Predicting Job Placements of Economics Graduate Programs

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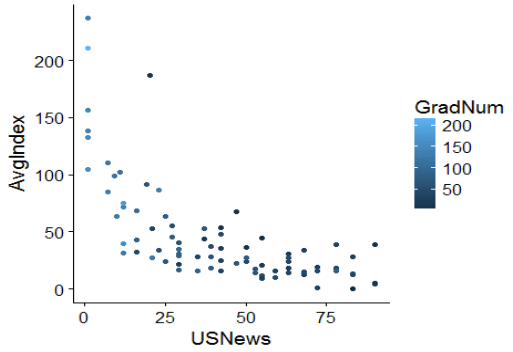
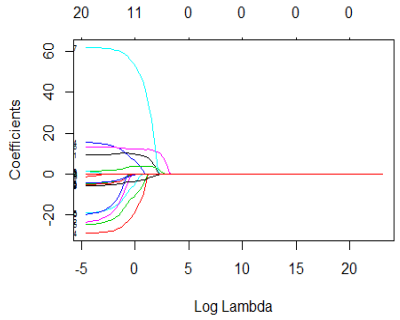
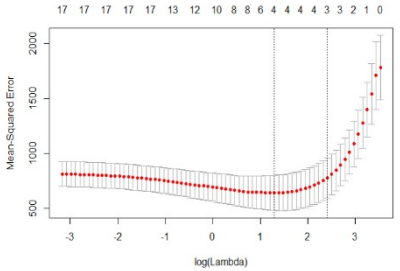
I am grateful to Juan Carlos Escanciano and many graduate students for their encouragement and guidance.

Outline







Data

- Program Characteristics
- Placement Quality Measure

Model

- Lasso
- Cross Validation

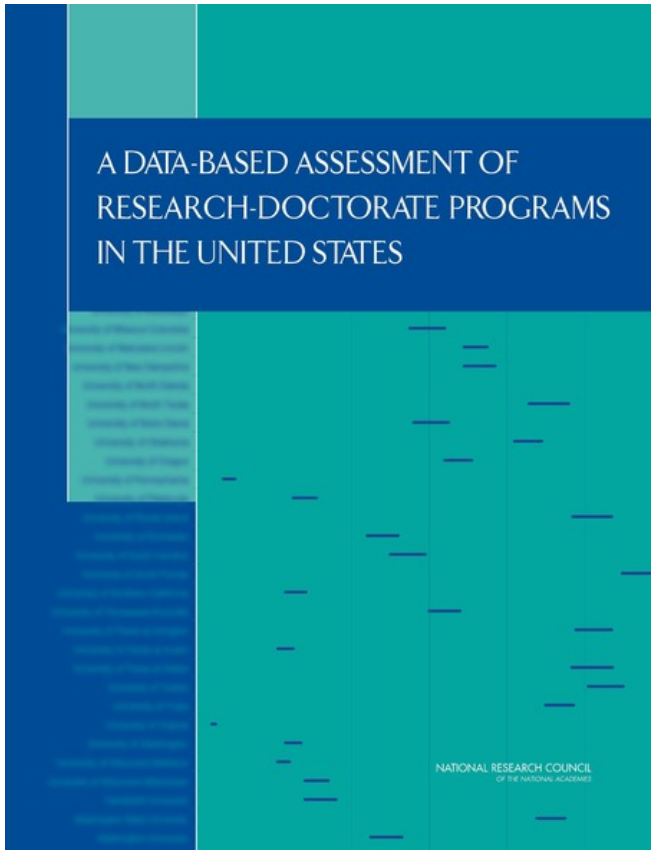
Result

- Implication
- Future Work

Literature on "New Economists"

Paper	Authors	Data	Method	Result (Predictors)
What Does Performance in Graduate School Predict? (2007)	Susan Athey, Lawrence F. Katz, Alan B. Krueger, Steven Levitt, and James Poterba	1029 grad students at Top 5 in the 1990s	Descriptive Statistics, OLS	First-year course grades, Top undergraduate institutions
Forecasting Job Placements of Economics Graduate Students (2000)	Alan Krueger and Stephen Wu	344 students in one department in 1989	Tobit model and OLS	GRE (math and economics), ratings of the admissions committee
15 Years of Research on Graduate Education in Economics (2014)	John Siegfried and Wendy Stock	585 students at 27 programs	Descriptive Statistics, OLS	Office spaces and research assistantships lead to higher completion rate
Predicting Job Placements of Economics Graduate Programs	(In Progress)	104 programs' average placement quality (covering 3915 graduates) from 2010 to 2017	Data Visualization, Regularized Regression, Model Selection	Faculty Productivity

Program Characteristics ("X")



- The National Research Council's "A Data-Based Assessment of Research-Doctorate Programs" in 2010
- Examines the program characteristics of 110 Economics Ph.D. doctoral programs in the U.S
- Private or public universities, location, scholarship amount, size, providing office space or not, diversity, the number of publications per faculty member, funding, citations per publication, number of grants, diversity, etc.
- We use 18 program-value exogenous variables that are related to students' placement in the following analysis.

Collecting Placements

- Compiled the initial job placement of these 110 Economics doctoral programs from 2010 to 2017.

- No data on Five programs
(Auburn, Northern Illinois, RPI, SUNY Buffalo and Utah State)

- 3915 observations specifying each student's pedigree, graduation year, initial employer and corresponding positions

- Ex:
University of A (2015) → University of B, Assistant Professor

Choose the ranking

Name	Coverage	Methodology	Latest Data
U.S News Economics Ranking	Top 90 U.S Programs	Results of peer assessment surveys	2017
“Ranking of Academic Journals and Institutions in Economics” (Kalaitzidakis et al., 2003)	Top 200 programs	Publications in 30 leading economics journals	2003
RePEc/IDEAS rankings	Top 10% of Institutions (Scores for 378 programs)	Publications of registered authors	2017
“Ranking Economics Departments Worldwide on the Basis of PhD Placement” (Amir and Knauff, 2005)	Top 58 worldwide departments	Sum of the values of its PhD graduates	2006
The Tilburg University Worldwide Economics Schools Research Ranking	About 1000 worldwide programs with at least one publications from 2010 to 2017	Publications in 70 leading economics journals	2017

Matching Placement With Tilburg Ranking

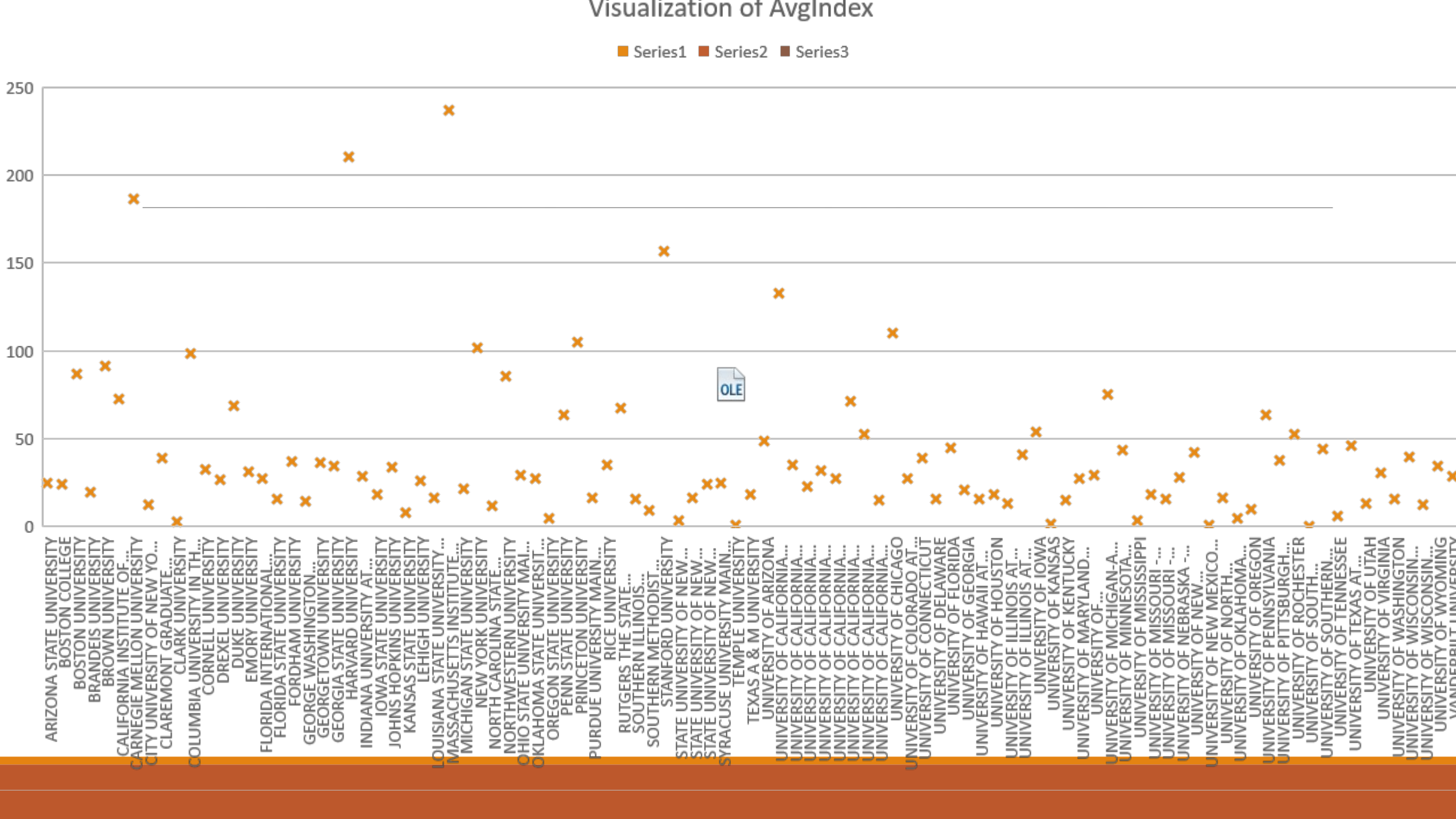
- The journal counts are treated as the scores to indicate the placement quality.
- There are 275 departments tied with rank 988 for $score = 1$ (one publication)
- 3003 out of 3915 placements (77%) are successfully assigned scores
- The remaining 912 entries are assigned 0.
- Discount rate for different positions (Krueger and Wu (2000))

Job Positions	Discount Rate	Counts(%)	Comment
Tenure-track assistant professor	1	3231 (83%)	Most ideal academic placement
Postdocs	0.6	520 (13%)	Pre-assistant professors
Lecturer/Visiting/Practice/Clinical assistant professor	0.4	130 (3%)	Non-tenure track, teaching positions

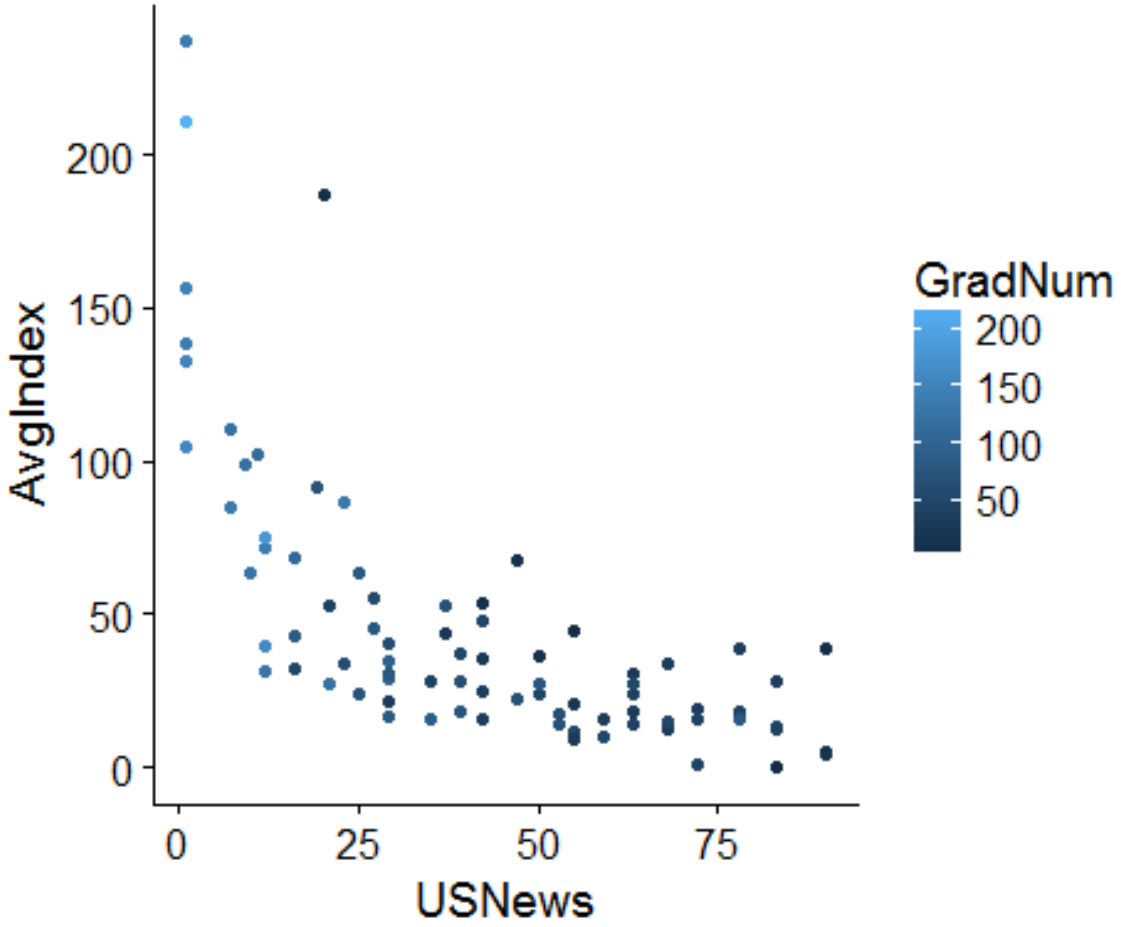
AvgIndex("y")

- AvgIndex
  - $\text{AvgIndex} = \frac{\text{sum of all graduates' placement scores}}{\text{number of graduates}}$

Quantiles	*AvgIndex*	Example Institutions
0%	0	Gettysburg College
25%	15	Miami University
50%	28	Fordham University
75%	45	University of Georgia
100%	237	Cornell University

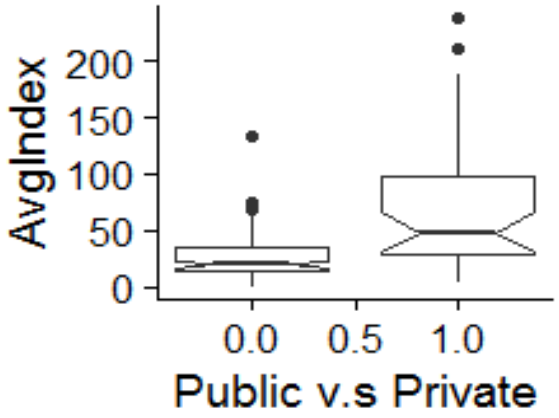

Visualization of AvgIndex
Series1
Series2
Series3
250
200
150
100
50
0
OLE
ARIZONA STATE UNIVERSITY
BOSTON COLLEGE
BOSTON UNIVERSITY
BRANDEIS UNIVERSITY
BROWN UNIVERSITY
CALIFORNIA INSTITUTE OF...
CARNEGIE MELLON UNIVERSITY
CITY UNIVERSITY OF NEW YO...
CLAREMONT GRADUATE...
CLARK UNIVERSITY
COLUMBIA UNIVERSITY IN TH...
CORNELL UNIVERSITY
DREXEL UNIVERSITY
DUKE UNIVERSITY
EMORY UNIVERSITY
FLORIDA INTERNATIONAL...
FLORIDA STATE UNIVERSITY
FORDHAM UNIVERSITY
GEORGE WASHINGTON...
GEORGETOWN UNIVERSITY
GEORGIA STATE UNIVERSITY
HARVARD UNIVERSITY
INDIANA UNIVERSITY AT...
IOWA STATE UNIVERSITY
JOHNS HOPKINS UNIVERSITY
KANSAS STATE UNIVERSITY
LEHIGH UNIVERSITY
LOUISIANA STATE UNIVERSITY...
MASSACHUSETTS INSTITUTE...
MICHIGAN STATE UNIVERSITY
NEW YORK UNIVERSITY
NORTH CAROLINA STATE...
NORTHWESTERN UNIVERSITY
OHIO STATE UNIVERSITY MAI...
OKLAHOMA STATE UNIVERSIT...
OREGON STATE UNIVERSITY
PENN STATE UNIVERSITY
PRINCETON UNIVERSITY
PURDUE UNIVERSITY MAIN...
RICE UNIVERSITY
RUTGERS THE STATE...
SOUTHERN ILLINOIS...
SOUTHERN METHODIST...
STANFORD UNIVERSITY
STATE UNIVERSITY OF NEW...
STATE UNIVERSITY OF NEW...
STATE UNIVERSITY OF NEW...
SYRACUSE UNIVERSITY MAIN...
TEMPLE UNIVERSITY
TEXAS A & M UNIVERSITY
UNIVERSITY OF ARIZONA
UNIVERSITY OF CALIFORNIA...
UNIVERSITY OF CALIFORNIA...
UNIVERSITY OF CALIFORNIA...
UNIVERSITY OF CALIFORNIA...
UNIVERSITY OF CALIFORNIA...
UNIVERSITY OF CALIFORNIA...
UNIVERSITY OF CALIFORNIA...
UNIVERSITY OF CHICAGO
UNIVERSITY OF COLORADO AT...
UNIVERSITY OF CONNECTICUT
UNIVERSITY OF DELAWARE
UNIVERSITY OF FLORIDA
UNIVERSITY OF GEORGIA
UNIVERSITY OF HAWAII AT...
UNIVERSITY OF HOUSTON
UNIVERSITY OF ILLINOIS AT...
UNIVERSITY OF ILLINOIS AT...
UNIVERSITY OF IOWA
UNIVERSITY OF KANSAS
UNIVERSITY OF KENTUCKY
UNIVERSITY OF MARYLAND...
UNIVERSITY OF...
UNIVERSITY OF MICHIGAN-A...
UNIVERSITY OF MINNESOTA...
UNIVERSITY OF MISSISSIPPI
UNIVERSITY OF MISSOURI -...
UNIVERSITY OF MISSOURI -...
UNIVERSITY OF NEBRASKA -...
UNIVERSITY OF NEW...
UNIVERSITY OF NEW MEXICO...
UNIVERSITY OF NORTH...
UNIVERSITY OF OKLAHOMA...
UNIVERSITY OF OREGON
UNIVERSITY OF PENNSYLVANIA
UNIVERSITY OF PITTSBURGH...
UNIVERSITY OF ROCHESTER
UNIVERSITY OF SOUTH...
UNIVERSITY OF SOUTHERN...
UNIVERSITY OF TENNESSEE
UNIVERSITY OF TEXAS AT...
UNIVERSITY OF UTAH
UNIVERSITY OF VIRGINIA
UNIVERSITY OF WASHINGTON
UNIVERSITY OF WISCONSIN...
UNIVERSITY OF WISCONSIN...
UNIVERSITY OF WYOMING

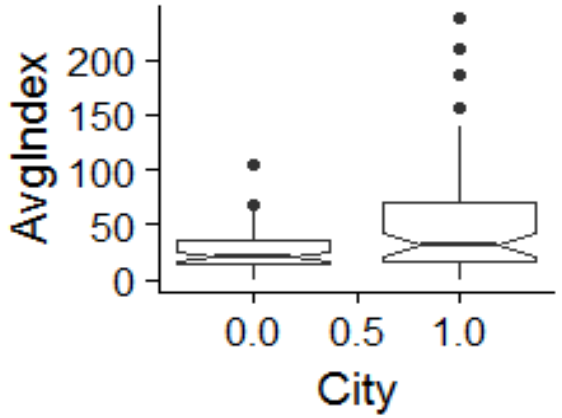
Does US News Ranking predict “y”?

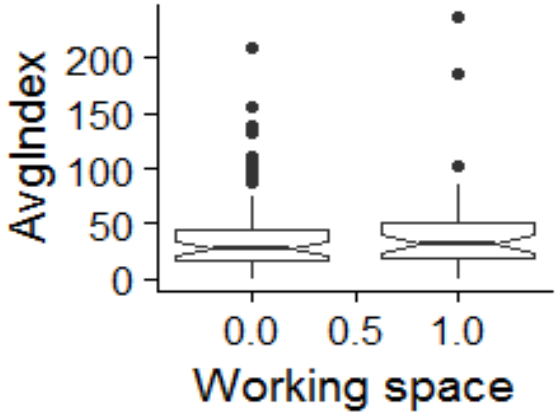


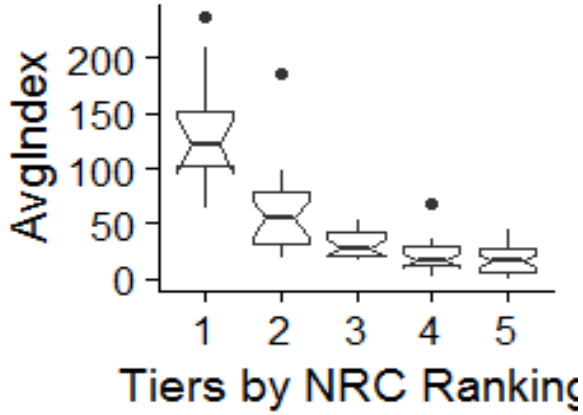
- Plot the ‘AvgIndex’ as a function of ‘USNews’
- The size of dot : relative number of graduates
- The AvgIndex increases when the rank climbs
- Among Top 25 programs, AvgIndex increases more steeply when the rank goes up.
- There are no significant AvgIndex differences among the rest of the programs.

Explore “X” (categorical) and “y”







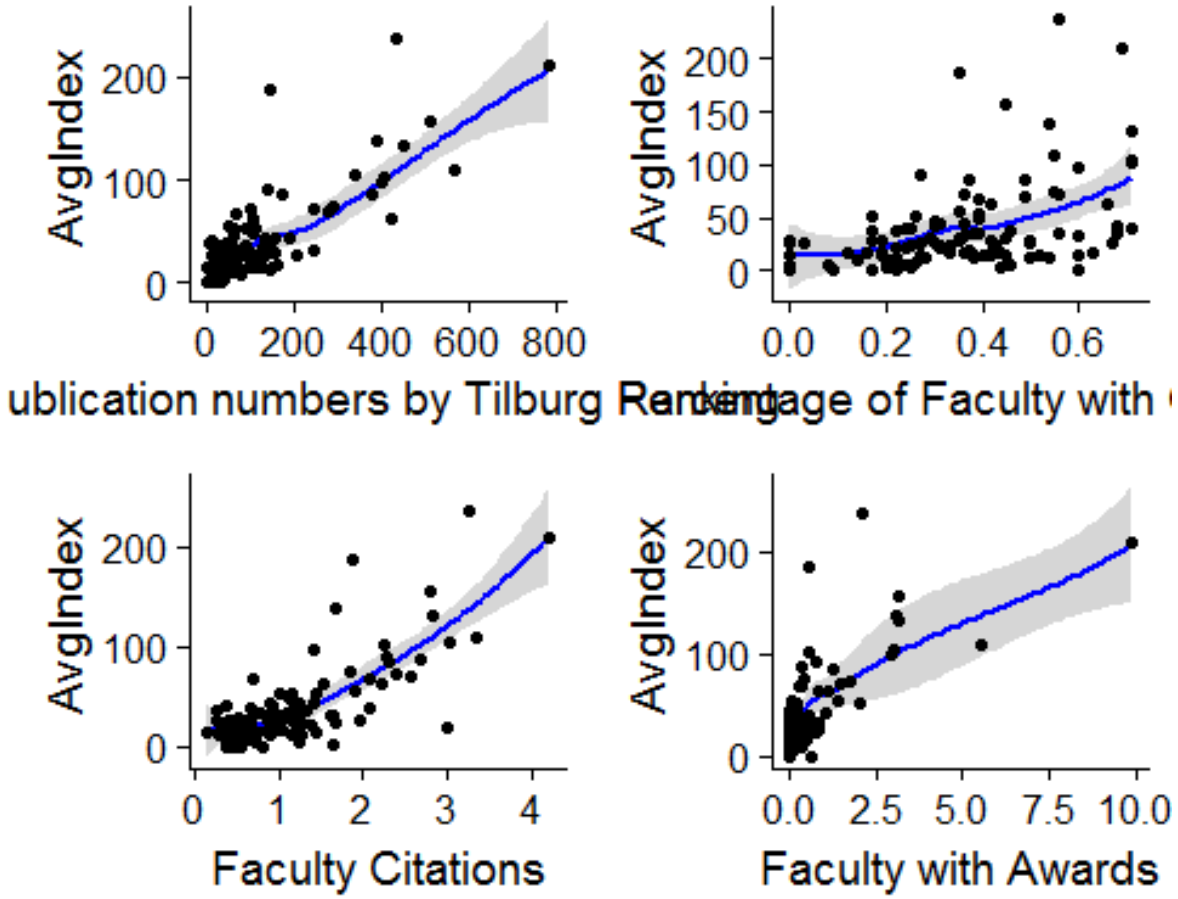


- Private institutions have higher AvgIndex on average
- No significant difference causd by campus setting. Best performing departments are in a city with 10k population.
- Working Space has no effect on AvgIndex

(Stock and Siegfried (2006) found providing working space increased completion rate)

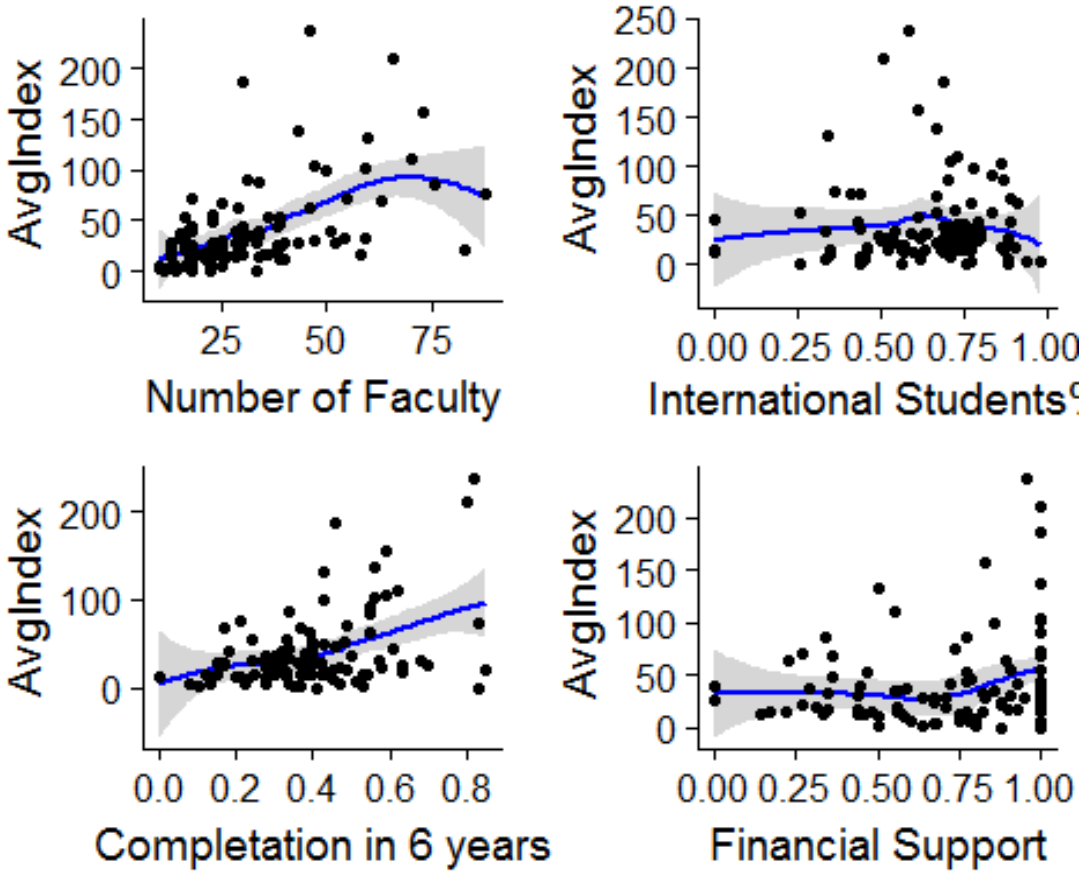
- The differences among Top 30-104 are small

Explore “X” (continuous) and “y”



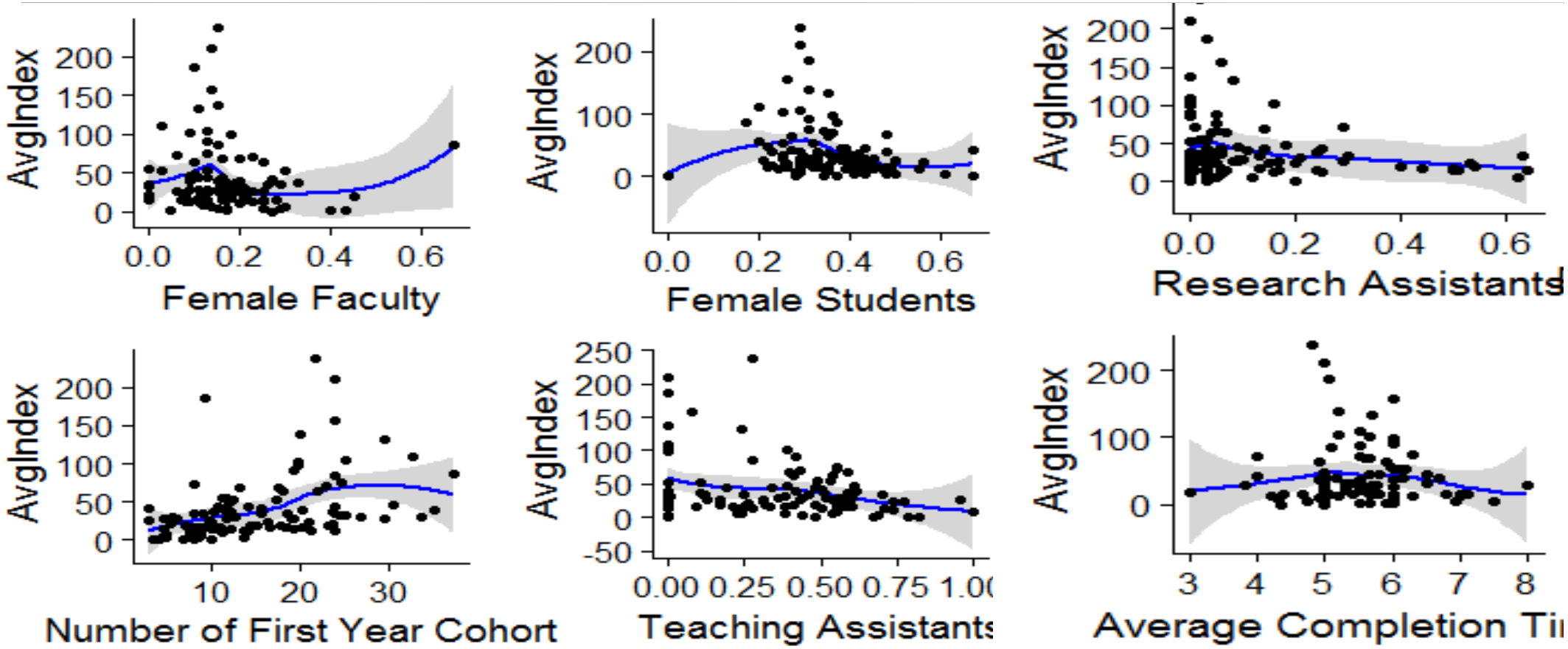
- Publication numbers (Tilburg), Grants, Citations, Awards are indicators of faculty quality
- They are highly correlated with AvgIndex

Explore “X” (continuous) and “y”



- Financial Support has no significant effect on AvgIndex
- Bolli et al. (2015) found institutional student support caused higher completion rates

Explore “X” (continuous) and “y”



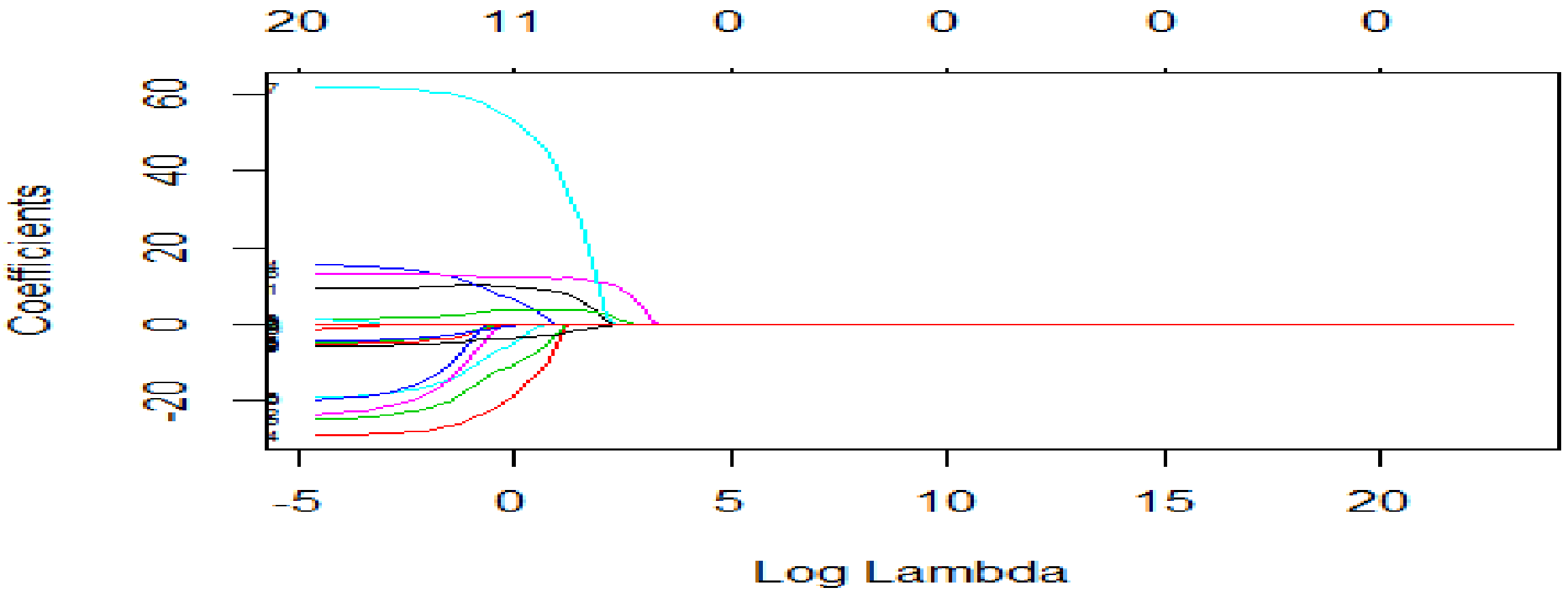
Regularized Regression

- We use the Lasso to fit the prediction model
- Reasons: 1. Large number of predictors (18)
  2. Prefer a model with smaller variance and MSE (OLS gives high variance)
  3. More interpretable model (Ridge uses l-2 in penalty term; keeps all coefficients)
- Coefficients minimize the quantity

$$\sum_{i=1}^{n}\left(y_i-\beta_0-\sum_{j=1}^{p}\beta_j x_{ij}\right)^2+\lambda\sum_{j=1}^{p}|\beta_j| = \mathrm{RSS}+\lambda\sum_{j=1}^{p}|\beta_j|.$$

- In the penalty term, the tuning parameter λ controls the degree of penalty.
- If λ becomes larger, the penalty term will shrink more coefficients to be zero.
- If λ is 0 (unregularized), we get same coefficients from least square fit.

For each value of λ, we get different sets of coefficient estimates



Model Selection

- **Cross-validation** helps us estimate prediction error and select optimal model
- Step1: Split the data into 5 folds. Start with initial $\log(\lambda)$

1	2	3	4	5
Train	Train	Validation	Train	Train

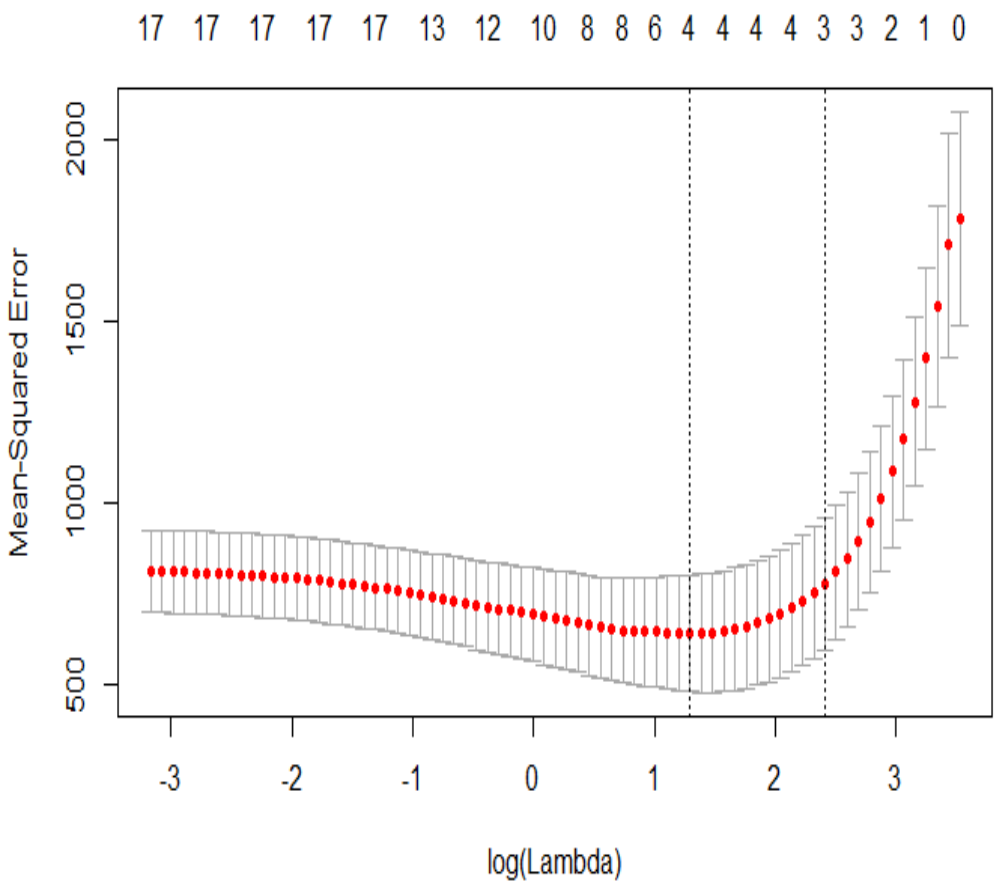
- Step2: Leave out part 1, fit the model to the rest;

  Obtain MSE for the 1st part
- Step3: Repeat the process for k=2,3,4,5

$$\mathrm{CV}_{(K)} = \sum_{k=1}^{K} \frac{n_k}{n} \mathrm{MSE}_k$$

where $\mathrm{MSE}_k = \sum_{i \in C_k} (y_i - \hat{y}_i)^2 / n_k$, and $\hat{y}_i$ is the fit for observation i, obtained from the data with part k removed.

- Step4: Iterate for different values of $\log(\lambda)$



Model with minimum MSE

(Intercept)	5.9870935
Pri	7.2644151
City	.
Space	.
FS	.
International	.
Citations	12.5342821
Faculty	.
Grants	.
Awards	4.3116645
`Completion%`	.
`Female Faculty`	.
`Female Students`	.
`First Year`	.
RA	.
TA	.
Time	.
GradNum	.
Tilburg	0.1196028

- 3.03 (Four predictors)
- *Optimal n: 3.03 (Four predictors)*
- Useful for predicting updated AvgIndex on new NRC data
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- For department chairs and administrators, hiring productive professors may be the best strategy to boost placement quality
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- For graduate students (current and potential), potential advisors' research productivities matter a lot if they want to start a promising career in academia.
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Reference

1. *American Economic Association.* (2017). Aeaweb.org. Retrieved 2 December 2017, from https://www.aeaweb.org/joe/listings
2. Amir, R., & Knauff, M. (2008). Ranking Economics Departments Worldwide on the Basis of Ph.D. Placement. *Review Of Economics And Statistics*, 90(1), 185-190. http://dx.doi.org/10.1162/rest.90.1.185
3. Athey, S., Katz, L., Krueger, A., Levitt, S., & Poterba, J. (2007). What Does Performance in Graduate School Predict? Graduate Economics Education and Student Outcomes. *American Economic Review*, 97(2), 512-518. http://dx.doi.org/10.1257/aer.97.2.512
4. Bolli, T., Agasisti, T., & Johnes, G. (2013). The impact of institutional student support on graduation rates in US Ph.D. programmes. *Education Economics*, 23(4), 396-418. http://dx.doi.org/10.1080/09645292.2013.842541
5. Chen, J., Liu, Q., & Billger, S. (2013). Where Do New Ph.D. Economists Go? Recent Evidence from Initial Labor Market. *Journal Of Labor Research*, 34(3), 312-338. http://dx.doi.org/10.1007/s12122-013-9162-4
6. Ehrenberg, R. (2004). Prospects in the Academic Labor Market for Economists. *Journal Of Economic Perspectives*, 18(2), 227-238. http://dx.doi.org/10.1257/0895330041371312
7. James, Gareth,. Witten, Daniela., Hastie Trevor., & Tibshirani, Rovert. (2013). *An Introduction to Statistical Learning*. New York.: Springer
8. Krueger, A., & Wu, S. (2000). Forecasting Job Placements of Economics Graduate Students. *The Journal Of Economic Education*, 31(1), 81. http://dx.doi.org/10.2307/1183344
9. Oyer, P. (2006). Initial Labor Market Conditions and Long-Term Outcomes for Economists. *Journal Of Economic Perspectives*, 20(3), 143-160. http://dx.doi.org/10.1257/jep.20.3.143
10. Staff, N. (2010). *Assessment of Research-Doctorate Programs in the U.S.*. Washington: National Academies Press.
11. Stock, W., & Siegfried, J. (2014). Fifteen Years of Research on Graduate Education in Economics: What Have We Learned?. *The Journal Of Economic Education*, 45(4), 287-303. http://dx.doi.org/10.1080/00220485.2014.942410
12. Stock, W., Finegan, T., & Siegfried, J. (2009). Can you earn a Ph.D. in economics in five years?. *Economics Of Education Review*, 28(5), 523-537. http://dx.doi.org/10.1016/j.econedurev.2009.04.001
13. *Tilburg University Economics Ranking - Tilburg University.* (2017). Econtop.uvt.nl. Retrieved 4 November 2017, from https://econtop.uvt.nl/rankingsandbox.php
14. *U.S News Best Graduate Economics Programs .* (2017). Retrieved 4 April 2017, from https://www.usnews.com/best-graduate-schools/top-humanities-schools/economics-rankings