

# CARNEGIE SENSITIVITY ANALYSIS: MOVING FROM R2 TO R1

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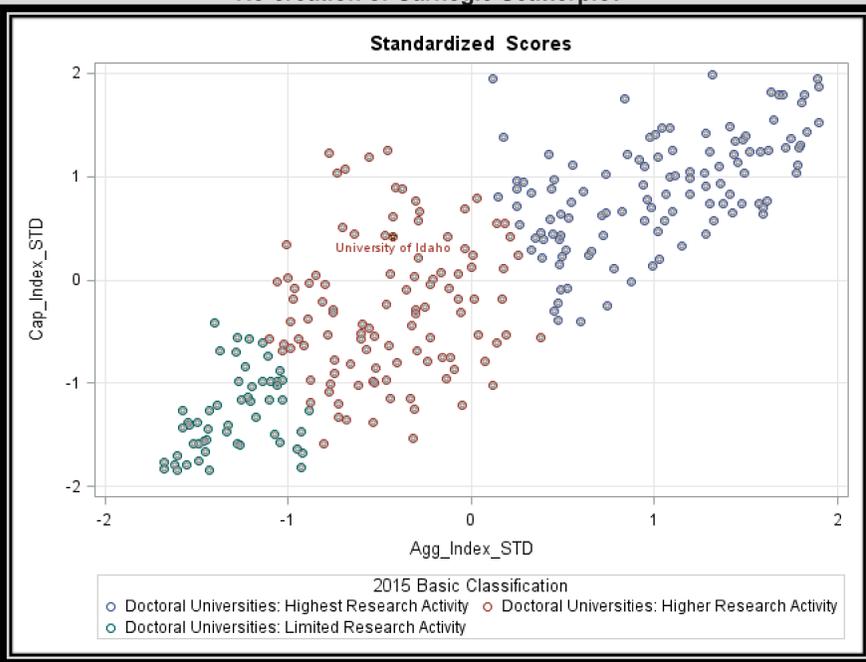


## ABSTRACT

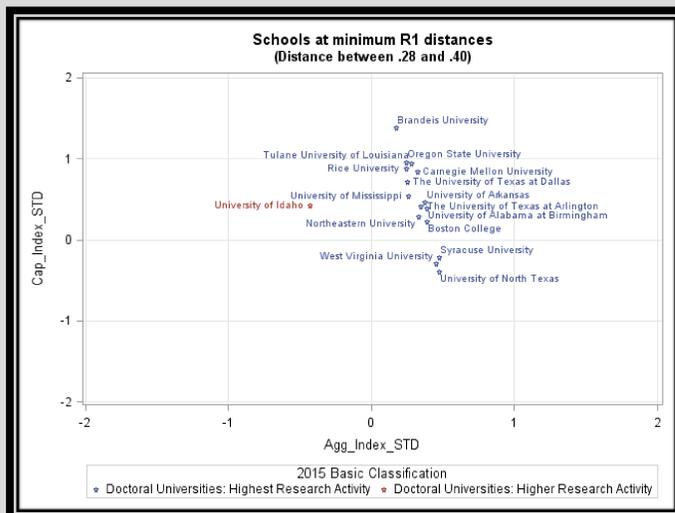
Carnegie Institutional Rankings have been a very strong influence in higher education. Many institutions have prioritized obtaining R1 status, or very high research, in order to obtain prestige and respect. The University of Idaho has established a goal of obtaining R1 Carnegie status within its strategic plan. There are limitations to a static analysis of a dynamic process. However, by recreating the 2015 analysis, we can find selected inputs that would have merited an R1 status in 2015. This is no guarantee of future R1 status - these values would change in upcoming Carnegie rankings and would be dependent on other institutions' values, since the rankings, rather than the absolute values, are used. However, it is instructive to determine how arduous the path to R1 may be, and to identify the most cost-effective and sensitive inputs that go into the rankings.

In the 2015 rankings, the UI has a distance from the origin of -0.32. To obtain R1 status, the UI would have to obtain a distance of +0.28. R1 schools with a minimum distance are included below.

Re-creation of Carnegie Scatterplot



This scatterplot can be compared to the output from Carnegie as a rough guide of the quality of the reconstruction. The Carnegie output is actually raw scores, with the standardized values for axis labels. This plot is purely standardized values.



These universities serve as an interesting comparison group since they are nearest to the boundary between R2 and R1.

## METHODS

The Carnegie Rankings are the result of two weighted means that establish a Cartesian plane.

$$\text{Aggregate Index} = .914 * \text{STEMRSD} + .902 * \text{PDNFRSTAFF} + .9 * \text{SERD} + .873 * \text{SOCSCRSRSD} + .819 * \text{HUMRSD} + .791 * \text{NONSERD} + .616 * \text{OTHERRSD}$$

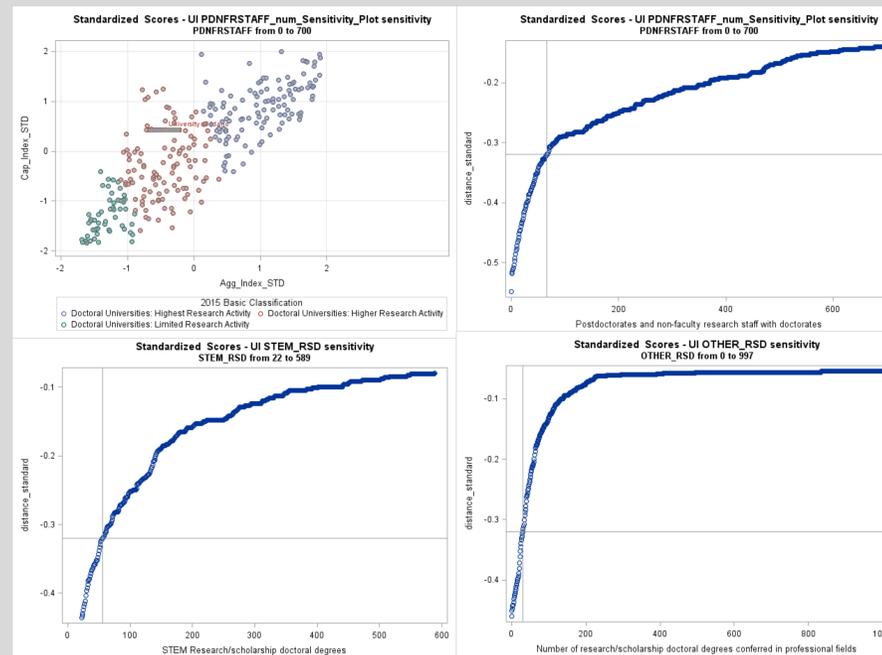
$$\text{Capita Index} = .931 \left( \frac{\text{SERD}}{\text{FACNUM}} \right) + .614 \left( \frac{\text{NONSERD}}{\text{FACNUM}} \right) + .928 \left( \frac{\text{PDNFRSTAFF}}{\text{FACNUM}} \right)$$

Distance from the origin provides cut-offs between R1, R2, and R3 classifications and weights are established from a principal component analysis. In order to reproduce the analysis:

1. Download the data from the Carnegie website and identify the eight data input fields you need. (STEM\_RSD, HUM\_RSD, STEM\_RSD, SOCSC\_RSD, OTHER\_RSD, NONS\_ER\_D, PDNFRSTAFF, FACNUM)
2. Divide S\_ER\_D, NONS\_ER\_D, and PDNFRSTAFF by FACNUM to make them *per capita*.
3. Rank aggregate and *per capita* inputs (omitting FACNUM).
4. Multiply seven ranked inputs by provided weights (from PCA) and sum. Standardize to create Agg\_Index\_STD (X-axis in Carnegie plot.)
5. Multiply three ranked *per capita* inputs by provided weights (from PCA) and sum. Then standardize to create Capita\_Index\_STD (Y-axis in Carnegie plot.)
6. Create distance from origin using the Euclidean distance formula.
7. Plot, adjust values, and compare resulting and original distances from origin.

## RESULTS

Carnegie reconstruction allows users to adjust single or multiple input values and see the impact on the Carnegie Ranking (distance from origin). The plots below depict univariate changes for individual inputs. The UI currently has sixty-six "Postdoctorates and non-faculty research staff with doctorates" (PDNFRSTAFF). Adjusting PDNFRSTAFF from zero to seven-hundred moves the University of Idaho in a horizontal line because this input is only used in the aggregate index (below – top left). Adjustment of a *per capita* measure would have moved the point along both axes. Note the diminishing return, i.e., even maximizing PDNFRSTAFF does not push the UI into R1, ceteris paribus. The steepness of the curve shows how much an increase in the raw value impacts the distance from origin. The current values for the UI are depicted as gray 'cross-hairs'.



## CONCLUSIONS

Carnegie Classifications are intended for classification rather than ranking. However, many institutions of higher learning are interested in obtaining a "better" classification. Since Carnegie provides the data and the weights from their PCA, recreating the procedure and adjusting the inputs to see their corresponding impact is a useful exercise. The steepness of the curve indicates the ease by which an increase in the input improves an institution's distance from the origin. For many institutions, it may be impossible to increase a specific measure, e.g., if there is no social science program, it would be very expensive to increase the number of social science Ph.D.s produced. However, if an institution has such programs and could easily increase the number of Ph.D.s, this cost would be minimal. The sensitivity analysis provides an agnostic view of the impacts of such changes in a process where many stakeholders have an inherent interest in increasing a specific measure.

While the results are contingent on the circumstances of the institution, in the UI's case, it is clear that an increase in "Postdoctorates and non-faculty research staff with doctorates" would contribute significantly towards R1 status at a relatively low cost. Similarly, increases in "Humanities research/scholarship doctoral degrees" and "Social Science Research/scholarship doctoral degrees" would provide efficient increases in distance from the origin. It is difficult to ascertain the availability of additional funds for the two expenditure inputs and it is left to senior administration to determine the efficiency of increasing these measures.

## LEGEND

- STEM\_RSD -STEM Research/scholarship doctoral degrees
- HUM\_RSD -Humanities research/scholarship doctoral degrees
- STEM\_RSD -STEM Research/scholarship doctoral degrees
- SOCSC\_RSD -Social Science Research/scholarship doctoral degrees
- OTHER\_RSD -Science & Engineering Research & Development Expenditures (\$Thousands)
- NONS\_ER\_D -Non Science & Engineering Research & Development Expenditures (\$Thousands)
- PDNFRSTAFF -Postdoctorates and non-faculty research staff with doctorates
- FACNUM -Number of faculty in ladder rank (assistant, associate, and full professors)
- Cap\_Index\_STD -Standardized Per Capita Index
- Agg\_Index\_STD -Standardized Aggregate Index

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