundberg, 44
moment
generating function, 194
moving average, 4

negative
binomial distribution, 183
net present value, 145
non-causal, 4
notional, 137
notional amount, 135
NPV, 145

OLS, 20
operational risk, v

pair trading, 19
Pareto distribution, 66, 209
partition, 174, 196
Pascal distribution, 183
physical measure, 107
Poisson
compound martingale, 36
distribution, 183
process, 29, 123
premium, 21
pure, 55
probability
acceptance curve, 152
conditional, 173
default curve, 152, 165
density function, 177
joint, 180
distribution, 177
measure, 171
sample space, 167
space, 172
process
counting, 29
Cox, 33
quantmod, 16, 51

R code, 12, 25, 35, 36, 38, 71, 80, 99–102, 164, 185, 188, 213
R package
quantmod, 16, 51
tseries, 15
random
product, 192
sum, 191
variable, 175
rate
default, 123
Receiver Operating Characteristics (ROC), 162
recovery rate, 127, 128
recovery value, 110
reduced-form approach, 121
regression
logistic, 158
reserve process, 42
risk measure, 52
coherent, 54
pure premium, 55
ROC, 162
Sklar’s theorem, 95
solvency, 60
spread, 21
St. Petersburg paradox, 186
stationary
strictly, 10
weakly, 10
stochastic
default, 123
stopping time, 124
strictly stationary, 10
strong Markov property, 34
structural approach, 107
surplus process, 42
survival copula, 105
survival probability, 121
Tail Value at Risk, 70, 87
telescoping sum, 7
tenor structure, 128, 135
test
Dickey-Fuller, 13
KPSS, 15
theorem
Sklar, 95
tower property, 189, 193, 199, 229
TPR, 162
True Positive Rate (TPR), 162
N. Privault

tseries, 15
uniform distribution, 178
unit circle, 11
root test, 10
unit circle, 203

Value at Risk
Gaussian, 64
value at risk, 60
variance, 191
weakly stationary, 10
white noise, 1

XVA, 145
Author index

Aas, K. 145
Bhatia, M. 115
Black, F. 111
Bosq, D. 31
Brigo, D. 148

Castellacci, G. 139, 148, 233
Chen, R.R. 128
Cheng, X. 128
Chourdakis, K. 148
Çınlar, E. 177
Cont, R. 41
Cox, J.C. 111

De Vylder, F. 47
Dellacherie, C. 125
Devore, J.L. 167
Dickey, D. 13, 22
Dozzi, M. 48

Einhorn, D. 69
Elliott, R.J. 125, 127
Enders, W. 22
Engle, R.F. 22

Fabozzi, F. 128
Finger, C.C. 115
Fuller, W. 13, 22

Gibson, M. 116
Gourieroux, C. v
Granger, C.W.J. 22
Grasselli, M.R. 107, 111
Guo, X. 124
Gupton, G.M. 115

Hamilton, J.D. 14
Huang, J.Z. 128
Hull, J. 116

Hurd, T.-R. 107, 111
Ignatova, G. 47
Ishikawa, K. 25

Jacod, J. 127, 167
Jarrow, R. 124
Jasiak, J. v
Jeanblanc, M. 125, 127
Jeulin, Th. 127
Jones, S. 115

Kaishev, V. 47
Kallenberg, O. 200
Krachunov, R. 47
Krehbiel, T. 116

Lando, D. 124
Lee, S. 115
Lefèvre, C. 47
Li, D.X. 114, 116
Li, W.P. 116
Liu, B. 128
Loève, M. 95
Loisel, S. 47

Maisonneuve, B. 125
Masetti, M. 148
Menn, C. 124
Merton, R.C. 107, 116, 144
Meyer, P.A. 125
Milne, J.S. 239

Nguyen, H.T. 31
Norris, J.R. 34

Picard, D. 47
Pitman, J. 167
Poisson, S.D. 29
Pourahmadi, M. 10
Privault, N. 47

This version: September 13, 2020
https://www.ntu.edu.sg/home/nprivault/index.html
Protter, P. 125, 167
Rullière, D. 47
Salmon, F. 115
Shreve, S. 111
Slark, M. 95
Stroock, D.W. 198
Takayanagi, S. 25
Tankov, P. 41
Vallois, P. 48
Vašíček, O. 116, 144
Wei, X. 47
White, A. 116
Yor, M. 125, 127

This version: September 13, 2020
https://www.ntu.edu.sg/home/nprivault/index.html
References


Notes on Financial Risk


These notes cover some aspects of financial risk and analytics. This includes classical topics such as Value at Risk and expected shortfall, as well as structures of random dependence. Credit default is treated via defaultable bonds, Credit Default Swaps (CDS) and collateralized debt obligations (CDOs), based on stochastic calculus. Basic risk Theory and credit scoring are presented with examples in R. The concepts presented are illustrated by examples and by 42 exercises with their complete solutions.