

DECLARATION

I, Suparna Biswas, hereby declare that the work contained in the thesis titled “**Estimation and Applications of Some Risk Measures in Finance**” is a bonafide research undertaken by me, a student in the Department of Mathematical Sciences, Tezpur University, under the guidance of Dr. Santanu Dutta for the award of Doctor of Philosophy and that this work has not been submitted elsewhere for a degree.

August, 2017

Suparna Biswas
Department of Mathematical Sciences
Tezpur University

TEZPUR UNIVERSITY



*Dr. Santanu Dutta,
Dept. of Mathematical Sciences
Napaam-784028, Assam, India*

*Phone(Ext.): 03712-27-5508
9707454982(M)
E-mail: sdutta@tezu.ernet.in*

CERTIFICATE OF THE SUPERVISOR

This is to certify that the thesis entitled “**Estimation and Applications of Some Risk Measures in Finance**” submitted to the School of Sciences of Tezpur University in partial fulfilment for the award of the degree of Doctor of Philosophy in Mathematical Sciences is a record of research work carried out by **Ms. Suparna Biswas** under my supervision and guidance. All help received by her from various sources have been duly acknowledged.

No part of this thesis have been submitted elsewhere for award of any other degree.

Place: Tezpur

Date:

Dr. Santanu Dutta
Department of Mathematical Sciences
School of Sciences
Tezpur University, Assam

Publications, Communication and Awards

PUBLICATIONS

1. Biswas, S. and Dutta, S. Assessing market risk of Indian Index Funds. *Global Business Review*, **16**(3):511-523, 2015.
2. Dutta, S. and Biswas, S. Extreme quantile estimation based on financial time series. *Communications in Statistics-Simulation and Computation*, **46**(6), 2017.
3. Dutta, S. and Biswas, S. Nonparametric estimation of $100(1 - p)$ percent expected shortfall: $p \rightarrow 0$ as sample size is increased. *Communications in Statistics-Simulation and Computation*, 2016, DOI:10.1080/03610918.2016.1152370.

PAPER COMMUNICATED

1. Biswas, S and Dutta, S. Comparing market risk of Indian balanced and small & mid cap Funds. communicated in the journal IIMB Management Review.

AWARDS

Best poster award in the conference ‘Statistical Methods in Finance 2016’ held at CMI

1. Dutta, S. & Biswas, S. Nonparametric estimation of $100(1 - p)$ percent expected shortfall: $p \rightarrow 0$ as sample size is increased, *Communications in Statistics-Simulation and Computation*, 2016, DOI:10.1080/03610918.2016.1152370.

Acknowledgement

I express my thanks and gratitude to my supervisor Dr. Santanu Dutta for his inspiration, supervision, and his help in writing some of the R codes and proofs. I thank my Doctoral Committee Members Prof. Munindra Borah and Prof. Munmun Hazarika, Department of Mathematical Sciences, Tezpur University.

I am grateful to Prof. Mihir Kanti Chaudhuri, Vice-Chancellor, Tezpur University for his inspiration and providing all the necessary facilities for the research scholars. I thank and acknowledge the help and support of head of the Department of Mathematical Sciences, Tezpur University. Also, I am thankful to all other faculty and staff members of the Department of Mathematical Sciences, Tezpur University, for their help and support.

I am fortunate to have great friends Pinkimani, Junali, Pearl, Jayanta, Zakir, Pallabi, Dimpal, Momi, Nilufar, Parama, Ajay, Jutirekha, Sougata, Moon Moon, Kuwali, Subhajit, Subha, Deepak, Mandeep, Shyamalima, Momina, Gayatri and Yogendra. I thank them for their encouragement. I thank Dr. Pinky Dutta, a research scholar of the Department of Business Administration, Tezpur University, for her help.

My sincere thanks and regards to my parents. I am deeply indebted to them for their blessing, love, patience, inspiration and special care. They have an immense influence on my life. Also, I thank my younger brother and Gokul for their love and support.

I thank and acknowledge the research grant(F1-17.1/2013-14/RGNF-2013-14-SC-ASS-38478) received from the University Grants Commission(UGC), India for supporting my research in the form of Rajiv Gandhi National Fellowship(RGNF).

August, 2017

(Suparna Biswas)

List of Tables

2.1	Ratios estimated at 99% for i.i.d. cases.	27
2.2	Bias/sd estimated at 99% for i.i.d. cases.	28
2.3	Ratios estimated at 99% for dependent cases.	29
2.4	Bias/sd estimated for ARMA models at 99%.	30
2.5	Bias/sd estimated for GARCH models at 99%.	31
2.6	Ratios estimated for i.i.d. cases with varying p	32
2.7	Bias/sd estimated for i.i.d. cases with varying p	33
2.8	Ratios estimated for ARMA model with varying p	34
2.9	Bias/sd estimated for ARMA model with varying p	35
2.10	Ratios estimated for GARCH model with varying p	36
2.11	Bias/sd estimated for GARCH model with varying p	37
2.12	Ratios estimated under netting condition at 99%.	38
2.13	Bias/sd estimated under netting condition at 99%.	38
2.14	Ratios estimated under netting condition with varying p	38
2.15	Bias/sd estimated under netting condition with varying p	39
3.1	Ratios estimated for Student's t distribution and GARCH model with varying p	51
3.2	Estimating ES of nifty returns at 99% and 99.9%.	51
3.3	Ratios estimated for i.i.d. cases with varying p	52
3.4	Ratios estimated for ARMA model with varying p	53
3.5	Ratios estimated for GARCH model with varying p	54
3.6	Ratios estimated under netting condition with varying p	55
4.1	VaR of returns of the Nifty Index Funds.	64
4.2	VaR of returns of the Sensex Index Funds.	65
4.3	ES of returns of the Nifty Index Funds.	66
4.4	ES of returns of the Sensex Index Funds.	67
4.5	Sharpe Ratio of the Nifty Index Funds.	67

4.6	Sharpe Ratio of the Sensex Index Funds.	68
4.7	Treynor Ratio of the Nifty Index Funds for daily returns.	68
4.8	Treynor Ratio of the Nifty Index Funds for monthly returns.	69
4.9	Treynor Ratio of the Sensex Index Funds for daily returns.	69
4.10	Treynor Ratio of the Sensex Index Funds for monthly returns.	69
4.11	List of fund managers of the Nifty Index Funds.	70
4.12	List of fund managers of the Sensex Index Funds.	70
5.1	Estimating VaR of the Balanced funds(Growth) at 99%.	85
5.2	Estimating VaR of the Balanced funds(Dividend) at 99%.	85
5.3	Estimating VaR of the Small & Mid Cap(Growth) at 99%.	86
5.4	Estimating VaR of the Small & Mid Cap(Dividend) at 99%.	86
5.5	Estimating VaR of the Large Cap funds(Growth) at 99%.	87
5.6	Estimating VaR of the Large Cap funds(Dividend) at 99%.	88
5.7	Comparing the statistics of VaR estimates (Growth).	88
5.8	Comparing the statistics of VaR estimates (Dividend).	89
5.9	Estimating ES of the Balanced funds(Growth) at 99%.	89
5.10	Estimating ES of the Balanced funds(Dividend) at 99%.	89
5.11	Estimating ES of the Small & Mid Cap(Growth) at 99%.	90
5.12	Estimating ES of the Small & Mid Cap(Dividend) at 99%.	90
5.13	Estimating ES of the Large Cap funds(Growth) at 99%.	91
5.14	Estimating ES of the Large Cap funds(Dividend) at 99%.	92
5.15	Comparing the statistics of ES estimates (Growth).	93
5.16	Comparing the statistics of ES estimates (Dividend).	93
5.17	Estimating Sharpe Ratio of the Balanced funds(Growth).	94
5.18	Estimating Sharpe ratio of the Balanced funds(Dividend).	94
5.19	Estimating Sharpe Ratio of the Small & Mid Cap(Growth).	95
5.20	Estimating Sharpe Ratio of the Small & Mid Cap(Dividend).	95
5.21	Estimating Sharpe Ratio of the Large Cap funds(Growth).	96
5.22	Estimating Sharpe ratio of the Large Cap funds(Dividend).	96
5.23	Comparing the statistics of Sharpe Ratio (Growth).	97
5.24	Comparing the statistics of Sharpe Ratio (Dividend).	97
5.25	Estimating Value Research Fund Risk for Balanced(Growth).	98
5.26	Estimating Value Research Fund Risk of the Balanced funds(Dividend).	98
5.27	Estimating Value Research Fund Risk of the Small & Mid Cap(Growth).	99
5.28	Estimating Value Research Fund Risk of the Small & Mid Cap(Dividend).	99

5.29	Estimating Value Research Fund Risk for Large Cap(Growth).	100
5.30	Estimating Value Research Fund Risk of the Large Cap funds(Dividend). . .	101
5.31	Comparing the statistics of Value Research Fund Risk (Growth).	101
5.32	Comparing the statistics of Value Research Fund Risk (Dividend).	101
A.1	List of index funds imitating Nifty	102
A.2	List of index funds imitating Sensex.	103
A.3	List of Balanced funds for growth option.	103
A.4	List of Balanced funds for dividend options.	103
A.5	List of Small & Mid cap funds for growth options.	104
A.6	List of Small & Mid cap funds for dividend option.	104
A.7	List of Large cap funds for growth option.	105
A.8	List of Large cap funds for dividend option.	106

List of Notations

$X_n \xrightarrow{d} N(0, \sigma^2)$	$\{X_n\}$ converge in distribution to a normal random variable with mean 0 and variance σ^2 as $n \rightarrow \infty$.
$a_n = o(b_n)$	$\lim_{n \rightarrow \infty} \frac{a_n}{b_n} = 0$.
$a_n = O(b_n)$	$\{ \frac{a_n}{b_n} \}$ is a bounded sequence.
X^+	$\max\{X, 0\}$, for any random variable X .
$I_A(w)$	Equals 1 for $w \in A$ and equals 0 otherwise.
$E(X A)$	Conditional expectation of a random variable X given the event A .
a.s.	Almost surely.
i.i.d.	Independent and identically distributed.
GPD	Density function of Generalized Pareto Distribution is $\frac{1}{\sigma}(1 + \frac{\xi(x-\mu)}{\sigma})^{-(\frac{1}{\xi}+1)}$, $x \geq \mu$ for $\xi \geq 0$ and $\mu \leq x \leq \mu - \frac{\sigma}{\xi}$ for $\xi < 0$, where ξ is the shape parameter.
Student's t distribution	Density function is $\frac{\Gamma(\frac{\nu+1}{2})}{\sqrt{\nu\pi}\Gamma(\frac{\nu}{2})}(1 + \frac{x^2}{\nu})^{-(\frac{\nu+1}{2})}$, where $\nu > 0$ is the degrees of freedom and $x \in (-\infty, +\infty)$.
VaR	Value-at-risk.
ES	Expected shortfall.
MS	Median shortfall.
MSE	Mean squared error.
NAV	Net asset value.