

# **Enrollment Projections Application: Empowering Data-Driven Enrollment Strategies**

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## **Abstract**

Accurate enrollment projections are vital for institutional planning, funding allocation, and academic strategy in higher education. Traditional approaches to enrollment forecasting often rely on manual processes and siloed predictive models, which limit scalability and accuracy. This paper presents the design and implementation of NC State University's **Enrollment Projections Application**, a system that integrates predictive modeling, relational database design, and role-based secure access. The application leverages SQL Server for backend data management, a PHP-based user interface, and Shibboleth authentication to support program-level forecasting. Results demonstrate improved accuracy in projections, enhanced accessibility for stakeholders, and real-time insights through daily admissions reporting. The study highlights how predictive analytics can transform enrollment management into a dynamic, data-driven process.

## **1. Introduction**

Enrollment forecasting is central to the operational and strategic success of higher education institutions. Accurate projections allow universities to align admissions targets with financial models, faculty hiring, classroom utilization, and student services. At NC State University, increasing complexities in program-level admissions, coupled with resource constraints, highlighted the need for a robust and scalable enrollment projection system.

Traditional forecasting methods relied heavily on manual calculations and static spreadsheets. While functional, these approaches lacked the flexibility to respond to changing admission cycles and did not provide granular, program-level insights. The Enrollment Projections Application was developed to address these gaps and empower institutional leaders with accurate, real-time data for informed decision-making.

## **2. Literature Review**

Previous research emphasizes the critical role of predictive modeling in higher education management. Studies have shown that regression models and machine learning techniques improve enrollment forecasting compared to manual approaches. For

example, linear regression has been widely used in higher education for trend analysis, while recent applications of machine learning have demonstrated potential for enhanced predictive accuracy.

However, gaps remain in the integration of predictive modeling with institutional governance structures. Many systems fail to address **role-based access**, **academic hierarchy alignment**, and **real-time data reporting**. The Enrollment Projections Application seeks to bridge this gap by combining predictive analytics with institutional data governance and secure, user-friendly technology.

### 3. Methodology

#### 3.1 Academic Structure and Data Sources

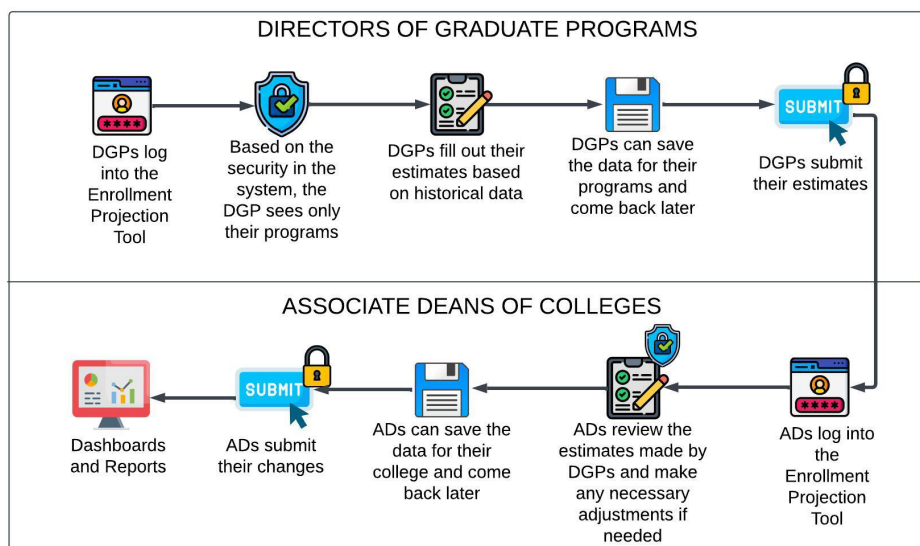
The system is organized according to the institutional academic hierarchy:

- **College → Program → Plan** (e.g., College of Engineering → Mechanical Engineering → MEMS/MEMR/PhD).

Data sources include admissions data, historical enrollment trends, and student group segmentation (new vs. continuing students).

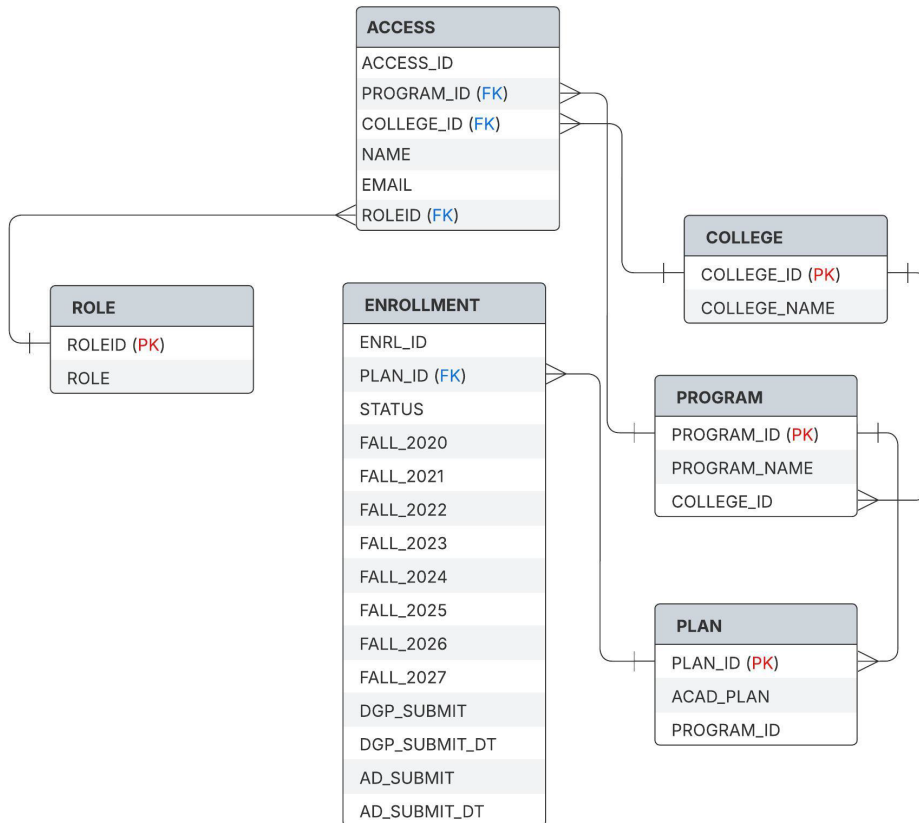
#### 3.2 Technology Infrastructure

- **Backend:** Microsoft SQL Server to manage relational datasets.
- **Frontend:** PHP-based application for accessibility and user interaction.
- **Security:** Shibboleth integrated with Active Directory for authentication and access control.



### 3.3 Database Design

The system integrates program data from the Directory of Graduate Programs (DGP) and role-based assignments from Active Directory. Custom tables were designed to store admissions activity, historical data, and projection outputs.



ROLE		ACCESS						
ROLE_ID	ROLE	ACCESS_ID	PROGRAM_ID	COLLEGE_ID	NAME	EMAIL	ROLE_ID	
1	DGP	1	ME	COE	Raj	<a href="mailto:pnbhosal@ncsu.edu">pnbhosal@ncsu.edu</a>	1	
2	AD	2	CE	COE	Rushik	<a href="mailto:rpatel@ncsu.edu">rpatel@ncsu.edu</a>	1	
		3		COE	Peter	<a href="mailto:peter@ncsu.edu">peter@ncsu.edu</a>	2	
		4	PHY	COS	Anna	<a href="mailto:anna@ncsu.edu">anna@ncsu.edu</a>	1	

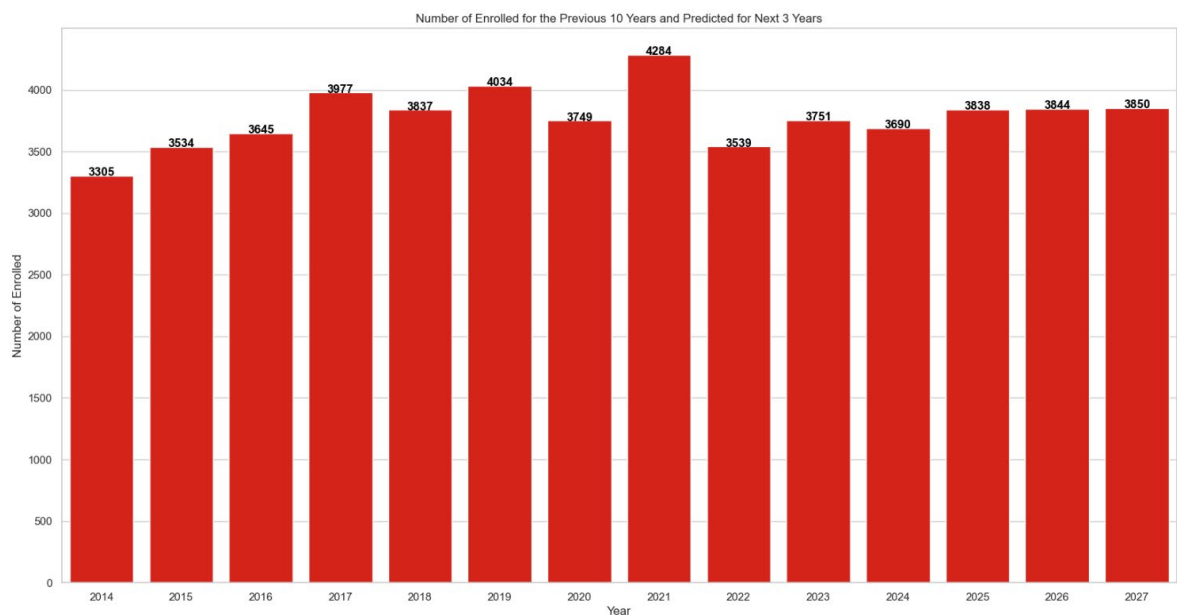
  

COLLEGE		PROGRAM			PLAN		
COLLEGE_ID	COLLEGE	PROGRAM_ID	PROGRAM	COLLEGE_ID	PLAN_ID	ACAD_PLAN	PROGRAM_ID
COE	College of Engineering	ME	Mechanical Engineering	COE	MEMS	Mechanical Engineering - MS	ME
COS	College of Sciences	CE	Civil Engineering	COE	MEMR	Mechanical Engineering - MR	ME
		PHY	Physics	COS	CEMS	Civil Engineering - MS	CE
					PHYPHD	Physics - PhD	PHY

ENRL_ID	PLAN_ID	STATUS	FALL_20	FALL_21	FALL_22	FALL_23	FALL_24	FALL_25	FALL_26
1	14CEMS	New	7	24	12	13	9	15	NULL
2	14CEMS	Continuing	19	13	19	18	20	23	NULL
3	14MEMS	New	48	72	48	58	47	55	NULL
4	14MEMS	Continuing	143	112	103	102	90	117	NULL
5	17PYPHD	New	13	11	15	17	21	25	NULL
6	17PYPHD	Continuing	107	108	95	85	81	95	NULL

### 3.4 Predictive Modeling

Predictive models were developed in **Python (Jupyter Notebook)** using **linear regression**. An **80/20 train-test split** was employed to validate the model. The approach ensured accuracy while maintaining generalizability for future projections.



### 3.5 Reporting and Application Interface

The interface provides directors and deans with dashboards for forecasting, including daily admissions reports. Users can filter by program, college, or student group to tailor projections to their decision-making needs.

## Enrollment Projection

- This application is intended to assist DGP's and their respective Associate Deans for Academics (ADA) in developing enrollment targets for their programs for Fall 2026.
- The tool provides the previous five years of enrollment data by program and the percentage change in enrollment as compared to last year. You can download the information for further collaboration and review.
- The enrollment targets for all programs in a College will be routed to the Associate Dean for Graduate program for final review and approval.
- The Graduate School will incorporate the final targets on the daily/weekly admissions reports that will be initiated during the enrollment cycle for the Fall 2026 cohort to compare against the actual enrollments.
- The "Dashboard" button on the top right corner provides a dynamic chart of Admissions and Enrollment for the most recent 5 years. Information on this dashboard can be drilled down further by Program, Degree Type, and Academic Plan to assist the AD/DGP in the target setting process.

Please Select College

Please Select Program

Dashboard

Show 10 entries

Search:

Plan	Acad Plan	Status	Fall 2020	Fall 2021	Fall 2022	Fall 2023	Fall 2024	Percentage Difference (From Last Year)	Fall 2025
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Export

Show 10 entries

Search:

Plan	Acad Plan	Status	Fall 2020	Fall 2021	Fall 2022	Fall 2023	Fall 2024	Percentage Difference (From Last Year)	Fall 2025
-MS		New	21	28	20	25	40	60 %	40
-MS		Continuing	27	42	50	45	46	2.2 %	78
-PHD		New	9	5	11	6	19	216.7 %	15
-PHD		Continuing	25	28	29	34	41	20.6 %	37
-MS		New	48	72	48	58	47	-19 %	55
-MS		Continuing	143	112	103	102	90	-11.8 %	117
-PHD		New	20	23	38	19	23	21.1 %	25
-PHD		Continuing	94	95	95	103	102	-1 %	94

Export

Showing 1 to 8 of 8 entries

Previous 1 Next

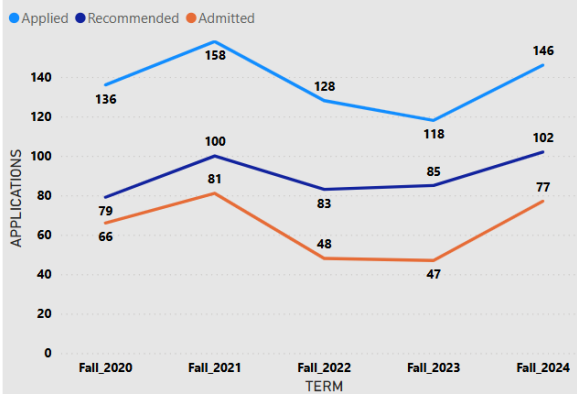
College

Program

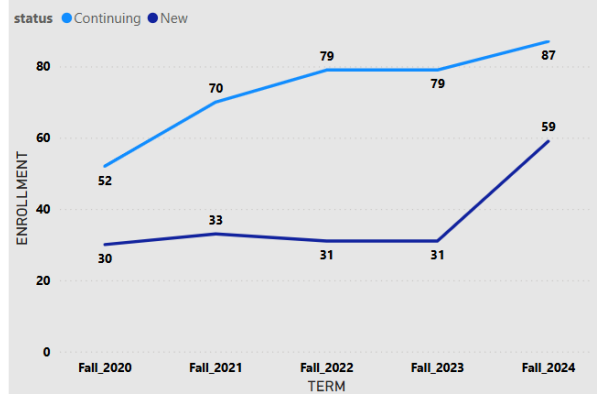
Degree\_Type

Plan

Applied, Recommended and Admitted



ENROLLMENT



## 4. Results

Implementation of the Enrollment Projections Application yielded several outcomes:

- **Accuracy:** Predictive modeling reduced reliance on manual forecasting and improved precision at the college and program level.
- **Accessibility:** Role-based access allowed Directors of Graduate Programs and Assistant Deans to independently generate projections.
- **Efficiency:** Daily admissions reporting provided real-time updates, enabling proactive adjustments to enrollment targets.
- **Scalability:** The system's modular database design allows future expansion to additional programs and datasets.

## 5. Discussion

The findings highlight the transformative potential of integrating predictive analytics with institutional governance. By aligning the academic hierarchy with forecasting models, the application ensured usability for stakeholders at multiple levels. The system also reduced administrative inefficiencies by centralizing forecasting efforts into a single, secure platform.

Limitations include reliance on linear regression, which, while effective, may not capture nonlinear enrollment behaviors. Future enhancements could explore machine learning models (e.g., random forests, neural networks) for greater accuracy. Additionally, integration with retention data and financial aid metrics could expand the scope of enrollment management insights.

## 6. Conclusion

The Enrollment Projections Application demonstrates how higher education institutions can leverage data-driven tools to enhance enrollment forecasting. By integrating predictive modeling, secure role-based access, and daily reporting, NC State University has established a scalable system that supports both strategic planning and operational decision-making.

Future research will explore advanced machine learning techniques and broader institutional datasets to refine projection accuracy and applicability. This initiative serves as a model for other universities seeking to modernize their enrollment management processes.