Supervised Learning Capstone

U.S. college graduation rates

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Introduction

Motivation, Explanation of Data

Motivation

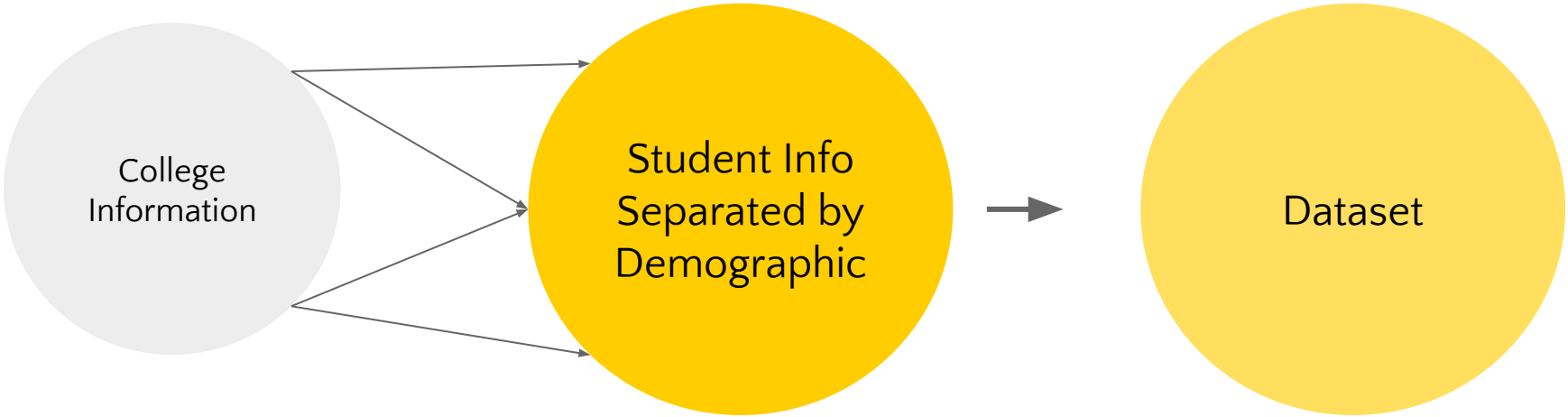
- Interest in college graduation rates/performance
  - Hot topic of increasing costs
- Data Source: Chronicle of Higher Education with support from the Bill & Melinda Gates Foundation
- What dimensions are most correlated to grad rates? What changes could be made? Any importance of student demographics?

Explanation of Data

- College completion data from 3,800 degree-granting institutions in the U.S.
- Full-time degree-seeking undergraduate cohort of at least 100 students at the undergraduate level in 2013
- Awarded undergraduate degrees **between 2011 and 2013**

Structure of Data

- Joined 2 tables (one-to-many)
- Resulted in 790560 observations, 70 columns

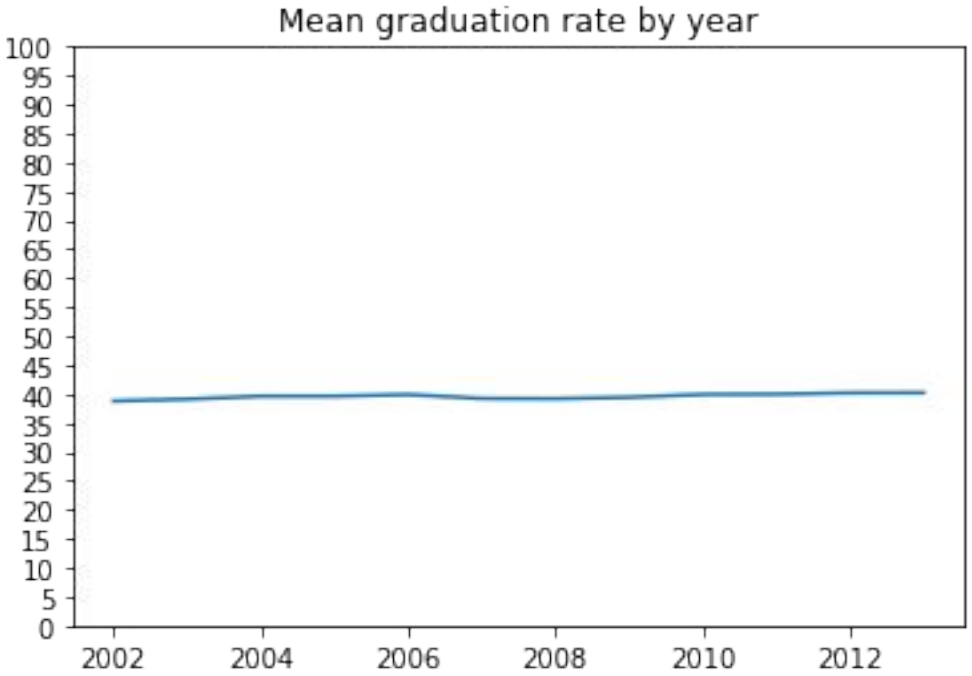


2

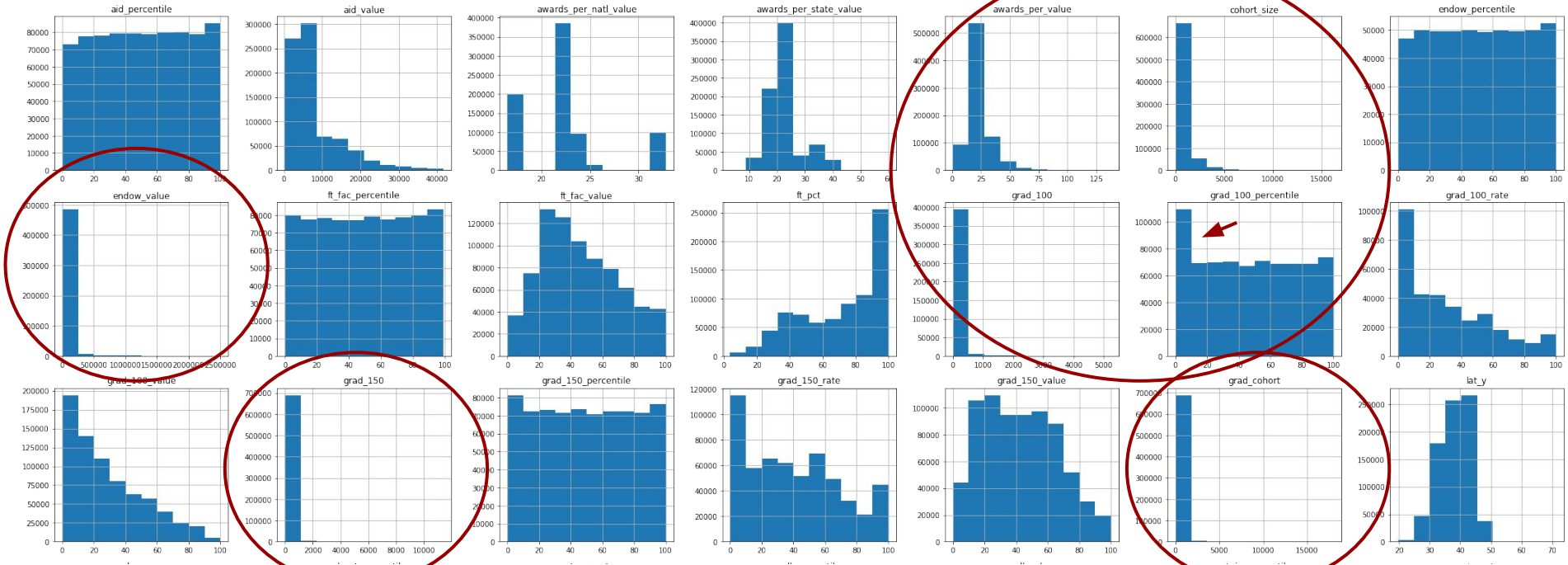
Data Exploration & Cleaning

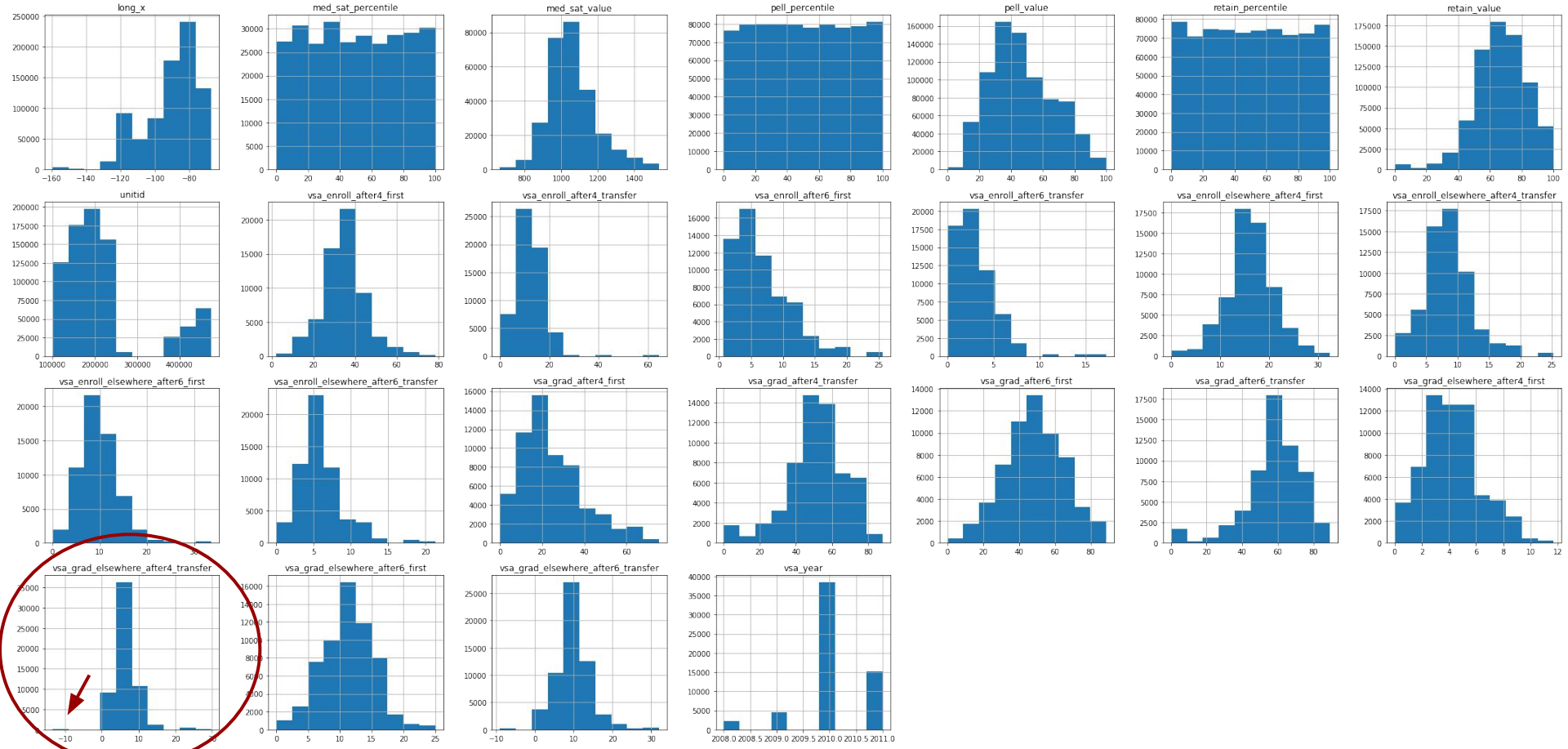
For continuous and discrete variables

Target Variable: 6-year Grad Rate



Continuous Variables

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Discrete Variables

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top	Metro Business College	Chicago	California	4-year	Public	Associates--Private For-profit	X	X	www.itt-tech.edu	100.0|07	NSU	M	H	4y bach
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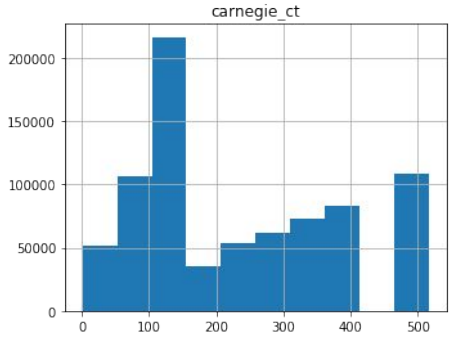
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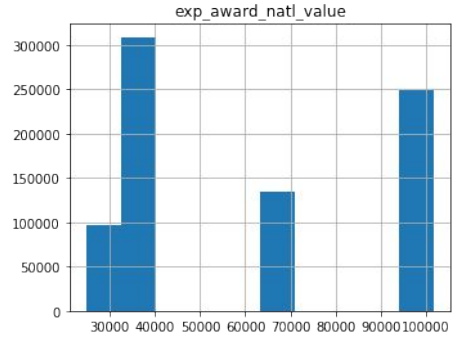
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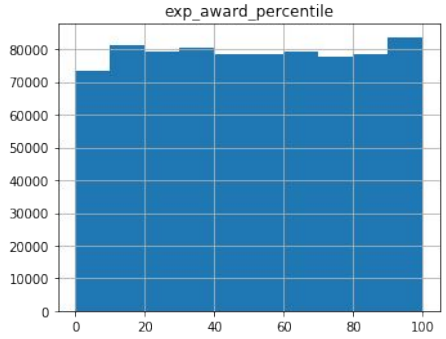
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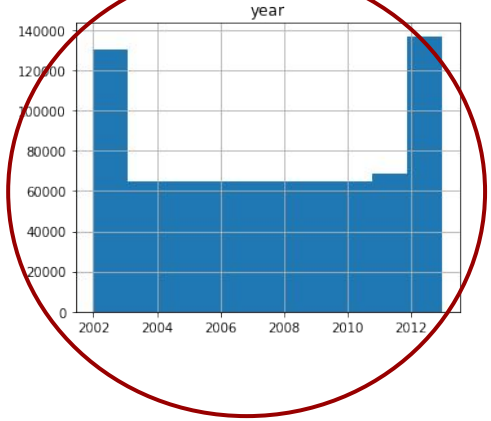
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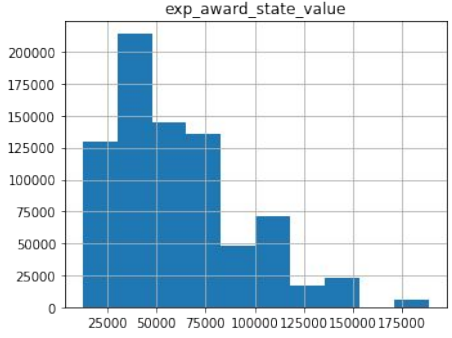
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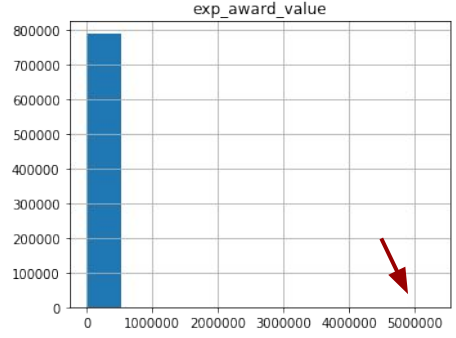
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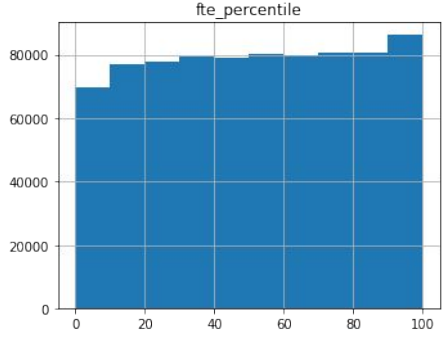
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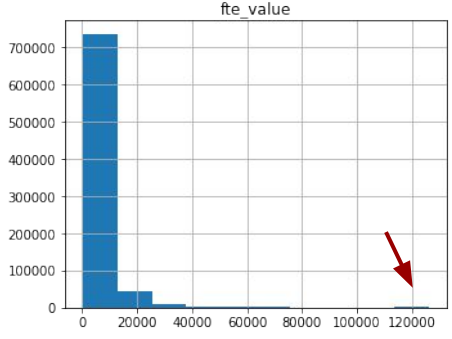
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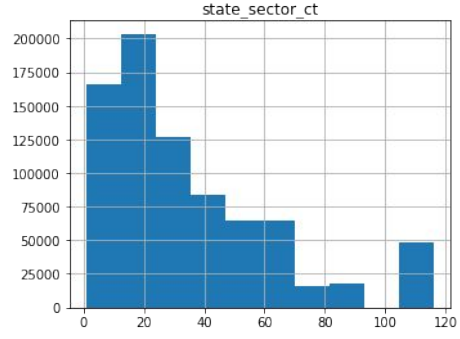
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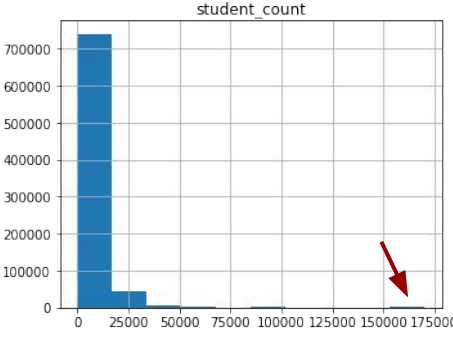
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3 Feature Engineering

New Features Examined

- Student/Faculty Ratio
- Interaction Variables:
  - Public School * Endowment
  - Public School * Aid
  - Public School * Percentage of students who transfer out and graduate elsewhere
    - Had to be an interaction variable because of limited data
    - Only significant new variable

4

Modeling & Tuning Process

Modeling Process

Decision Tree Regressor

1. Randomized Grid Search
2. Fit Best Model
3. Prune Features
4. Randomized Grid Search on Smaller Dataset
5. Fit Best Model

Gradient Boosted Random Forest Regressor

1. Randomized Grid Search
2. Fit Best Model

Linear Regression

1. PCA
2. Fit Model with PCA Components
3. Fit Model with top 7 Variables (from Random Forest)
4. Chose to use PCA moving forward

Regularized Linear Regression Models

1. Randomized Grid Search
2. Fit Best Model
3. Repeat for Each Model

5 Results

Metric Comparison

	Train Score	Test Score	Train - Test
Decision Tree	.371	.344	.027
Decision Tree (Pruned)	.256	.107	.148
Gradient Boosted Random Forest	**.420**	**.398**	**.022**
Linear Regression (with PCA)	.322	.322	0
Best Regularized Linear Regression (Ridge)	.322	.323	-.001

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Conclusion

Key Takeaways and Lessons Learned

Top 3 most important variables:

Freshman retention rate
Estimated educational spending per degree
Median SAT value (for incoming students)

Best model:

Gradient Boosted Random Forest

42% | 40%

Train accuracy | Test Accuracy

Takeaways

- Freshmen retention, educational spending per student, and student achievement prior to college (measured by SAT scores) are the most related to higher 6 year graduation rates.
- While correlation does not indicate causation, this is still meaningful insight
- Can provide data to back decisions made by universities and 2 year colleges.

Missing Variables

- Student GPA (first year)
- Transfer information for non-public 4-year institutions
- Percentage of faculty that are full time
- Faculty Salary

Further study: Look at 4 year grad rates or collect data above for colleges in the existing dataset

Lessons Learned

- Data cleaning can be an iterative process
  - Spending a lot of time with the variable descriptions helps
- Regularization (of linear regression models) provides most benefit when looking to increase prediction scores
- Ensure all engineered features have real meaning and the units make sense

Thanks!

Any questions ?

Sources

- Data Accessed On: https://data.world/databeats/college-completion
- Secondary Sources: https://www.chronicle.com/

  https://www.gatesfoundation.org/

  https://www.clarion.edu/about-clarion/offices-and-administration/university-support-and-business/office-of-institutional-research/retention-and-graduation-rate-analysis-clarion-university.pdf

  https://pdfs.semanticscholar.org/64f7/064c0d0d5b3417166e6e7ca9e4e157673eb2.pdf