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Predicting Six-Year Graduation Probabilities of First-Time Full-Time Freshmen

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Overview

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Introduction

❖ Virginia Commonwealth University (VCU)

- A major public research university located in Richmond, the state capital of Virginia.
- Classified as a Research University-Very High Research Activity, the highest ranking by the Carnegie Foundation.
- Total enrollment of 32,000; 222 degree and certificate programs, 67 of which are unique in the state of Virginia.
- One of the largest academic health centers in the nation. The VCU Medical Center was named the No. 1 hospital in the state in 2013 by U.S. News & World Report.

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Key Metrics on Student Success

	First-year retention (F2014 cohort)	Six-year graduation (F2009 cohort)	High-school GPA (F2015 cohort)	Student/ Faculty Ratio (F2015)
Virginia Commonwealth University	86% **(4)**	62% **(4)**	3.64 **(4)**	16:1 **(1)**
University of Alabama, Birmingham	79%	55%	3.66	18:1
University of Cincinnati	88% **(1)**	65%	3.48	18:1
University of Illinois, Chicago	82%	60%		
University of Louisville	79%	53%	3.60	16:1 **(1)**
University of South Carolina	88% **(1)**	72% **(1)**	4.07 **(1)**	18:1
University of South Florida, Tampa	88% **(1)**	68%	3.94	24:1

(All numbers were obtained from 2015-16 Common Data Set.)

Problem Identification

- VCU six-year graduation rate is 62% → there is still a lot of room for improvement.
- Enhancing six-year graduation rate lines up with VCU's commitment to student success.
- Higher graduation rates:
  - → Higher institutional reputation and ranking
  - → Less costs for students and their families
  - → More meaningful achievement for both institution and students

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Problem Identification (Cont.)

Being able to predict "at-risk" students at an early stage (after the first semester) and provide them with necessary assistance to graduate in time is crucial for all parties involved.

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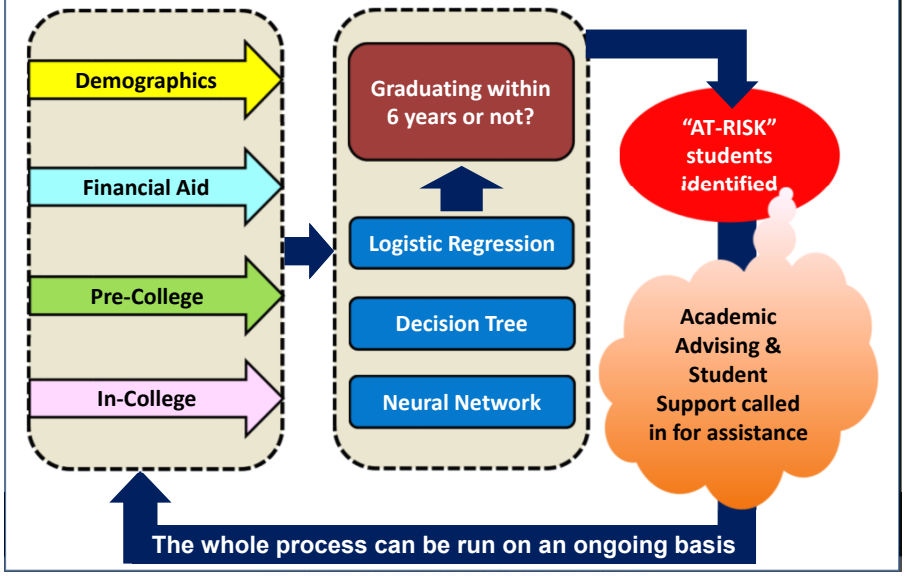
Conceptual Framework



Data

- Data collected from Banner ODS modules (Admissions, Enrollment, Financial Aid) after the first semester (fall)
- Fall 2009 full-time first-time freshman cohort (3,644 students)
- Four groups of predictors: demographics, financial aid, pre-college, and in-college

Data (Cont.)

Demographics	Financial Aid
Residency	Dependent/Independent
Gender	Applied for FASFA or not
Race/Ethnicity	Amount of Pell grant received
First generation	Percent of need met
	Median income of zip code

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Data (Cont.)

Pre-College	
High school GPA	SAT Combined/Math/Verbal
IB/AP credits recognized	
In-College (at the end of the first semester)	
Transfer hours recognized	On-campus/Off-campus
STEM major	College/School enrolled
Student class (FR/SO/JR/SR)	Athlete/Honors

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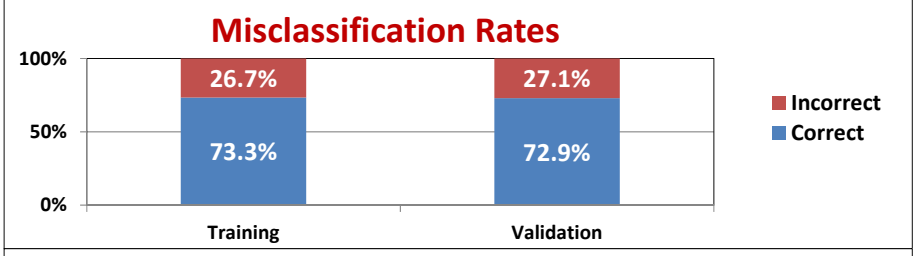
Data (Cont.)

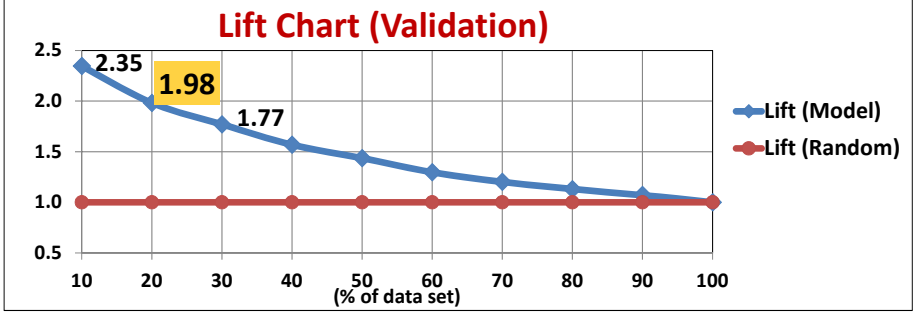
In-College (at the end of the first semester)	
Term hours attempted/earned	Number of Math/Physics/Chemistry courses taken
Term quality points/GPA hours	Academic standing
Number of D/F/W grades	Applied for transcript or not

Methods and Software

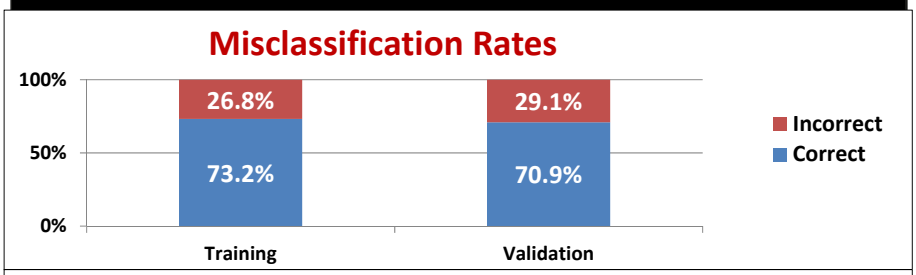
- Data are extracted and prepared with SAS Base.
- Imputation for missing values and modeling tasks are done with SAS Enterprise Miner.
- Three techniques: logistic regression, decision tree, and neural network models. The best model is selected based on misclassification rates.
- Original data set is split into two: 60% for training and 40% for validation.

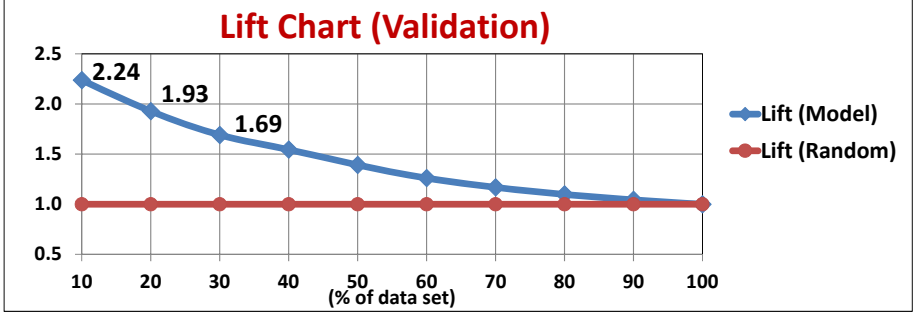
1 – Logistic Regression



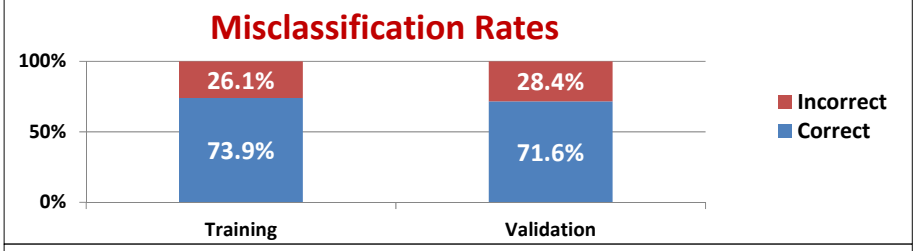


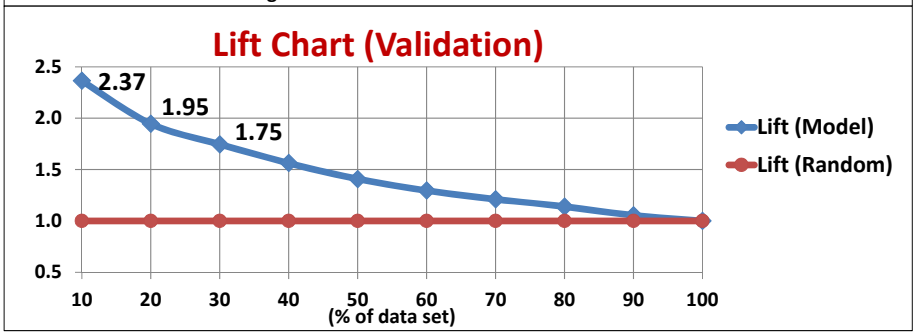
2 – Decision Tree





3 – Neural Network





Findings

- Logistic regression model is chosen based on misclassification rate, lift chart, and easiness of model interpretation.
- Significant predictors: first generation, academic standing, college, cumulative hours earned/GPA, SAT Verbal, high school GPA, percent of unmet need, and applied for transcript or not.

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Findings (Cont.)

- The lift of logistic regression at 20% is **1.98** → if the top 20% (sorted by highest to lowest probabilities) of total cohort were selected, the number of "at-risk" students captured by the model would be 1.98 times as many as when 20% of total cohort were selected at random.

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Findings (Cont.)

Total cohort (3,644 students): graduated in 6 years (2,269 students, or 62%), did not graduate in 6 years (1,375 students, or 38%)

	No modeling (random)	**Logistic regression**
Selecting 20% of total cohort	3,644*20% = 729 students	
→ **Number of "at-risk" students captured**	729*38% = 277	277***1.98** = 548
→ **If 70% of those "at-risk" students were helped to graduate in 6 years**	277*70% = 194	548*70% = 384
→ **Improved six-year graduation rate by targeting 20% of the total cohort**	(2,269+194)/3,644 = **68%**	(2,269+384)/3,644 = **73%**

Further Study

- Other variables can be introduced to the models to improve accuracy: average time spent in library, intent to complete a degree program (from SAT/ACT record)…
- Cluster analysis can be conducted on the predicted non-graduates to see if they shared any common characteristics.

Other Applications

- "High-risk" students can be monitored continuously on a semester basis and passed onto Academic Advising and Student Support for help so that they can graduate in time.
- A customized model can be developed for each school/college to help keep track of the progress of their own students.

Other Applications (Cont.)

- The same framework and methods can be developed to predict students' probabilities of **retention/attrition** at various levels (university, school/college, or department).

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Thank You

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