Exploring City Colleges of Chicago Enrollment Intensity and Continuity:

Key Findings from a Cluster Analysis of Student Engagement

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About the University of Chicago Inclusive Economy Lab

For generations, government policies and institutional choices have excluded many Americans— and especially the Black and Latinx communities—from opportunities for education, employment, and wealth creation. Ending intergenerational poverty and building an inclusive economy—one that provides real economic opportunities for all communities— requires collaboration across sectors, as well as scientific evidence about what works and what doesn't. Traditional research can take years, and the results often don't reach those who need the information most—the people living with and working on these issues. The University of Chicago Inclusive Economy Lab solves this by working with policymakers, organizations, and communities to identify their most urgent and pressing challenges, co-generate evidence about what works, and translate that evidence into real policy changes that expand economic opportunity and improve lives.

Acknowledgments

Executive Summary

Traditionally, the path to higher education has taken the form of a student graduating from high school and enrolling in, and graduating from a four-year institution. Though this route is still applicable for some students, many students undertake alternative pathways to attain a post-secondary education. For students who cannot afford the rising cost of college tuition, community colleges are a viable alternative to attaining education credentials.

Though community colleges offer students an alternative pathway to achieving a post-secondary education, little research has been done on the complex enrollment patterns of community college students. This report aims to better understand these enrollment patterns by examining the enrollment patterns of Chicago City College (CCC) students. Specifically, this report focuses on the 82,360 CCC students who first declared an intent to complete a certificate or degree and took a credit course between summer 2012 and spring 2016. The Inclusive Economy Lab hopes that by shedding light on CCC enrollment patterns, better services can be identified to help community college students.

Several findings have emerged from this study, with some of the key findings being:

1. CCC students have a myriad of ways of engaging in higher education -such that no approach to attending CCC is truly "typical."
2. The six major types of enrollment patterns identified from the data are Intermittent Persisters, Short-Term Students, Four-Term Persisters, Four-Year Drop-In Students, Transfer Out Students, and Two-Year Drop-In Students.
3. Racial disparities emerged between these enrollment patterns, with Short-Term Students, Four- Term Persisters, and Intermittent Persisters predominantly identifying as Black and Hispanic, while white students were overrepresented in patterns that display the highest rates of credential completion (Transfer Out students and both Drop-In patterns).
4. Community college students' enrollment patterns fluctuate in intensity and continuity over time, meaning that understanding these patterns requires looking beyond first-term intensity.
5. Community college enrollment is best understood in the context of students' experiences and aspirations within the broader higher education landscape.

This study has established that students' enrollment choices are varied and complex. Additional exploration into what factors contribute to these students' disengagement from postsecondary education can help community colleges better understand the needs of their students, and to support them through degree completion.

Introduction

Community colleges are a critical component of the higher education ecosystem, offering affordable postsecondary education to students with a variety of academic aspirations. It is common for students to switch between two- and four-year institutions, as well as full-time and part-time status – yet there is little research on the complex enrollment behaviors of community college students. The goal of the study presented here is to identify ways of better-serving community college students by providing a holistic picture of students' enrollment patterns.

Community colleges serve a variety of functions for different students, who attend with unique academic goals in mind. Student bodies may include first-time-in-college associate degree seekers, professional certificate seekers, four-year college summer drop-ins, career changers who already hold a bachelor's degree, and more. Enrollment patterns of community college students vary widely in both intensity (part- or full-time course load) and continuity (consecutive terms). Thus, the typical classification of a student as part-or full-time based on one term is insufficient to describe their overall level of engagement.

To date, much of the research that has sought to measure the relationship between postsecondary enrollment behaviors and academic performance has relied on students' first-term enrollment intensity as the primary enrollment behavior indicator. In addition, few studies focus exclusively on the enrollment patterns of community college students, whose work, family, and other commitments tend to differ substantially from their four-year-student counterparts. The analyses of student enrollment behavior presented here aim to generate a better understanding of this variation and diversity in students' enrollment patterns, to make connections between enrollment behavior and academic success. This research aims to build the literature on enrollment intensity and continuity, both by analyzing enrollment behavior from a large student sample at a prominent community college network – the City Colleges of Chicago (CCC) – and by pioneering the inclusion of National Student Clearinghouse postsecondary data in observing these patterns.

The research questions this paper seeks to answer are:

> (1) What are the typical patterns of CCC enrollment, both in terms of intensity and continuity?
>
> (2) How are CCC enrollment patterns related to student outcomes?
>
> (3) How do student characteristics differ between CCC enrollment patterns?

In this paper, the term "enrollment intensity" refers to the credit hours in which students are enrolled for a given term. For consistency, intensity is simply referred to in terms of full-time and part-time course loads. "Enrollment continuity" is an indicator of students' persistence in course-taking over time. Multiple terms of consecutive enrollment with few or no interruptions constitute strong continuity, while sporadic enrollment with large periods of non-enrollment represents weak continuity.

In investigating these questions, four main findings emerged:

1. Community college students enter the system with a variety of educational backgrounds, which inform their enrollment decisions.

2. Community college student enrollment patterns fluctuate in intensity and continuity over time – understanding these patterns requires looking beyond first-term intensity.

3. Community college enrollment is best understood in the context of students' experiences and aspirations within the broader higher education landscape.

4. A better understanding of enrollment patterns highlights several potential opportunities to provide students with targeted services.

Review of Literature on Enrollment Patterns

Much of the current research on community college student enrollment patterns focus on students' first-semester experiences. Notable contributions from Stratton, O'Toole, Wetzel (2004, 2006), and O'Toole, Stratton, Wetzel (2003) present analyses exploring the link between first-term enrollment intensity and dropping out of college among two-year and four-year college students. These studies found that – while there is not a direct relationship between first-term enrollment intensity and dropping out, as many factors contribute to attrition – there are differences in the observable factors associated with dropping out based on students' initial enrollment status (full-time vs part-time).[i] That is to say, the observable factors associated with attrition for part-time starters are different from those associated with attrition for full-time starters.

Studies that do look at intensity over time tend to be older and/or broader in scope, examining both two- and four-year institutions. Some of the most recent research comes from a 2012 paper examining the relationship between academic momentum and degree attainment (Attewell, Heil, & Reisel), where the main indicators of momentum were: 1. Direct versus non-direct matriculation after high school, 2. Enrolling full-time in the first semester, 3. Enrolling part-time in the first semester, and 4. Enrolling the first summer after freshman year. This study found that stronger academic momentum is indeed associated with increased chances of completing a college degree. Direct matriculation from high school and enrolling full-time were associated with higher graduation rates, as were enrolling in larger course loads and enrolling the first summer following freshman year.[ii]

Other research (NCES reports; Adelman (1999, 2006)) has concentrated on four-year institutions and bachelor's degree completion. Adelman also concluded that academic momentum – full-time attendance, continuous enrollment, and accumulation of at least 20 credits within the first calendar year – were associated with an increased likelihood of earning a bachelor's degree.[iii]

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[i] O'Toole, Dennis & Stratton, Leslie & Wetzel, James. (2003). A Longitudinal Analysis of the Frequency of Part-Time Enrollment and the Persistence of Students Who Enroll Part-Time. Research in Higher Education. 44. 10.1023/A:1025491208661; Crosta, Peter. (2014). Intensity and Attachment: How the Chaotic Enrollment Patterns of Community College Students Relate to Educational Outcomes. Community College Review. 42. 118-142. 10.1177/0091552113518233.

[ii] Attewell, Paul & Heil, Scott & Reisel, Liza. (2012). What Is Academic Momentum? And Does It Matter? Educational Evaluation and Policy Analysis. 34. 27-44. 10.3102/0162373711421958.; Crosta, Peter. (2014). Intensity and Attachment: How the Chaotic Enrollment Patterns of Community College Students Relate to Educational Outcomes. Community College Review. 42. 118-142. 10.1177/0091552113518233.

[iii] Adelman, Clifford. (2006). The Toolbox Revisited: Paths to Degree Completion From High School Through College.

Crosta introduced a novel clustering approach utilizing input features based solely on characteristics of student enrollment patterns, such as total number of terms, percent full-time terms, number of switches between full-time and part-time enrollment, and number of terms completed before the first interruption in contiguous enrollment. By including only the data points that related to enrollment choices, the resulting clusters reflected purely the overarching enrollment patterns demonstrated by students, independent of students' demographic or other academic characteristics.

This research produced three key insights about community college students' enrollment and outcomes. First, many students switch frequently between full-time and part-time, indicating that first-term enrollment intensity alone is insufficient for categorizing students into enrollment behavior archetypes. Second, student enrollment behavior varies significantly. Crosta's sample of 14,462 students produced thousands of unique enrollment patterns. Third, consistent outcomes patterns emerge within groups that demonstrate similar levels of intensity and/or continuity. Enrollment continuity – contiguous term-to-term enrollment without interruptions – is associated with students' likelihood of earning a community college credential. Enrollment intensity – full-time versus part-time credit loads – is associated with the likelihood of transferring to a four-year institution.

While Crosta's focus on community college students facilitated the discovery of important insights about this unique group of students, the focus on first-time-in-college students and their enrollment only at participating community colleges poses limitations for the generalizability of these findings. The study cannot speak to enrollment behaviors among students who transfer into community colleges from other institutions. It also does not provide the full context of students' postsecondary journeys, including enrollment in four-year institutions.

Employing a similar clustering technique as the one introduced by Crosta, the present study builds off this seminal work in several key ways. We include transfer-in students in the sample of community college-goers to get a broader picture of how students use community colleges. We also include a larger and more recent sample of community college students to track more recent trends in enrollment behavior. Finally, our analyses include student enrollment data from the National Student Clearinghouse (NSC), allowing us to link and synthesize both community college enrollments and enrollments at other two-year and four-year institutions for the students in our sample. This provides additional context into student enrollment decisions and facilitates a more complete landscape of student behavior and outcomes.

Background on City Colleges of Chicago (CCC)

The City Colleges of Chicago is a community college system comprised of seven colleges and five satellite locations. CCC is the largest community college system in Illinois and one of the largest in the nation, with more than 4,500 faculty and staff serving 77,000 students annually. The colleges offer basic certificates, advanced certificates, and associate degree programs across 14 academic disciplines. The student body has historically been predominantly Hispanic and Black, as well as majority female. As of 2021, the CCC student body was 41 percent Hispanic, 22 percent Black, 12 percent white, 5 percent Asian, and 18 percent unspecified.[iv] In terms of gender makeup, 38 percent identified as female, 23 percent as male, and the remaining 39 percent were

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[iv] CCC FY' 21 Statistical Digest (2021). ccc.edu. Retrieved March 24, 2021, from https://www.ccc.edu/menu/pages/facts-statistics.aspx

unspecified.[v] It is important to note that these data represent pandemic-era demographics, and therefore reflect changes to the student population that was brought on by the effects of COVID-19 on student enrollment.

CCC student enrollment, demographics, and outcomes have fluctuated substantially from year to year, including during our study period: summer 2012 through spring 2016. An analysis of CCC enrollment and completion conducted by our research team in collaboration with the Consortium on Chicago School Research found that between the 2012-13 and 2015-16 academic years, a larger share of CCC students were recent high school graduates under the age of 19 and that the proportion of Hispanic students increased, while the proportions of Black and white students decreased.[vi] It also revealed a dramatic decline in enrollment for students taking credit-bearing courses at CCC during this time. Many factors likely contributed to these changes in enrollment, including evolving employment opportunities and the changing demographics of the city of Chicago.

Notably, associate degree completion rates at CCC doubled during these four cohorts while certificate completion rates remained stable. While the rate of transfer to a four-year institution for associate degree earners more than doubled, overall transfer rates to four-year institutions declined during this period, driven by a decrease in the portion of students who transfer without a credential. A variety of factors may have influenced transfer rates, such as employment opportunities, financial aid, and the timing of transfers. However, as CCC plays a variety of roles in students' postsecondary pathways, aggregate completion and transfer rates may not capture the nuance of how students use CCC to achieve their postsecondary goals.

Data

This report focuses on the 82,360 CCC students who first declared an intent to complete a certificate or degree and took a credit course between summer 2012 and spring 2016. Given the data available at the time of analysis, this allowed us to describe student outcomes for three academic years from when they first enrolled at CCC, following the convention used by the National Center for Educational Statistics that allows 150 percent of "normal" time for degree completion.

Credit-bearing courses are courses whose credits can be applied toward earning a credential (i.e., associate degree or certificate). Because a key focus of this study was to draw conclusions about the relationship between enrollment patterns and completion and transfer outcomes, we only examined students who enrolled in credit courses with the intent to complete a certificate or degree. If a student participated in non-credit courses at CCC (e.g. Adult Education) or was a high school student taking CCC courses for credit (Early College), they were only included in our sample if they later enrolled in a credit-bearing course as a certificate or degree-seeking student. Our sample included students who first enrolled at another institution and then enrolled at CCC and students who only had a part-time credit load status.

The CCC administrative data contained information about demographic characteristics like age, race, and gender. It also included stated first-term academic intentions including declared focus

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[v] *Ibid.*

[vi] University of Chicago Urban Labs, Inclusive Economy Lab. (2020). Completion and Transfer of City Colleges of Chicago Students: A First Look

area, declared academic plan, declared degree intentions, and whether the student was awarded the CCC Star scholarship. It is important to note that we used the stated academic intentions for the first-term students who took a credit-bearing course at CCC though intentions may have changed over time. The administrative data included detail about the particular type of associate or certificate program completed, but in this report, we classified CCC credentials into three categories: Basic Certificate, Advanced Certificate, and Associate Degree.

There are six Associate Degree programs offered at CCC, each requiring between 60 and 68 credit hours for completion. These six programs are: Associate in Arts (AA), Associate in Fine Arts (AFA), Associate in General Studies (AGS), Associate in Science (AS), Associate in Applied Science (AAS), and Associate in Engineering Science (AES). CCC offers 71 Basic Career Program certificates, which range from .5 to 29 credit hours, and 47 Advanced Career Program certificates which range from 30 to 50 credit hours. Programs span 14 academic focus areas which include but are not limited to, Agriculture and Natural Resources, Business, Culinary and Hospitality, Information Technology, and Manufacturing. All but one of the focus areas offer programs at each of the three credential levels. For instance, students may pursue a basic certificate in Accounting, which requires 17 credit hours, or an advanced certificate in Accounting requiring 30 credit hours. They could also pursue an Associate in Arts (AA) or an Associate in Applied Science (AAS) Accounting degree, which consists of 61 and 63 credit hours, respectively.

To examine other postsecondary enrollment before, during, and after their time at CCC, we used National Student Clearinghouse (NSC) data provided by CCC. The NSC data allowed us to follow CCC students' postsecondary enrollment patterns at both CCC campuses and colleges across the country.

Methodology

Our research employed cluster analyses to group students with like-enrollment behaviors so that we could subsequently analyze student outcomes and demographics based on a general enrollment typology. Observable student data was supplied to the cluster algorithm – indicators such as the number of terms enrolled during the study period, percent of terms that are full-time, degree intentions, new or transfer status, and more – as well as a pre-specified number of groups in which to partition the data. The number of groups was determined through an iterative cluster validation process. The algorithm then grouped like data points, such that the students in the predetermined number of clusters are as similar to one another as possible.

To visualize students' enrollment patterns, enrollment vectors were created to codify each pattern. Enrollment vectors are strings of characters that represent students' enrollment behaviors term-by-term. The vectors here share the foundational structure of the enrollment vectors devised by Crosta. As the observational period for this study was 11 terms, the enrollment vectors are 11 characters long, accordingly. "Term 1" represents the first term a student appears as a credit-bearing student in the CCC administrative data; their enrollment behavior was observed for 10 additional terms thereafter. Each character in an enrollment vector string represents the enrollment type for that term (i.e. full-time, part-time, not enrolled). Figure 1 presents the possible values in an enrollment vector, and what each character represents:

Figure 1: Enrollment Vector Key

Enrollment Type	4-yr + CCC FT	4-yr	4-yr + CCC PT	2-yr + CCC FT	2-yr	2-yr + CCC PT	CCC FT	CCC PT	Not Enrolled
Symbol	5	4	!	3	2	t	1	0	.

Two vectors were created for each student in the sample – one containing CCC enrollments only, and another incorporating NSC enrollment data. In the combined CCC + NSC vector, CCC and NSC enrollments were represented by unique sets of characters so that they are distinguishable. These vectors facilitated the visualization of enrollment intensity and continuity, and they also provided the basis for most of the input features used in the clustering process.

Input features – the data supplied to the cluster algorithm – were based solely on enrollment behavior. Using the enrollment vectors, variables such as the total number of terms enrolled, percent full-time terms, and term of first enrollment interruption were calculated for each student. These were first calculated using just CCC enrollment data; Subsequently, they were re-calculated including enrollments found in the NSC data. Both sets of indicators were included in the total set of input features supplied to the clustering algorithm.

Categorical variables such as start term (fall, spring, summer) and declared degree were also included as input features to the cluster algorithm. These data points elevate the quality of clustering by allowing for important distinctions not captured in the numerical features. For instance, each degree type (i.e. certificate vs associate degree) has unique enrollment requirements, and therefore the expected outcomes associated with a given enrollment pattern will be different based on students' declared degrees.

Table 1 presents a subset of input features, calculated at the sample level. Features marked with an "(n)" in the table represent average counts, while those marked with "(%)" indicate the percentage of the sample bearing that feature. The exception is 'Full-Time CCC Terms', for which the value shown represents the average percentage of full-time CCC enrollments across the sample. (Feature tables that are broken down by Enrollment Pattern can be found in Appendix C: CCC-SPECIFIC FEATURES - Appendix F: FULL CCC + NSC FEATURES (NUMERIC).)

The average number of CCC enrollments for this sample was 3.1 terms during the 11-term study period. Total enrollments during this period – those at CCC and outside institutions – averaged 4.1 terms. Before their first CCC enrollment, students had an average of 0.8 enrollments at another two-year institution, and 1.5 enrollments at a four-year institution. Some students entered CCC with prior degrees – 2.2 percent of the sample held a two-year degree upon their first enrollment at CCC, and 6 percent held a four-year degree. The cluster patterns themselves are distinct. But, it is worth mentioning that although "transfer out" is a distinct cluster, the act of transferring is apparent in all clusters. While multiple clusters may share transferring as a characteristic, the enrollment intensity and the number of terms spent at CCC create the distinction.

The majority of the sample were new students at CCC (57 percent). Across the sample, 52.2 percent of enrollments at CCC were full-time. Students' first CCC enrollments were most likely to be in the fall: 53.4 percent of CCC start terms were in the fall, 30.8 percent were in Spring, and 15.8 percent were in Summer. Terminal degrees were the most common CCC-declared degree type (57.7 percent), followed by Transfer (30.9 percent) and Certificate (11.4 percent).

Clustering – an unsupervised machine learning technique – was used to partition similar enrollment patterns into like groups. Provided with a pre-established number of groups to divide the data into, the algorithm partitions the data to minimize intra-group variation. The data supplied to the algorithm are the input features described above. As such, the resulting clusters were based exclusively on student enrollment data.

Table 1: Sample-Level Features

Total Terms Enrolled		
CCC	(n)	3.1
Anywhere (CCC + NSC)	(n)	4.1
Pre-CCC Academics		
Terms at Other Two-Year Institution	(n)	0.8
Terms at Four-Year Institution	(n)	1.5
Two-Year Degree	(%)	2.2
Four-Year Degree	(%)	6.0
CCC Characteristics		
New Student	(%)	57.0
Full-Time CCC Terms	(%)	52.2
CCC Start Term		
Fall	(%)	53.4
Spring	(%)	30.8
Summer	(%)	15.8
CCC Declared Degree Type		
Certificate	(%)	11.4
Terminal	(%)	57.7
Transfer	(%)	30.9

The number of clusters to group data into was chosen based on an iterative validation procedure, the elbow method. The number of clusters is considered optimal when (a) the total within-cluster sum of squares (WSS) is minimized, making clusters as compact as possible, and (b) adding another cluster doesn't meaningfully improve the total WWS, preventing overfitting.

The clustering method employed for this research was the K-prototypes cluster algorithm. K-prototypes allow for the inclusion of categorical input features by combining the traditional K-means algorithm for clustering numeric data, and the K-modes algorithm for clustering categorical data. K-prototypes define a dissimilarity measure that takes into account both numeric and categorical attributes. An overview of these clustering approaches is provided below, in Table 2.

Table 2: Clustering Methods

Method	Description
K-Means	K represents the predetermined number of clusters to be fit; the algorithm groups observations into those k clusters by using Euclidean distance to measure the distance between points and the cluster centroid, returning partitioned clusters once a minimized WWS has been achieved.
K-Modes	Employs matching dissimilarity measures to handle categorical objects, replaces means of clusters with modes, and uses a frequency-based method to update modes in the clustering process.
K-Prototypes	**Similar to K-means, but uses the K-modes approach to update the categorical attribute values of cluster prototypes.**

Findings

Findings are organized according to the three research questions this paper set out to address:

(1) What are the typical patterns of CCC enrollment, both in terms of intensity and continuity?

(2) How are enrollment patterns related to student outcomes?

(3) How do student characteristics differ between enrollment patterns?

RQ1: WHAT ARE THE TYPICAL PATTERNS OF COMMUNITY COLLEGE ENROLLMENT?

CCC students have myriad ways of engaging in higher education - such that no approach to attending CCC is truly "typical." Across the 82,360 students in our sample, we observe 19,907 unique enrollment vectors (patterns of part-time, full-time, and non-enrollment in CCC and other higher education institutions). To illustrate how varied enrollment behaviors are across students, 75.8 percent of the enrollment vectors were demonstrated by just one student in the sample.

Table 3 depicts the top 10 most common CCC + NSC combined enrollment vectors exhibited by students in the sample. All vectors are 11 characters long, such that each term is represented by an enrollment type; "0" represents a part-time enrollment, "1" represents a full-time enrollment, and "." indicates non-enrollment. For example, as the first line of the table shows, the most common enrollment pattern in the sample, experienced by 14.6 percent of students, is a part-time enrollment at CCC followed by 10 terms in which the student is not enrolled in any higher education institution. While the top 10 enrollment vectors account for almost 40 percent of the

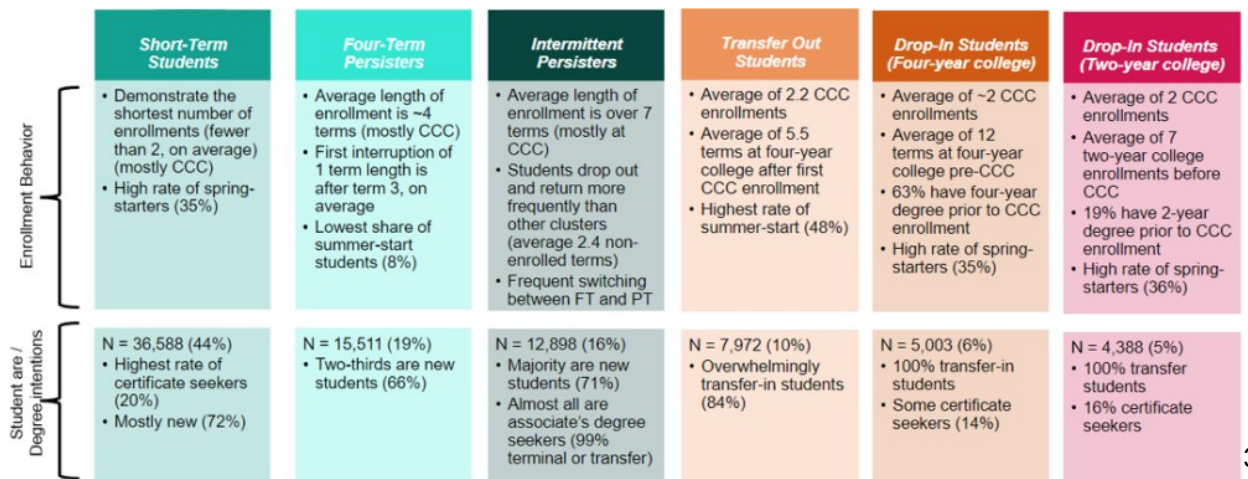sample, there is a steep drop off in the frequency with which we observe the vectors after the first two.

Table 3: 10 Most Common Enrollment Vectors (Based on Combined CCC + NSC Vectors)

Enrollment Vector	Count	Percent	Cumulative Percent
0..........	12,047	14.6	14.6
1..........	7,855	9.5	24.2
11.........	3,804	4.6	28.8
00.........	2,092	2.5	31.3
10.........	1,871	2.3	33.6
1.1........	841	1.0	34.6
11.1.......	819	1.0	35.6
01.........	674	0.8	36.4
0.0........	630	0.8	37.2
11.11......	539	0.7	37.8

Interestingly, although the combined CCC + NSC vectors were used to identify the most common enrollment patterns, the 10 most common vectors contained only CCC enrollments. Meaning, while 29 percent of our sample enrolled in a non-CCC institution of education during the study period, all of the top 10 most common enrollment vectors – representing 37 percent of the sample – include only CCC enrollments.

Despite this diversity of experiences, the cluster analysis identified six distinct patterns that summarize the college engagement of the sample. Figure 2 provides an overview of the six groups and details the defining characteristics that make them unique. Each pattern is discussed in more detail below.

Figure 2: Pattern Names and Descriptions

	Short-Term Students	Four-Term Persisters	Intermittent Persisters	Transfer Out Students	Drop-In Students (Four-year college)	Drop-In Students (Two-year college)
Enrollment Behavior	• Demonstrate the shortest number of enrollments (fewer than 2, on average) (mostly CCC) • High rate of spring-starters (35%)	• Average length of enrollment is ~4 terms (mostly CCC) • First interruption of 1 term length is after term 3, on average • Lowest share of summer-start students (8%)	• Average length of enrollment is over 7 terms (mostly at CCC) • Students drop out and return more frequently than other clusters (average 2.4 non-enrolled terms) • Frequent switching between FT and PT	• Average of 2.2 CCC enrollments • Average of 5.5 terms at four-year college after first CCC enrollment • Highest rate of summer-start (48%)	• Average of ~2 CCC enrollments • Average of 12 terms at four-year college pre-CCC • 63% have four-year degree prior to CCC enrollment • High rate of spring-starters (35%)	• Average of 2 CCC enrollments • Average of 7 two-year college enrollments before CCC • 19% have 2-year degree prior to CCC enrollment • High rate of spring-starters (36%)
Student are / Degree intentions	N = 36,588 (44%) • Highest rate of certificate seekers (20%) • Mostly new (72%)	N = 15,511 (19%) • Two-thirds are new students (66%)	N = 12,898 (16%) • Majority are new students (71%) • Almost all are associate's degree seekers (99% terminal or transfer)	N = 7,972 (10%) • Overwhelmingly transfer-in students (84%)	N = 5,003 (6%) • 100% transfer-in students • Some certificate seekers (14%)	N = 4,388 (5%) • 100% transfer students • 16% certificate seekers

Short-Term Students comprise 44 percent of the sample and are characterized by weak enrollment continuity. This group demonstrates the shortest average engagement at CCC, with fewer than two enrollments on average. Specifically, Short-Term Students tend to enroll for an initial one to two terms before disengaging from postsecondary education. Among students that exhibit this pattern, 49 percent of CCC enrollments are full-time. Short-Term Students are mostly new students and have the highest rate of certificate seekers and spring-term starters.

Four-Term Persisters make up 19 percent of the sample. Students with this pattern display moderate enrollment continuity but comparatively strong intensity. Like the Intermittent Persisters described below, 62 percent of enrollments are enrolled full-time. Four-Term Persisters enroll off-and-on at CCC with an average total enrollment of four terms. Two-thirds are new to college, and their degree intentions are more mixed than other patterns. Slightly less than two-thirds enter CCC seeking terminal degrees, while over a third seek transfer degrees.

Intermittent Persisters – 15 percent of the sample – are predominantly associate degree seekers who are new students at CCC. They demonstrate strong enrollment continuity, averaging more than seven CCC enrollments during the study period. Students with this pattern switch between full- and part-time more than any other pattern; however, 62 percent of CCC enrollments are full-time, which constitutes the strongest enrollment intensity represented across all patterns.

Transfer-Out Students account for 10 percent of the sample. They tend to enroll at CCC for roughly two terms and then successfully transfer to a four-year institution. This pattern demonstrates the strongest enrollment continuity, averaging over eight enrollments total during the study period. Enrollment intensity is split nearly down the middle: 49 percent of enrollments are full-time.

Four-Year Drop-In Students are entirely transfers-in (100 percent), most of whom have earned a degree (63 percent) or have significant enrollments at a four-year institution before coming to CCC. They make up 6 percent of the sample. Enrollment continuity after entering CCC is rather weak, however; Four-Year Drop Ins average fewer than two CCC enrollments during the study period, and fewer than four enrollments total (including at outside institutions). Enrollment intensity is also the lowest for this pattern compared to the others – 30 percent of CCC enrollments are part-time.

Two-Year Drop-In Students comprise the remaining five percent of the sample. Much like Four-Year Drop-In Students, they are transfer-in students (100 percent) who also average roughly two CCC enrollments. However, the total average length of enrollment, including at outside institutions, is fewer than three terms. Many students with this pattern have earned a two-year degree (19 percent) or have significant enrollments at a two-year institution before coming to CCC.

Figure 3 below visualizes the relative size of each cluster according to the portion of the full sample it represents. The first three patterns – all characterized by enrolling primarily at CCC throughout the study period – collectively represent 79 percent of the sample. On the left, the teal block labeled "Short-Term Students" is the largest color block in the chart, as this pattern is the most prominent in the sample. Short-Term Students constitute 44 percent of the sample, and accordingly, the teal color block assumes nearly half of the chart. Four-Term Persisters is the next largest pattern, containing 19 percent of students in the sample, and appearing as an aqua color block. Subsequently, Intermittent Persisters (shown in dark green) constitute 16 percent of the sample.

Figure 3: Distribution of Students Across Enrollment Patterns
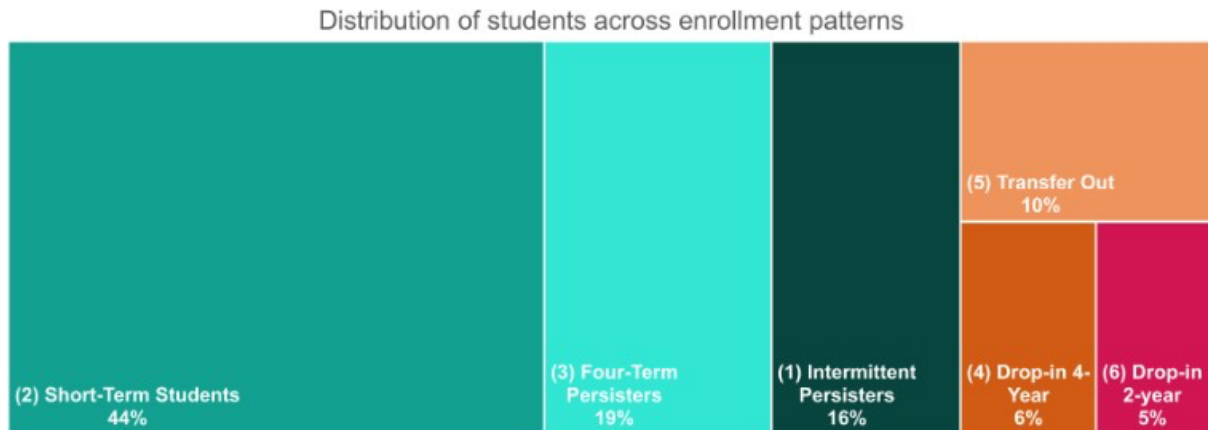
The remaining three patterns collectively constitute just 21 percent of the sample and are characterized by enrolling predominantly at institutions outside of CCC during the study period. The Transfer Out pattern is the largest of these three, containing 10 percent of students in the sample and represented by a light orange color block. The two Drop-In patterns – Drop-Ins from four-year institutions and two-year institutions – respectively constitute six percent and five percent of the sample and are represented by a dark orange block and a pink block.

RQ2: HOW ARE ENROLLMENT PATTERNS RELATED TO STUDENT OUTCOMES?

Outcome differences by pattern are best understood in concert with the term-to-term enrollment behavior displayed by students with that pattern. Figure 4 displays a sample diagram visualizing one pattern's collective enrollment behavior to orient the reader. In the enrollment behavior visualizations, the color group indicates institution type. The orange family of colors corresponds to enrollments at four-year institutions, pinks correspond to enrollments at non-CCC two-year institutions, and aqua represents CCC-only enrollments.

Within each group, color intensity indicates enrollment intensity, as is depicted in Figure 5. In the aqua color family, representing CCC enrollments, teal indicates a full-time enrollment and aqua indicates a part-time enrollment. As reliable data on enrollment intensity – full-time vs part-time status – is not available for institutions outside of CCC, the color variations for the orange and pink groups indicate standalone vs concurrent (CCC) enrollments at other two- and four-year institutions. Dark orange represents concurrent four-year and CCC full-time enrollments, medium orange represents four-year standalone (non-concurrent) enrollments, and light orange – four-year and CCC part-time concurrent enrollments. Accordingly, dark pink connotes concurrent two-year and CCC full-time enrollments, medium pink – two-year standalone (non-concurrent) enrollments, and light pink – two-year and CCC part-time concurrent enrollments. White spaces indicate non-enrollment.

The horizontal or x-axis indicates the relevant term and the vertical or y-axis refers to the cumulative number of students with each enrollment type in that term. Bear in mind that frequency here is imprecise. Rather than visualizing the enrollment patterns of each student across entire patterns containing thousands of students, the algorithm selects a representative sample of students in each pattern whose patterns to present in these charts.

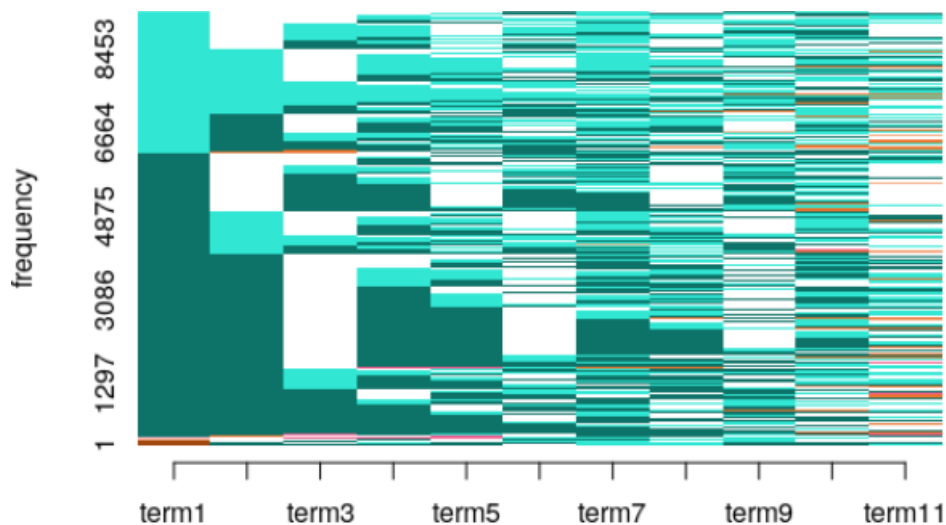Figure 4: Example Enrollment Pattern Visualization

Figure 5: Enrollment Pattern Visualization Key

Enrollment Type	4-yr + CCC FT	4-yr	4-yr + CCC PT	2-yr + CCC FT	2-yr	2-yr + CCC PT	CCC FT	CCC PT	Not Enrolled
Symbol	5	4	f	3	2	t	1	0	.
Color									

To contextualize enrollment patterns, each pattern's enrollment visualization is presented alongside its corresponding outcomes chart. These visualizations display the percentage of students having achieved a given outcome, by term, for the given pattern. For the outcomes "Any CCC Credential", "Basic CCC Certificate", "Any CCC Associates", and "Complete 4+ year Degree", the bubbles above each term on the x-axis indicate the cumulative percentage of

students who earned that outcome during or before that term. 'Transfer to four-year is the only outcome not presented cumulatively – the values displayed for this outcome are term-specific.

Though the same colors are used in the enrollment and outcomes diagrams, there is no direct relationship between their usage in each type of visualization. The colors in the outcomes charts do not relate to enrollment type. In the outcomes charts, bubble size corresponds to the proportion of students with that pattern earning each outcome. The sizes are scaled at the pattern level, meaning a given bubble size may represent different values across different patterns' outcomes charts.

These visualizations display outcome data through term 11 – the full duration of the study period. However, all other visualizations and discussions of outcomes refer to three-year outcomes. This is due to the unavailability of 12th-term data, which would have been necessary to report four-year outcomes.

Figure 6 presents the enrollment behavior charts for each of the six patterns, side-by-side. This agglomerated view highlights the contrast in the enrollment behaviors between patterns. For instance, while Intermittent Persisters (pattern one) tend to remain enrolled at CCC consistently over multiple years, Short-Term students (pattern two) tend to discontinue enrollment after their first term. Importantly, the differences between Short-Term students' and Transfer-Out students' (pattern five) enrollment behaviors after term one emphasize the importance of looking at broader contexts of postsecondary enrollment to understand students' trajectories. While for both patterns enrollment at CCC tends to wane after students' initial term, the subsequent enrollment behaviors diverge significantly. Accordingly, as the following section shows, each pattern's respective outcomes reflect these different trajectories. Below are the enrollment behavior and outcomes visualizations for each pattern.

Figure 6: Enrollment Visualizations for All Patterns
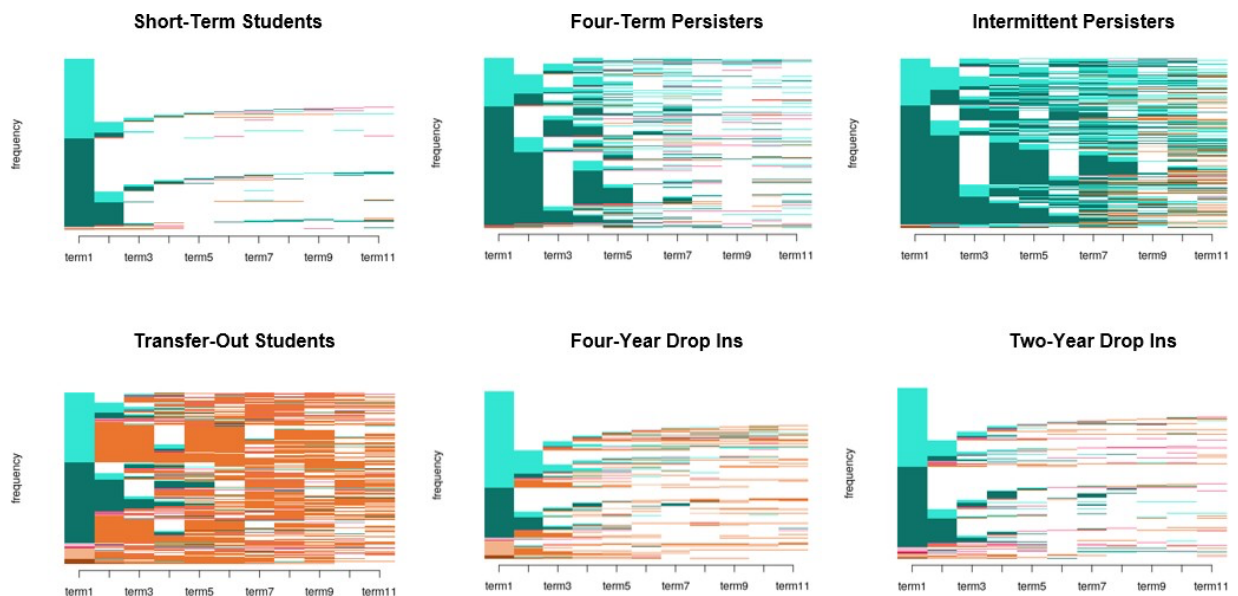
Short-Term students are characterized by discontinuation of enrollment at any postsecondary institution after their initial term (Figure 7). The average length of enrollment for this group is fewer than two terms total (1.81), including CCC and outside institutions. Enrollment intensity is split almost evenly – 49 percent of CCC enrollments are full-time.

However, within three years of the first enrollment, 17.8 percent of Short-Term students earned a certificate. This suggests that the short-term nature of engagement for some students with this pattern may have been intentional as it was sufficient for achieving a basic certificate. Just 4.9 percent of Short-Term students transfer to a four-year institution within 11 terms of their first CCC enrollment, and 0.9 complete a four-year degree within that time.

Figure 7: Short-Term Students Enrollment Pattern and Outcomes Visualizations
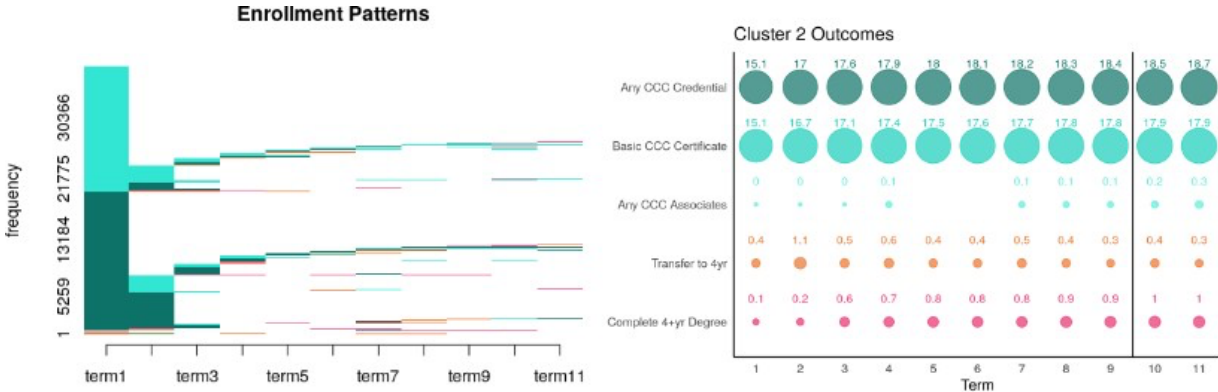
Enrollment continuity for Four-Term Persisters is moderate, as is shown in Figure 8. These students enroll intermittently, and primarily at CCC: the average length of enrollment at CCC is 4.10 terms, and the average total length of enrollment is 4.56 terms. The enrollment visualization also suggests a two-terms-on, one-term-off trend for this group. In terms of intensity, Four-Term Persisters tend to enroll full-time slightly more often than part-time, with 62 percent of the CCC enrollments observed being full-time. The average Four-Term Persister switches between full-time and part-time status 0.86 times during the study period.

This group demonstrates lower rates of CCC credential attainment compared to Intermittent Persisters and Short-Term students. Within three years, 8.3 percent of Four-Term Persisters earn an associate degree, and 10.1 percent earn a certificate. 7.9 percent transfer to a four-year institution and 0.4 percent earn a four-year degree (Figure 8).

Figure 8: Four-Term Persisters Enrollment Pattern and Outcomes Visualizations
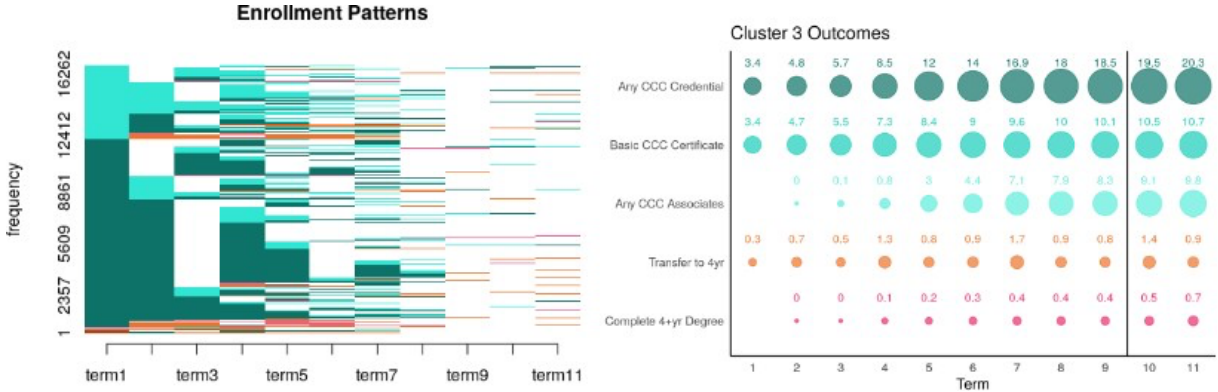
Intermittent Persisters demonstrate a high level of enrollment continuity. They remain enrolled off-and-on throughout the 11-term study period, and they tend to enroll primarily at CCC. However, a small incidence of transfer-out activity can be observed in later terms. Intermittent Persisters average 7.25 CCC enrollments and 8.04 total enrollments (CCC combined with outside institutions). Roughly two-thirds (65.63 percent) of students with this pattern start in the fall semester, and – as Figure 9 below illustrates – many demonstrate a two-terms-on, one-term-off cadence. Enrollment intensity for this group is mixed; 62 percent of CCC enrollments for this group are full-time, but Intermittent Persisters switch frequently between full-time and part-time status. They average 1.78 switches during the study period – more than students with any other pattern. Intermittent Persisters demonstrate the highest rate of associate degree attainment within three years across all patterns, with 33.4 percent of students earning this credential. They also have a substantial rate of CCC certificate earners – 13.8 percent – making them the pattern with the strongest completion rate by far for 'Any CCC Credential'. Despite a moderate proportion of students with this pattern transferring to a four-year institution during the study period (17.5 percent), just 0.2 percent of Intermittent Persisters complete a four-year degree within 11 terms of their first CCC enrollment.

Figure 9: Intermittent Persisters Enrollment Pattern and Outcomes Visualizations
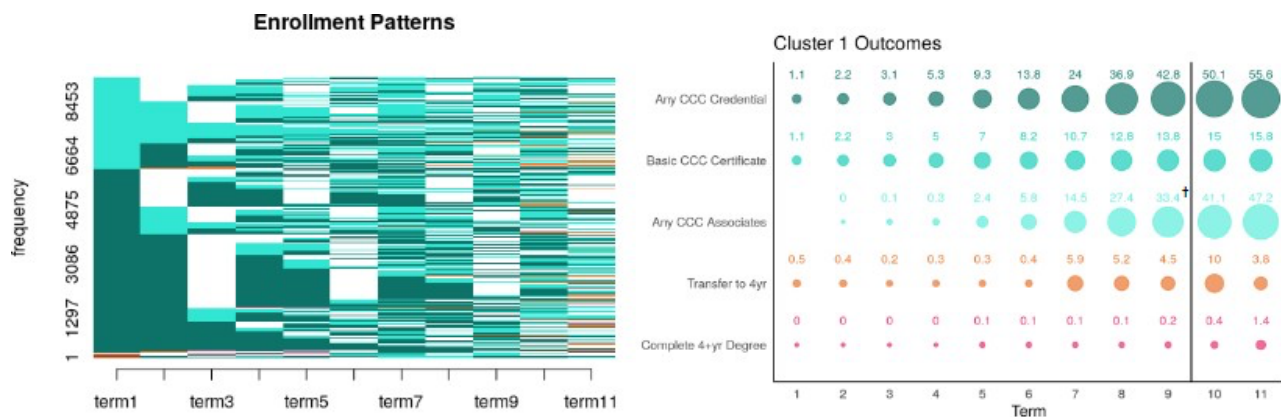
Transfer Out students also exhibit significant enrollment intensity, as evidenced in the enrollment visualization in Figure 10. However, this group is characterized by students enrolling first at CCC, and then matriculating into a four-year institution. Students with this pattern attend CCC for an average of 2.21 terms, and nearly half of these enrollments (49 percent) are full-time. The average total enrollment for this group is 8.15 terms– the highest across all patterns.

The rate at which students transfer to a four-year institution is also highest for this group compared to other patterns: 41.4 percent of Transfer Out students matriculate in term two alone, and 92.6 percent do so within three years. These students also enter CCC with an average of 3.15 enrollments at a 4-year institution. Unsurprisingly, Transfer Out students' four-year and advanced degree completion rate is also the highest across all the patterns. Within three years, 32 percent of these students earn a bachelor's degree or higher, including 4.8 percent who earn advanced degrees. This group demonstrates the lowest rates of CCC basic certificate completion (5.7 percent), but the second-highest rate of CCC associate degree completion (5.1 percent).

Figure 10: Transfer Out Students Enrollment Pattern and Outcomes Visualizations
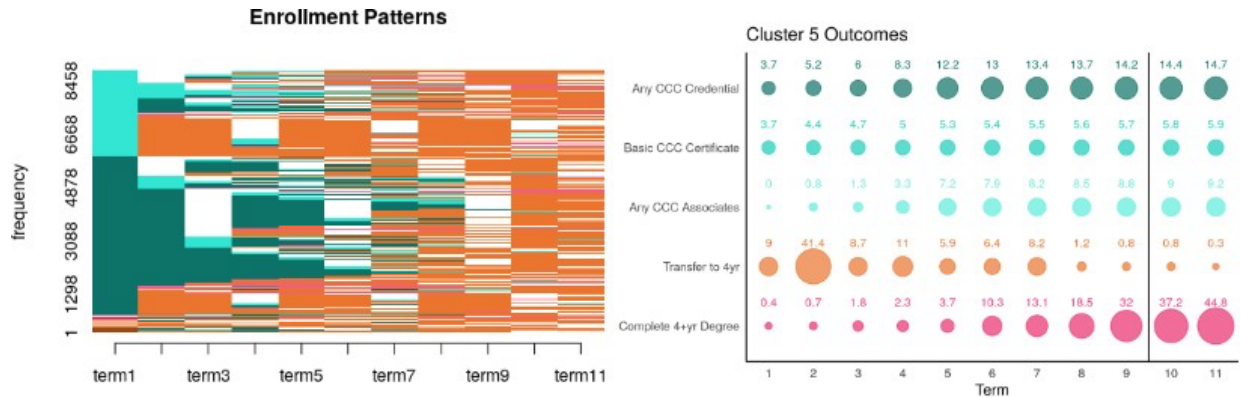
The Four Year Drop In pattern is characterized by a brief, part-time engagement at CCC, followed by transferring to a four-year institution or non-enrollment. Students with this pattern have an average of fewer than two CCC enrollments (1.89), 70 percent of which are part-time. The total average length of enrollment for Four Year Drop Ins is 3.25 terms. However, these students demonstrate substantial enrollment continuity in their pre-CCC enrollments. On average, they enter CCC with 12 prior terms at four-year institutions.

Accordingly, Figure 11 shows that Four Year Drop In students exhibit strong outcomes compared to other patterns: 36.1 transfer to a four-year institution within three years of their first CCC enrollment, and 21.4 percent earn four-year or advanced degrees within that time. This 21.4 percent includes 7.7 percent who complete advanced degrees within three years – the highest rate across all patterns. It is important to note that 63 percent of Four Year Drop In students had already completed a four-year or advanced degree before entering CCC. A substantial proportion of these students earn CCC basic certificates (18.6 percent), however, associate degree completion is low (0.5 percent).

Figure 11: Four-Year Drop In Students' Enrollment Pattern and Outcomes Visualizations
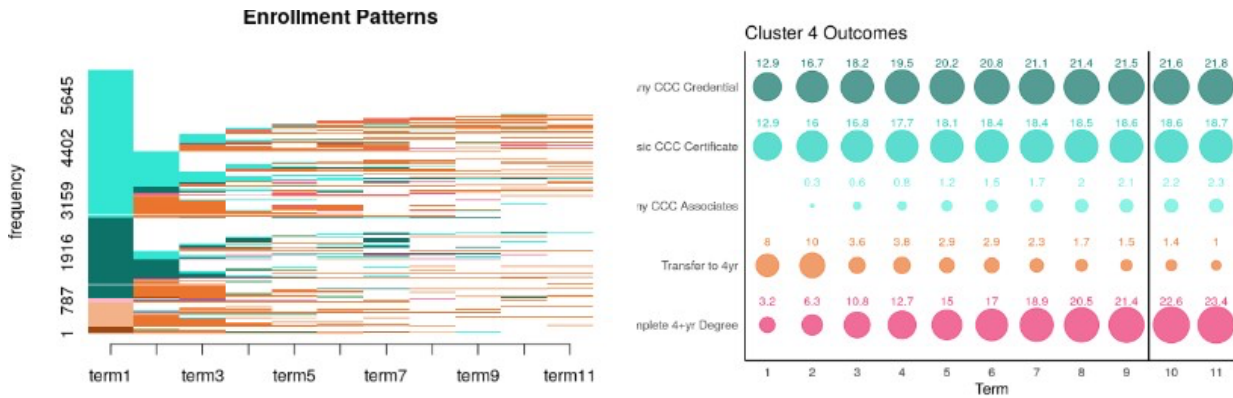
For Two-Year Drop-In students, enrollment continuity is strongest in their pre-CCC enrollments. These students enter CCC with substantial postsecondary enrollment experience, averaging 7.04 enrollments at an outside two-year institution prior to their first CCC enrollment. Nearly one-fifth (19 percent) enter with a prior two-year degree. Two Year Drop In students exhibit an average of roughly two CCC enrollments (1.97), which are slightly more likely to be part-time (54 percent). Including outside institutions, the average total enrollment for this group is 2.80 terms (Figure 12).

While CCC basic certificate completion is strongest for Two Year Drop In students compared to all other patterns (19.8 percent), CCC associate degree completion is low (1.1 percent). 14.8 percent of this group transfers to a four-year institution within three years of their first CCC enrollment, and 4.4 percent complete a four-year degree in this time.
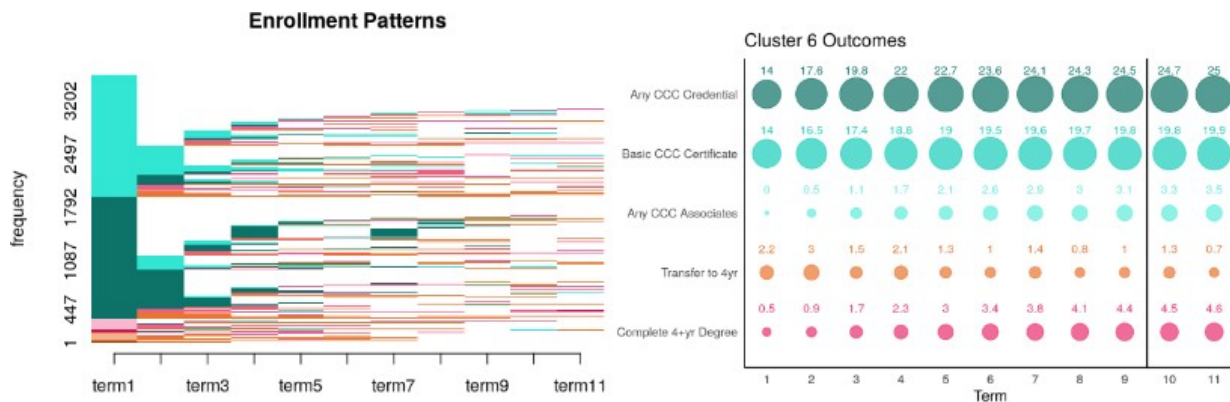
Viewing pattern outcomes side-by-side helps contextualize each group's three-year outcomes (Figure 13). Intermittent Persisters showed the highest overall rates of CCC credential attainment (42.8 percent), driven mostly by associate degree completion. Notably, 41.2 percent of this groupcontinues to enroll at CCC beyond three years. While Short-Term students had a moderate rate of certificate earners, their rates of associate degree earners and transfer to a four-year institution were the lowest across all patterns (0.1 percent and 3.7 percent, respectively). This group had the highest share of students who demonstrated no credential or transfer outcome and were not enrolled after three years (72.9 percent). Four-Term Persisters' outcomes trailed behind other patterns across all categories, and they demonstrated the second highest rate of unenrolled and credentialless students after three years (60.9 percent). Four-Year Drop-In students exhibited high rates of certificate and four-year degree completion (18.6 percent and 21.4 percent, respectively), as well as the highest rate of advanced degree completion (7.7 percent). Transfer Out students showed the highest rates of transfer (92.6 percent) and completion of (32.0 percent) a four-year degree. Finally, Two-Year Drop-In Students had the highest rate of CCC certificate earners (20.9 percent).

Figure 13: Three-Year Outcomes, by Pattern
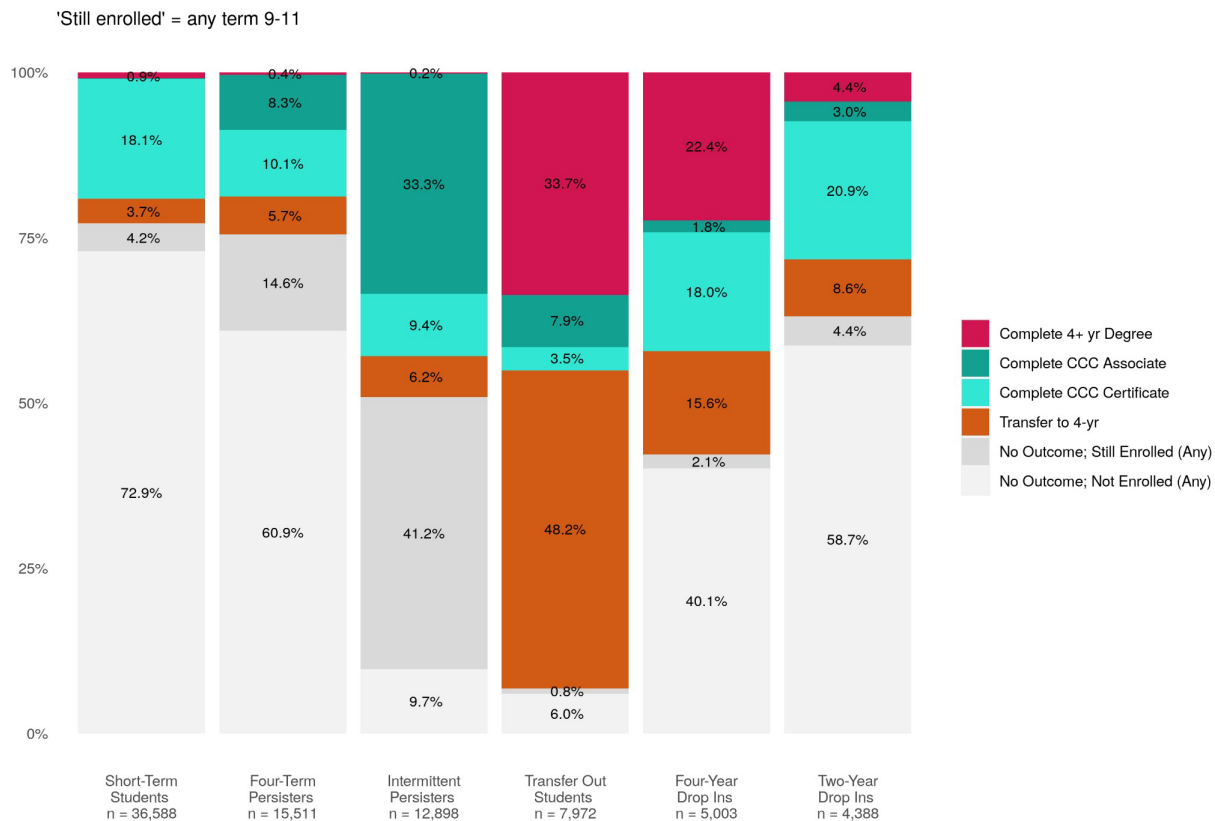
'Still enrolled' = any term 9-11

Figure 14 presents sample-wide demographic characteristics. As a whole, the sample was predominantly Black (37.6 percent) and Hispanic (31.6 percent). White students accounted for 17.1 percent of the sample, Asian students made up 7.4 percent, and 2.4 percent identified as Multiracial (Non-Hispanic). Fewer than one percent identified as Hawaiian/ Pacific Islander or American Indian. Race was not specified for 3.7 percent of the sample. The majority of students identified as female (52.6 percent), and the average age at first CCC enrollment was 24 years old.

Pell Grant recipients comprised 54 percent of the sample, and 1.2 percent were CCC Star Scholars. Pell Grants are federal grants available to any undergraduate student with significant financial need who has not already earned any type of degree. The CCC Star Scholarship is a merit-based scholarship offered by CCC to selected CPS graduates based on criteria such as grade point average at graduation and SAT score. Star scholars receive waivers for all tuition and books not covered by financial aid.

Though demographics were not included in the data used to cluster the sample, the students that exhibited each enrollment pattern did differ demographically, which can be observed in Figure 15. Black students were most likely to exhibit the Short-Term enrollment pattern, making up 44.8 percent of this pattern. Black students were second most likely to be Four-Term Persisters or Two-Year Drop-Ins. They were represented in each pattern nearly equally: 37 percent and 37.1 percent, respectively. Hispanic students exhibited the Intermittent Persister and Four-Term

Persister patterns most often – making up 44.7 percent and 40.1 percent of these patterns, respectively. White students were most likely to be Four-Year Drop-Ins, as they made up 40.6 percent of this pattern. Asian students were represented in the Transfer Out pattern more than in any other enrollment pattern, making up 10.4 percent of Transfer Out students.

Figure 14: Full Sample Demographics

	%
Race/ Ethnicity	
American Indian	0.2
Asian	7.4
Black	37.6
Hawaiian/ Pacific Islander	0.1
Hispanic	31.6
Multi Racial, Non-Hispanic	2.4
White	17.1
Not Specified	3.7
Gender	
Female	52.6
Male	46.9
Missing	0.5
Age	
Age	24.2
Missing	0.1
Financial Aid	
Star Scholar	1.2
Pell Recipient (Ever)	54.0

23

Figure 15: Student Race/ Ethnicity, by Pattern
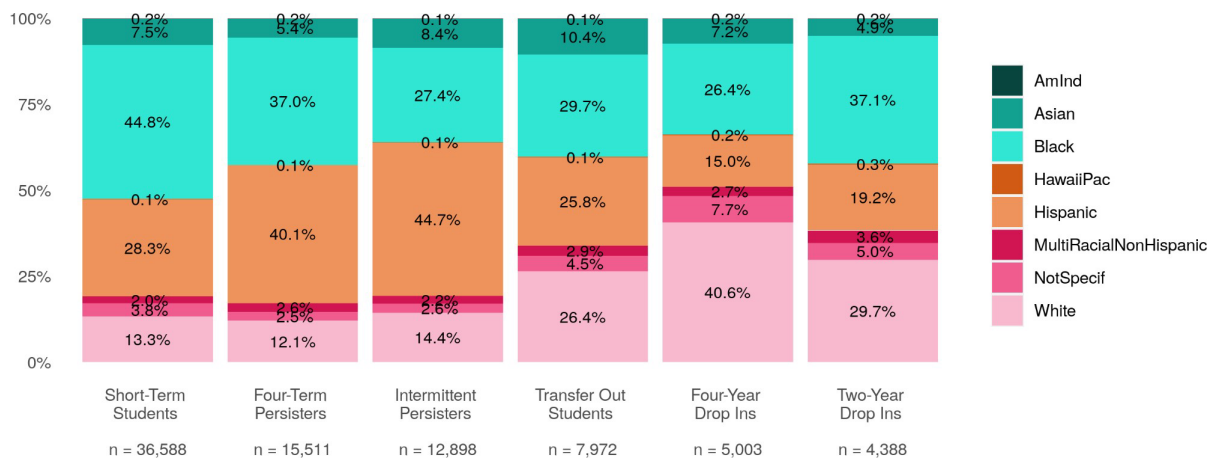
All patterns – except for Short-Term students – were majority female (Figure 16). Short-Term students had only slightly more male students (52.3 percent) than females. The Two-Year Drop Ins group was nearly evenly split, with 49.5 percent and 49.7 percent male and female students, respectively. All other patterns were between 55.5 percent and 59.3 percent women. Note that CCC's demographic data collection on gender is limited to the categories "male", "female", and "missing", so some students' gender identities may not be accurately represented in this analysis.

Figure 16: Student Gender, by Pattern
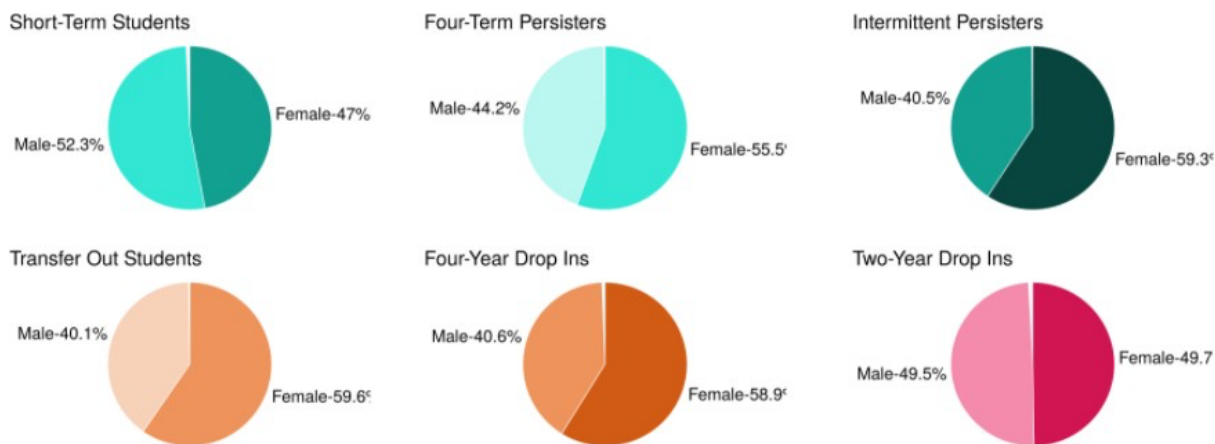
The average age was calculated as the median age at first term for each group. Transfer Out Students, Four-Term Persisters, and Intermittent Persisters were the youngest in terms of age at first CCC enrollment. The median ages were between 21 and 22 years, however, Figure 17 shows that most students were 20 or younger when they first enrolled at CCC. Four-Year Drop-In students and Two-Year Drop-In students – both of which contained large proportions of students having earned an outside credential prior to enrolling at CCC – had the highest starting enrollment ages, at 28 and 27. Short-Term Students' median age at first CCC enrollment was 25.

Intermittent Persisters and Four-Term Persisters contained the highest proportions of both Pell recipients and Star Scholars. Four-Year Drop-In students had the smallest overall proportions of financial aid recipients (Figure 18).

Figure 17: Student Age, by Pattern

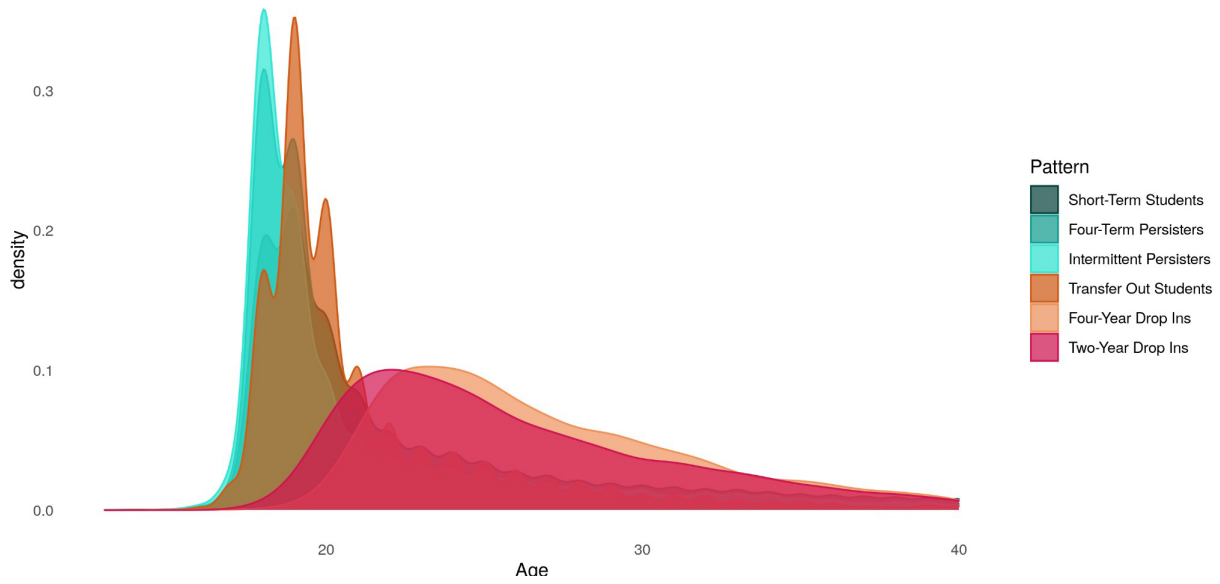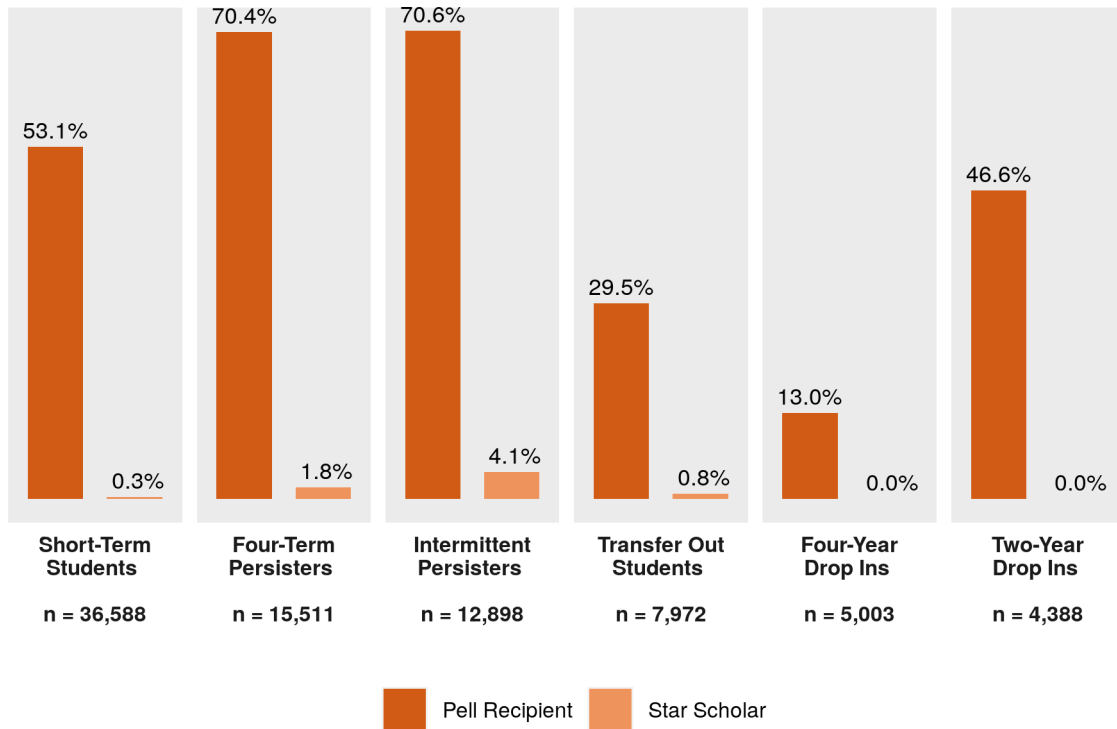## Figure 18: Student Financial Aid Status, by Pattern

Four-Term Persister and Intermittent Persister Comparison

The Four-Term Persister and Intermittent Persister groups share many meaningful similarities. For both patterns, most students are young, Pell recipients, and new students at CCC. They tend to start in the fall semester and intend to pursue an associate degree. However, Intermittent Persisters are much more likely to attain this goal (33.4 percent compared to 4.8 percent of Four-Term Persisters). To better understand the similarities and differences between students with these patterns, we conducted several sub-analyses.

Table 4 displays the 10 most common enrollment patterns exhibited by Four-Term Persisters and Intermittent Persisters. While Intermittent Persisters' enrollment intensity fluctuates term-to-term (they switch between full-time and part-time status more often than Four-Term Persisters), they tend to demonstrate stronger enrollment continuity. Intermittent Persisters enroll longer before and re-enroll for more terms after their first enrollment interruption. Intermittent Persisters are also more likely to be Star scholars.

Table 4: 10 Most Common Enrollment Vectors, Four-Term Persisters, and Intermittent Persisters

22 A. Four-Term Persisters

10 Most Common Vectors

	vector_all	vec_count	cum_perc
1	11.1.......	783	5.048
2	11.11......	523	8.420
3	11.0.......	372	10.818
4	00.0.......	286	12.662
5	1.11.......	279	14.461
6	1..1..1....	270	16.201
7	11.11.1....	263	17.897
8	11.10......	185	19.090
9	0.00.......	149	20.050
10	10.0.......	148	21.004

22 B. Intermittent Persisters

10 Most Common Vectors

	vector_all	vec_count	cum_perc
1	11.11.11...	248	1.923
2	11.11.10...	128	2.915
3	11.11.11.44	127	3.900
4	00.00.00.00	80	4.520
5	11.11.11.0.	78	5.125
6	11.11.11.10	70	5.668
7	11.11.11.1.	68	6.195
8	11.11.11.11	67	6.714
9	11111.44.44	62	7.195
10	11.11.14.44	60	7.660

Demographic differences between the patterns are moderate but statistically significant. The Intermittent Persister pattern has slightly larger shares of Asian, Hispanic, and white students compared to the Four-Term Persisters (Table 5). Black students account for 27.42 percent of Intermittent Persisters and 36.96 percent of Four-Term Persisters – a difference of 9.5 percentage points. The patterns also bear slightly different gender compositions. There are slightly more students who identify as female in the Intermittent Persister pattern – 59.27 percent compared to 55.52 percent in the Four-Term Persister Pattern (Table 6).

Table 5: Student Race/ Ethnicity, Four-Term Persisters, and Intermittent Persisters

Pattern	n	American Indian (%)	Asian (%)	Black (%)	Hawaiian/ PI (%)	Hispanic (%)	Multi; Non-Hisp (%)	Not Specified (%)	White (%)
Four-Term Persisters	15,511	0.17	5.36	36.96	0.12	40.10	2.62	2.55	12.11
Intermittent Persisters	12,898	0.07	8.40	27.42	0.14	44.71	2.25	2.60	14.41

Chi-Sq p_val = 0.0004996

Table 6: Student Gender, Four-Term Persisters, and Intermittent Persisters

Pattern	n	Female (%)	Male (%)	Missing (%)
Four-Term Persisters	15,511	55.52	44.19	0.30
Intermittent Persisters	12,898	59.27	40.55	0.18

Chi-Sq p_val = 0.0004998

The observable differences between students exhibiting these two patterns offer preliminary identifiers for students who may benefit from additional institutional support. Four-Term Persisters' first enrollment interruption is likely to be in terms two or three. They are less likely to be receiving financial support from CCC in the form of a Star Scholarship, and they are more likely to be Black.

Discussion and Implications

This paper explores community college student enrollment behavior by examining enrollment intensity and continuity for a sample of 82,360 CCC students over a span of 11 terms. The analyses presented above reveal that CCC students come from a broad variety of educational backgrounds, which inform their enrollment decisions. Some are new to college, some hold prior associate and bachelor degrees, and some are concurrently enrolled at a university. Student enrollment behaviors, demographic characteristics, and outcomes vary significantly across enrollment patterns. In highlighting the wide variety of student experiences, this research underscores that understanding community college student enrollment patterns and how they correspond to academic outcomes requires looking beyond just first-term enrollment intensity. These findings help us begin to differentiate between students who appear on track to achieve their academic goals versus those who might benefit from additional support.

The Transfer Out and Drop In patterns (both Two-Year and Four-Year) reveal that many students who engage with community college for a brief period of time do so intentionally, and as part of a broader postsecondary journey. Together, these three patterns represent 21 percent of the sample, and the collective average engagement at CCC was just two terms. These students had some of the strongest rates of CCC credential achievement, and the strongest rates by far of transfer to four-year institutions and completion of four-year and advanced degrees.

A distinguishing characteristic of these patterns was that the vast majority of students were transfers-in to CCC – 100 percent of both Drop in patterns, and 84 percent of Transfer Out students. The first CCC enrollment for students in these three patterns was about equally likely to be in the fall, spring, or summer.

On the other hand, while the Four-Term Persister and Short-Term Student patterns are also characterized by shorter lengths of enrollment in community college, many of these students disengage from postsecondary education before earning any credential. These patterns combined make up nearly two-thirds of the total sample. Of this group, roughly 18 percent earned a CCC credential within three years, and fewer than one percent earned a four-year degree.

Finally, while nearly 43 percent of Intermittent Persisters (16 percent of the sample) successfully earned a CCC credential within three years of their first enrollment, many (41 percent) were still working towards a degree 11 terms after their first enrollment. This begs the question: Could these students' success be accelerated and, if so, how might community colleges play a role?

Short-Term Students, Four-Term Persisters, and Intermittent Persisters were more likely to be new students and to start in the fall term; roughly 70 percent of these students were new, first-time students at CCC, and approximately 60 percent enrolled for the first time in a fall semester. Importantly, racial disparities also emerged in post-clustering demographic analyses. Short-Term Students, Four-Term Persisters, and Intermittent Persisters predominantly identify as Hispanic or Black. White students were overrepresented in patterns that display the highest rates of credential completion (Transfer Out students and both Drop-In patterns).

Therefore, the current analyses suggest that students' race and ethnicity, start term, and new versus transfer-in status help point to who may benefit from additional support in achieving academic success. Community colleges can better serve their new students and students of color by building a stronger understanding of patterns of disengagement and designing new supports to help students remain enrolled until they have achieved their academic goals.

Future research can help to inform the design of support services by exploring other aspects of the student experience that may contribute to stop-out behavior. Specifically, studying the following topics at the pattern level would help foster a deeper understanding of what may be contributing to or driving premature dis-enrollment, and therefore, where community colleges might develop stronger student supports:

- **Pre-postsecondary academic preparedness**: By understanding whether there is a link between academic preparedness at the time that students enter community college and their subsequent enrollment behavior thereafter, indicators such as high school GPA and standardized test scores may help predict who is more likely to fall short of earning a credential. This insight could be used to identify and offer greater academic support to certain subgroups of students.

- **Initial course placement**: Relatedly, for students exhibiting enrollment patterns associated with stopping short of credential attainment, investigating whether students with these patterns are more likely to be placed into particular courses upon entering community college can offer valuable insight. For instance, if there are courses that Short Term Students or Four-Term Persisters are more likely to be placed into, additional academic or other supports could be extended to students enrolled in that course.

- **First-term academic performance**: Students' decision to re-enroll in a subsequent term could be influenced by their initial academic performance. If so, indicators such as first-term grades or GPA could also help identify who community colleges could be proactively reaching out to and designing support for, in order to encourage enrollment persistence.

- **Registration Holds** (including academic and financial holds): Registration holds can prevent students from re-enrolling in subsequent terms. Understanding to what extent these holds affect credential-seeking students can also help illuminate where community colleges might better work with students to address administrative issues without discouraging re-enrollment.

- **Financial need** (including use of emergency financial assistance): An inability to afford the costs of continuing education or personal or familial financial obligations can cause students to take time off from their postsecondary education. Discovering what students are more likely to disengage due to financial constraints would allow community colleges to design targeted financial supports to help these students remain engaged.

- **Housing instability**: Students affected by housing instability may struggle to consistently remain enrolled in postsecondary education. Identifying these students and better understanding their needs is an important way community colleges can strive to make access to postsecondary education truly equitable.

Using comprehensive analyses of enrollment behavior to explore how students move through community college, this paper has established that students' enrollment choices are varied and complex. Many students enroll in community college and successfully achieve their postsecondary goals within the current ecosystem of support and opportunities. However, many students stop enrolling before having earned a credential. This research has begun to identify who these students are and how they might be better served by community college institutions. Additional exploration into what factors contribute to these students' disengagement from postsecondary education can help community colleges better understand the needs of their students, and to support them through degree completion.

Appendix
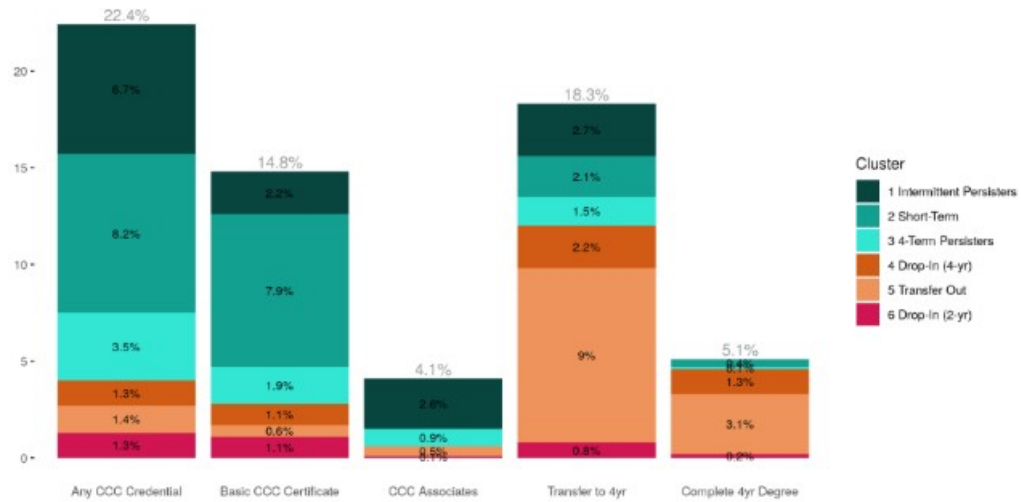
Source: CCC and NSC data
N = 82,360

Across the full sample, 22.4 percent of students earned a CCC credential within three years of their first CCC enrollment. This was driven mostly by basic certificate earners (14.8 percent), as opposed to associate degree earners (4.1 percent). Note– the 3.5 percentage point difference between the sum of basic certificate earners and associate degree earners, and the total of CCC credential earners is accounted for by advanced certificate earners. Many students' postsecondary paths included four-year institutions, with 18.3 percent of students transferring to a four-year institution within three years of their first CCC enrollment, and 5.1 percent completing a four-year or advanced degree within three years of their first CCC enrollment.

At the outcome level, CCC certificate attainment across the sample was driven largely by Short-Term students, who alone accounted for half of certificate earners in the sample (7.9 percent of 14.8 percent total). Intermittent Persisters accounted for the majority of CCC associate earners (2.6 percent of 4.1 percent total). Half of all students who transferred to a four-year institution came from the Transfer Out pattern. Transfer Out students also made up the largest share of four-year degree completers.

The features defined below were all calculated based on observed enrollment behavior within the 11-term study period. Exceptions include those that explicitly state they were constructed using 'pre-CCC' or 'pre-CST' (Cohort Start Term) data. The definitions provided describe each feature as they were calculated at the student level. However, the features as they appear in subsequent tables all represent the averages for each pattern of these student-level indicators.

Feature Name	Definition
# Terms	Average # terms enrolled during the study period
% FT Terms	Average # CCC enrollments that were full-time
1st Interruption of.	
1 T	Index of enrollment vector where the first instance of (exactly) one non-enrollment occurs
2 Ts	Index of enrollment vector where the first instance of (exactly) two consecutive non-enrollments occurs
3 Ts	Index of enrollment vector where the first instance of (exactly) three consecutive non-enrollments occurs
Transitions (Consecutive)	(Based on raw enrollment vector, including non-enrollments. Transitions between non-enrollment and full- or part-time were not counted)
FT > PT	# transitions from full-time enrollment to part-time enrollment
FT > FT	# transitions from full-time enrollment to full-time enrollment
PT > FT	# transitions from part-time enrollment to full-time enrollment
PT > PT	# transitions from part-time enrollment to part-time enrollment
Transitions (Without Gaps)	(Ignoring non-enrollments in enrollment vector, meaning all transitions were counted)
FT > PT	# transitions from full-time enrollment to part-time enrollment
FT > FT	# transitions from full-time enrollment to full-time enrollment
PT > FT	# transitions from part-time enrollment to full-time enrollment
PT > PT	# transitions from part-time enrollment to part-time enrollment
Non-Enroll	Index of enrollment vector where the first instance of (at least) one non-enrollment occurs

Total Switches	Total # switches between full-time and part-time status
# Terms…	
@ NSC 2yr	Total # terms enrolled at a non-CCC 2-year institution
@ NSC 4yr	Total # terms enrolled at a 4-year institution
Pre-CCC 2yr	Total # terms enrolled at a non-CCC 2-year institution prior to the student's first enrollment at CCC
Pre-CCC 4yr	Total # terms enrolled at a 4-year institution prior to the student's first enrollment at CCC
Pre-CST…	
4+yr Deg	(Boolean) Indicator for whether student held a 4-year or advanced degree prior to their first CCC enrollment
2yr Deg	(Boolean) Indicator for whether student held a 2-year degree prior to their first CCC enrollment
< 2yr Deg	(Boolean) Indicator for whether student held a less-than-2-year credential prior to their first CCC enrollment
Any Deg	(Boolean) Indicator for whether student held any degree prior to their first CCC enrollment
% New Students	% of pattern that were new students (non-transfers-in) at CCC
Start Term	
% Fall	% of pattern that started in the fall term
% Spring	% of pattern that started in the spring term
% Summer	% of pattern that started in the summer term
Declared Degree	
% Terminal	% of pattern whose declared degree upon entering CCC was a terminal degree
% Transfer	% of pattern whose declared degree upon entering CCC was a transfer degree
% Certificate	% of pattern whose declared degree upon entering CCC was a certificate

Pattern	N Students	% Students	# Terms	% FT Terms	Consecutive				Without Gaps				Non-Enroll	Total Switches	1st Interrupt 1 Term	1st Interrupt 2 Terms	1st Interrupt 3 Terms
					FT>PT	FT>FT	PT>FT	PT>PT	FT>PT	FT>FT	PT>FT	PT>PT					
Short-Term Students	36,588	44%	1.59	0.49	0.03	0.07	0.01	0.04	0.05	0.10	0.02	0.06	1.20	0.19	2.32	2.44	2.55
Four-Term Persisters	15,511	19%	4.10	0.62	0.07	0.21	0.04	0.09	0.13	0.36	0.07	0.17	2.23	0.86	3.09	5.03	6.44
Intermittent Persisters	12,898	16%	7.25	0.62	0.10	0.30	0.07	0.14	0.14	0.42	0.10	0.20	2.43	1.78	4.51	9.63	10.52
Transfer Out Students	7,972	10%	2.21	0.49	0.04	0.12	0.02	0.05	0.06	0.16	0.04	0.10	1.39	0.35	2.63	3.05	3.41
Four-Year Drop Ins	5,003	6%	1.89	0.30	0.02	0.05	0.02	0.10	0.04	0.07	0.02	0.15	1.27	0.19	2.49	2.77	3.08
Two-Year Drop Ins	4,388	5%	1.97	0.46	0.03	0.08	0.02	0.06	0.06	0.14	0.03	0.10	1.36	0.25	2.47	2.78	3.13

Note:
Location of i'th interruption' features include zeros (i.e. cases where interruptions of that length are not applicable)

Appendix D: CCC + NSC features (numeric)

Pattern	# Terms	Non-Enroll	# Terms..				1st Interruption of..			Pre CST			
			@ NSC 2yr	@ NSC 4yr	pre-CCC 2yr	pre-CCC 4yr	1 T	2 Ts	3 Ts	4+yr Deg	2yr Deg	< 2yr Deg	Any Deg
Short-Term Students	1.81	1.28	0.11	0.12	0.21	0.44	2.36	2.51	2.67	0.01	0.01	0.00	0.02
Four-Term Persisters	4.56	2.37	0.27	0.22	0.36	0.58	3.14	5.28	7.12	0.01	0.01	0.00	0.02
Intermittent Persisters	8.04	2.39	0.09	0.77	0.47	0.62	4.70	10.65	11.50	0.02	0.01	0.00	0.03
Transfer Out Students	8.15	2.04	0.80	5.45	0.98	3.15	5.19	10.28	11.23	0.09	0.03	0.00	0.11
Four-Year Drop Ins	3.25	1.53	0.20	1.36	1.14	12.19	2.93	3.58	4.32	0.63	0.04	0.00	0.65
Two-Year Drop Ins	2.80	1.63	0.49	0.44	7.04	1.38	2.66	3.22	3.89	0.05	0.19	0.01	0.22

Note:
Indicators for NSC records that take place after a student's 11th ccc term were not included
Counts of 2-year and 4-year NSC enrollments both include double (concurrent) enrollments
'Location of i'th interruption' features include zeros (i.e. cases where interruptions of that length are not applicable)
The '4+yr Deg' indicator refers to students who earned a bachelors and/or advanced degree

Appendix E: CCC features (categorical)

Pattern	N Students	% Students	% New Students	Start Term			Declared Degree		
				% Fall	% Spring	% Summer	% Terminal	% Transfer	% Certificate
Short-Term Students	36,588	44%	71.74	52.54	35.01	12.44	53.23	26.81	19.95
Four-Term Persisters	15,511	19%	66.39	63.82	28.50	7.68	61.03	36.64	2.32
Intermittent Persisters	12,898	16%	70.62	65.63	24.49	9.88	60.06	39.26	0.68
Transfer Out Students	7,972	10%	16.43	31.84	20.47	47.69	65.24	31.26	3.50
Four-Year Drop Ins	5,003	6%	0.00	37.04	34.50	28.46	61.00	25.20	13.79
Two-Year Drop Ins	4,388	5%	0.00	46.42	36.28	17.30	58.23	25.96	15.82

APPENDIX F: FULL CCC + NSC FEATURES (NUMERIC)

Pattern	# Terms	Non-Enroll	@ NSC 2yr	@ NSC 4yr	pre-CCC 2yr	pre-CCC 4yr	1 T	2 Ts	3 Ts	FT > 2yr	FT > 4yr	PT > 2yr	PT > 4yr	2yr -> FT	2yr -> PT	4yr -> FT	4yr -> PT	2yr -> 4yr	4yr -> 2yr	FT > 2yr	FT > 4yr	PT > 2yr	PT > 4yr	2yr -> FT	2yr -> PT	4yr -> FT	4yr -> PT	2yr -> 4yr	4yr -> 2yr	4+yr Deg	2yr Deg	< 2yr Deg	Any Deg
			# Terms..				1st Interruption of..			Consecutive										Without Gaps										Pre CST			
Short-Term Students	1.81	1.28	0.11	0.12	0.21	0.44	2.36	2.51	2.67	0.01	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.02	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.02
Four-Term Persisters	4.56	2.37	0.27	0.22	0.36	0.58	3.14	5.28	7.12	0.01	0.02	0.01	0.01	0.00	0.00	0.01	0.01	0.00	0.00	0.06	0.06	0.04	0.04	0.01	0.01	0.02	0.01	0.01	0.00	0.01	0.01	0.00	0.02
Intermittent Persisters	8.04	2.39	0.09	0.77	0.47	0.62	4.70	10.65	11.50	0.01	0.10	0.01	0.08	0.01	0.01	0.03	0.02	0.00	0.00	0.02	0.20	0.02	0.13	0.01	0.01	0.03	0.02	0.01	0.00	0.02	0.01	0.00	0.03
Transfer Out Students	8.15	2.04	0.80	5.45	0.98	3.15	5.19	10.28	11.23	0.04	0.30	0.03	0.38	0.01	0.01	0.08	0.10	0.09	0.06	0.07	0.46	0.06	0.49	0.01	0.02	0.10	0.12	0.12	0.09	0.09	0.03	0.00	0.11
Four-Year Drop Ins	3.25	1.53	0.20	1.36	1.14	12.19	2.93	3.58	4.32	0.00	0.05	0.02	0.07	0.00	0.01	0.01	0.02	0.01	0.01	0.02	0.10	0.05	0.21	0.00	0.01	0.01	0.03	0.02	0.01	0.63	0.04	0.00	0.65
Two-Year Drop Ins	2.80	1.63	0.49	0.44	7.04	1.38	2.66	3.22	3.89	0.02	0.02	0.03	0.02	0.01	0.01	0.00	0.00	0.01	0.01	0.08	0.05	0.10	0.07	0.01	0.02	0.00	0.01	0.03	0.02	0.05	0.19	0.01	0.22

Note:
Indicators for NSC records that take place after a student's 11th ccc term were not included
Counts of 2-year and 4-year NSC enrollments both include double (concurrent) enrollments
'Location of i'th interruption' features include zeros (i.e. cases where interruptions of that length are not applicable)
Features that mark transitions from CCC to NSC all start with singular (non-concurrent) ccc enerollments
The '4+yr Deg' indicator refers to students who earned a bachelors and/or advanced degree

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