

Table of Contents

1. Introduction	1
1.1. Statistics	1
1.2. Sources of Uncertainty	2
1.3. Systematic Error	2
1.3.1. Data Measurement	3
1.3.2. Data Collection	3
1.3.3. Data Modeling	3
1.4. Random Error	4
1.4.1. Definitions of Commonly Used Statistical Terms	5
1.4.2. Confidence and Precision	7
1.5. Sample Size Determination	11
1.6. Determination of Metering Period	13
1.7. Modeling	14
1.7.1. Coefficient of Determination (R^2)	15
1.7.2. t-statistic	16
1.8. Modeling Errors	18
1.8.1. Omission of Relevant Variables	18
1.8.2. Inclusion of Irrelevant Variables	18
1.8.3. Functional Form	19
1.8.4. Data Shortage	19
1.8.5. Autocorrelation	19
1.8.6. Prediction Errors	20
1.8.7. Overfitting	21
1.9. Combining Uncertainty	21
2. Option A: Lighting Efficiency	24
2.1. Situation	24
2.2. M&V Plan	24
2.3. Savings	25
2.4. Sources of Error	26
2.5. Sample Design	26

3. Option B: Motor Replacement	29
3.1. Situation	29
3.2. Measurement Options and Measurement Error	30
3.2.1. Power Metering, Pre/Post – Stable Loads (Option B)	30
3.2.2. Power Metering, Pre/Post – Variable Loads (Option B)	31
3.2.3. Power Metering, Post-Only	32
3.2.4. Amperage Metering, Post-Only	33
3.2.5. Run Time Logging, Post Only	35
3.3. Example Option B M&V Plan	37
3.3.1. Situation	37
3.3.2. Assumptions	39
3.3.3. Sample Design	39
3.4. Combining Sampling and Measurement Errors	43
4. Option C: Whole Facility Regression-Based Savings Estimate	45
4.1. Calculating the Precision of a Regression-Based Savings Estimate	45
4.1.1. Forecast Model	45
4.1.2. Use of an Indicator Variable for the Reporting Period	49
4.1.3. Special Considerations for Interval Meter Data	51
4.2. Managing Autocorrelation	51
4.2.1. What is Autocorrelation?	51
4.2.2. Diagnosing Autocorrelation	51
4.2.3. Remedial Measures	55
4.2.3.1. Omitted Variable Bias	55
4.2.3.2. Misspecification	57
4.2.3.3. The ASHRAE Correction	58
4.2.3.4. Newey-West Standard Errors	59
5. Option D: New Construction of a Medium Office	61
5.1. Situation	62
5.2. Building Modeling and Analysis Tools	62
5.3. Energy Model and Variable Characterization	63
5.4. Local One-step-at-a-time (OAT) sampling analysis	65
5.5. Bootstrap Based Analysis	68