**CEA Lab Session**

**IES Methods Training in Cost-Effectiveness and Benefit-Cost Analysis**

**May 2017**

A local school district has a stated goal of emphasizing STEM (Science, Technology, Engineering, and Mathematics) skills through interdisciplinary, project-based instruction. One element of their overall instructional strategy is an after-school Robotics club for 7th grade students, where students learn about and apply skills in systems thinking, engineering, and computer programming by writing code using tablet computers to direct small robotic devices called Sphero to perform specific tasks.

The program has proven to be quite popular, and 50 students have signed up for 25 slots that have been allocated via lottery. The district hopes that the program will have an effect on the Iowa Test of Basic Skills math assessment after one year of program participation as a measure of how it improves participants’ general quantitative reasoning abilities. The students (both treatment and control) also complete a performance assessment before and after the intervention, developed by the makers of Sphero, that tests their computer programming and logical thinking abilities by requiring them to use the robot to complete several complex tasks.

The district has asked you to perform a cost-effectiveness analysis of the robotics club. Since the program occurs after school and students would have otherwise gone home, all costs can be considered incremental to business-as-usual. Through the ingredients method, you learn that the following are ingredients of the program:

* The program meets twice a week for one hour after school and requires one hour per week of planning time, so three hours per week for 36 weeks for a science teacher. The teacher has a Master’s degree and 8 years of experience.
* The teacher went to a week-long training over the summer, spending 40 hours. The training also entailed $200 of travel costs and a $500 registration fee (which were covered by the school).
* The principal meets with the teacher for 45 minutes per month over the 10-month school year to discuss how the program is going and give feedback and suggestions for improvement.
* The program meets in a standard, 900 square foot classroom.
* There is one robot for each group of 5 students. The robots have an estimated useful life of 5 years.
* The robot is controlled by a tablet computer, running a specialized software program that uses a simplified computer programming language to give directions to the robot.

You decide to use national average prices to estimate the cost of the ingredients, and obtain the following prices from the CBCSE Database of Educational Resource Prices (note that we have made adjustments to the prices for inflation, annualization, fringe benefits, and to match the units of the ingredient for you):

* Teacher with MA and 6-9 years of experience, $51,400 per academic year in 2011 dollars (adjusted price of $53.35 per hour for program delivery and $11.82 per hour annualized price for training)
* Training registration and travel costs, annualized price of $155.05
* Principal with any level of experience (national average across all principals, from Schools and Staffing Survey), $90,500 per academic year in 2011 dollars (adjusted price of $93.93 per hour)
* New construction price of a standard elementary school classroom (adjusted for land acquisition and furnishings) is $243,124.63 in 2013 (adjusted and annualized price of $9.39 per hour)
* The robots cost $130 each in 2016 (annualized price of $28.80)
* In 2012, the average price of tablet computers was $386 (as estimated by IMS Research and reported in PC World magazine; annualized and adjusted price of $88.92)

Calculate the total cost of the program and the average cost per participant. Document where you need to make and consider how they may affect your analysis.

What is the total cost?

What is the average cost per participant?

After one year, you find that, comparing pre-post gains on the Iowa math assessment for treatment and control groups, the program had a small but statistically significant effect on math score gains of 0.1 standard deviations. Using this information, calculate a cost-effectiveness ratio for the program.

Using a similar methodology based on teacher-reported scores using a rubric on the robotics and computer science assessment, you find a large and statistically significant improvement of 0.4 standard deviations on computer science and robotics. Calculate the cost-effectiveness ratio using this outcome measure.

Plot each cost-effectiveness ratio on the CE plane.

What does its position tell you?

What more would you want to know to make a judgment on the cost-effectiveness of the program?

In an alternative program, also focused on improving STEM instruction and outcomes, students participate in an online mathematics tutoring program. The program serves 25 students per year and costs $11,000. Seventh grade students randomly assigned to the program achieved 0.2 effect size gains in math (on the Stanford Achievement Test) compared to a control group.

Calculate the total cost, average cost per participant, and cost-effectiveness ratio for this program.

Plot the cost-effectiveness ratio for this program on the CE plane.

Which program would you prefer? Why?

Under what circumstances would your position/recommendation change?