Third Edition

ESSENTIAL STATISTICS IN BUSINESS AND ECONOMICS



David P. Doane | Lori E. Seward



Essential Statistics

in Business and Economics

Third Edition

David P. Doane

Oakland University

Lori E. Seward

University of Colorado





ESSENTIAL STATISTICS IN BUSINESS AND ECONOMICS

Published by McGraw-Hill Education, 2 Penn Plaza, New York, NY 10121. Copyright © 2020 by McGraw-Hill Education. All rights reserved. Printed in the United States of America. No part of this publication may be reproduced or distributed in any form or by any means, or stored in a database or retrieval system, without the prior written consent of McGraw-Hill Education, including, but not limited to, in any network or other electronic storage or transmission, or broadcast for distance learning.

Some ancillaries, including electronic and print components, may not be available to customers outside the United States.

This book is printed on acid-free paper.

1 2 3 4 5 6 7 8 9 LWI 21 20 19 18

ISBN 978-1-260-54764-1 MHID 1-260-54764-7

Cover Image: ODe Visu/Shutterstock

All credits appearing on page or at the end of the book are considered to be an extension of the copyright page.

The Internet addresses listed in the text were accurate at the time of publication. The inclusion of a website does not indicate an endorsement by the authors or McGraw-Hill Education, and McGraw-Hill Education does not guarantee the accuracy of the information presented at these sites.

BRIEF CONTENTS

Overview of Statistics 2

Data Collection 22

CHAPTER THREE
Describing Data Visually 56

CHAPTER FOUR
Descriptive Statistics 104

CHAPTER FIVE
Probability 166

CHAPTER SIX
Discrete Probability Distributions 206

CHAPTER SEVEN
Continuous Probability Distributions 242

CHAPTER EIGHT
Sampling Distributions and Estimation 280

One-Sample Hypothesis Tests 326

Two-Sample Hypothesis Tests 366

CHAPTER ELEVEN
Analysis of Variance 416

CHAPTER TWELVE Simple Regression 444

CHAPTER THIRTEEN
Multiple Regression 508

CHAPTER FOURTEEN
Chi-Square Tests 564

APPENDIXES

A Binomial Probabilities 598

B Poisson Probabilities 600

C-1 Standard Normal Areas 603

C-2 Cumulative Standard Normal Distribution 604

D Student's t Critical Values 606

E Chi-Square Critical Values 607

F Critical Values of $F_{.10}$ 608

G Solutions to Odd-Numbered Exercises 616

H Answers to Exam Review Questions 637

Writing and Presenting Reports 639

J Excel Statistical Functions 644

INDEX 650

CONTENTS

Chapter Exercises 154

CHAPTER ONE	CHAPTER FIVE
Overview of Statistics 2	Probability 166
 1.1 What Is Statistics? 3 1.2 Why Study Statistics? 5 1.3 Statistics in Business 7 1.4 Statistical Challenges 9 1.5 Critical Thinking 15 Chapter Summary 17 Chapter Exercises 18 	 5.1 Random Experiments 167 5.2 Probability 169 5.3 Rules of Probability 173 5.4 Independent Events 178 5.5 Contingency Tables 182 5.6 Tree Diagrams 189 5.7 Bayes' Theorem 191 5.8 Counting Rules 195
CHAPTER TWO	Chapter Summary 199
Data Collection 22	Chapter Exercises 200
 2.1 Variables and Data 23 2.2 Level of Measurement 27 2.3 Sampling Concepts 31 2.4 Sampling Methods 34 2.5 Data Sources 43 	CHAPTER SIX Discrete Probability Distributions 206 6.1 Discrete Probability Distributions 207 6.2 Expected Value and Variance 210
2.6 Surveys 44 Chapter Summary 49 Chapter Exercises 50	 6.3 Uniform Distribution 214 6.4 Binomial Distribution 216 6.5 Poisson Distribution 223 6.6 Hypergeometric Distribution 229 6.7 Transformations of Random Variables
CHAPTER THREE	(Optional) 232
Describing Data Visually 56 3.1 Stem-and-Leaf Displays and Dot Plots 57 3.2 Frequency Distributions and Histograms 62	Chapter Summary 235 Chapter Exercises 236
3.3 Effective Excel Charts 70	CHAPTER SEVEN
3.4 Line Charts 71	Continuous Probability Distributions 242
 3.5 Column and Bar Charts 75 3.6 Pie Charts 79 3.7 Scatter Plots 81 3.8 Tables 85 3.9 Deceptive Graphs 89 Chapter Summary 92 Chapter Exercises 93 	 7.1 Continuous Probability Distributions 243 7.2 Uniform Continuous Distribution 245 7.3 Normal Distribution 247 7.4 Standard Normal Distribution 250 7.5 Normal Approximations 263 7.6 Exponential Distribution 267 Chapter Summary 272
CHAPTER FOUR	Chapter Exercises 274
Descriptive Statistics 104	THE CONTRACTOR OF
4.1 Numerical Description 105	CHAPTER EIGHT
4.2 Measures of Center 107	Sampling Distributions and Estimation 280 8.1 Sampling and Estimation 281
4.3 Measures of Variability 1204.4 Standardized Data 128	8.2 Central Limit Theorem 285
4.5 Percentiles, Quartiles, and Box Plots 132	8.3 Sample Size and Standard Error 290
4.6 Covariance and Correlation 1414.7 Grouped Data 146	8.4 Confidence Interval for a Mean (μ) with Known σ 292
4.8 Skewness And Kurtosis 148 Chapter Summary 152	8.5 Confidence Interval for a Mean (μ) with Unknown σ 295

Confidence Interval for a Proportion (π)

8.7 Estimating From Finite Paradaia	Language For Y 471
and the contractions to the contractions to the contractions to the contractions to the contraction to the c	12.7 Confidence and Prediction Intervals For Y 471
de de de de la companie de la compan	12.8 Residual Tests 4/4
and the content in the state of	12.9 Unusual Observations 480 Tening (Optional) 483
8.10 Confidence Interval for a Population Variance, σ^2 (Optional) 314	12.10 Other Regression Topics (Optional) 483
Chapter Summary 316	12.11 Logistic Regression (Optional) 490 Chapter Summary 492
Chapter Exercises 318	Chapter Summary 492 Chapter Exercises 494
	Chapter Exercises
CHAPTER NINE	CHAPTER THIRTEEN
One-Sample Hypothesis Tests 326	Multiple Regression 508
9.1 Logic of Hypothesis Testing 327	13.1 Multiple Regression 509
9.2 Type I and Type II Errors 330	13.2 Assessing Overall Fit 515
9.3 Decision Rules and Critical Values 333	13.3 Predictor Significance 518
9.4 Testing a Mean: Known Population Variance 337 9.5 Testing a Mean: Unknown Population Variance 344	13.4 Confidence Intervals for Y 522
and the state of t	
9.6 Testing a Proportion 350 Chapter Summary 359	13.6 Tests for Nonlinearity and Interaction 533
Chapter Exercises 360	13.7 Multicollinearity 537
500	15.6 Regression Diagnostics
CHAPTER TEN	13.9 Other Regression Topics (Optional) 547 Chapter Summary 549
Two-Sample Hypothesis Tests 366	Chapter Exercises 551
10.1 Two-Sample Tests 36710.2 Comparing Two Means: Independent Samples 369	CHAPTER FOURTEEN
10.2 Comparing Two Means: Independent Samples 369 10.3 Confidence Interval for the Difference of Two	Chi-Square Tests 564
Means, $\mu_1 - \mu_2 = 377$	
10.4 Comparing Two Means: Paired Samples 379	14.1 Chi-Square Test for Independence 565
10.5 Comparing Two Proportions 386	14.2 Chi-Square Tests for Goodness-of-Fit 576 14.3 Uniform Goodness-of-Fit Test 579
10.6 Confidence Interval for the Difference of Two	14.4 Normal Chi-Square Goodness-of-Fit Test 583
Proportions, $\pi_1 - \pi_2 = 393$	14.5 ECDF Tests (Optional) 586
10.7 Comparing Two Variances 394	Chapter Summary 587
Chapter Summary 401 Chapter Exercises 403	Chapter Exercises 588
Chapter exercises 403	
CHAPTER ELEVEN	APPENDIXES
Analysis of Variance 416	A Binomial Probabilities 598
11.1 Overview of Anova 417	B Poisson Probabilities 600
11.2 One-Factor Anova (Completely Randomized Model) 419	C-1 Standard Normal Areas 603
11.3 Multiple Comparisons 427	C-2 Cumulative Standard Normal Distribution 604
11.4 Tests for Homogeneity of Variances 429	D Student's t Critical Values 606
11.5 Kruskal-Wallis Test (Optional) 433 Chapter Summary 434	E Chi-Square Critical Values 607
Chapter Exercises 435	F Critical Values of F ₁₀ 608
The state of the s	G Solutions to Odd Number 17
CHAPTER TWELVE	
Simple Regression 444	Terren Questions 03/
12.1 Visual Displays and Correlation Analysis 445	Writing and Presenting Reports 639
12.2 Simple Regression 451	J Excel Statistical Functions 644
12.3 Regression Models 453 12.4 Ordinary Least Squares Formulas 457	
12.4 Ordinary Least Squares Formulas 457 12.5 Tests for Significance 461	
12.6 Analysis of Variance: Overall Fit 467	■ INDEX 650



Your grades. Your time. Make the most of it.

You want to achieve the best grades possible with the limited time you have to study. McGraw-Hill Connect helps you do just that. Connect is your personalized digital learning assistant that makes earning better grades and managing time easier, quicker, and more convenient than ever.

Students who access Connect sooner, do better.*

Activate your Connect subscription today!

11%

Average increase in student scores when using Connect on day 1 vs. day 14 of class 85%

of students pass their courses using Connect compared to **72**% of students not using Connect

3395

*Source: The Impact of Connect on Student Success. McGraw-Hill Connect® Effectiveness Study 2016



If you need a hand getting started with Connect, or at any step along the way, we're standing by—ready to help.

mhhe.com/collegesmarter 800.331.5094



