



Standard Guide for Selecting Techniques for Treating Uncertainty and Risk in the Economic Evaluation of Buildings and Building Systems¹

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1. Scope

1.1 This guide recommends techniques for treating uncertainty in input values to an economic analysis of a building investment project. It also recommends techniques for evaluating the risk that a project will have a less favorable economic outcome than what is desired or expected.²

1.2 The techniques include breakeven analysis, sensitivity analysis, risk-adjusted discounting, the mean-variance criterion and coefficient of variation, decision analysis, and simulation.

1.3 The techniques can be used with economic methods that measure economic performance, such as life-cycle cost analysis, net benefits, the benefit-to-cost ratio, internal rate of return, and payback.

2. Referenced Documents

2.1 ASTM Standards:

E 833 Terminology of Building Economics³

E 917 Practice for Measuring Life-Cycle Costs of Buildings and Building Systems⁴

E 964 Practice for Measuring Benefit-to-Cost and Savings-to-Investment Ratios for Buildings and Building Systems⁴

E 1057 Practice for Measuring Internal Rate of Return and Adjusted Internal Rate of Return for Investments in Buildings and Building Systems⁴

E 1074 Practice for Measuring Net Benefits for Investments in Buildings and Building Systems⁴

E 1121 Practice for Measuring Payback for Investments in Buildings and Building Systems⁴

E 1185 Guide for Selecting Economic Methods for Evaluating Investments in Buildings and Building Systems⁴

2.2 ASTM Adjuncts:

Discount Factor Tables, Adjunct to Practice E 917⁵

Computer Program and User's Guide to Building Maintenance, Repair, and Replacement Database for Life-Cycle Cost Analysis, Adjunct to Practices E 917, E 964, E 1057, E 1074, and E 1121.⁶

3. Terminology

3.1 *Definitions*—For definitions of terms used in this guide, refer to Terminology E 833.

4. Summary of Guide

4.1 This guide identifies related ASTM standards and adjuncts. It describes circumstances when measuring uncertainty and risk may be helpful in economic evaluations of building investments. This guide defines uncertainty, risk exposure, and risk attitude. It presents nonprobabilistic and probabilistic techniques for measuring uncertainty and risk exposure. This guide describes briefly each technique, gives the formula for calculating a measure where appropriate, illustrates the techniques with a case example, and summarizes its advantages and disadvantages.

4.2 Since there is no best technique for measuring uncertainty and risk in every economic evaluation, this guide concludes with a discussion of how to select the appropriate technique for a particular problem.

4.3 This guide describes in detail how risk exposure can be measured by probability functions and distribution functions (see Annex A1). It also describes how risk attitude can be incorporated using utility theory and other approaches (see Annex A2).

5. Significance and Use

5.1 Investments in long-lived projects such as buildings are characterized by uncertainties regarding project life, operation and maintenance costs, revenues, and other factors that affect project economics. Since future values of these variable factors are generally not known, it is difficult to make reliable economic evaluations.

5.2 The traditional approach to project investment analysis

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² For an extensive overview of techniques for treating risk and uncertainty, see Marshall, Harold E.—*Techniques for Treating Uncertainty and Risk in the Economic Evaluation of Building Investments*, National Institute of Standards and Technology, Special Publication 757, 1988.

³ *Annual Book of ASTM Standards*, Vol 04.07.

⁴ *Annual Book of ASTM Standards*, Vol 04.11.

⁵ Available from ASTM Headquarters. Order PCN 12-509179-10.

⁶ Available from ASTM Headquarters. Order PCN 12-509171-10 for the 3.5 in. disk. Order PCN 12-509172-10 for the 5.25 in. disk.