Proceedings of the 2017 Winter Simulation Conference
W. K. V. Chan, A. D'Ambrogio, G. Zacharewicz, N. Mustafee, G. Wainer, and E. Page, eds.

SIMULATION MODELING FOR MAKING DECISION ON CLINICAL TRIALS USING ACCEPTABILITY CURVE OF COST-EFFECTVENESS AND EXPECTED NET BENEFITS

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ABSTRACT

Simulating empirical distributions of costs and health benefits are widely used for making decisions on health interventions. Decisions using acceptability curves (CEAC) are commonly adopted to represents the probability of incremental cost-effectiveness model regarding the Northeast quadrant of joint density of incremental cost and benefits distributions, considering variability within samples. Using an expected net benefits model, we show how to integrate in one curve the distributed points of costs and benefits that fall in Northeast, Southeast, Northwest and Southwest quadrants, considering variability between and within samples. We applied the methods to a clinical trial that evaluates the effects of resonance magnetic image and computerized tomography image in the diagnostic of stroke. Thus, modeling and simulation of expected net benefits allow for drawing an acceptability curve, integrating the four quadrants of joint density of incremental cost and benefits without altering decisions that might be undertaken using the classical acceptability curve approach.

1 INTRODUCTION

The benefits of clinical trials on health and cost effects often are uncertain. When conducting such trials, economic evaluation of health interventions are the usual methods used to estimate the cost of treatments that occur beside the efficacy or effectiveness, and to make decision on cost-effectiveness. Cost-Effectiveness analysis studies the incremental health benefits of two health interventions effects, measured as the difference in effectiveness or effectiveness adjusted by quality of life, with respect to their incremental cost ($\Delta E/\Delta C$). Considering variability in cost-effectiveness analysis, researchers have applied modeling and simulation for empirical or statistical distributions of cost-effectiveness, and presented the results through curves of acceptability for decision makers. The CEAC draws the probability of incremental cost-effectiveness model regarding the Northeast quadrant (NE) of joint density of incremental cost and benefits distributions. When an experimental intervention results in higher benefits and lower cost with respect to the standard one concluding that the experimental is dominant intervention, an expected net benefits model (ENB) can be used to formalized an acceptability curve that represents the probability of incremental cost-effectiveness with regard to the Southeast (SE) of the simulated distributions of cost and benefits. However, the decisions using such presentations only consider variability within samples. Variability between samples may influence such decisions. Thus, using the standardized expected net benefits model, our aim is to show how to integrate in one curve the distributed points of costs and benefits that fall in the four quadrants (Northeast, Southeast, Northwest and Southwest) of the plane, considering variability between and within samples.

2 METHODS

Considering variability within samples, modeling and simulation was applied to simulate and construct an acceptability curve of incremental cost-effectiveness when the experimental health intervention exhibits higher cost and benefits, and a curve of expected net benefits when the experimental exhibits lower cost and higher benefits. Considering variability within and between samples, a standardized expected net benefits model was applied to construct one CEAC that integrates all simulated couples of cost and benefits when comparing the effects of an experimental health intervention with respect to a standard intervention. The applied models for achieving our objective are similar to those developed in (Fenwick et al. 2001 and 2004, and Abbas 2017).

3 RESULTS

A clinical trial was conducted for comparing MRI versus CT in patients with acute stroke. The trial was a multi-centre randomized clinical trial aimed at preventing stroke events. The inputs of the models obtained from the trial are effectiveness (0.1123 (0.2815) under the MRI, 0.1638 (0.2286) under CT) and cost of treatment (6184 (2413) under MRI, 6129 (2546) under CT) and the outputs are shown in figures 1 and 2. To verify the consistency of the results, other cases will also be presented and commented.

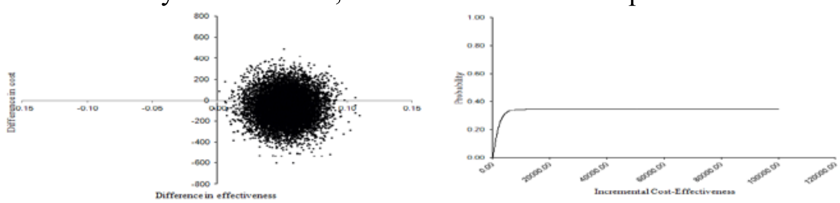

Figure 1: The joint distributions of ΔE and ΔC (left panel) and CEAC of cost-effectiveness (right panel) of NE quadrant.

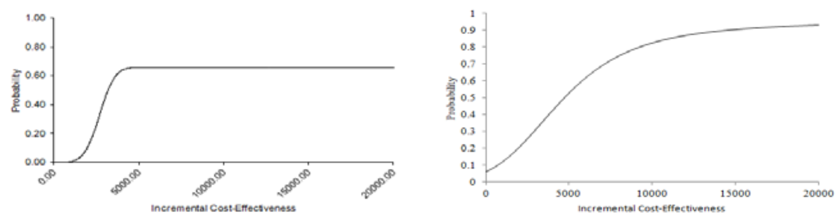

Figure 2: CEAC of Southeast quadrant of cost-effectiveness (left panel) and of all four quadrants (right panel) of ΔE and ΔC distribution.

Figure 1 and 2 show the results of 10.000 simulated joint distributions of incremental cost and effectiveness analyzed by the classical curve of acceptability and the curve of expected net benefits.

4 DISCUSSION AND CONCLUSIONS

Modeling and simulation of expected net benefits allow for drawing an acceptability curve that integrates in one curve the four quadrants of joint density of incremental cost and benefits without altering decisions that might be undertaken using the classical acceptability curve approach.

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