

---

Jan Ubøe

# Introductory Statistics for Business and Economics

Theory, Exercises and Solutions



Springer

---

# Contents

<b>1 Descriptive Statistics .....</b>	<b>1</b>
1.1 Population and Samples .....	1
1.2 The Median.....	4
1.3 Quartiles and Mode .....	6
1.4 Relative Frequency and Histograms .....	7
1.5 The Mean.....	8
1.6 Sample Variance and Sample Standard Deviation.....	10
1.7 Sample Covariance and Coefficient of Variation .....	12
1.8 Using Excel .....	17
1.9 Summary of Chap. 1 .....	18
1.10 Problems for Chap. 1 .....	20
<b>2 Probability .....</b>	<b>27</b>
2.1 Sample Space .....	27
2.2 Probability .....	29
2.2.1 Events .....	30
2.2.2 Uniform Probability .....	30
2.2.3 Set Theory .....	31
2.2.4 Computing Probabilities .....	33
2.2.5 The Negation Principle .....	35
2.3 Summary of Chap. 2 .....	35
2.4 Problems for Chap. 2 .....	36
<b>3 Combinatorics .....</b>	<b>41</b>
3.1 Counting Combinations .....	41
3.1.1 Ordered Selections .....	42
3.1.2 Unordered Choices Without Replacement.....	44
3.1.3 Combinatorial Probabilities .....	47
3.2 Summary of Chap. 3 .....	49
3.3 Problems for Chap. 3 .....	49

<b>4 Conditional Probability .....</b>	55
4.1 Conditional Probability .....	55
4.1.1 Computing Conditional Probabilities .....	57
4.1.2 Splitting the Sample Space .....	59
4.1.3 Probability Trees .....	60
4.2 Subjective Probabilities .....	64
4.3 Independence .....	65
4.4 Summary of Chap. 4 .....	66
4.5 Problems for Chap. 4 .....	67
<b>5 Random Variables, Mean, and Variance .....</b>	75
5.1 Random Variables .....	75
5.2 Expectation .....	80
5.2.1 Computing Expectations .....	82
5.2.2 General Expectations and Variance .....	83
5.3 Some Simple Facts About Option Pricing .....	85
5.3.1 Hedging Portfolios .....	86
5.4 Summary of Chap. 5 .....	88
5.5 Problems for Chap. 5 .....	89
<b>6 Joint Distributions .....</b>	97
6.1 Simultaneous Distributions .....	97
6.2 Covariance .....	103
6.2.1 An Alternative Formula for the Covariance .....	104
6.2.2 Sums of Random Variables .....	105
6.3 Summary of Chap. 6 .....	106
6.4 Problems for Chap. 6 .....	106
<b>7 Basic Probability Distributions .....</b>	113
7.1 The Indicator Distribution .....	113
7.2 The Binomial Distribution .....	114
7.3 The Hypergeometric Distribution .....	118
7.4 The Poisson Distribution .....	122
7.5 The Normal Distribution .....	124
7.5.1 The General Normal Distribution .....	127
7.5.2 Standardizing Random Variables .....	128
7.5.3 The Central Limit Theorem .....	129
7.5.4 Integer Correction .....	135
7.5.5 Normal Approximation of Hypergeometric and Poisson Distributions .....	136
7.5.6 Summing Normal Distributions .....	137
7.5.7 Applications to Option Pricing .....	138
7.6 Summary of Chap. 7 .....	140
7.7 Problems for Chap. 7 .....	142

<b>8</b>	<b>Estimation</b>	159
8.1	Estimation	159
8.1.1	Estimators	160
8.1.2	Reporting Estimates	162
8.1.3	The Measurement Model	162
8.2	Confidence Intervals	164
8.2.1	Constructing Confidence Intervals	164
8.2.2	The $t$ -Distribution	166
8.3	The Lottery Model	169
8.4	Summary of Chap. 8	171
8.5	Problems for Chap. 8	172
<b>9</b>	<b>Hypothesis Testing</b>	177
9.1	Basic Ideas	177
9.2	Motivation	179
9.3	General Principles for Hypothesis Testing	181
9.4	Designing Statistical Tests	183
9.4.1	One-Sided and Two-Sided Tests	187
9.4.2	Confidence Intervals and Hypothesis Testing	188
9.4.3	$P$ -Value	189
9.5	Summary of Chap. 9	192
9.6	Problems for Chap. 9	192
<b>10</b>	<b>Commonly Used Tests</b>	201
10.1	Testing Binomial Distributions	201
10.2	$t$ -Test for Expected Value	203
10.3	Comparing Two Groups	206
10.3.1	$t$ -Test for Comparison of Expectation in Two Groups	206
10.3.2	$t$ -Test Executed in Excel	210
10.3.3	$t$ -Test for Comparison of Expectation in Two Groups, Paired Observations	210
10.3.4	$t$ -Test with Paired Observations Executed in Excel	214
10.4	Wilcoxon's Distribution Free Tests	215
10.4.1	The Wilcoxon Signed-Rank Test	218
10.4.2	Comparison of $t$ -Tests and Wilcoxon Test	221
10.5	The $U$ -Test for Comparison of Success Probabilities	221
10.6	Chi-Square Test for Goodness-of-Fit	224
10.6.1	The Chi-Square Test Executed in Excel	226
10.7	The Chi-Square Test for Independence	227
10.7.1	The Chi-Square Test for Independence Executed in Excel	230
10.8	Summary of Chap. 10	230
10.9	Problems for Chap. 10	231

<b>11</b>	<b>Linear Regression</b>	245
11.1	Linear Correspondence	245
11.2	Linear Regression	248
11.3	Residuals and Explanatory Power	251
11.3.1	Naming Variables	253
11.4	Hypothesis Testing in the Regression Model	254
11.5	Prediction/Estimation	257
11.6	Regression Using Excel	261
11.7	Multiple Regression	263
11.7.1	Explanatory Power	263
11.8	Causality	265
11.9	Multicollinearity	266
11.10	Dummy Variables	267
11.11	Analyzing Residuals	269
11.11.1	Histogram	269
11.11.2	Normal Score Plot	269
11.11.3	Residuals in Observed Order	270
11.11.4	Residuals Sorted with Respect to Size	270
11.12	Summary of Chap. 11	271
11.13	Problems for Chap. 11	274
<b>Solutions</b>		315
<b>Index</b>		465