CYCLE-BASED BUDGETING TOOLKIT

Academic Return on Investment (A-ROI)

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READ ME FIRST

As a general concept, A-ROI is concerned with how much academic or academic-related gain is achieved for how many students and at what cost. This index can be formulated in many different ways. The challenge is to find a balance between rigor (necessary for a valid comparison) and practicality (needed for practical use). In this document, one formulation of A-ROI is presented with a discussion of the issues around developing such an index.

If you have questions or need assistance, please contact us at support@cyclebasedbudgeting.org or post them to the Cycle-based Budgeting web site forum.

DEFINITION

Assuming a gain is an increase in the outcome measure[1], a program's A-ROI is defined as[2]

$$A\text{-}ROI =$$

$$\frac{(Annual\ Budget) * (t_e - t_b + 1)}{\left(Pct_{t_e} - Pct_{t_b}\right) * 100 * \frac{\sum_{j=t_b}^{t_e}\left(w_{ece}N_{ecej} + w_{esl}N_{eslj} + N_{gj}\right)}{t_e - t_b + 1}}, \textit{ if outcome is categorical} \quad (1)$$

$$\begin{cases} \frac{(Annual\ Budget) * (t_2 - t_1 + 1)}{\frac{\left(\frac{\sum_{i=1}^{N_{t_e}} X_{it_e}}{N_{t_e}} - \frac{\sum_{i=1}^{N_{t_b}} X_{it_b}}{N_{t_b}}\right)}{\frac{\sum_{i=1}^{N_{t_b}} X_{it_b}}{N_{t_b}}} * 100 * \frac{\sum_{j=t_b}^{t_e}\left(w_{ece}N_{ecej} + w_{esl}N_{eslj} + N_{gj}\right)}{t_e - t_b + 1}}, \textit{ if outcome is continuous} \end{cases} \quad (2)$$

where,

t_b is the beginning year of the school year when the program is implemented (e.g., t_b=2015 for a program implemented in 2015-16)

t_e is the beginning year of the school year when the program reaches the end of its continuous improvement cycle (e.g., t_e=2017 for a program with an end of cycle year in 2017-18)

X_{it_b} is the baseline outcome of student *i* in year t_b

X_{it_e} is the outcome of student *i* in year t_e

N_{t_b} is the number of targeted students in year t_b

N_{t_e} is the number of targeted students in year t_e

N_{gj} is the number of target general education students in year *j* ($j = t_b, \dots, t_e$)

N_{ecej} is the number of target ECE education students in year *j* ($j = t_b, \dots, t_e$)

N_{eslj} is the number of target ESL education students in year *j* ($j = t_b, \dots, t_e$)

w_{ece} is the weight for ECE students

[1] If a gain is a reduction in the outcome measure, then the order of the two terms in the two outcome deductions should be reversed. If there is a negative gain, A-ROI will not be calculated.

[2] There are many technical complexities around A-ROI as a valid (unbiased and reliable) index for program funding and change decisions. In the first year of implementing A-ROI, it is suggested to favor simplicity over complexity. As people become more familiar with A-ROI and your system capacity grows, the limitations discussed later in this document can be addressed by making adjustments.

w_{esl} is the weight for ESL students

The interpretation of this definition is, on average, the unit cost associated with one percent gain in the academic or academic-related outcome. Please note that this formulation of A-ROI is an indirect rather than a direct measure of above definition. It captures the true total investment, but does not calculate the true gains by including all students who are impacted[3]. This indirect approach is preferred mainly because it is easy to calculate and still maintains the commensurability. The trade-off is that we lose some accuracy.

DESIGN PRINCIPALS

In essence, developing an A-ROI index is a balancing act between rigor and practicality. The above formulation of A-ROI is based on the following five design principals:

- *Interpretability*
  The A-ROI index should be easy to interpret and understand by stakeholders who usually do not have a strong research background.
- *Manipulability*
  The A-ROI index should not be subject to easy manipulation by stakeholders to gain an unfair or unjustifiable advantage.
- *Commensurability*
  The A-ROI index should allow for comparison between programs using different outcome measures.
- *Validity*
  While not a cost-effectiveness measure, the A-ROI index should make the comparison fair and reliable.
- *Extensibility*
  Considering that our understanding of A-ROI will continue to develop, the A-ROI index should leave room for future improvement without making drastic shift in how the index is calculated.

ASSUMPTIONS

With the A-ROI defined in equations (1) and (2), we make three major assumptions about the index when using it to compare cost and benefit for budget decisions.

[3] A direct measure will include all students who are impacted by the investment during the program's implementation. For example, a program has a k-year continuous improvement cycle to reduce Novice percentage. During the three years, the number of target students is N_1, N_2, …, and N_k, respectively; and the number of students moving out of the Novice category is n_1, n_2, …, and n_k, respectively. A-ROI can be formulated as $\frac{(Annual\ Budget)*(t_e-t_b+1)}{\frac{\sum_{i=1}^{k}\frac{n_i}{N_i}}{k}*100*\sum_{i=1}^{k}N_i}$

First, the academic or academic-related gain is entirely due to the investment. In other words, there is no natural growth among the students in the outcome and no other factors are impacting the outcome either positively or negatively.

Second, there is a linear relationship between academic or academic-related outcome gain and baseline outcome. That is, a 1% gain is equivalent regardless where the target students start with, low, intermediate, or high.

Third, there is a linear relationship between amount of investment and amount of gain. In other words, a 1% gain from a $100,000 investment in 100 students is equivalent to a 1% gain from a $200,000 investment in 200 students, a 2% gain from a $100,000 investment in 50 students, or a 2% gain from a $200,000 investment in 100 students.

LIMITATIONS AND MITIGATIONS

A review of the assumptions quickly reveals the limitations of the A-ROI index defined in equations (1) and (2). In reality, all three major assumptions will be probably violated.

First, it is very unlikely a gain in the academic or academic-related outcome can be solely attributed to the investment. Without a study employing rigorous design, we cannot make an inference about the causal relationship between the investment and gain. Given the number investments the district is making, however, it is simply not realistic to conduct rigorous studies for all of them. One way to mitigate this problem is to provide contextual information about what other programs are implemented at the same time that can potentially impact the outcome.

Second, the relationship between academic or academic-related outcome gain and baseline outcome is probably curvilinear rather than linear. Based on the past research, it is likely that academic or academic-related return will decrease as students' baseline outcome increases. In the future, an index can be added to the equations to offset the descending academic or academic-related return when baseline outcome increases, once we learn more about that curvilinear relationship. For now, we can provide baseline outcome data together with A-ROI data so that it can be factored in when making budget decisions.

Third, again, the relationship between amount of investment and amount of gain is probably more complex than linear. At this point, we know very little about that relationship. More research is needed to understand what adjustment can be made when this assumption is violated.

Fourth, random variation in target student is adjusted for by using the average student population size during the continuous improvement cycle years. However, relying on the baseline and end-of-cycle year data only, random variation in academic or academic-related return is not adjusted for. We can apply the same approach to academic or academic-related return by calculating the average of returns over the years. However, that means increased complexity in the equations and more labor for calculating the index.