

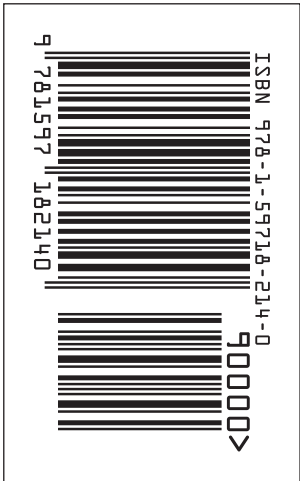
Financial Econometrics Using Stata is an essential reference for graduate students, researchers, and practitioners who use Stata to perform intermediate or advanced methods. After discussing the characteristics of financial time series, the authors provide introductions to ARMA models, univariate GARCH models, multivariate GARCH models, and applications of these models to financial time series. The last two chapters cover risk management and contagion measures. After a rigorous but intuitive overview, the authors illustrate each method by interpreting easily replicable Stata examples.

Simona Boffelli, PhD, is a quantitative analyst at Fineco Bank in Milan, part of the Unicredit Group. She is a researcher associate to the Department of Management, Economics and Quantitative Methods of Bergamo University in Italy and to the Centre for Econometric Analysis of Cass Business School in London. Her research interests are in financial econometrics, with focus on risk management, contagion analysis, and the assessment of linkages between macroeconomics and financial markets. She has published in the *International Journal of Forecasting*, *International Journal of Money and Finance*, and *Journal of Financial Econometrics*.

Giovanni Urga, PhD, is a professor of finance and econometrics and the director of the Centre for Econometric Analysis at Cass Business School in London, and is a professor of econometrics at the Department of Management, Economics and Quantitative Methods of Bergamo University in Italy. His research interests are in financial econometrics, panel data, modeling risk and cross-market correlations, asset pricing, structural breaks, modeling common stochastic trends, and credit spreads. He has published in the *Journal of Econometrics*, *Journal of Business and Economic Statistics*, *Economics Letters*, *Econometric Theory*, *Oxford Bulletin of Economics and Statistics*, *Journal of Applied Econometrics*, *International Journal of Forecasting*, *International Journal of Money and Finance*, *Journal of Financial Econometrics*, and others. He is an associate editor for *Empirical Economics* and has been a guest editor for the *Journal of Econometrics* and the *Journal of Business and Economic Statistics*.

Telephone: 979-696-4600
800-782-8272
800-STATAPC
Fax: 979-696-4601

service@stata-press.com
stata-press.com



**BOFFELLI
URGA**

**FINANCIAL ECONOMETRICS
USING STATA**



Financial Econometrics Using Stata



**SIMONA BOFFELLI
GIOVANNI URGA**

**STATA
Press**

**STATA
Press**

**STATA
Press**

Financial Econometrics Using Stata

SIMONA BOFFELLI

University of Bergamo (Italy) and Centre for Econometric Analysis, Cass Business School, City University London (UK)

GIOVANNI URGÀ

Centre for Econometric Analysis, Cass Business School, City University London (UK) and University of Bergamo (Italy)



STATA® *Press*

A Stata Press Publication
StataCorp LP
College Station, Texas



® Copyright © 2016 StataCorp LP
All rights reserved. First edition 2016

Published by Stata Press, 4905 Lakeway Drive, College Station, Texas 77845

Typeset in L^AT_EX 2_ε

Printed in the United States of America

10 9 8 7 6 5 4 3 2 1

Print ISBN-10: 1-59718-214-1

Print ISBN-13: 978-1-59718-214-0

ePub ISBN-10: 1-59718-215-X

ePub ISBN-13: 978-1-59718-215-7

Mobi ISBN-10: 1-59718-216-8

Mobi ISBN-13: 978-1-59718-216-4

Library of Congress Control Number: !!

No part of this book may be reproduced, stored in a retrieval system, or transcribed, in any form or by any means—electronic, mechanical, photocopy, recording, or otherwise—without the prior written permission of StataCorp LP.

Stata, **stata**, Stata Press, Mata, **mata**, and NetCourse are registered trademarks of StataCorp LP.

Stata and Stata Press are registered trademarks with the World Intellectual Property Organization of the United Nations.

NetCourseNow is a trademark of StataCorp LP.

L^AT_EX 2_ε is a trademark of the American Mathematical Society.

Contents

	List of figures	ix
	Preface	xiii
	Notation and typography	xv
1	Introduction to financial time series	1
1.1	The object of interest	1
1.2	Approaching the dataset	2
1.3	Normality	8
1.4	Stationarity	14
1.4.1	Stationarity tests	17
1.5	Autocorrelation	22
1.5.1	ACF	22
1.5.2	PACF	25
1.6	Heteroskedasticity	26
1.7	Linear time series	30
1.8	Model selection	31
1.A	How to import data	33
2	ARMA models	37
2.1	Autoregressive (AR) processes	37
2.1.1	AR(1)	37
2.1.2	AR(p)	46
2.2	Moving-average (MA) processes	47
2.2.1	MA(1)	47
2.2.2	MA(q)	53
2.2.3	Invertibility	54

2.3	Autoregressive moving-average (ARMA) processes	54
2.3.1	ARMA(1,1)	54
2.3.2	ARMA(p,q)	58
2.3.3	ARIMA	58
2.3.4	ARMAX	58
2.4	Application of ARMA models	58
2.4.1	Model estimation	61
2.4.2	Postestimation	70
2.4.3	Adding a dummy variable	75
2.4.4	Forecasting	78
3	Modeling volatilities, ARCH models, and GARCH models	81
3.1	Introduction	81
3.2	ARCH models	82
3.2.1	General options	85
	ARCH	85
	Distribution	86
3.2.2	Additional options	91
	ARIMA	91
	The het() option	92
	The maximize_options options	94
3.2.3	Postestimation	95
3.3	ARCH(p)	99
3.4	GARCH models	101
3.4.1	GARCH(p,q)	101
3.4.2	GARCH in mean	110
3.4.3	Forecasting	111
3.5	Asymmetric GARCH models	114
3.5.1	SAARCH	116
3.5.2	TGARCH	116
3.5.3	GJR-GARCH	117

3.5.4	APARCH	118
3.5.5	News impact curve	121
3.5.6	Forecasting comparison	123
3.6	Alternative GARCH models	126
3.6.1	PARCH	126
3.6.2	NGARCH	127
3.6.3	NGARCHK	128
4	Multivariate GARCH models	131
4.1	Introduction	131
4.2	Multivariate GARCH	132
4.3	Direct generalizations of the univariate GARCH model of Bollerslev	134
4.3.1	Vech model	134
4.3.2	Diagonal vech model	136
4.3.3	BEKK model	137
4.3.4	Empirical application	138
	Data description	138
	Dvech model	142
4.4	Nonlinear combination of univariate GARCH—common features . .	148
4.4.1	Constant conditional correlation (CCC) GARCH	149
	Empirical application	151
4.4.2	Dynamic conditional correlation (DCC) model	158
	Dynamic conditional correlation Engle (DCCE) model . . .	158
	Empirical application	160
	Dynamic conditional correlation Tse and Tsui (DCCT) . . .	174
	Prediction	183
4.5	Final remarks	186
5	Risk management	187
5.1	Introduction	187
5.2	Loss	188
5.3	Risk measures	189

5.4	VaR	190
5.4.1	VaR estimation	191
5.4.2	Parametric approach	191
5.4.3	Historical simulation	206
5.4.4	Monte Carlo simulation	210
5.4.5	Expected shortfall	216
5.5	Backtesting procedures	217
5.5.1	Unilevel VaR tests	218
	The unconditional coverage test	218
	The independence test	221
	The conditional coverage test	223
	The duration tests	224
6	Contagion analysis	227
6.1	Introduction	227
6.2	Contagion measurement	229
6.2.1	Cross-market correlation coefficients	229
	Empirical exercise	231
6.2.2	ARCH and GARCH models	236
	Empirical exercise	238
	Markov switching	243
6.2.3	Higher moments contagion	251
	Empirical exercise	252
	Glossary of acronyms	259
	References	261
	Author index	267
	Subject index	269