

Educational persistence and performance of first-time students in three minority-serving institutions

What factors matter at what time?

CIERP, University of Texas at El Paso
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Overview

- This research is part of a Lumina-funded collaborative project to build institutional knowledge infrastructures at MSIs to support student-success practices.
- First-time students at three Texas minority-serving institutions (MSIs) were studied to identify factors that explain academic persistence and performance.
- We used discrete-time event history models to examine the effects of time and time-dependent factors on student departure/return and binary outcome models to examine factors that explain baccalaureate attainment. Using multiple linear regression models, we also examined predictors of academic performance separately for students who depart and who graduate.
- We refined the concept of student success to incorporate both persistence and performance in its definition; then we used competing- risk models to examine the redefined types of successful exit.
- We will present findings from the three study institutions and discuss the connection between research and institutional practices.



Outline

1. Research question / literature
2. 3-D: definition, description, and design
3. Factors of success and risk
 - Persistence: departure/return and BA attainment
 - Performance: term and cumulative GPA
 - Successful exit: refined concept of student success
4. Summary
5. Implications
6. Q&A, additional information



Section I: Research Question

What factors explain first-time-in-college (FTIC) students' success at minority-serving institutions (MSI)?

Do the success and risk factors have changing effects over time?



1.2 Literature

- Educational attainment is a process; students' rate of progress underlies various measures of persistence
- Departure from institution \neq Departure from education
- Departure \neq Failure: departure and graduation are not mutually exclusive
- Involvement is the key to retention
- Social, economic, academic and cultural capitals (SEAC) are important factors of success
- Financial aid and developmental education (DE) may alleviate the disadvantage in SEAC



Section II: 3-D

2.1 Definition

What are the outcomes that define and measure “student success”?

2.2. Description

What does each outcome look like?

2.3 Design

How do we identify factors that influence the outcomes and estimate their effects?



2.1 Definition

Success = Persistence + Performance

Why is it important to study both performance and persistence?

- They are complementary measures of student success
- They are joint predictors of success beyond college years
- Earlier performance predicts subsequent persistence



2.1 Definition

Academic Persistence	
Academic progress	Number of credits earned
Term-to-term retention	1 if changed enrollment status in next term*
Baccalaureate attainment	1 if graduated (BA)
Academic Performance	
Term GPA	End-of-term average grade, 0-4
Degree GPA	Cumulative GPA as of graduation, 0-4
Departure GPA	Cumulative GPA as of departure, 0-4
Student success	
Successful exit	1 if graduated (BA) 2 if departed with GPA ≥ 2.0

*Next term includes next regular term or next summer term.

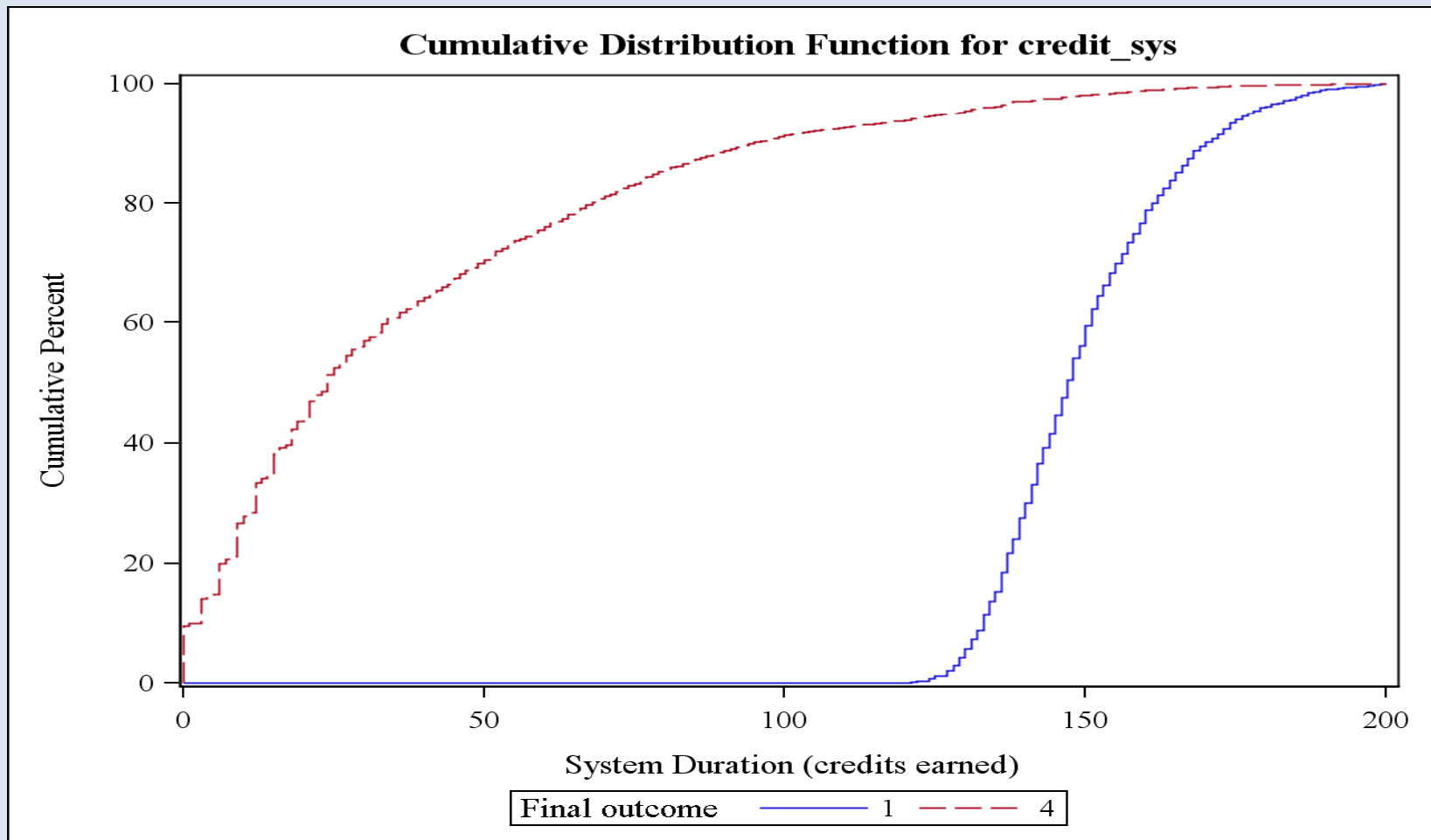


2.2 Description

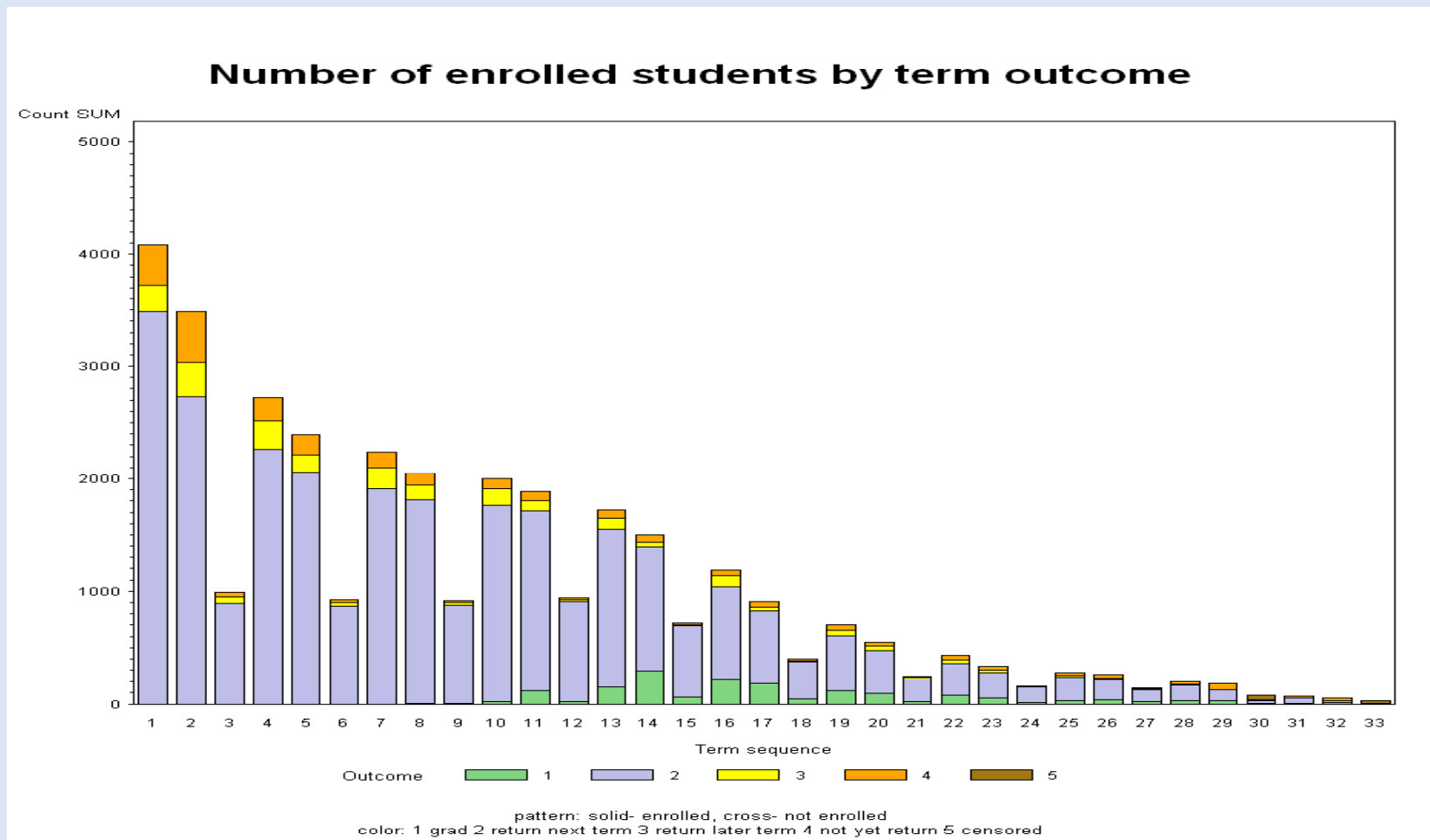
Outcomes	Graphs
Academic Persistence	
Academic progress	Cumulative distribution of exit credits, graduates and leavers
Term-to-term retention	Enrolled & non-enrolled students by term outcome
BA attainment	Graduates, term and cumulative counts
Academic Performance	
Term GPA	GPA distribution by term
Exit GPA	Cumulative distribution of exit GPA, graduates and leavers
Student Success	
Successful exit	Number of graduates and leavers with cumulative GPA ≥ 2.0 , term and cumulative counts



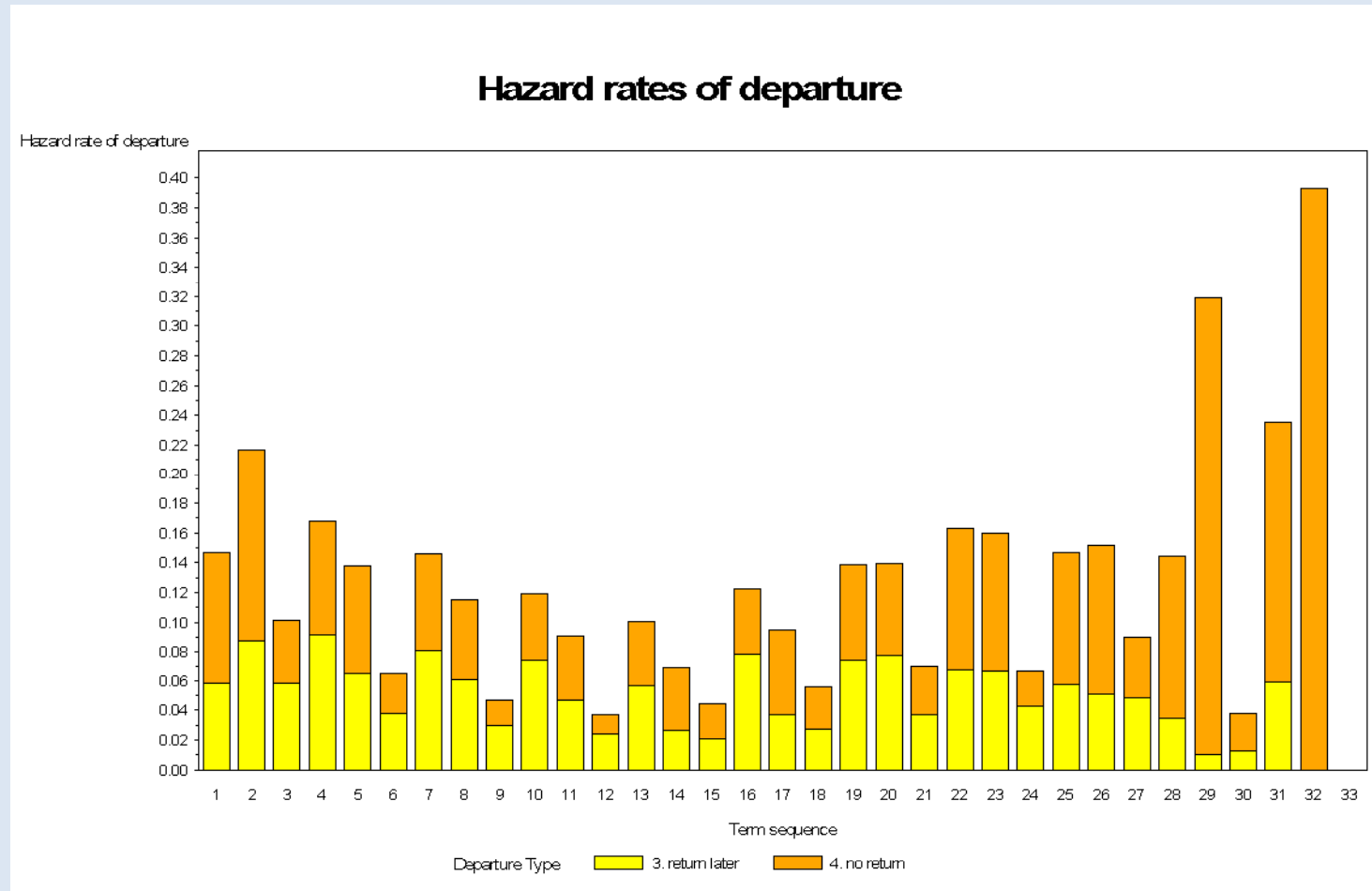
2.2.1 Academic progress



2.2.2 Term-to-term retention

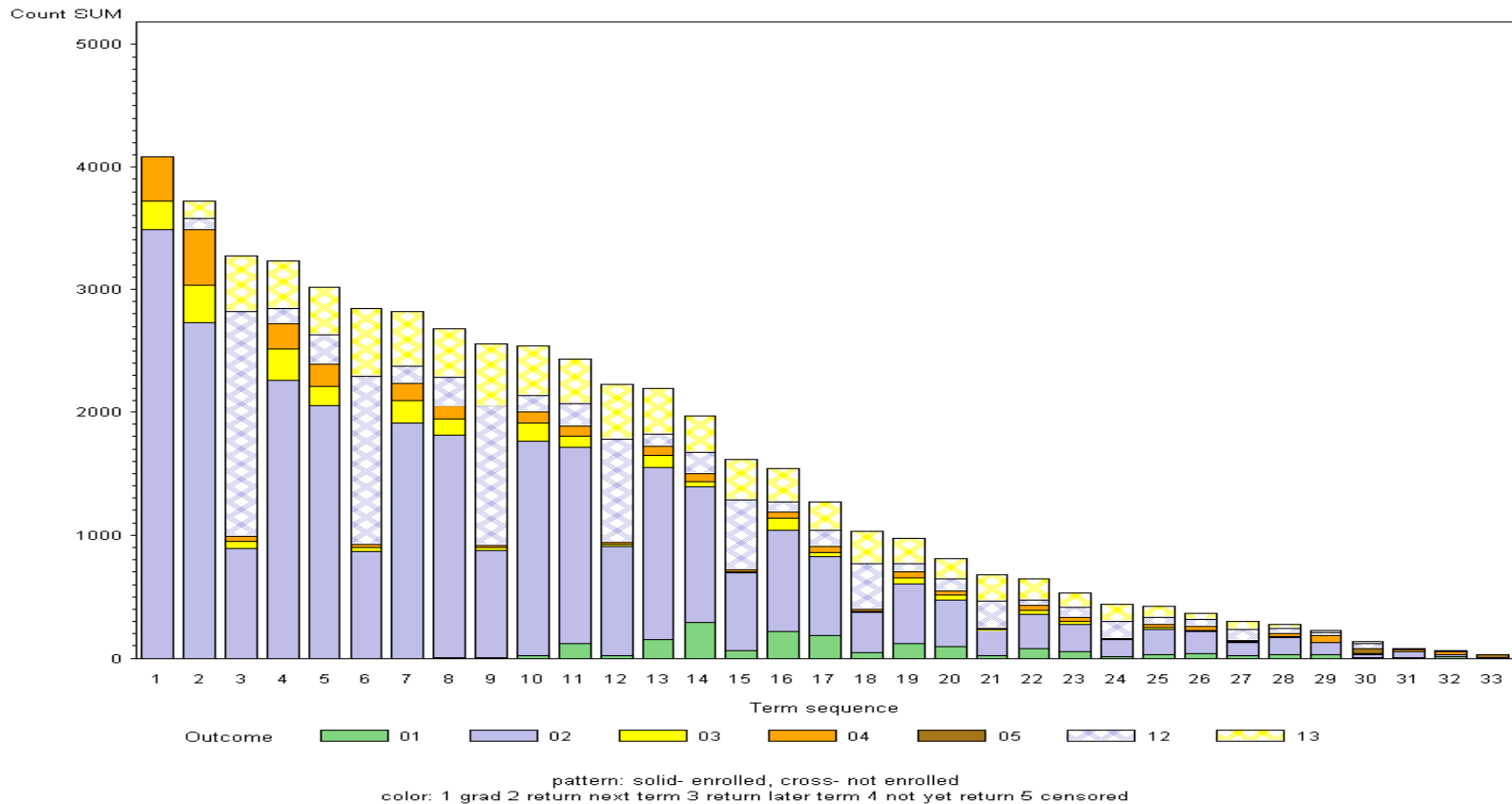


2.2.3 Term-to-term departure

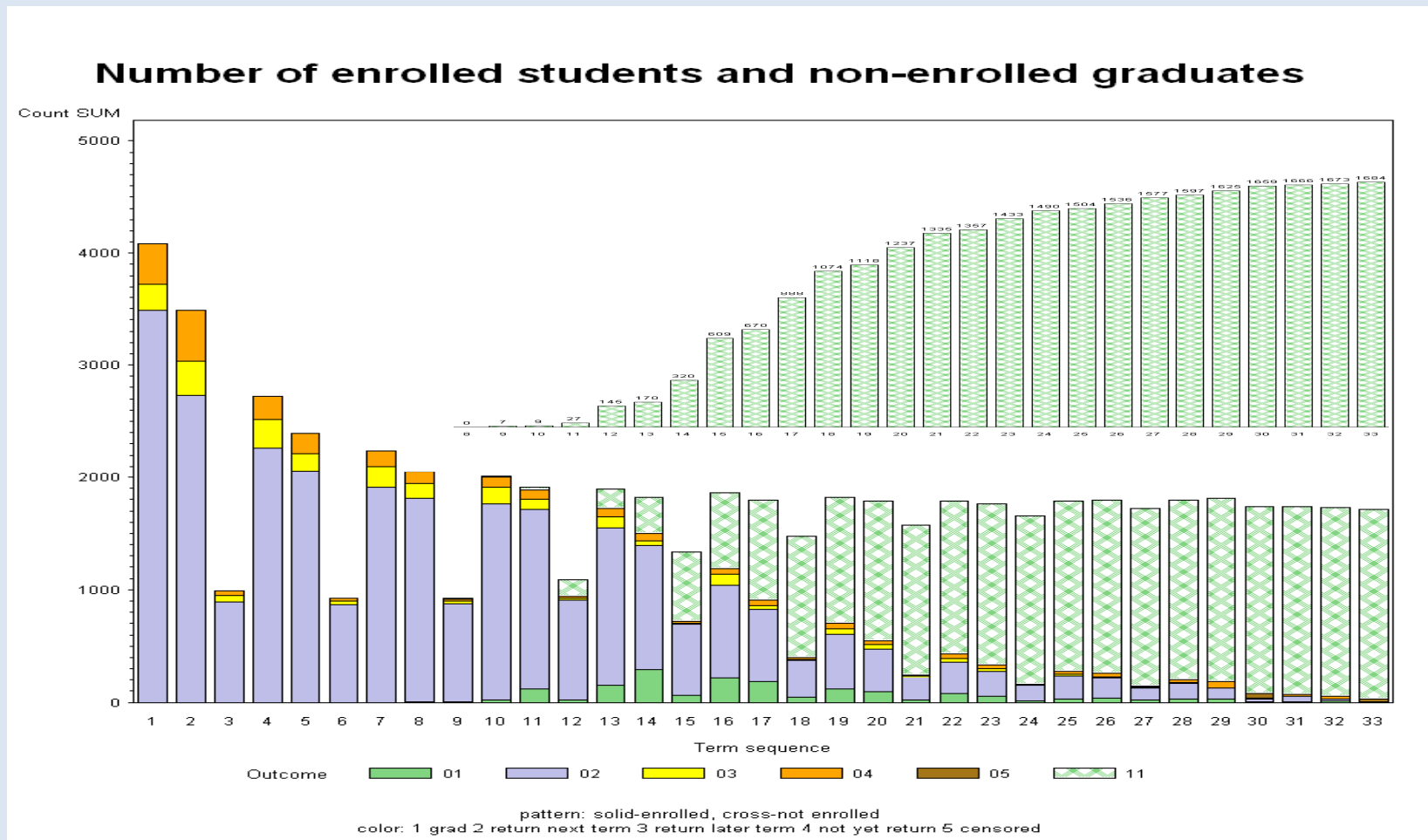


2.2.4 Term-to-term persistence

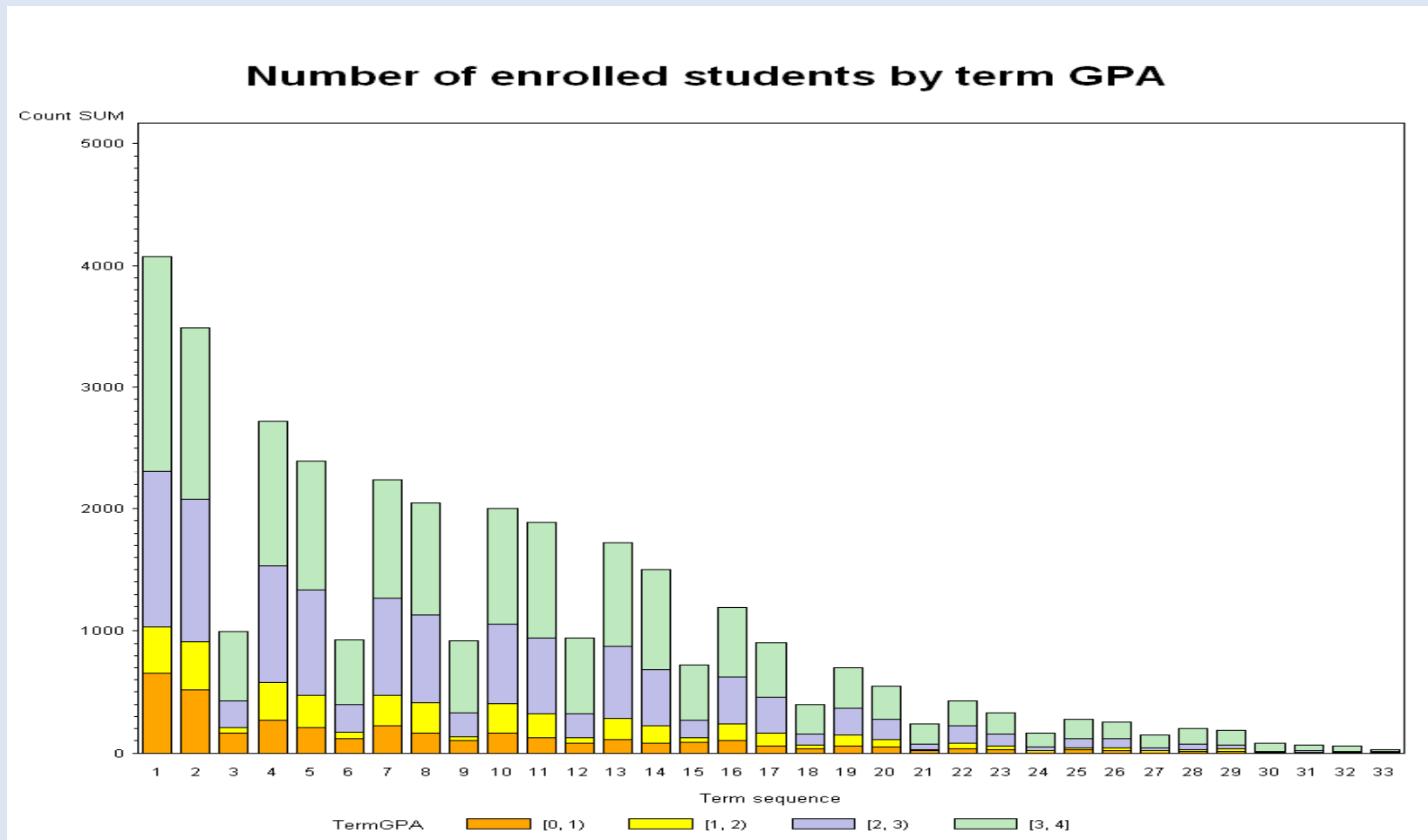
Number of enrolled and non-enrolled students by term outcome



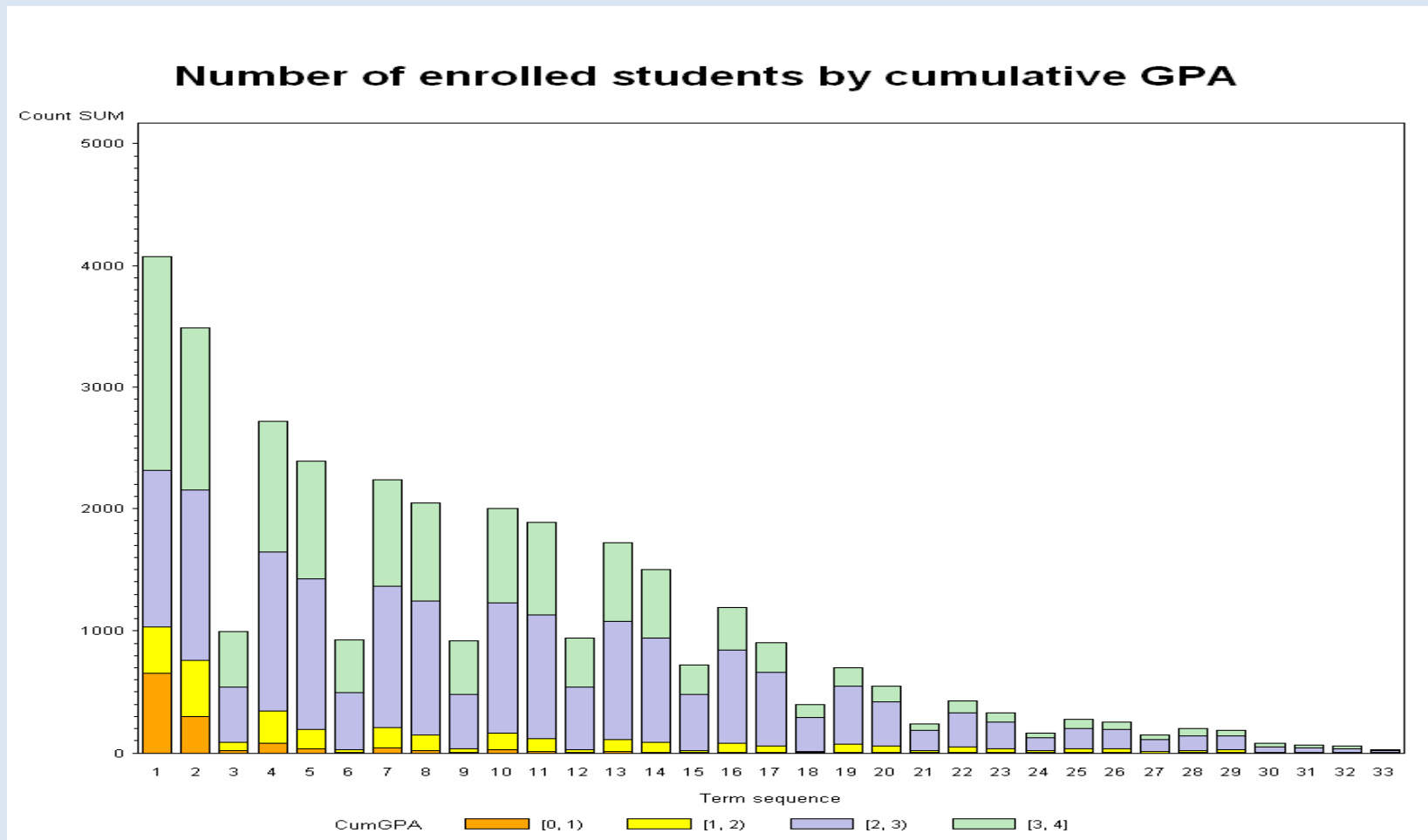
2.2.5 Baccalaureate attainment



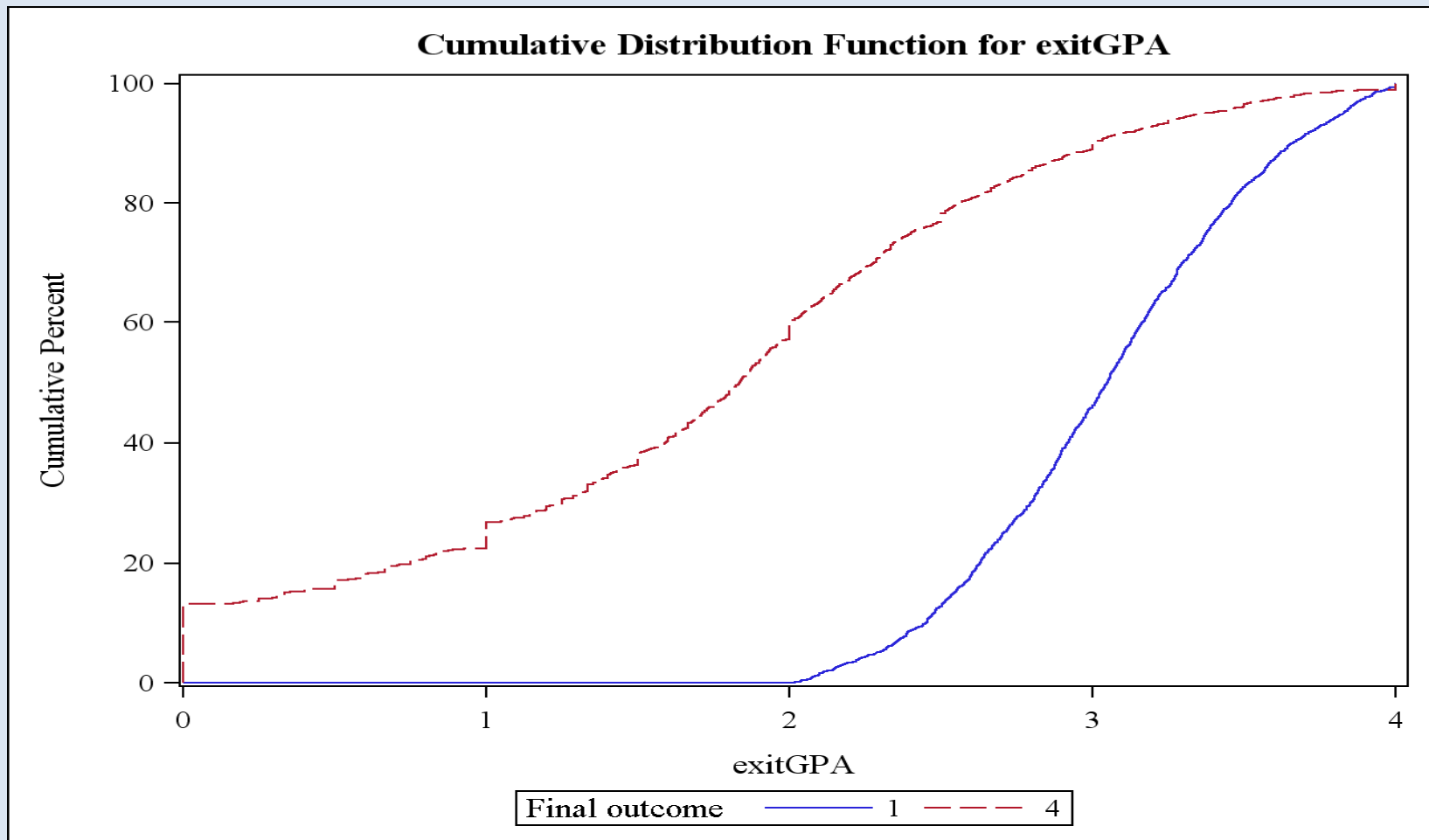
2.2.6 Term GPA



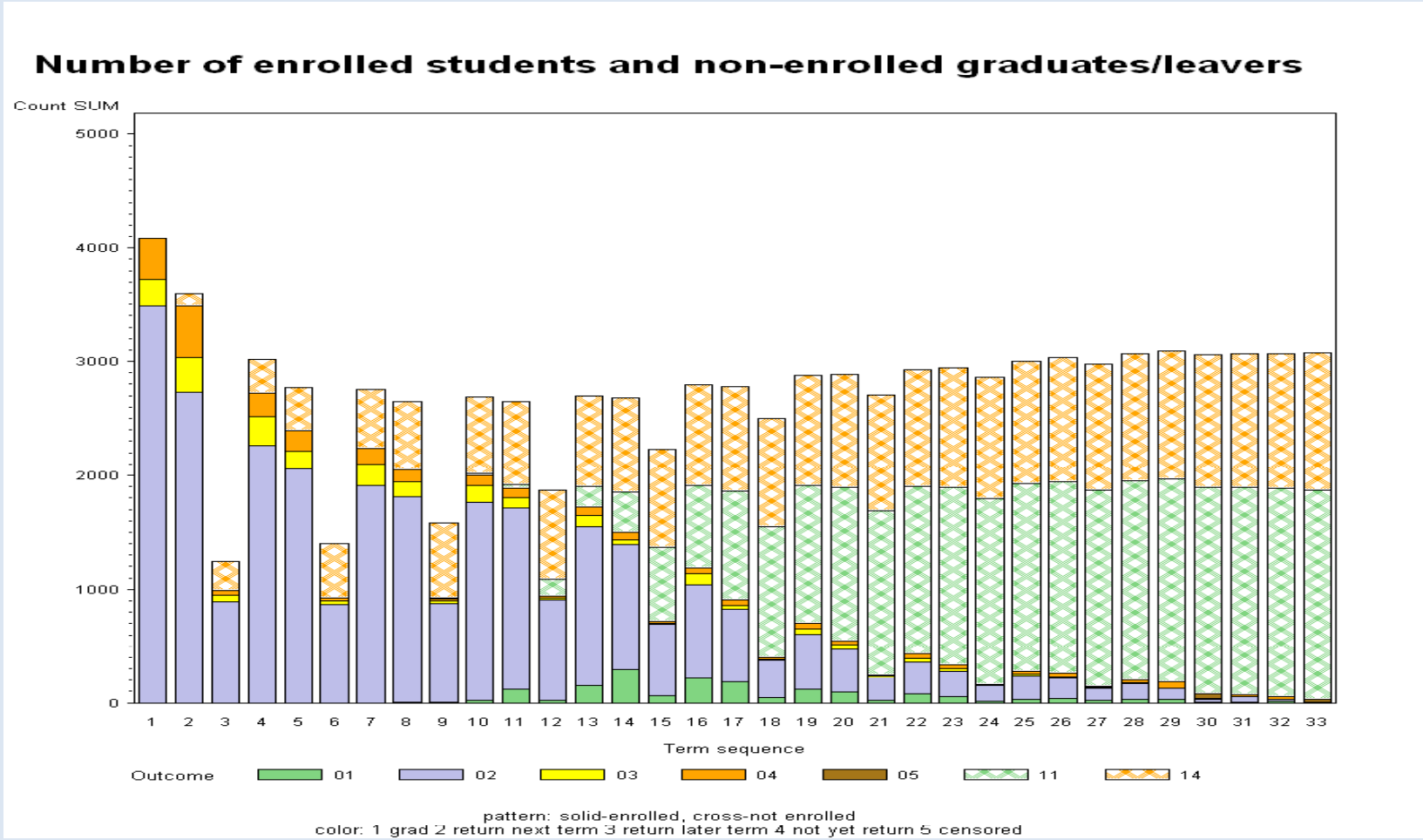
2.2.7 Cumulative GPA



2.2.8 Exit cumulative GPA



2.2.9 Successful exit



2.3 Design

Outcomes	Models
Academic Persistence	
Academic progress	Used as a measure of time
Term-to-term retention	Discrete-time logistic regression
Baccalaureate attainment	Binary-outcome logistic regression
Academic Performance	
Term GPA	Multiple linear regression
Cumulative GPA at exit	Multiple linear regression
Student Success	
Successful exit	Competing-risk PH models



2.3.1 Multiple linear regression

$$Y = \beta' X + \varepsilon$$

Strength

- Easy to interpret
- Useful as an explorative method

Limitation

- Inadequate to handle limited dependent variables



2.3.2 Binary logistic regression

$$P(Y=1 | X) = G(\beta' X)$$

$$\text{where } G(z) = \frac{e^z}{1 + e^z}$$

written in logit form as

$$\log(\text{odds}) = \log\left(\frac{P(Y = 1|X)}{1 - P(Y = 1|X)}\right) = \beta' X$$

Logistic transformation: while z takes the value of any real number, $G(z)$ takes the value strictly between zero and one.



2.3.2 Binary logistic regression

Strength

- Handles the restricted range of dependent variable for dichotomous outcomes.
- Addresses questions with well-defined (or externally imposed) time ranges, e.g., four-year or six-year graduation.

Limitation

- Loss of duration information caused by treating all events within an arbitrary observation period as identical
- Bias caused by treating events beyond observation as non-events
- Model estimates may be sensitive to the arbitrary choice of cut point
- Fail to address dynamic covariates that change over time



2.3.3 Discrete-time logistic regression

$$F(t_m) = P(T < t_m) = \sum_{k < m} f(t_k)$$

$$S(t_m) = P(T \geq t_m) = \sum_{k \geq m} f(t_k)$$

$$h(t_m) = P(T = t_m | T \geq t_m) = \frac{f(t_m)}{S(t_m)}$$

$$h(t) = G(\alpha_t + \beta_t' X_t) \text{ where } G(z) = \frac{e^z}{1 + e^z}$$

F: cumulative distribution function

S: **survivor** function

h: **hazard** function



2.3.3 Discrete-time logistic regression

Strength

- Captures the longitudinal nature of events with logistic regression models
- Handles both true discrete time and discrete measures of continuous time
- Handles large number of tied events
- Incorporates dynamic covariates and effects
- Handles repeated events in both one-way and two-way transitions

Limitation

- Unobserved heterogeneity and dependence among observations
- Informative censoring



2.3.4 Competing risk PH regression

$$F_j(t) = P(T \leq t, J = j)$$

$$S(t) = P(T > t)$$

$$h_j(t) = \lim_{\Delta \rightarrow 0} \frac{P(t \leq T < t + \Delta, J = j | T \geq t)}{\Delta} = \frac{f_j(t)}{S(t)}$$

$$\log h_j(t) = \alpha_j(t) + \beta_j'X$$

F: type-specific cumulative incidence function

S: overall survivor function

h: type-specific hazard function



2.3.4 Competing risk PH regression

Strengths

- Handles unordered events of different types (e.g., different ways of exit from college)
- Allows one individual to experience more than one type of event

Limitations

- Assumes that the rate of different types of events are independent, conditional on the measured covariates



Section III: Factors of Success and Risk

3.1 Academic persistence

- Retention
- BA attainment

3.2 Academic performance

- Term GPA
- Degree GPA
- Departure GPA

3.3 Successful exit



3.1.1 Variables

Y's: Academic Persistence		
TR	Term-to-term retention	1 if changed enrollment status in next term
BA	Baccalaureate attainment	1 if graduated (BA)
X's: Covariates		
T	Timing of entry and exit	Entry year/term/age, duration
C	Social, economic, academic and cultural capitals (SEAC)	parental education, family income, high school percentile, standardized test scores, ethnic group, gender
B	Student behavior /involvement	enrollment intensity, continuity, and work hours
P	Policy and program participation	DE placement and enrollment, financial aid, major field/college



3.1.2 Term Retention

Timing

- The rates of departure decrease over terms but increase for subsequent enrollment spells
- Longer enrollment duration in the first spell predicts lower rates of departure in the second enrollment spell
- The rates of return from departure increase for subsequent non-enrollment spells
- Rates of departure are higher during spring and summer terms (first year)
- Entry in fall is associated with lower rates of departure
- Direct matriculation is a success factor; within delayed entrants, age of entry has a small effect on departure



3.1.2 Term Retention

SEAC

- Hispanic ethnic background are success factors at two HSIs
- High school percentile and math readiness are success factors at all three institutions
- Lower family income is a risk factor at one institution

Student involvement

- High enrollment intensity is a success factor, associated with both lower rates of departure and higher rates of return from departure
- Hours spent working is a risk factor for departure

Policy / Program

- All forms of grant aid are success factors, loans and work study have mixed effects across cohorts and institutions



3.1.3 BA attainment

Timing

- Direct matriculation and entry in Fall semesters are success factors for graduation at one study institution

SEAC

- Female students are more likely to graduate at two study institution
- Hispanic students are more likely to graduate at one study institution
- High school percentile is positively associated with graduation



3.1.3 BA attainment

Student involvement

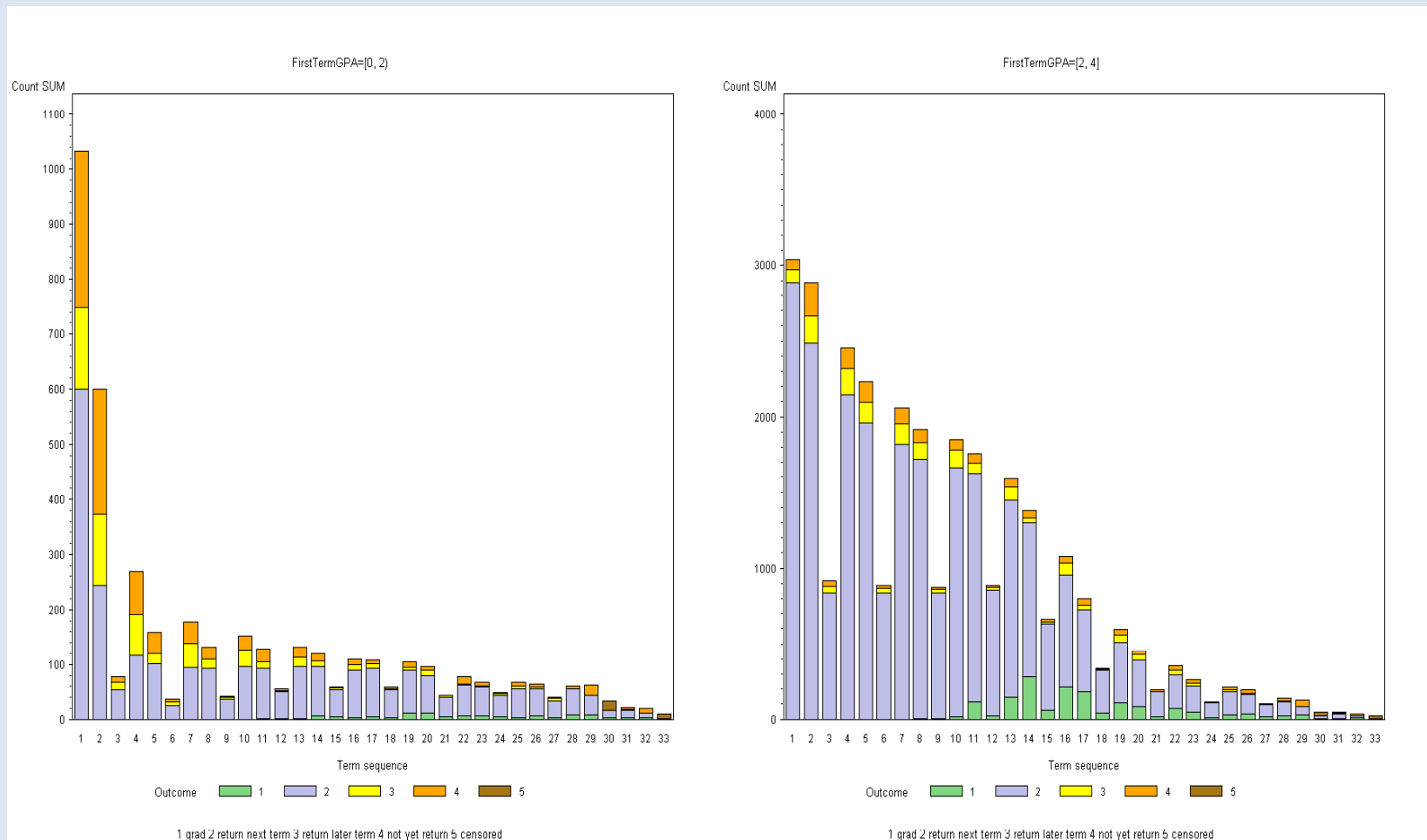
- Enrollment intensity is positively associated with graduation

Policy / Program

- Students with scholarships are more likely to graduate at one study institution
- Placement at developmental levels are risk factors for graduation



3.1.4 Performance as predictor



3.1.4 Performance as predictor

Academic performance variables are significant predictors of baccalaureate attainment at all study institutions:

- Higher semester GPA and cumulative GPA are success factors of graduation
- Course failure and/or withdrawals are risk factors of graduation



3.2 Performance as outcome

- What factors influence academic performance?
- Do the factors that influence persistence have similar or different effects on academic performance?



3.2.1 Variables

Y's: Academic Performance		
TG	Term GPA	End-of-term average grade
CG1	Degree GPA	Cumulative GPA as of graduation
CG0	Departure GPA	Cumulative GPA as of departure
X's: Covariates		
T	Timing of entry and exit	Entry year/term/age, duration
C	Social, economic, academic and cultural capitals (SEAC)	parental education, family income, high school percentile, standardized test scores, ethnic group, gender
B	Student involvement	enrollment intensity, continuity, and work hours
P	Program participation	college of entry, DE placement and enrollment, financial aid



3.2.2 Term GPA

Timing

- Age at start of term is a consistent success factor associated with higher Term GPA

SEAC

- High school percentile and SAT are success factors
- Females have higher GPA



3.2.2 Term GPA

Student involvement

- Enrollment intensity has a positive but decreasing association with higher term GPA

Policy / Program

- Work study, Grants, and Loans are all associated with higher term GPA; the effect size of loans are the smallest on average
- Over time, the effect of loans changed from positive to negative, and grant has positive effects with increasing effect size



3.2.3 Degree GPA

Timing

- Age as of entry is positively associated with degree GPA

SEAC

- Female graduates have higher degree GPA
- High school percentile is positively associated with degree GPA

Policy / Program

- Financial aid has a positive effect on departure GPA in general



3.2.4 Departure GPA

Timing

- Direct matriculation and age as of entry are both positively associated with departure GPA (delay and maturation effects)

SEAC

- High school percentile and SAT are positively associated with departure GPA

Student involvement

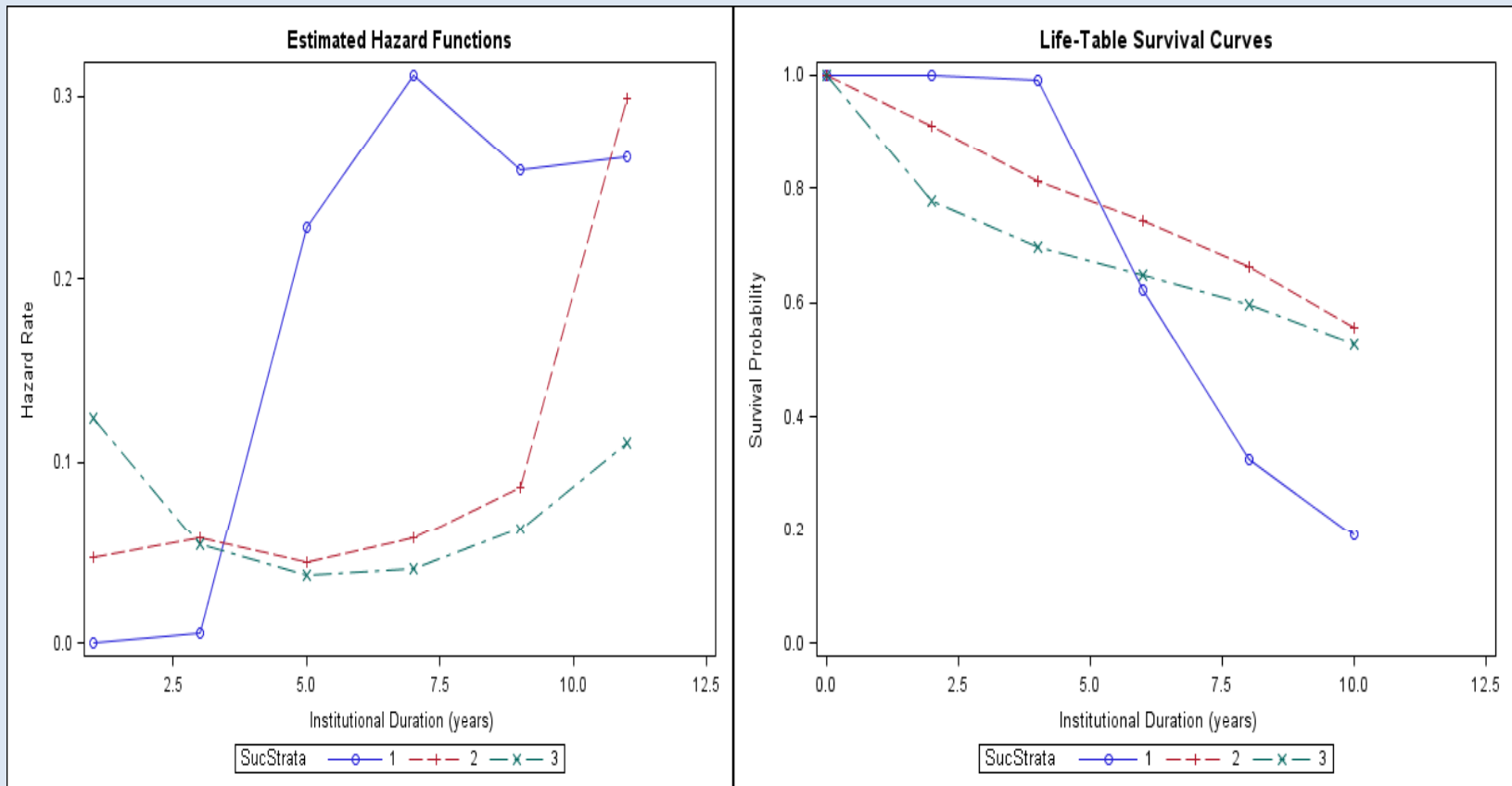
- Enrollment intensity is positively associated with departure GPA

Policy / Program

- Financial aid has a positive effect on departure GPA in general



3.3 Successful exit



Exit types

- 1 if graduated
- 2 if last departed with cumulative GPA ≥ 2.0
- 3 if last departed with cumulative GPA < 2.0



3.3 Findings

- Students who leave an institution without degree follow two distinctive hazard rate profiles
- High school percentile is a success factor that has opposite impacts on type 2 and type 3 exits
- Enrollment intensity is a success factor that differentiate type 2 and type 3 exit



Section IV: Summary

- Baccalaureate attainment metrics alone do not fully capture the meaning of student success
- Students who have been uniformly labeled as “dropouts” follow very different paths of institutional departure
- Student success is a longitudinal process that is dynamically influenced by both timing factors and time-dependent covariates
- Minority students attending MSIs tend to have a more equitable chance of success



4. Summary (cont'd)

- Student involvement and performance provide the best dynamic signals to identify students who need help
- SEAC factors that are identified by the general literature may or may not be applicable to specific institutions, hence the necessity of institution-specific studies
- The type of financial aid matters



Section V: Implications

What make MSIs special?

- Conditions and programs that meet the needs of students who lack certain SEAC capitals.

How to incorporate timing into intervention programs?

- Early interventions target departures due to poor academic performance; later interventions target departures due to non-academic reasons.

How to adapt the models to assess the effects of program interventions?

- Students' program participation data may be added to the longitudinal database to assess 1) a program's dynamic impacts at different points in time and 2) the differential impacts of the same program offered to students at different academic stages



Section VI

1. Methodological References
2. Handouts
3. Questions?



6.1 Methodological references

- *Applied longitudinal data analysis : modeling change and event occurrence*, by Judith B. Singer and John B. Willett (2003)
- *Survival analysis using SAS: a practical guide*, by Paul Allison (1995, 2010)
- *Event history analysis*, by Kazuo Yamaguchi (1991)
- *Event history modeling: a guide for social scientists*, by Janet M. Box-Steffensmeier and Bradford S. Jones (2004)
- Articles by Stephen DesJardins
- Technical references published for SAS, SPSS, R, or STATA



6.2 Paperless handouts

Save a tree! These documents will be provided through email upon request:

- Student Success Knowledge Infrastructure: A brief guide to analytical methods
- Student Success Knowledge Infrastructure: A file management system for collaboration, analytical efficiency, replicability, and adaptation
- Analytical Guide: predicting student success in baccalaureate degree attainment (SPSS)



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