

# Contents

<b>1</b>	<b>Introduction</b> .....	1
1.1	Background .....	1
1.2	Planning a Systematic Review.....	2
1.3	Analyzing Complex Data from a Meta-analysis .....	4
1.4	Interpreting Results from a Meta-analysis.....	4
1.5	What Do Readers Need to Know to Use This Book?.....	5
	References.....	6
<b>2</b>	<b>Review of Effect Sizes</b> .....	7
2.1	Background .....	7
2.2	Introduction to Notation and Basic Meta-analysis .....	7
2.3	The Random Effects Mean and Variance .....	8
2.4	Common Effect Sizes Used in Examples.....	10
2.4.1	Standardized Mean Difference.....	10
2.4.2	Correlation Coefficient.....	10
2.4.3	Log Odds Ratio .....	11
	References.....	12
<b>3</b>	<b>Planning a Meta-analysis in a Systematic Review</b> .....	13
3.1	Background .....	13
3.2	Deciding on Important Moderators of Effect Size .....	14
3.3	Choosing Among Fixed, Random and Mixed Effects Models.....	16
3.4	Computing the Variance Component in Random and Mixed Models .....	18
3.4.1	Example .....	20
3.5	Confounding of Moderators in Effect Size Models .....	21
3.5.1	Example .....	23
3.6	Conducting a Meta-Regression .....	25
3.6.1	Example .....	25
3.7	Interpretation of Moderator Analyses .....	28
	References.....	32

<b>4</b>	<b>Power Analysis for the Mean Effect Size</b> .....	35
4.1	Background .....	35
4.2	Fundamentals of Power Analysis .....	37
4.3	Test of the Mean Effect Size in the Fixed Effects Model.....	39
4.3.1	Z-Test for the Mean Effect Size in the Fixed Effects Model.....	39
4.3.2	The Power of the Test of the Mean Effect Size in Fixed Effects Models.....	41
4.3.3	Deciding on Values for Parameters to Compute Power .....	42
4.3.4	Example: Computing the Power of the Test of the Mean .....	43
4.3.5	Example: Computing the Number of Studies Needed to Detect an Important Fixed Effects Mean .....	45
4.3.6	Example: Computing the Detectable Fixed Effects Mean in a Meta-analysis .....	46
4.4	Test of the Mean Effect Size in the Random Effects Model.....	47
4.4.1	The Power of the Test of the Mean Effect Size in Random Effects Models.....	48
4.4.2	Positing a Value for $\tau^2$ for Power Computations in the Random Effects Model.....	49
4.4.3	Example: Estimating the Power of the Random Effects Mean .....	50
4.4.4	Example: Computing the Number of Studies Needed to Detect an Important Random Effect Mean .....	51
4.4.5	Example: Computing the Detectable Random Effects Mean in a Meta-analysis.....	52
	References.....	53
<b>5</b>	<b>Power for the Test of Homogeneity in Fixed and Random Effects Models</b> .....	55
5.1	Background .....	55
5.2	The Test of Homogeneity of Effect Sizes in a Fixed Effects Model.....	56
5.2.1	The Power of the Test of Homogeneity in a Fixed Effects Model.....	56
5.2.2	Choosing Values for the Parameters Needed to Compute Power of the Homogeneity Test in Fixed Effects Models.....	57
5.2.3	Example: Estimating the Power of the Test of Homogeneity in Fixed Effects Models.....	58

5.3	The Test of the Significance of the Variance Component in Random Effects Models.....	59
5.3.1	Power of the Test of the Significance of the Variance Component in Random Effects Models .....	60
5.3.2	Choosing Values for the Parameters Needed to Compute the Variance Component in Random Effects Models.....	61
5.3.3	Example: Computing Power for Values of $\tau^2$ , the Variance Component.....	62
	References.....	66
<b>6</b>	<b>Power Analysis for Categorical Moderator Models of Effect Size .....</b>	<b>67</b>
6.1	Background .....	67
6.2	Categorical Models of Effect Size: Fixed Effects One-Way ANOVA Models .....	68
6.2.1	Tests in a Fixed Effects One-Way ANOVA Model.....	68
6.2.2	Power of the Test of Between-Group Homogeneity, $Q_B$ , in Fixed Effects Models .....	68
6.2.3	Choosing Parameters for the Power of $Q_B$ in Fixed Effects Models .....	70
6.2.4	Example: Power of the Test of Between-Group Homogeneity in Fixed Effects Models .....	70
6.2.5	Power of the Test of Within-Group Homogeneity, $Q_W$ , in Fixed Effects Models.....	71
6.2.6	Choosing Parameters for the Test of $Q_W$ in Fixed Effects Models .....	72
6.2.7	Example: Power of the Test of Within-Group Homogeneity in Fixed Effects Models .....	73
6.3	Categorical Models of Effect Size: Random Effects One-Way ANOVA Models .....	74
6.3.1	Power of Test of Between-Group Homogeneity in the Random Effects Model.....	74
6.3.2	Choosing Parameters for the Test of Between-Group Homogeneity in Random Effects Models .....	76
6.3.3	Example: Power of the Test of Between-Group Homogeneity in Random Effects Models .....	76
6.4	Linear Models of Effect Size (Meta-regression) .....	78
	References.....	78
<b>7</b>	<b>Missing Data in Meta-analysis: Strategies and Approaches .....</b>	<b>79</b>
7.1	Background .....	79
7.2	Missing Studies in a Meta-analysis.....	80
7.2.1	Identification of Publication Bias.....	80
7.2.2	Assessing the Sensitivity of Results to Publication Bias .....	82

7.3	Missing Effect Sizes in a Meta-analysis.....	85
7.4	Missing Moderators in Effect Size Models.....	86
7.5	Theoretical Basis for Missing Data Methods.....	87
7.5.1	Multivariate Normality in Meta-analysis.....	88
7.5.2	Missing Data Mechanisms or Reasons for Missing Data .....	89
7.6	Commonly Used Methods for Missing Data in Meta-analysis.....	90
7.6.1	Complete-Case Analysis.....	90
7.6.2	Available Case Analysis or Pairwise Deletion .....	92
7.6.3	Single Value Imputation with the Complete Case Mean .....	93
7.6.4	Single Value Imputation Using Regression Techniques.....	95
7.7	Model-Based Methods for Missing Data in Meta-analysis .....	97
7.7.1	Maximum-Likelihood Methods for Missing Data Using the EM Algorithm.....	97
7.7.2	Multiple Imputation for Multivariate Normal Data .....	99
	References.....	106
<b>8</b>	<b>Including Individual Participant Data in Meta-analysis .....</b>	<b>109</b>
8.1	Background .....	109
8.2	The Potential for IPD Meta-analysis .....	110
8.3	The Two-Stage Method for a Mix of IPD and AD.....	112
8.3.1	Simple Random Effects Models with Aggregated Data.....	112
8.3.2	Two-Stage Estimation with Both Individual Level and Aggregated Data.....	114
8.4	The One-Stage Method for a Mix of IPD and AD .....	115
8.4.1	IPD Model for the Standardized Mean Difference.....	115
8.4.2	IPD Model for the Correlation.....	116
8.4.3	Model for the One-Stage Method with Both IPD and AD.....	116
8.5	Effect Size Models with Moderators Using a Mix of IPD and AD .....	118
8.5.1	Two-Stage Methods for Meta-regression with a Mix of IPD and AD .....	119
8.5.2	One-Stage Method for Meta-regression with a Mix of IPD and AD .....	120
8.5.3	Meta-regression for IPD Data Only .....	121
8.5.4	One-Stage Meta-regression with a Mix of IPD and AD .....	121
	References.....	130

<b>9</b>	<b>Generalizations from Meta-analysis</b> .....	133
9.1	Background .....	133
9.1.1	The Preventive Health Services (2009) Report on Breast Cancer Screening .....	134
9.1.2	The National Reading Panel's Meta-analysis on Learning to Read .....	135
9.2	Principles of Generalized Causal Inference .....	135
9.2.1	Surface Similarity .....	135
9.2.2	Ruling Out Irrelevancies .....	136
9.2.3	Making Discriminations .....	137
9.2.4	Interpolation and Extrapolation.....	138
9.2.5	Causal Explanation.....	138
9.3	Suggestions for Generalizing from a Meta-analysis .....	139
	References.....	140
<b>10</b>	<b>Recommendations for Producing a High Quality Meta-analysis</b> .....	143
10.1	Background .....	143
10.2	Understanding the Research Problem .....	143
10.3	Having an a Priori Plan for the Meta-analysis .....	144
10.4	Carefully and Thoroughly Interpret the Results of Meta-analysis .....	145
	References.....	146
<b>11</b>	<b>Data Appendix</b> .....	147
11.1	Sirin (2005) Meta-analysis on the Association Between Measures of Socioeconomic Status and Academic Achievement.....	147
11.2	Hackshaw et al. (1997) Meta-analysis on Exposure to Passive Smoking and Lung Cancer.....	149
11.3	Eagly et al. (2003) Meta-analysis on Gender Differences in Transformational Leadership .....	151
	References.....	152
	<b>Index</b> .....	153