



# ***Introduction to Statistics and Econometrics***

***Rolando A. Danao***

UNIVERSITY OF THE PHILIPPINES PRESS

**INTRODUCTION TO  
STATISTICS AND ECONOMETRICS**

---



# INTRODUCTION TO STATISTICS AND ECONOMETRICS

**Rolando A. Danao**

University of the Philippines Press  
2002



Published by the University of the Philippines Press  
E. de los Santos St., U.P. Campus, Diliman, Quezon City  
Tel. Nos. 928-2558/925-3243  
E-mail: [press@up.edu.ph](mailto:press@up.edu.ph)

© 2002 by Rolando Danao

All rights reserved. No copies of this book can be made in any form or by any means, electronic or mechanical, including photocopying, recording, scanning or by any information storage or retrieval system, without permission in writing from the author.

Book and Cover Design  
*Arwin Ayson*

ISBN 971-542-355-8

Printed in the Philippines

# CONTENTS

---

Preface ix

- 1 PROBABILITY 1
  - 1.1 Sample Spaces and Events 1
  - 1.2 Intuitive and Abstract Probability 2
  - 1.3 Conditional Probability 8
  - 1.4 Independent Events 9
  - 1.5 Summary 12
  - Exercises 13
  
- 2 RANDOM VARIABLES AND PROBABILITY DISTRIBUTIONS 17
  - 2.1 Random Variables 17
  - 2.2 Joint Probability Distributions 27
  - 2.3 Marginal and Conditional Distributions 31
  - 2.4 Conditional Distribution and Independent Random Variables 32
  - 2.5 Mathematical Expectation 35
  - 2.6 Special Mathematical Expectations 39
  - 2.7 Summary 42
  - Exercises 44
  
- 3 SPECIAL PROBABILITY DISTRIBUTIONS 47
  - 3.1 Introduction 47
  - 3.2 The Normal Distribution 47
  - 3.3 The Gamma and Chi-Square Distributions 54
  - 3.4 The  $t$  and  $F$  Distributions 58
  - 3.5 Summary 62
  - Exercises 63

- 4 ESTIMATION AND HYPOTHESIS TESTING 67
  - 4.1 Random Samples 67
  - 4.2 Point Estimation 73
  - 4.3 Some Methods of Estimation 79
  - 4.4 Interval Estimation 84
  - 4.5 Hypothesis Testing 87
  - 4.6 Summary 94
    - Exercises 96
  
- 5 ECONOMETRIC MODELS AND ECONOMIC DATA 99
  - 5.1 Econometric Models 99
  - 5.2 Variables 101
  - 5.3 Basic Functional Forms 102
  - 5.4 Data 109
  - 5.5 Data Presentation 112
  - 5.6 Summary Measures of Data 116
  - 5.7 Summary 119
    - Appendix to Chapter 5: Using the Computer 121
    - Introduction to EViews 3* 121
    - Exercises 128
  
- 6 SIMPLE LINEAR REGRESSION 133
  - 6.1 The Classical Simple Linear Regression Model 133
  - 6.2 Estimation of the Regression Coefficients 137
  - 6.3 Distribution of the Least Squares Estimators 148
  - 6.4 Goodness-of-Fit: the Coefficient of Determination  $R^2$  152
  - 6.5 Significance of the Regression Coefficient: *The t Test* 157
  - 6.6 Significance of the Regression Equation: *The F Test* 160
  - 6.7 Normality of the Residuals: *The Jarque-Bera Test* 162
  - 6.8 Forecasting 163
  - 6.9 Summary 169
    - Appendix to Chapter 6: Using the Computer 171
    - Least Squares Estimation in EViews 3* 171
    - Exercises 179
  
- 7 MULTIPLE LINEAR REGRESSION 185
  - 7.1 The Classical Multiple Linear Regression Model 185
  - 7.2 The Multiple Linear Regression Model in Matrix Form 188
  - 7.3 Estimation of the Regression Coefficients 190

7.4	Distribution of the Least Squares Estimator	194
7.5	Goodness-of-Fit: The Adjusted Coefficient of Determination	196
7.6	Significance of the Regression Coefficients: <i>The t Test</i>	197
7.7	Significance of the Regression Equation: <i>The F Test</i>	201
7.8	Forecasting	203
7.9	Testing Linear Equality Restrictions on the Coefficients	206
7.10	Testing for Structural Stability	213
7.11	Summary	216
	Appendix to Chapter 7: Using the Computer	217
	Exercises	219
8	PROBLEMS IN LINEAR REGRESSION	225
8.1	Multicollinearity	226
8.2	Serial Correlation	236
8.3	Heteroskedasticity	257
8.4	Stochastic Regressors	270
8.5	Specification Errors	271
8.6	Errors in Variables	277
8.7	Nonnormality of the Error Terms	279
8.8	Error Terms with Nonzero Mean	280
8.9	Summary	281
	Appendix to Chapter 8: Using the Computer	286
	Exercises	290
9	SELECTED TOPICS IN ECONOMETRICS	297
9.1	Dummy Explanatory Variables	297
9.2	Lag Models	308
9.3	Granger Causality	315
9.4	Stochastic Time Series	317
9.5	Stationarity	318
9.6	The Autocorrelation Function	321
9.7	Unit Roots	326
9.8	Cointegration	336
9.9	Summary	340
	Appendix to Chapter 9: Using the Computer	343
	Exercises	344



10	SIMULTANEOUS-EQUATIONS MODELS	351
10.1	Introduction	351
10.2	Description of Econometric Simultaneous-Equations Models	352
10.3	Simultaneous-Equations Bias	355
10.4	The Identification Problem	356
10.5	Methods of Estimation	364
10.6	Summary	371
	Appendix to Chapter 10: Using the Computer	373
	Exercises	376
	Appendix: Statistical Tables	379
	Table 1. Cumulative Standard Normal Distribution	380
	Table 2. Percentiles of the $t$ Distribution	381
	Table 3. Percentiles of the Chi-Squared Distribution	382
	Table 4a. 95th Percentiles of the $F$ Distribution	384
	Table 4b. 99th Percentiles of the $F$ Distribution	388
	Table 5a. Durbin-Watson $d$ Statistic: 5% Significance Points of $d_L$ and $d_U$	392
	Table 5b. Durbin-Watson $d$ Statistic: 1% Significance Points of $d_L$ and $d_U$	398
	References	405
	Index	409