

*Student Money Management Center
University of Illinois System*

BADGES & BIG DATA:

AN ANALYSIS OF THE SMMC DIGITAL BADGES PROGRAM

Authors:

*Kagen Quiballo
Arch Patel
Safa Waqar
Linjie Yang*

Project Supervision:

*Andrea Pellegrini
Kristin Palmsiano*

May 15th, 2020

ABSTRACT

The Student Money Management Center, a division of the University Bursar, empowers students to make positive behavioral changes associated with their finances by providing financial education to students, parents, employees, and alumni for all institutions in the University of Illinois System - Urbana, Chicago, and Springfield. The Student Money Management Center developed and maintains a digital badges program through the Moodle Learning Management System. Its goal is to improve financial skills and knowledge of the 5 financial core competencies laid out by the United States Department of Treasury: Borrow, Earn, Protect, Save, and Spend (Financial Education Core Competencies; Comment Request, 2010). Participants get recognition for enhancing their financial knowledge and skills by earning digital badges for different categories.

The goal of the Badges Data Analysis Project is to improve financial literacy of students under the University of Illinois System and financial planning. By analyzing data from the digital badges program on student participation and engagement, predictive models and statistical analyses can provide insights on improving the outreach and success of this initiative. Recommendations using the analysis can be made for the development of the program as well as strategy related to increasing participation and engagement.

Many students make their first key financial decisions in college, but are often ill-informed due to a lack of access to financial literacy resources (Chen & Volpe, 1998). The literary work of Kezar and Yang discusses the importance of financial literacy in students and claims that not only is it the responsibility of educators to provide students with resources to improve financial competency, but studies also show that financial literacy can increase the odds of students staying and succeeding in college (Kezar and Yang, 2010).

The focus of this analysis will be on the Core Competency with the highest engagement: the Borrow Badge. The Borrow Badge had the most quiz participation, page views, and students enrolled relative to the other 4 badges.

In this report, we also cover a statistical analysis and predictive analysis section. After cleaning Banner datasets, Moodle dashboards, and Moodle log files in SAS, SQL, and Microsoft Excel, a statistical analysis using machine learning techniques in R was implemented to create 3 predictive models and identify trends. 2 generalized linear models with binomial linked participation responses and financial variable predictors were assessed under Akaike Information Criterion (AIC), Hosmer-Lemeshow Goodness of Fit (GOF), and Confusion Matrices. The odds ratios of the generalized linear models indicated that ethnicity, institution,

and financial aid (in the form of loans, grants, or scholarships) indicated significant odds of participation. A random forest was also created in R to predict participation based on financial variables and college information with variable importance plots indicating that age of participant and loan amounts incurred were the most important variables in predicting participation. Insights, actionable items, and future directions on these particular populations having a higher likelihood or odds of participating in the badges program is discussed at the end of the report.

AUTHORS



Kagen Quiballo is a senior at University of Illinois at Urbana-Champaign pursuing a double major in mathematics and statistics, a minor in informatics (data management track), and certificates in data science and undergraduate research. After graduating in May 2020, he plans to pursue an industry career in data analytics and data science fields in the Chicagoland Area.



Safa Waqar is a junior at the University of Illinois at Urbana-Champaign pursuing a Bachelor of Arts in Economics and a minor in Business, with a Finance and Accounting track. After graduating in May 2021, she plans to go into financial analytics and data science fields.



LinJie Yang is a junior at University of Illinois at Urbana-Champaign pursuing a major in mathematics, minors in informatics and statistics (Applied Statistics Track), and certificate in Leadership. After graduating in May 2021, he plans to go into graduate school in the data science or business analysis field.



Arch Patel is a junior at the University of Illinois at Urbana-Champaign pursuing a Bachelor of Arts in Economics and a minor in Informatics. After graduating in May 2021, he plans to go into financial analytics or data analytics at some business company.

TABLE OF CONTENTS

SECTION I: Badges Overview & User Experience Analysis

Borrow Badge Contributes Majority of Engagement

Analysis of Feedback Surveys

SECTION II: Breakdown of Program Engagement by Module

Number of Quizzes per Participant

Likelihood of Quiz Participation and Badge Completion: All Badges

Most Popular Module: Borrow Badge Participation

Most Popular Month: Borrow Badge Participation

Moodle Page Views

by Badge

by Module: Borrow Badge, Earn Badge, Protect Badge, Save Badge, Spend Badge

Influential Factors on Page Views

SECTION III: Descriptive Analysis of Badge Participants

Program Engagement by Institution vs UIllinois Data

Ethnicity of Enrollees by Institution vs UIllinois Data

College Information Analysis by Institution, College, and Major

SECTION IV: Statistical Analyses, Hypothesis Testing, and Likelihood of Participation

Campaign Influence on Participation

Likelihood of UIC Participation by Badge

Likelihood of Cross-Participation in Multiple Badges

Credit Hours Impact on Participation

Bidirectional Impact of Financial Holds and Campaign Participation

Financial Hold Impact on Future Participation in “Avoidable Fees”

Participation in “Understand Your Refund” Impact on Incurring Future Financial Holds

SECTION V: Predictive Modeling and Insight on Significant Variables

Generalized Linear Modeling

Demographic Model

Financial Model

Assessing Accuracy and Significant Variables

Random Forest

Methodology

Significant Variables

Extrapolating Insight and Actionable Items

SECTION I: Badges Overview & User Experience Analysis

Section I Overview

The digital badges program encompasses 5 different badges, of which the Borrow Badge comprises the majority of engagement. Engagement in the program can take various forms such as enrollment, participation in quizzes, page viewing, and feedback surveys. Based on feedback surveys, we find that the majority of enrollees either “agree” or “strongly agree” that modules are well organized and have useful material.

Borrow Badge Contributes Majority of Engagement

Badge	# enrolled	# participants	# quizzes	# page views	#feedback surveys
borrow	18,150 (97.91%)	2,903 (97.03%)	3,854 (95.87%)	8,292 (89.68%)	118 (95.16%)
earn	204 (1.10%)	35 (1.17%)	65 (1.62%)	530 (5.73%)	4 (3.23%)
protect	41 (0.22%)	18 (0.60%)	31 (0.77%)	89 (0.96%)	0 (0.00%)
save	67 (0.36%)	16 (0.53%)	33 (0.82%)	152 (1.64%)	1 (0.81%)
spend	76 (0.41%)	20 (0.67%)	37 (0.92%)	183 (1.98%)	1 (0.81%)
Total	18,538 (100%) 18,353 unique (can enroll in multiple)	2,992 (100%) 2,953 unique (can enroll in multiple)	4,020 (100%)	9,246 (100%)	124 (100%)

Table 1

Enrollees refers to students who choose to enroll in the digital badges program (there are 5 different badges: Borrow, Protect, Earn, Save, Spend). Students can enroll in multiple badges if they so choose. Each badge has several modules that enrollees can engage with in different ways. Quizzes at the end of the module assess the enrollee’s knowledge of the module’s content. We call enrollees that take at least one quiz participants. If a participant completes 3 or more quizzes from one badge, they may earn a digital badge that may be displayed on an online profile to signify their knowledge and completion of the course. Page views refer to the number of views a page received on Moodle: the platform used for the digital badges program. Feedback surveys refer to an optional section after each module where enrollees can give their opinions on the structure and material of a module. All data from Table 1 was collected from Fall 2018 to Fall 2019.

Looking at Table 1, it is evident that the majority of engagement can be attributed to the Borrow Badge, making up 97.91% of enrollment and 97.03% of participation (taking at least 1 quiz in that Badge course). Due to this Badge attributing to the highest engagement in the program, it will be the focus of many analyses in this report.

The focus of this analysis will be on the Core Competency with the highest participation: the Borrow Badge, which contains information on credit-based products and objectives such as; how to establish and maintain good credit, tips and cautions on looking for financial aid, organizing student loans to avoid overwhelming loan debt, and ways to reduce debt.

Analysis of Feedback Surveys

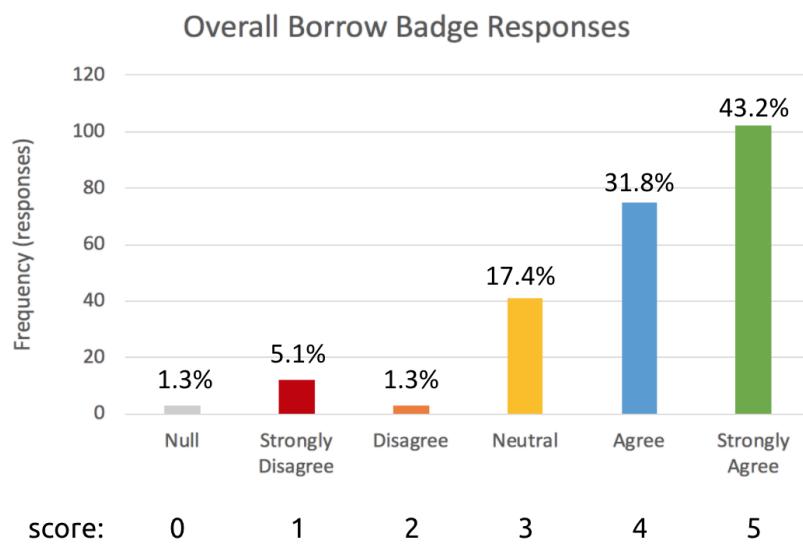


Image 1

As mentioned in the previous section, we will be focusing on the Borrow Badge due to the lack or representation and few data points from the surveys of other badges (*Refer to # of feedback surveys by badge in Table 1. 95.16% of feedback surveys came from the Borrow Badge*). The Borrow Badge had 118 feedback surveys completed on the modules for users to share their opinions. Each survey had 2 questions where an enrollee could share their opinions on the “organization of the module” and “usefulness of the material” on a 5-point Likert Scale. There was also an option to type in additional feedback.

From the Likert Scale Questions, responses were scaled from 1 to 5 (1 being strongly disagree and 5 being strongly agree). The average of “organization of the module” was 4.0 corresponding to Agree and the average of “useful information” was 4.1 also corresponding to agree. As seen from Image 1, a total of 31.8% Agree and 43.2% Strongly Agree totaling to 75.0% having a positive response to the module’s organization and usefulness.

We can conclude that because the majority of feedback was positive, SMMC is doing a satisfactory job in providing financial literacy resources through Moodle to UI System users in an accessible way.

Key Takeaways from Section I

Out of the five Badges, the Borrow Badge is leading in number of students enrolled, participants, quizzes, page views, and in feedback surveys. Based on the feedback surveys, most of the students agree that the program is organized well and provides useful information especially in the Borrow Badge. One cannot say the same thing about the other Badges because there wasn't enough data on the feedback surveys to conclude that information.

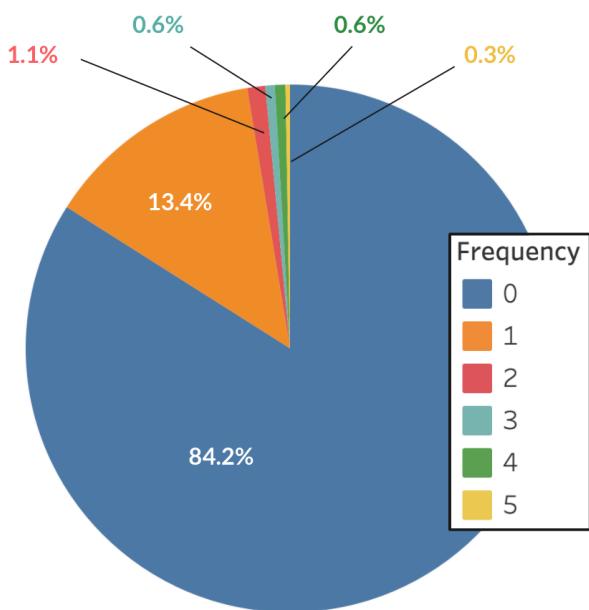
SECTION II: Breakdown of Program Engagement by Module

Section II Overview

Diving deeper into the digital badges program, we breakdown how enrollees engage with the program in different ways. More specifically, we will be discussing the page views for each of the badges and participation rates in quizzes and activities. The Borrow Badge has a 15.8% participation rate and its most popular modules are campaign based and occur during the fall semester.

Number of Quizzes per Participant

Image 2



As a preface to this section, it is important to remember that it is not required for enrollees to participate in any quizzes of any modules. However there are different incentives for participation which come down to intrinsic motivation and extrinsic motivation.

According to American psychologist and author of *Intrinsic and Extrinsic Motivation*, Steven Reiss, “Intrinsic motivation is most commonly defined as ‘doing something for its own sake,’ and extrinsic motivation, in contrast, refers to the pursuit of an instrumental goal” (Reiss, 2012).

To put these motivations in perspective of the digital badges program, intrinsic motivation is simply engaging in the program to educate oneself on financial literacy topics and to learn more. Extrinsic motivation is engaging in the program for possible incentives such as prize drawings for participation in campaign-based modules or the option to earn a digital badge by completing at least three quizzes in any badge category (which make these extrinsic motivators).

Of the 18,150 enrollees in the Borrow Badge, we see from Image 2 that the majority of them (84.2%) do not participate in any quizzes. This means that the remaining 15.8% of Borrow Badge enrollees participate in at least one quiz. Further analysis on the likelihood of participation can be seen in the following sections.

Overall, 3,854 quizzes were completed in the Borrow Badge from Fall 2018 through Fall 2019 by 2,903 unique participants. The majority only took one quiz but some participants took upwards of 5 quizzes during this time period.

Likelihood of Quiz Participation and Badge Completion: All Badges

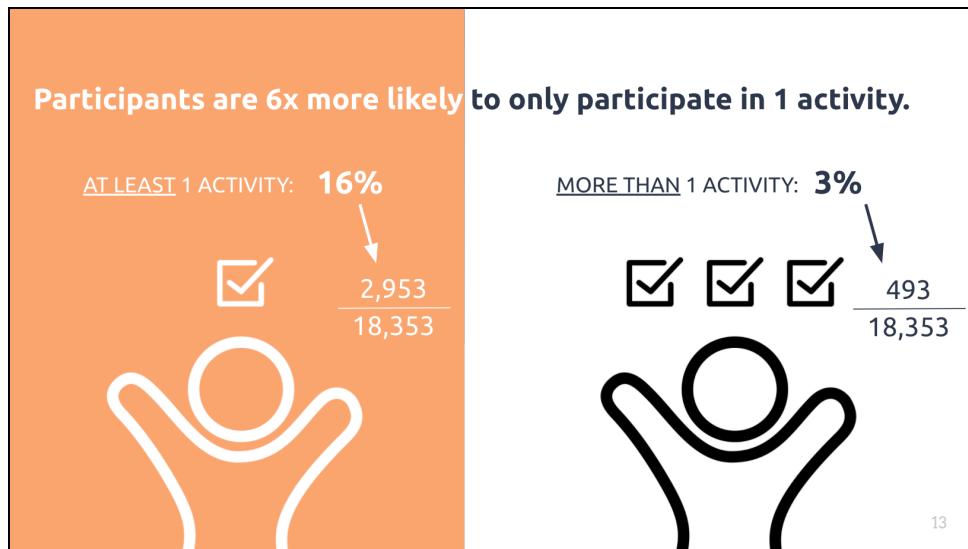


Image 3

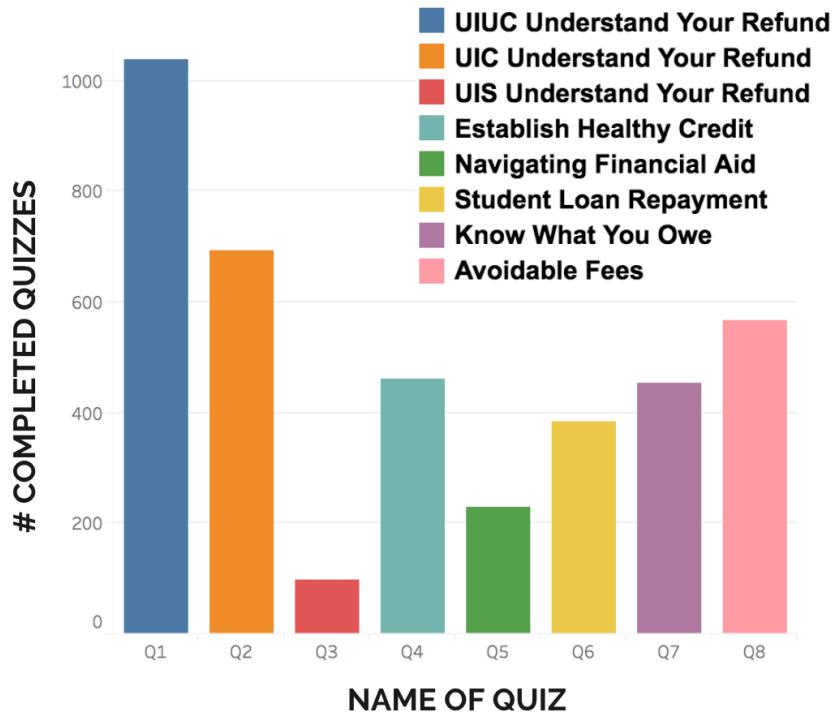
First, we would like to analyze the likelihood that a participant will complete at least 1 activity or more. Looking at Image 3, we see that of the 18,353 enrollees in the digital badges program (across all 5 badges), 2,953 enrollees participate in *at least* one activity which is equivalent to a 16.09% participation rate. On the contrary, only 493 enrollees choose to participate in *more than* one activity which is equivalent to a 2.69% participation rate. This is significantly lower than those who participate in *at least* one activity.

If we compare the percentages of likelihood of participation from Image 3, we see that **participants are 6 times more likely to participate in only 1 activity**. Only participating in 1

activity does *not* result in earning a digital badge which is an extrinsic motivator. Refer back to the previous section, *Number of Quizzes per Participant*, for an explanation of intrinsic and extrinsic motivation to participate in the Badges Program,

During the Fall 2018 to Fall 2019 period, 286 individuals earned badges in the program by completing three activities in any of the badges. This can also be quantified as 1.56% of *enrollees* earning a badge and 9.69% of *participants* earning a badge.

Most Popular Module: Borrow Badge Participation

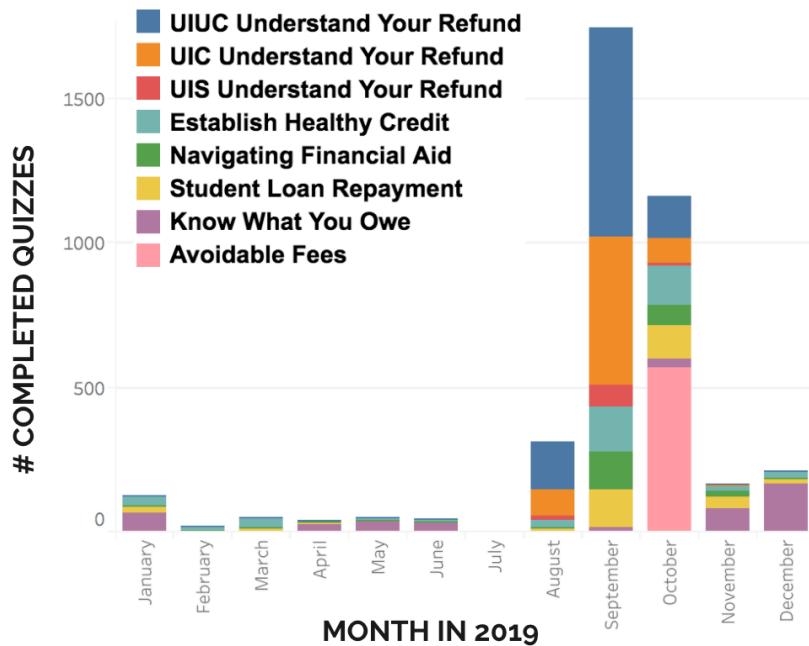


[Image 4](#)

There are 6 different modules under the borrow badge. The “Understand Your Refund” module comprising the highest amount of participation and is broken down in the graph by Institution.

Of the total 3,854 Borrow Badge participants we clearly see in Image 4 that the one with the highest participation is “Understand Your Refund” from Urbana and the lowest participation is “Understand Your Refund” at Springfield. This is reasonable, because Springfield has proportionally less students compared to Urbana which has the most. Aside from the “Understand Your Refund” campaign’s popularity, the “Avoidable Fees” campaign follows in a close second.

Most Popular Month: Borrow Badge Participation



[Image 5](#)

Image 5 represents the number of completed quizzes over time (a total of 3,854 quizzes in 2019). The completed quizzes are color coded by Module in the Borrow Badge. As seen, September is the month with the highest participation and slowly declines throughout the school year. The fall semester seems to have more participation compared to the spring and summer semester.

Additionally, it is important to point out that the 3 campaign based modules, “Understand Your Refund,” “Avoidable Fees,” and “Know What You Owe,” have the highest participation during the time periods that they are available (particularly in the Fall Semester).

“Avoidable Fees was available from 10/4/19 - 10/20/19. “Understand Your Refund” was available 1/14/19 - 3/18/19 and 8/26/19 - 10/1/19. “Know What You Owe was available 11/29/2018 - 1/15/2019, 4/15/2019 - 6/17/2019, and 11/11/2019 - 12/15/2019.

Moodle Page Views by Badge

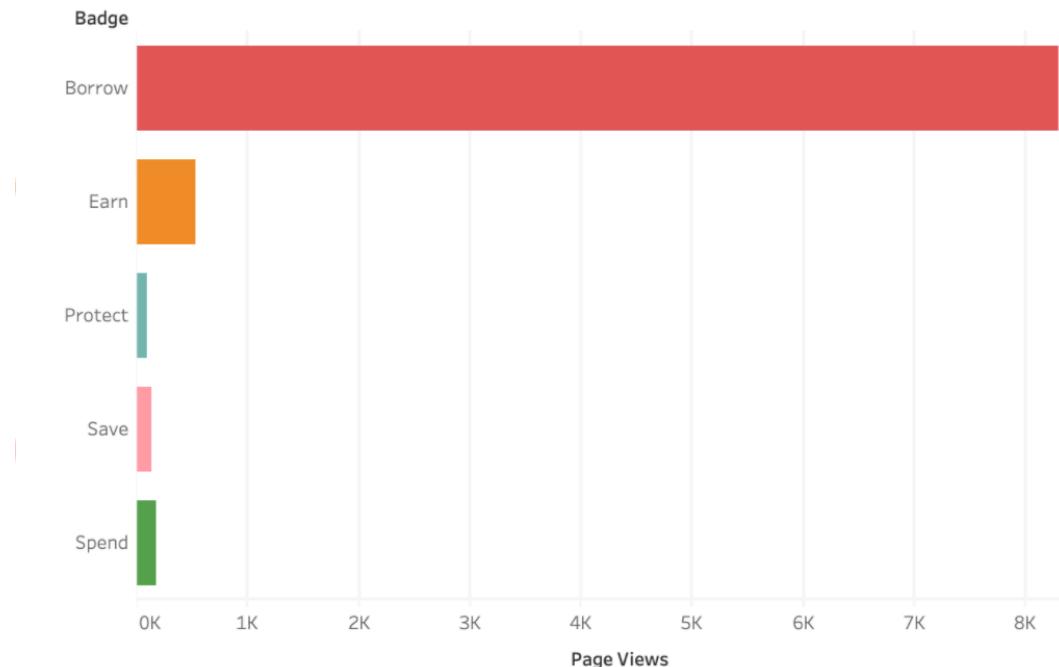


Image 6

Views By Badge Category	
Badge	Page Views
Borrow	8,292
Earn	530
Protect	89
Save	152
Spend	183
<i>TOTAL</i>	<i>9,246</i>

Table 2

Page views are another way to gauge participation across different Badges and Modules. It indicates more engagement than just enrolling in a Badge, but less engagement than participating in a quiz.

In the Moodle Dashboards analyzed from Fall 2018 to Fall 2019, there were a total of 9,246 page views. The Borrow Badge accounts for 89.68% of the page views across all badges which is reflected in the majority of enrollees and participants engaging in this badge (Image 6). The other 4 badges take up significantly less engagement for page views, with the Earn Badge having the second highest page views totaling to be 530 (Table 2).

Moodle Page Views by Module: Borrow Badge

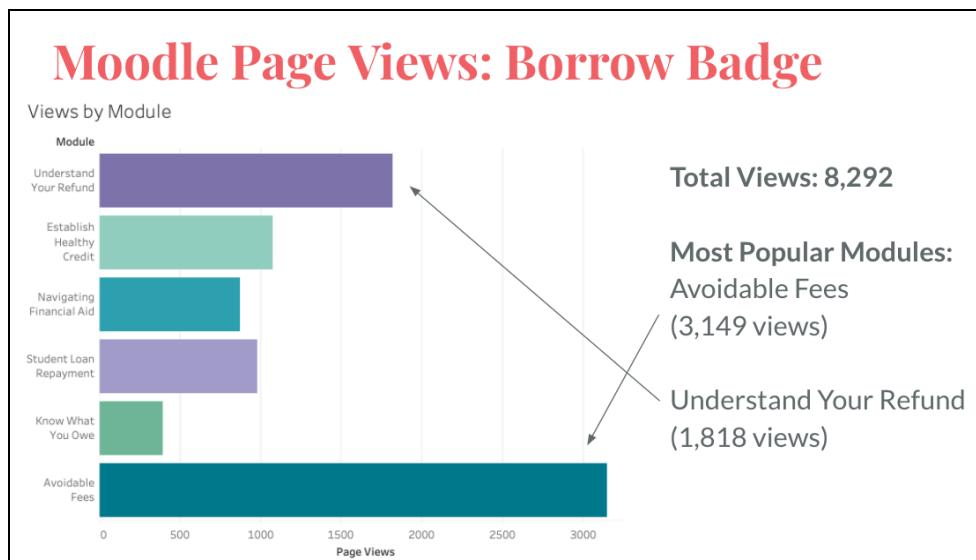


Image 7

Borrow Badge Page Views By Module		
Module	Views	Number of Pages
Understand Your Refund	1818	1
Establish Healthy Credit	1078	12
Navigating Financial Aid	873	5
Student Loan Repayment	979	13
Know What You Owe	395	6
Avoidable Fees	3149	4
<i>TOTAL</i>	8,292	

Table 3

The Borrow Badge accounts for the majority of page views in the badges program, as seen in the last section. Of the 6 Modules, Avoidable Fees had the highest number of page views totaling 3,149 (Table 3) followed by Understand Your Refund which had 1,818 page views. Both of these Modules are campaign based. The Understand Your Refund campaign provides a prize drawing for one of five gift cards. The Avoidable Fees campaign reversed the first late fee for undergrad UIC students that completed the quiz with at least 80% correct during the campaign period.

The fact that Avoidable Fees has the most views may be evidence to support that extrinsic motivation is a highly influential factor in getting engagement in the program. This campaign offered a one-time opportunity to reverse the first late fee on a student account for invited undergraduate Chicago students. This incentive likely played a significant role in engaging the most number of students.

The Understand Your Refund module only had 1 page to view. The Avoidable Fees module had 4 pages, of which, the Late Fees Compound the Cost of College was the most viewed page totaling 1,112 views.

Moodle Page Views by Module: Earn Badge

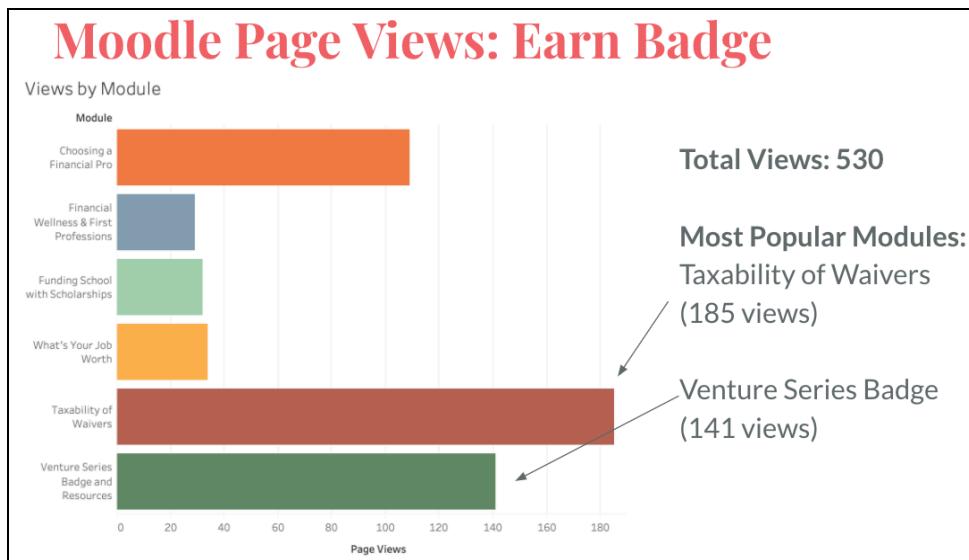


Image 8

Earn Badge Page Views By Module

Module	Views	Number of Pages
Choosing a Financial Pro	109	10
Financial Wellness & First Professions	29	8
Funding School with Scholarships	32	8
What's Your Job Worth	34	4
Taxability of Waivers	185	8
Venture Series Badge and Resources	141	5
TOTAL	530	

Table 4

The Earn Badge accounts for the second most number of page views totaling to 530 views. Distributed among 6 different modules, Taxability of Waivers has the most views (185 views) followed by the Venture Series Badge (141 views) seen in Image 8.

For the Taxability of Waivers Module, *Calculate the Impact* was the most viewed page (38 views) possibly due to the interactive resources. A net pay calculator from University Payroll & Benefits helps determine whether or not you will be affected by tuition and service fee waiver withholding based on your employment status, income, and value of graduate-level tuition & service fee waivers provided as a benefit of employment.

For the Venture Series Badge module, the Finance page was the most viewed page (55 views). The Venture Series Badge is a specific type of Earn badge offered by UICCollege of Business UIC Entrepreneurial Program. To obtain the “Earn Badge for the Venture Series,” participants attend live workshops with Steve Bob, director of the UIC Entrepreneurial Program, where they learn to build a solid foundation to start and grow a small business. The Finance page specifically speaks on how to fund a new business.

Moodle Page Views by Module: Protect Badge

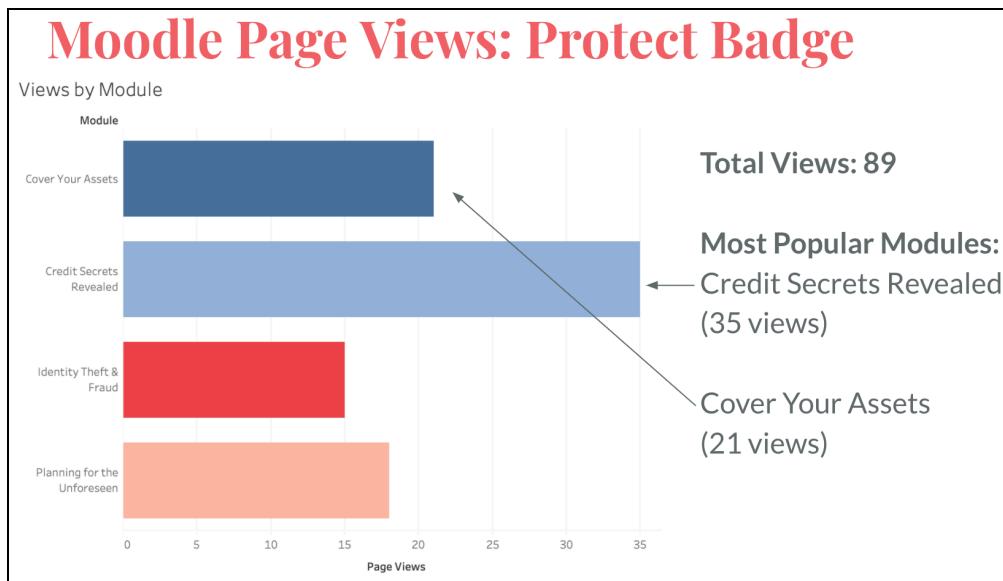


Image 9

Protect Badge Page Views By Module		
Module	Views	Pages
Cover Your Assets	21	5
Credit Secrets Revealed	35	14
Identity Theft & Fraud	15	12
Planning for the Unforeseen	18	11
TOTAL	89	

Table 5

The Protect Badge only has 89 page views distributed among 4 different modules. The most popular of which is the Credit Secrets Revealed module with 35 page views followed by Cover Your Assets with 21 page views (Image 9). Credit Secrets Revealed doesn't have any of the most viewed pages, but it does have some interesting information on credit reports, credit scores, and credit history. The most popular page is Insurance Basics (10 views) which comes from the Cover Your Assets module. It is the first page seen when enrolling in this badge which may play a role in giving it more exposure.

Moodle Page Views by Module: Save Badge

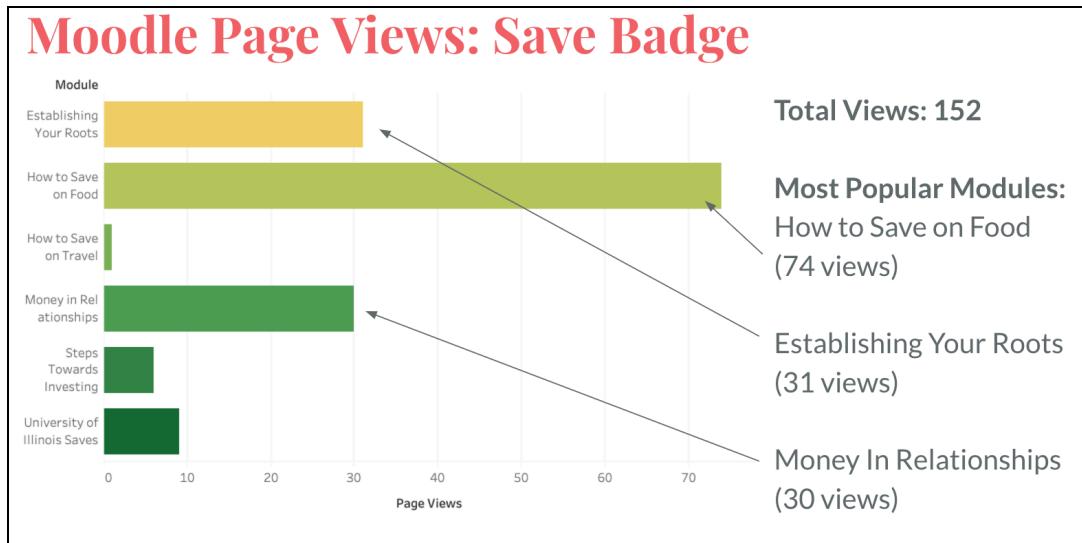


Image 10

Save Badge Page Views By Module		
Module	Views	Pages
Establishing Your Roots	34	6
How to Save on Food	74	14
How to Save on Travel	1	1
Money in Relationships	30	16
Steps Towards Investing	6	4
University of Illinois Saves	9	3
<i>TOTAL</i>	152	

Table 6

The Save Badge has a total of 152 page views distributed among 6 different modules (Table 6). The most popular module is How to Save on Food (74 views) followed by Establishing Your Roots (31 views) and Money in Relationships (30 views) seen in Image 11. The most popular pages from How to Save on Food are *Vegetables* (9 views), *Driving Down Costs when Dining Out* (9 views), and *Step Down Food Costs* (9 views).

Moodle Page Views by Module: Spend Badge

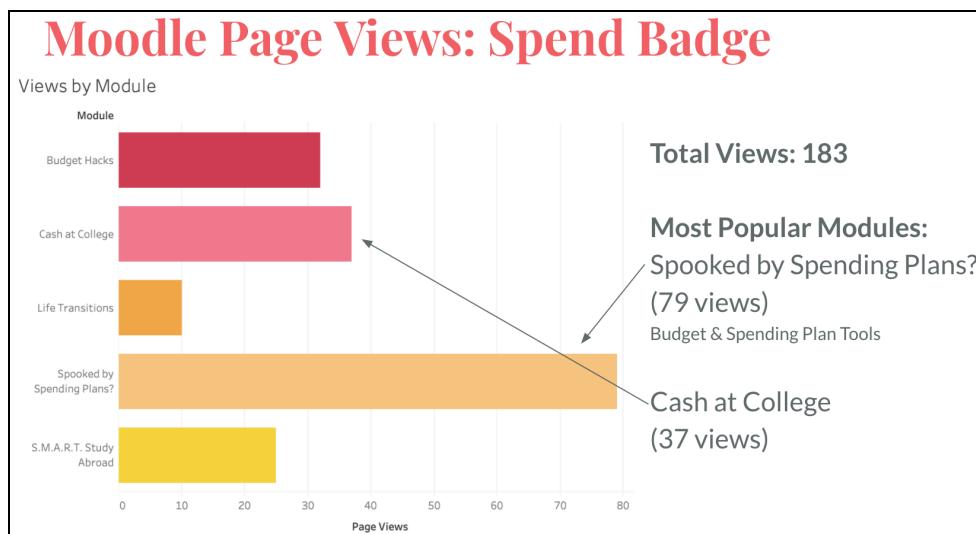


Image 11

Spend Badge Page Views By Module		
Module	Views	Pages
Budget Hacks	32	4
Cash at College	37	5
Life Transitions	10	6
Spooked by Spending Plans?	79	11
S.M.A.R.T. Study Abroad	25	7
TOTAL	183	

Table 7

The Spend Badge has a total of 183 page views distributed among 5 different modules (Table 7). The most popular module is Spooked by Spending Plans (79 views) followed by Cash at College (37 views) seen in Image 11. The most popular page from Spooked by Spending Plans is *Expenses* (12 views) and the most popular page from Cash at College is *Budgeting* (15 views). These pages and resources are mentioned in the Get Savvy webinars posted on YouTube & embedded in Moodle.

Moodle Page Views: Influential Factors on Page Views

Reflecting on the modules and the number of page views each one received over the Fall 2018 to Fall 2019 time period, it is important to remember the different types of intrinsic and extrinsic motivation that play a role in engaging enrollees.

It is important to note that campaign based modules had the highest number of page views. Some extrinsic motivators for these modules include rewards such as being entered into a raffle for the chance to earn a gift card. Some intrinsic motivators include learning about credit-based products, establishing good credit, and tips on looking for financial aid. From the data, we cannot determine if one motivator was more influential than the other. Overall, each module provides a great deal of resources in various engaging ways as well as enticing extrinsic motivators.

Key Takeaways from Section II

Most of the enrolled students do not participate in taking quizzes for that particular Badge. Image 2 shows that in Borrow Badge, 84.2% do not participate in any quizzes and only 15.8% participate in one or more quizzes. The likelihood that an enrolled student in the badges program completed at least 1 activity was 16% and students that completed more than 1 activity was 3%. Of the 18,353 enrollees, 286 individuals earned badges during the Fall 2018 to Fall 2019 period.

The most popular Badge is the Borrow Badge, and it consists of 6 different modules. The most popular quiz is “Understand Your Refund” from Urbana and the least popular quiz is “Understand Your Refund” at Springfield. School’s population plays a major role in this. Image 5 shows that September is the month with highest participation with 1,744 quizzes completed.

Since the Borrow Badge is the most popular Badge course it would make sense that out of all the badges it comprised the highest number of page views (89.84%) totaling to 8,292. The most viewed page on the Borrow Badge is the “Avoidable Fees.” Earn Badge had the second highest page views in the program totaling to 530. The most viewed page in the Earn Badge is the “Taxability of Waivers.”

SECTION III: Descriptive Analysis of Badge Participants

Section III Overview

Now that we have covered how students engage with the digital badges program, we would like to discuss more about the participants themselves. Coming from all different backgrounds with different financial stressors and knowledge, we will be covering which populations are participating and engaging with the program. This section will break down the demographics and college information of enrollees by institution, college major, and ethnicity.

Program Engagement by Institution vs UIllinois Data

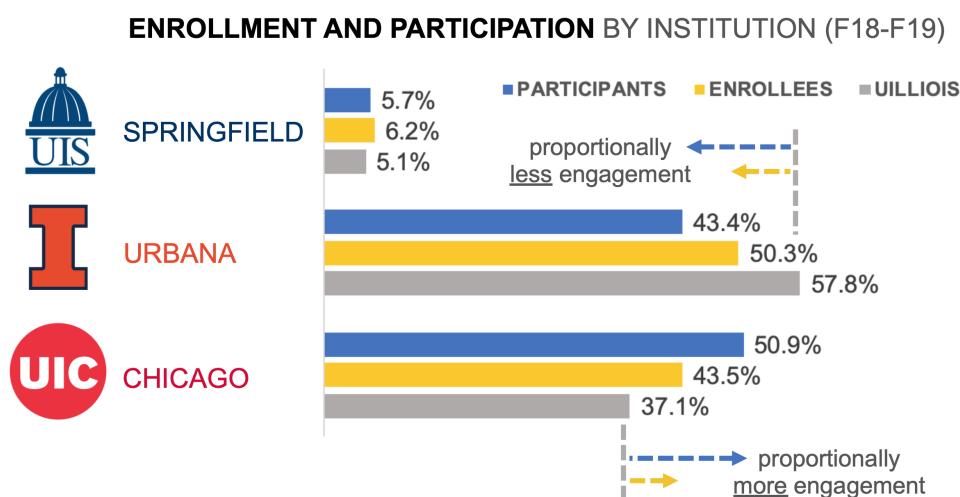


Image 12

It is important to know that participation in the program may be due to many different factors. When we compare, we want to do so within different groups to see how their participation may vary. The University of Illinois System has 3 institutions: Urbana, Chicago, and Springfield. Springfield has the least number of students, and Urbana has the most based on the UIllinois Census Data from Fall 2018 to Fall 2019 (“Enrollment,” 2020).

We would expect each institution to contribute a proportional amount of engagement relative to the number of students they have. Because Springfield only makes up 5.1% of students in the UIllinois Data, it makes sense that it only contributes 5.7% of participants and 6.2% of enrollees. However there are much larger differences in Urbana and Chicago.

Urbana makes up 57.8% of the UIllinois population but only accounts for 43.4% of participation and 50.3% of enrollment. Overall, Urbana has proportionally *less* engagement than the other institutions.

Chicago makes up 37.1% of the UIllinois population but accounts for 50.9% of participation and 43.5% of enrollment. Overall, Chicago has proportionally *more* engagement than the other institutions.

Now why might Urbana and Chicago have disproportionate engagement in the Badges Program? We will discuss this further based on differences in the institutions such as ethnicity, age, and degree level. More takeaways can be seen at the end of the predictive modeling section.

College Ethnicity of Enrollees by institution

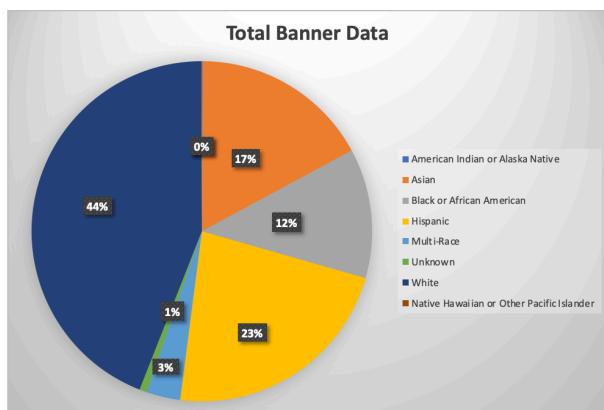


Image 13

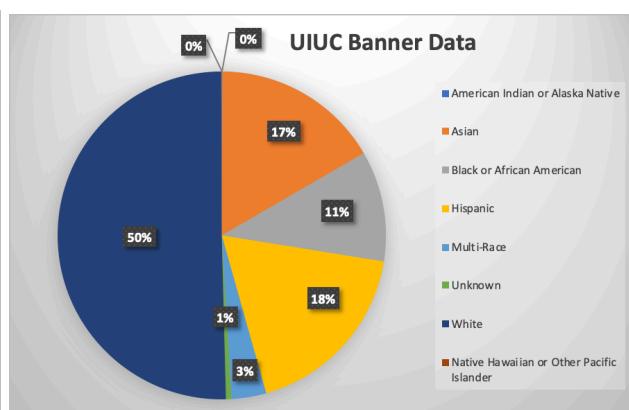


Image 14

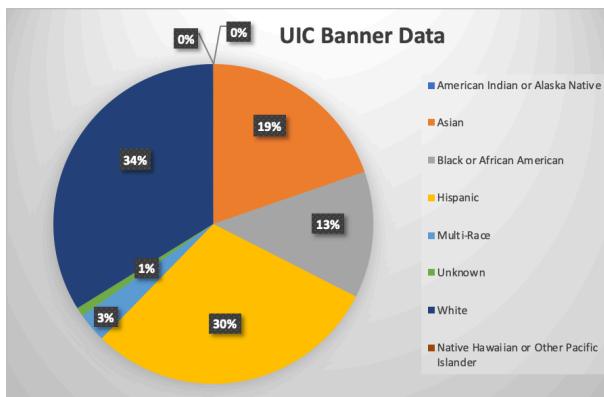


Image 15

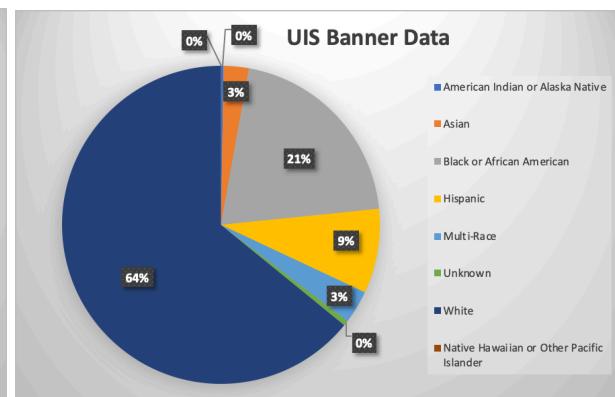


Image 16

It is important to know the enrollees' background because it tells us what kind of ethnicity are enrolled in the most and it also tells us what ethnicity we need to target in order to increase our participants in the Badges Program. Image 13 tells the majority of the ethnicities that are enrolled in the Program. The top 3 ethnicities to participate in the program are White (44%), Hispanic (23%), and Asian (17%).

We would expect the top 3 ethnicities to be similar for all three institutions. Urbana's top 3 ethnicities to participate in the Badges Program are white at 50%, then Hispanic at 18%, and Asian with 17%. Similar to Urbana, Chicago also has the same top 3 ethnicities to participate in the program. White ethnicity being the highest at 34%, after that Hispanic at 30%, and finishing with Asian at 19%. However, Springfield's top 3 ethnicities to participate are different compared to Urbana & Chicago. Springfield's top 3 ethnicities to participate in the Badges Program are White at 64%, then Black at 21% and Hispanic with 9%. We can conclude that White is the leading ethnicity in the Badges Program.

College Information Analysis by Institution, College, and Major ($n=16,006$)

Urbana-Champaign Undergraduate and Graduates



UIUC Undergraduate

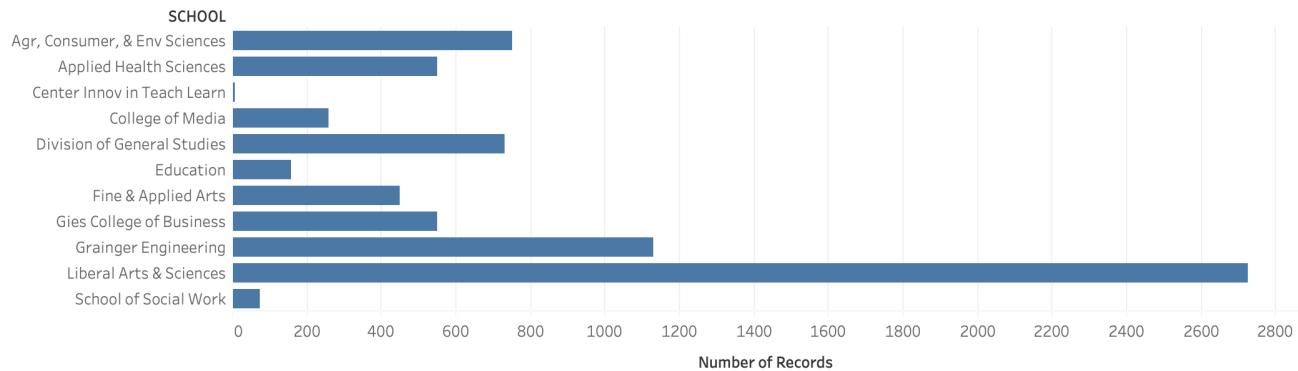


Image 17

Urbana undergraduates consist of 7,380 students which makes up **46.06%** of the total participants. Majority of students are from the school of Liberal Arts and Sciences, followed by the Grainger School of Engineering.

UIUC Masters

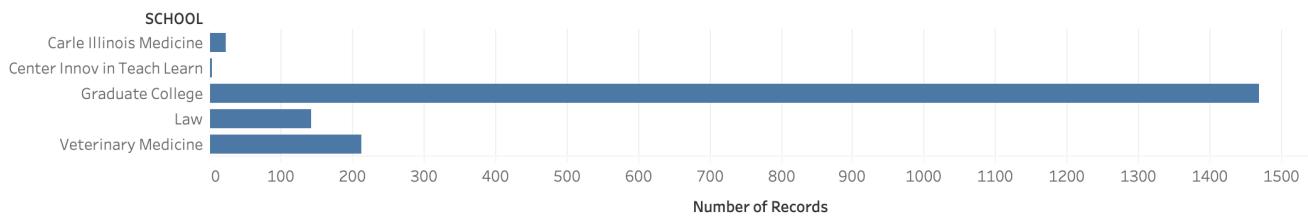


Image 18

Urbana graduate students consist of 381 students which makes up **2.38%** of the total participants. There is not much information on the specific schools of the graduate students for Urbana.

Chicago Undergraduates and Graduates



UIC Undergraduate

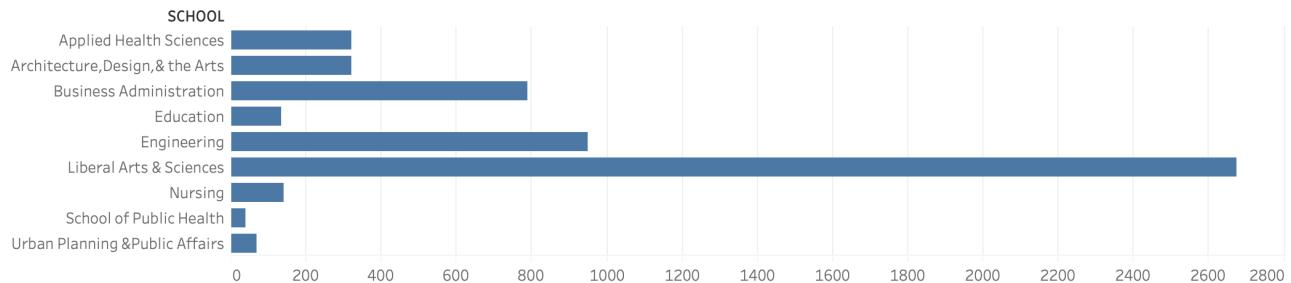


Image 19

Chicago undergraduates consist of 5,426 students, which make up **33.93%** of the total participants. Majority of the students also come from the school of Liberal Arts and Sciences, followed by Engineering, and Business Administration.

UIC Masters

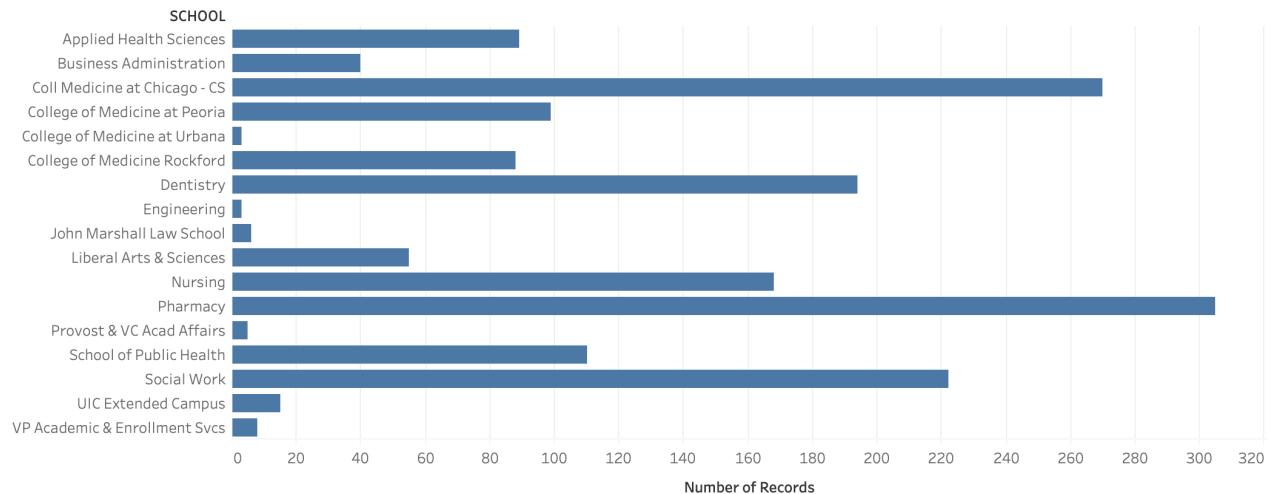


Image 20

Chicago graduate students consist of 1,680 students, which make up **10.48%** of the total participants. Most of the students come from Pharmacy, the College of Medicine at Chicago, Social Work, and Dentistry.

Springfield Undergraduates and Graduates



UIS Undergraduate

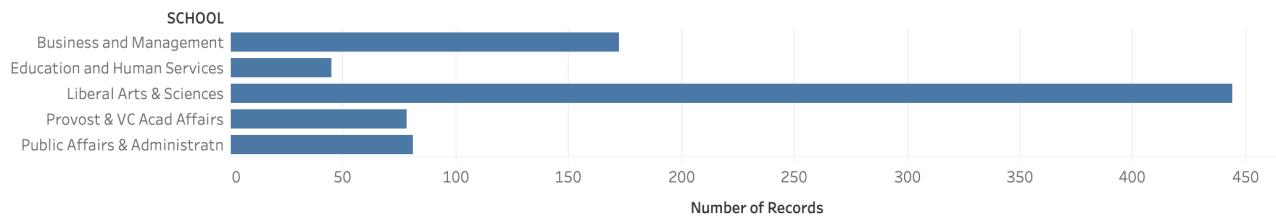


Image 21

Springfield undergraduates consist of 820 students, which make up **5.12%** of the total participants. Most of the students come from the school of Liberal Arts and Sciences, similar to the Urbana and Chicago campuses, as well as Business Management.

UIS Masters

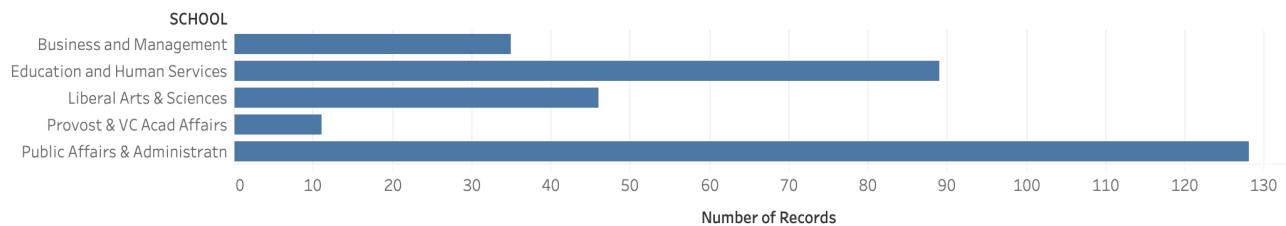


Image 22

Springfield graduate students consist of 309 students, which make up **1.9%** of the total participants. Most of the students are in the schools of Public Affairs & Administration, and Education and Human Services.

Key Takeaways from Section III

From Section III, we can see that the majority of students that participated in the Badges program ($n = 16,006$) come from the University of Illinois Urbana-Champaign campus **48.5%**. There are more undergraduate students in the program (**85.11%**) than graduate students. Additionally, most of the undergraduates come from either the schools of Liberal Arts and Sciences or Engineering.

Additionally, when comparing engagement in the digital badges program by institution to the UIllinois Database, we see that Urbana has proportionally lower engagement and Chicago has proportionally higher engagement. This is possibly due to the different demographics of each institution as well as curiosity in financial education.

SECTION IV: Statistical Analyses, Hypothesis Testing, and Likelihood of Participation

Section IV Overview

Pivoting to statistical analyses, this section encompasses the likelihoods of different populations participating in the digital badges program. More specifically, we will be covering the proportion or participation attributed to campaign-based modules, likelihood of participating in multiple badges, and financial holds' impact on participation in specific modules.

Campaign Influence on Participation

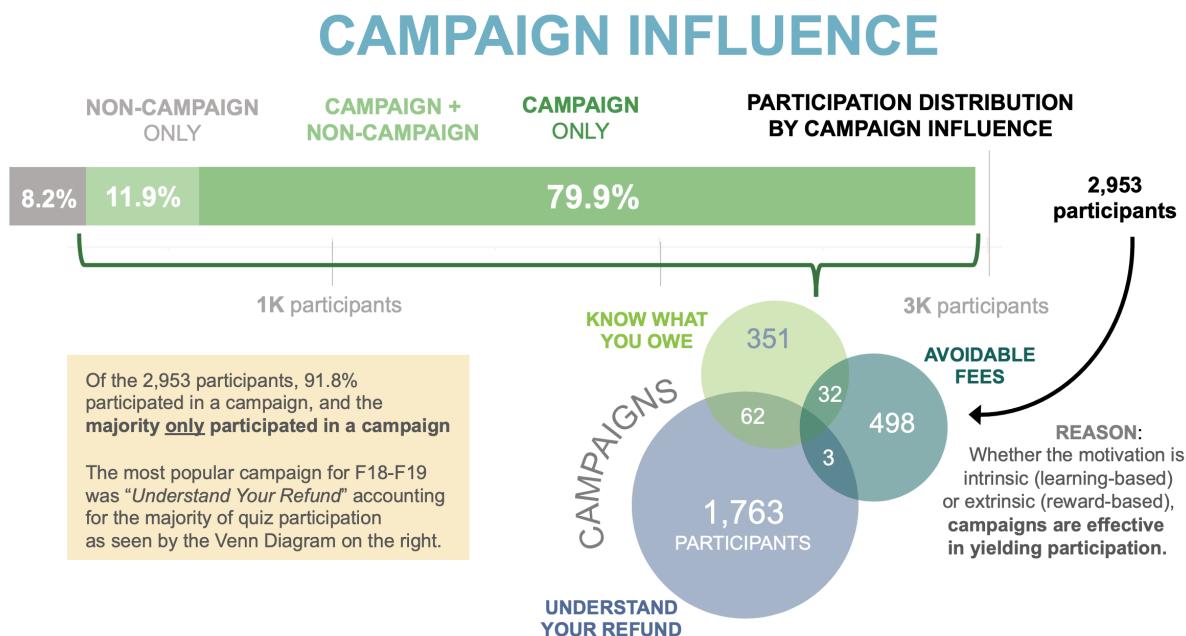


Image 23

In this section, we would like to answer how much of an influence do campaign based modules make on participation. From Image 23, the bar graph shows that 8.2% of all the 2,953 unique participants only take part in non-campaign based modules. 11.9% take part in both campaign and non-campaign based modules. And the majority (79.9%) take part in only campaign based modules. Overall, 91.8% of participants take part in these campaign based modules.

There are 3 different campaign based modules: Understand Your Refund, Avoidable Fees, and Know What You Owe. Of these 3, the Understand Your Refund is the most popular as seen in the Venn diagram in Image 23. The dates for these campaigns can be seen in Section II: *Most Popular Month: Borrow Badge Participation*.

Likelihood of UIC Participation by Badge

Badges with the most/least likelihood of UIC students participation

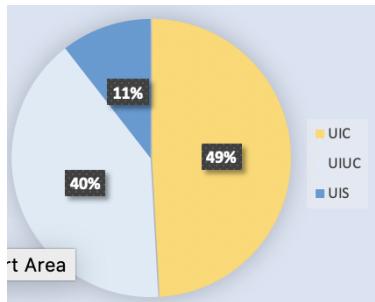


Image 24

	Parti	Amount	Percentage
UIC	28	0.49122807	
UIUC	23	0.40350877	
UIS	6	0.10526316	

Table 8

Besides the borrow badge which has the highest number of UIC Participants. The Earn Badge program is the one that has the highest likelihood of UIC students participating in. As we can see from Table 8. Among the total 57 participants, 28 of them are from UIC. Thus, the participation rate of UIC students is 49.12% which makes up nearly half of the total population that participates in the Earn badge.

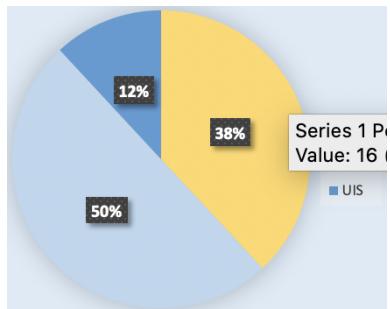


Image 25

	Parti	Amount	Percentage
UIC	16	0.38095238	
UIUC	21	0.5	
UIS	5	0.11904762	

Table 9

The Save Badge program, however, is the one that has the least likelihood of UIC students participating in. From the above chart on the right hand side, Among the 42 participants, only 16 of them are from UIC. The participation rate of UIC students is 38%

Although Borrow badge has the relatively highest number of UIC participants relative to than the rest of the four badges courses programs, there is still a huge difference of percentage of UIC students participating in among the Earn,Spend, Save and Protect badge .

Whether the motivation is to genuinely learn the information for intrinsic purposes or whether the extrinsic rewards such as forgiveness of late fees or gift card incentives, we can conclude without a doubt that campaigns are very effective in yielding participation.

Likelihood of Cross-Participation in Multiple Badges

Active borrow participants are defined as those who finish at least 3 quizzes in Borrow Badge. Among the total 18,151 Borrow badge enrollees participants, there are 271 active participants. Only 6 of these 271 participants who finish at least three quizzes in Borrow badge join in other Badge programs. Thus the participation rate is 2.2 percent.

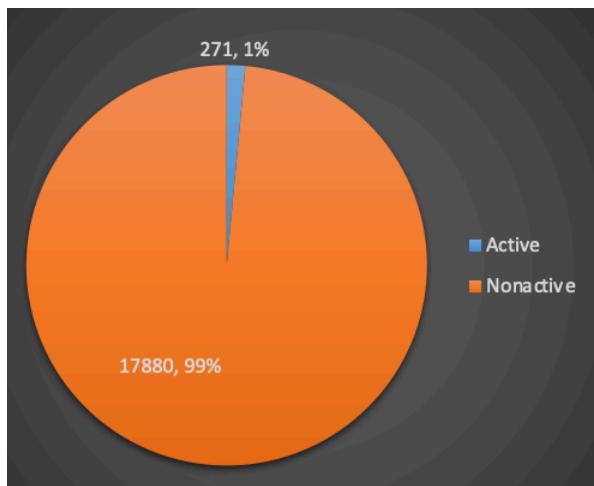


Image 26

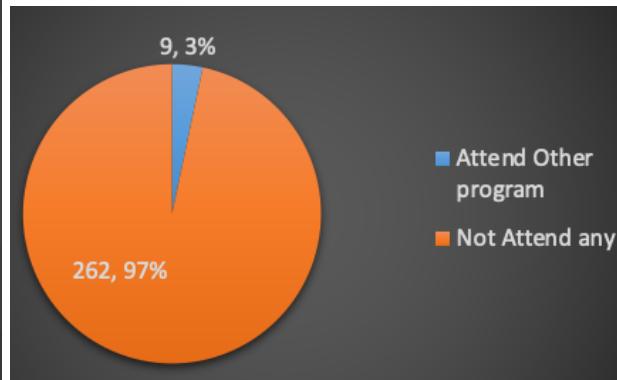


Image 27

The cross-participation rate among multiple badges is less than 5 percent, which is not very high. SMMC could advertise more on its different Badge programs to the participants of each specific badge program. Participants that finish multiple quizzes in one badge program are more likely to enroll into another badge since they are more passionate.

Number of Credit Hours by Institution

Average Number of Credit Hours				
	<i>Fall 18'</i>	<i>Spring 19'</i>	<i>Summer 19'</i>	<i>Fall 19'</i>
Overall	14.27	14.23	7.17	14.22
Urbana-Champaign	14.77	14.70	6.06	14.64
Chicago	14.05	14.08	8.50	14.11
Springfield	11.39	11.24	5.91	11.49
<i>TOTAL CREDITS</i>	12,195	12,505	3,494	17,190

Table 10

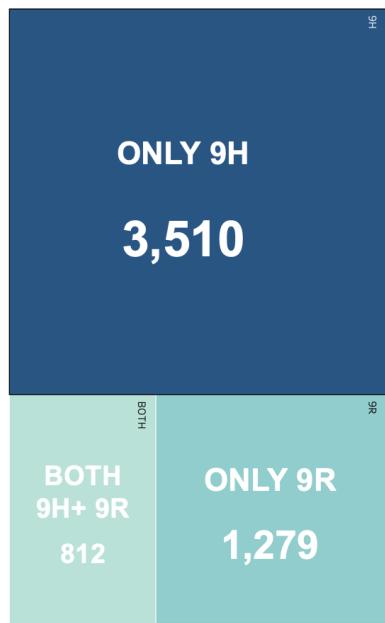
In this section, we will be taking a look at the enrolled student's average credits that they are taking during that semester. The National Average Credit for the nation is 15 credits per semester Marcus, J. (2020). Table 10 shows that most of the averages are really close to 15 except at Springfield. Students with higher credits get less time to participate in the Badges Program.

If we compare the averages from Fall 18' to Fall 19', we can notice the number of average credits taken by enrolled students increase as the number of enrolled students increased in the program from Fall 18' to Fall 19'. However, in Urbana-Champaign the average decreased from 14.77 to 14.64. The total number of credits being taken during a specific semester also increases as the number of enrollees increase over time. However, this could be an unrelated correlation.

One thing that stood out the most was during the summer 2019 semester. Chicago had the highest average credits compared to the other institutions at 8.5 credits. Participants who are on the higher end of credit hours per semester are more likely not to complete the activities in the Badges Program modules.

Bidirectional Impact of Financial Holds and Campaign Participation

Image 28



Financial holds are placed on accounts for monetary amounts that are not paid on time. A 9H hold is placed for past due amounts of \$200 or more and stops release of transcripts, diploma, and blocks registration. A 9R hold is placed for past due amounts of \$25 - \$199.99 and stops release of transcripts.

Of the 5,601 students with holds that were enrolled in the badges program, The majority had only a 9H hold. An even smaller amount had only a 9R hold, and even less had both holds on their account during the Fall 2018 - Fall 2019 time period as seen in the tree map in Image 28.

In the next two sections, we will discuss whether having a financial hold impacts participation in two different modules using statistical tests known as chi-squared tests to interpret the differences between groups.

Financial Hold Impact on Future Participation in “Avoidable Fees”

	QUIZ	NO QUIZ
HOLD	366	5235
NO HOLD	167	12585

Table 11

In this section, we will be testing whether there is a true difference in participation between those with holds and without holds, specifically for those that participate in Avoidable Fees, since this pilot campaign targeted UIC undergraduate students that received a late fee in fall 2019. The chi square test has a two way table in Table 11, and the results are shown below:

$$X^2 (df=1, N=18,353) = 376.7733$$

p-value < .00001

Students with a hold have a 6.5% participation rate

Students without a hold have a 1.3% participation rate

Because the p-value is less than 0.05, we can conclude that there is a statistically significant relationship between holds and “Avoidable Fees” participation. Those with holds are more likely to participate in “Avoidable Fees.” This makes sense because they are the students that are targeted to participate in this module.

“Understand Your Refund” Participation Impact on Incurring Future Financial Holds

	QUIZ	NO QUIZ
HOLD	296	5305
NO HOLD	1532	11220

Table 12

In this section, we will be testing whether there is a true difference in participation between those with holds and without holds, specifically for those that participate in Understand Your Refund. The chi square test has a two way table in Table 12, and the results are shown below:

$$X^2 (df=1, N=18,353) = 196.4891$$

p-value < .00001

Students that participated have a 16.2% proportion with holds

Students that did not participate have a 32.1% proportion with holds

Because the p-value is less than 0.05, we can conclude that there is a statistically significant relationship between “Understand Your Refund” participation and holds. Those who participate in “Understand Your Refund” incur less holds. This makes sense because the module is meant to work as a preventative measure to incur less holds after participation.

Key Takeaways from Section IV

From section IV, we can see that campaign based modules make the majority of the participation with 79.9%. Only 8.2% participants take part in the non-campaign based modules. 11.9% take part in the both campaign and non-campaign based modules. There are 3 different campaign based modules: Understand Your Refund, Avoidable Fees, and Know What You Owe. These 3 modules have the highest engagement out of all the other modules.

Financial holds also impact the likelihood of the participation. 62.67% of students have 9H holds, 22.84% students have 9R holds, and 14.50% of students have both 9H & 9R holds. The difference between 9H & 9R holds is that 9H hold is placed for past due amounts of \$200 or more and 9R holds is placed for past due amounts of \$25 - \$199.99. Financial Hold impacts the participation in modules especially in the “Avoidable Fees” module. 366 students with hold ended up taking the quiz and students without a hold that ended up taking the quiz was only 167. From the chi-squared test we found out that students with a hold have a 6.5% participation rate and without a hold have 1.3% participation rate. We did the same process for the “Understand Your Refund” module to see if a hold impacts the participation rate. We got the results that 16.2% students with hold participate in this module and 32.1% students without a hold participate in this module. So financial hold does play a major role in this module.

The number of credits students are taking per semester also affects the participation rate. The higher the number of credits they're taking the less they are likely to participate in the module activities. Table 9 shows that there is a big jump in the total credits number between Fall 18' to Fall 19'. The reason behind this jump in the numbers is because the number of enrolled students in the program increased as well.

SECTION V: Predictive Modeling and Insight on Significant Variables

Section V Overview

In the last section of this report we will be covering the methodology of creating 3 predictive models and their insights. All three models input the 18,353 enrollees in the digital badges program (Fall 2018 - Fall 2019) as inputs as well as their college information, demographics, and financial account information. Each model outputs a prediction of whether or not the enrollee will participate in at least one quiz. The goal is to identify which populations are more likely to participate and extrapolate reasoning as to why in hopes of better understanding and providing resources in the best way possible. Data was anonymized with Scrambled ID's, cleaned and queried using SAS, SQL syntax, and Microsoft Excel, and modeled in RStudio.

Generalized Linear Modeling: Demographic Model

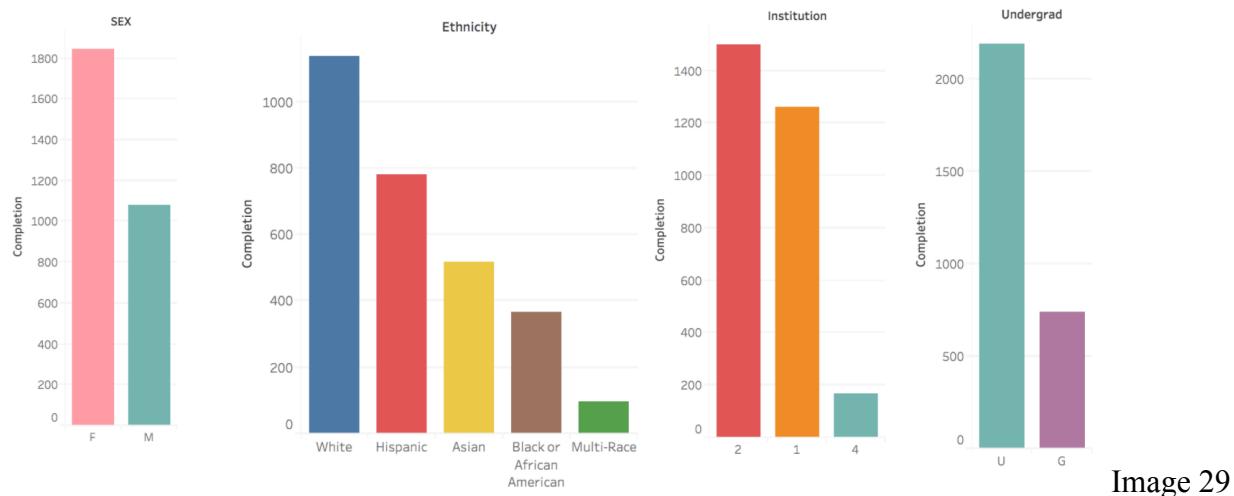


Image 29

Key for Image 29:

Sex: (F: identifies as Female, M: identifies as Male)

Institution (2: Chicago, 1: Urbana, 4: Springfield)

Undergrad (U: Undergrad, G: Graduate/Professional)

Model notation: participation ~ sex + ethnicity + institution + undergrad

Significant Variables (odds ratios)

- | | |
|------------------------|--------------------------------|
| *** Sex: M | 22% lower than females |
| * Ethnicity Asian | 17% higher than white students |
| *** Ethnicity Hispanic | 31% higher than white students |
| *** Institution UIUC: | 28% lower than UIC students |

* significant ($a < 0.1$)
*** highly significant ($a < 0.01$)

Table 13

In the first generalized linear model, we predict the odds of participating in at least one quiz of the badges program based on college information and demographics (such as sex of enrollee, ethnicity of enrollee, institution they attend, and level of degree). We want to see if these factors play a role in participation and draw insight on the reasons why. An analysis of the significant variables for this model can be found in the Generalized Linear Modeling: Assessing Accuracy and Significant Variables section. Image 29 shows the distribution of the participants demographics and college information to better understand population.

Generalized Linear Modeling: Financial Model



Image 30

Model notation: participation ~ hold + authorized payer + aid + payment agreement

Significant Variables (odds ratios)

- *** Hold: Y 33% lower than students without a hold
- *** Auth.Payer: Y 41% lower than students without an auth payer
- *** Financial Aid: Y 53% lower than students without financial aid

* significant ($a < 0.1$)
*** highly significant ($a < 0.01$)

Table 14

In the second generalized linear model, we predict the odds of participating in at least one quiz of the badges program based on financial information on student accounts. An analysis of the significant variables for this model can be found in the Generalized Linear Modeling: Assessing Accuracy and Significant Variables section. Image 30 shows the distribution of the participants financial account information to better understand population.

Generalized Linear Modeling: Assessing Accuracy and Significant Variables

	GLM #1 (demographics)	GLM #2 (financial)
AIC	AIC = 11,077	AIC = 10,947
GOF	p-value = 0.2159	p-value = 0.9973
Accuracy	75.6%	63.1%

Table 15

The Akaike Information Criterion (AIC) is a parameter used to describe how far off a model is from the truth. It is usually not interpretable in a quantifiable way but is better for comparison across models. Because the financial model has a lower AIC than the demographics model, we would say that the financial model is closer to the truth in predicting participation in the Badges Program.

The Goodness of Fit (GOF) test simply says whether or not the data seems to fit the model well. Because the p-values for both models are greater than 0.05, we can conclude that they both seem to fit the data well and that they do a fairly good job at predicting participation. The financial model has a higher p-value for GOF and thus seems to fit the data better.

The accuracy was calculated with a confusion matrix to determine how many individuals in the testing data set (30% of the population) were identified correctly using each model. The Demographics model had 75.6% accuracy and the Financial model has 63.1% accuracy. Neither of these accuracies are great considering that guessing no participation despite any demographic or financial information would have an 83.93% accuracy. Despite the poor predictive power, the Significant variables from each model do provide some novel insight.

It makes sense that the populations with the highest representation would have higher odds of participating. For example, most students are undergraduates, so it makes sense for them to have the highest odds of participating. However this is not the case for all significant variables.

The model points out that Hispanics have a 31% higher odds (and Asians have 17% higher odds) of participating than their white counterparts, despite whites making up the majority of the population.

Additionally, the model predicts Chicago to have 28% higher odds of participating than Urbana despite the proportionally higher number of students at Urbana (as seen in the UIllinois data).

Lastly, the model points out that students without financial aid (which includes student loans, waivers, scholarship, and grants) have a 53% higher odds of participating despite the majority of the population receiving some form of financial aid.

More takeaways and insight from these 3 significant variables can be found in the Random Forest: Extrapolating Insight and Actionable Items section.

Random Forest: Methodology

Random Forest Model Pipeline

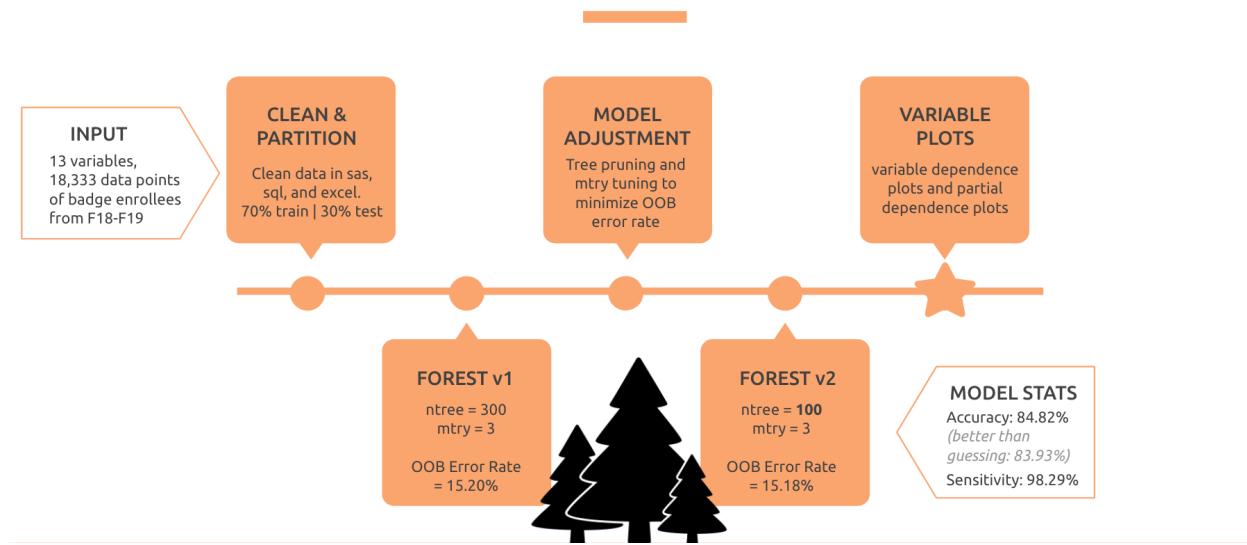


Image 31

In Image 31, we see the pipeline followed to create a random forest model. 18,333 data points were used in creating this model: all those enrolled in the badges program and without missing data points. The data was cleaned and queried using SAS, SQL syntax, and Excel. The output is a binary response: yes or no whether or not an enrollee is predicted to participate based on 13 predictors:

6 financial account variables:

- Loan Amount (2018-2019)
- Loan Amount (2019-2020)
- 9H Hold Incurred
- 9R Hold Incurred
- Has Authorized Payer
- Has Payment Agreements

7 demographic and college information variables:

- Sex
- Citizenship
- Ethnicity
- Birthdate
- Has Graduated
- Grad/Undergrad

Institution

After generating the first random forest in RStudio with default ntree and mtry values, the Out-of-Bag Error (OOB) error rate for the testing data set was 15.20%. After using tree pruning and mtry tuning, the plots tell us to minimize OOB error while maximizing efficiency with 100 trees and 3 nodes each. With these modifications, the final random forest had an OOB error rate of 15.18% translating to an accuracy of 84.82% (and sensitivity with 98.29%). This accuracy is better than simply guessing that enrollees won't participate despite any demographic or financial account information (83.93%). Although the model's accuracy isn't significantly better than guessing, the significant variable plots provide excellent insight on different populations' participation patterns as seen in the Random Forest: Significant Variables section.

Random Forest: Significant Variables

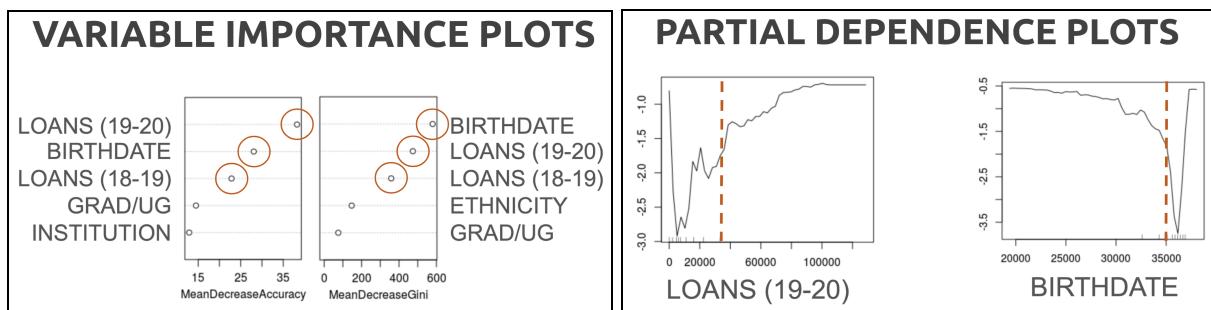


Image 32

Image 33

In Image 32, the variable importance plots tell us the most influential variables in predicting quiz participation out of the 13 in our model. We use MeanDecreaseAccuracy and MeanDecreaseGini as two different parameters in measuring the variable importance. Across both parameters, the loan amounts (across both academic years 2018-2019 and 2019-2020) as well as birthdate are the most important variables. Grad/Undergrad, Institution, and Ethnicity closely follow in variable importance. Authorized payer scored as the least important variable across both parameters.

In Image 33, the partial dependence plots of most important variables are shown. The loans partial dependence plot indicates that the random forest was more likely to predict participation from students with loan amounts greater than \$30,000-\$40,000 USD. The birthdate partial dependence plot indicates the random forest was more likely to predict participation from students born before 1985 (age 35 and older as of 2020).

More insight from these significant variables can be found in the Random Forest: Extrapolating Insight and Actionable Items section

Random Forest: Extrapolating Insight and Actionable Items

From the 2 generalized linear models and the random forest generated to predict participation in the Badges Program, we can draw insight on some of the significant variables. Overall, there seems to be a correlation to participation in the program and interest in financial education. We have broken down the variables into 3 sections to discuss why the models might have predicted higher participation in these groups, why they might have a higher need for financial literacy, and how to make the badges program resources more accessible to populations that show interest in them.

ETHNICITY + INSTITUTION

Minorities (especially represented at UIC) come from different backgrounds and have needs for financial literacy like anyone else. This may call for financial education available in the digital badges program. One way that SMMC already provides financial literacy resources is by collaborating with cultural houses to host workshops (for example, paying off loans or finding scholarships for people of color directly helps these target populations). A suggestion for further outreach would be to digitize these resources as we move to a digital model due to scale.

AGE + DEGREE

Older students (typically graduate or professional) are in a different stage of life which may require different financial competencies. One way the SMMC helps provide financial literacy resources to these populations is by contributing to GradLinks at Urbana. A suggestion for further outreach is to target these populations at Chicago and Springfield.

LOANS + AID

Students without financial aid, and students with higher loan amounts face the pressure of repaying debt. One way to help provide financial literacy resources to these populations is making sure that those who take out loans have access to relevant information and the badges programs.

Key Takeaways from Section V

Although neither of the generalized linear models had significant accuracy, and the random forest had accuracy only slightly higher than guessing, the variable importance plots had some important insight. Future predictive models can be run to give weight to variables of importance (based on previous models), and more harshly judging false positives (predicting no participation from those that participated).

Three different populations had higher likelihoods and odds of participating in the digital badges program: ethnic minorities and Chicago's institution, students above the age of 35 and pursuing a graduate or professional degree, and students with higher loan amounts incurred.

There are different ways to provide financial literacy resources to each of these populations, and it is important for SMMC to keep these populations in mind when moving to a digital model.

All students need financial literacy, and SMMC is actively engaging with the UIllinois System community to provide resources in any way that they can.

CONCLUSION

INCREASE ENROLLEE PARTICIPATION IN THE OTHER 4 BADGES

From the user experience analysis, which included analysis of the feedback surveys on organization, and whether or not the user found the Badges Program to be useful, results show that the Borrow badge accounts for the majority of enrollee engagement and participation out of all 5 badges. Improving the internal promotion of the targeted badges - Earn, Protect, Save, and Spend, could result in an increase in participation and engagement.

Results of the user experience analysis also show that the majority of the participants (75%) either “agreed” or “strongly agreed” when asked about their overall experience as well as the usefulness of the content. This suggests that most students had an overall positive experience with the Borrow badge, thus edits could be made to the content in the modules under the targeted 4 badges accordingly, based on the results of the user experience analysis.

ENROLLMENT ACROSS THE UNIVERSITIES

Since our college information analysis shows that the majority of enrollment in the Badges Program come from the Urbana-Champaign campus (48.44%), and UIC (44.41%), outreach could be improved for the Springfield campus, as currently less than 10% of participants that come from the Springfield campus.

SERVING UI SYSTEM

Overall, predictive models show that populations such as older students and ethnic minorities have the highest likelihood of participation and a great curiosity for financial education from the digital badges program. Results of the predictive analysis suggest that there may be a correlation to the likelihood of participating in the program interest in financial education, thus special attention can be paid towards outreach to these populations.

REFERENCES

Chen, H., & Volpe, R. (1998). An analysis of personal financial literacy among college students. Financial Services Review, 7(2), 107–128. doi: 10.1016/s1057-0810(99)80006-7

“Enrollment.” (2020). University of Illinois System. www.uillinois.edu/data/enrollment.

Financial Education Core Competencies; Comment Request. (2010, August 26). Retrieved May 15, 2020, from <https://www.govinfo.gov/content/pkg/FR-2010-08-26/pdf/2010-21305.pdf>

Kezar, A., & Yang, H. (2010). The Importance of Financial Literacy. About Campus, 14(6), 15–21. <https://doi.org/10.1002/abc.20004>

Marcus, J. (2020, March 30). Colleges confront the simple math that keeps students from graduating on time. Retrieved May 13, 2020, from <https://hechingerreport.org/colleges-confront-the-simple-math-that-keeps-students-from-graduating-on-time/>

Reiss, S. (2012). Intrinsic and Extrinsic Motivation. Teaching of Psychology, 39(2), 152–156. <https://doi.org/10.1177/0098628312437704>