

Executive Summary

This project, conducted in collaboration with **Macquarie University's Business Intelligence and Reporting (BIR) team**, aimed to transform institutional student data into actionable insights that enhance academic planning, retention strategies, and decision-making. Using Qlik Sense, a business intelligence platform, our team was able to create an engaging dashboard that examines enrolment and retention trends for students enrolled between 2020 and 2025. The main goal was to explore those crucial elements that shape student movement, completion, or withdrawal issues in Macquarie Business School.

The task entailed analysis targeting two academic personas, which are the unit convenor and the course director. Both personas demand specific knowledge to shape their teaching or curriculum-related undertakings. The associative model in Qlik Sense made it possible to easily merge two datasets, Enrolment Data and Retention Data, that are quite large using common fields (ACADEMIC_YEAR and HUB_COURSE_ADMISSION_KEY). It was possible to create an environment using these datasets to analyse unit-level and course-level data trends.

With the use of highly advanced Qlik extensions like Decomposition Tree and Sankey Chart, interactivity was enabled in the dashboard to drill down into retention, performance, or withdrawal trends according to mode of attendance, academic level, or unit code. The results identified that attainment was not just affected by difficulty of study but also by mode of delivery and cohort size. A large drop in attainment and retention was evident for 2022, which was the year with the largest student numbers, indicating that larger cohort sizes are putting pressure on teaching resources. In addition, off-campus students performed poorly compared to those studying on campus. At a course-level analysis, it was found that there was a high attrition rate in “gateway” courses like 1000-level units ACST1052, MATH1015, and STAT1371.

Despite attrition due to withdrawal from courses like these, there was minimal withdrawal from the university. Through the integration of data visualisation, statistical analysis, and a focus on persona-based narratives, this project illustrates how Qlik Sense can serve to close the gap between institutional data and strategic thinking. The dashboard provides academic leadership with a comprehensive data-based platform to design an intervention to improve student retention, learning equity, or curriculum alignment.

Table of Contents

Executive Summary	3
Table of Contents	3
Introduction	5
Persona 1 – Unit Convenor Analysis	7
Purpose	8
Unit Convener Dashboard Overview:	8
Key Insights	9
Recommendations	11
Example Visualization Insights	11
Persona 2 – Course Director Analysis	12
Purpose	13
Key Insights	14
Recommendations	17
Example Visualization Insights	17
Conclusion	18

Introduction

Institutional Context

In contemporary higher education environments, there seems to be an emerging trend where universities are seeking data-based approaches to academic management. One of these trends that allow universities to address academic success, retention, or completion includes using data to enable them to detect signs of possible attrition. At Macquarie University, there seems to be a driving force to ensure data-based academic management through Business Intelligence and Reporting (BIR).

Project Scope

The project was a collaboration with the BIR team to create an interactive dashboard using Qlik Sense to display trends related to student performance and retention data between 2020 and 2025 at Macquarie University for the bachelor's programme. The aim was to identify the determining elements that shape student flows in terms of completion and withdrawal trends.

The focus was based on two academic personas:

Course Director – Reviews programme-level quality, diversity of curriculum, and retention rates.

Unit Convenor – Focuses on areas related to student results, withdrawal trends, and participation in units.

With both perspectives incorporated into the project, there is a connection between teaching observations at a micro-level and educational outcomes observed at a macro-level.

Data Sources and Structure

Two main datasets were utilised — **Enrolment Data** and **Retention Data** — spanning the years 2020 to 2025. These datasets were merged using the shared keys **HUB_COURSE_ADMISSION_KEY** and **ACADEMIC_YEAR**, forming a unified analytical model. Key fields included **Weighted Average Mark (WAM)**, **Withdrawals**, **Completion Count**, **Attendance Mode**, and **Unit Status**. Derived measures such as **Retention Rate**, **Completion %**, and **Fail Rate** were calculated to capture academic trends and student persistence.

Methodology and Data Preparation

Data Understanding:

The first step involved analysing the data dictionary in great depth to learn more about field descriptions and how these correspond to student/unit or course numbers. Every field was related to its intended use in analysis, which was academic or demographic/administrative.

Data Cleaning and Integration:

Data preparation involved ensuring data integrity and consistency prior to analysis:

- Duplicates are removed to ensure a one-to-one mapping between datasets.
- In WAM or completion columns with null or missing data, mean substitution or exclusion was used based on completeness.
- The enrolment table and retention table were joined in Qlik Sense based on the composite key (HUB_COURSE_ADMISSION_KEY + ACADEMIC_YEAR).
- In Qlik's associative model, these correct relationships were automatically identified and verified using highly accurate yellow bars shown between datasets.

Calculated Measures:

Several key indicators were computed to quantify academic outcomes:

- Retention Rate (%) = (Students Continuing / Total Enrolled) × 100
- Completion %, Average Time to Completion, Withdrawal %, Average WAM and Fail Rate. Continuation flags were used to derive retention at course, faculty, and university levels.

Qlik Sense as the Analytical Platform:

Overview:

Qlik Sense was utilised as the analytical hub used to convert complex institutional data into engaging data stories. The data model's associative nature, real-time analysis capability, and data storytelling functionalities

made it perfectly suited for analysing trends in student enrolment, retention, and performance between 2020 and 2025.

Unlike conventional SQL-based solutions that use static joins to relate data, Qlik Sense's associative engine enables dynamic linking between data. Such flexibility enabled academic personas like course directors and unit convenors to infer data insights intuitively. Also, Qlik Sense's data solution integrates with Macquarie University's focus on evidence-based academic administration. In other words, users can make informed academic decisions based on data.

Associative Data Model and Data Integration:

The associative data engine in Qlik Sense serves as the cornerstone for its functionality. It automatically connects fields with common names across data sources. In doing analysis for the project, data sources Enrolment Data and Retention Data were related using common names HUB_COURSE_ADMISSION_KEY and ACADEMIC_YEAR to ensure that student data was aligned correctly across both data sources.

During the loading of these datasets, Qlik Sense automatically generated bidirectional mappings to allow users to easily alternate between analysis options based on units or courses. The mappings are shown in the Data Model Viewer, which uses a yellow association bar to show the strength of these mappings.

- A yellow Loc-Line bar indicated a positive or correct connection between field values. A yellow bar with a yellow flag indicated a strong or verified connection between field values. A yellow bar with

- A broken or partial bar indicated data inconsistencies or areas where key refinement was needed.

It was essential for data integrity to physically validate these results. With validation complete, Qlik's associative model enabled dynamic reactions to user inputs. In other words, filtering data based on academic year or mode of study updates associated data displays automatically. As a result, users performed real-time cross-analysis.

In this associative structure, users could:

- Investigate WAM values, retention, and withdrawal data interactively.
- Identify trends in student learning across units or courses.
- Compare between outcomes for internal and external study modes.

This model enabled analysis that was normally the result of complex SQL queries to become a point-and-click analysis task. As a result, institutional analytics became easier to engage with.

Interactive Exploration and Data Storytelling:

With these validated association values in place, a model was set up based on master items. These are standard field collections that promote uniformity across dashboards. The items update live when filters are applied. Master Items helped create an engaging environment. For example, when a course director viewed a filtered dashboard to explore data for 2023 external students, Qlik Sense calculated success percentages, withdrawal percentages, or progression percentages in real time across all graphics. Such interactivity helped with data discovery and telling stories to explore reasons behind data observations rather than focusing on observations alone.

Qlik Extensions and Advanced Visualisation:

To further enhance the features available in Qlik Sense, various Qlik AnyChart Extensions are used to enable analysis or create graphical interfaces, including:

- Decomposition Tree: Enabled drilldowns starting from average WAM to cater to study mode > academic year > unit code to determine underlying causes for variance in results.
- Sankey Diagrams: They provided pictorial representations of movements between courses, faculties, and Macquarie University. These helped establish that attrition mainly stemmed from internal shifts rather than withdrawal from Macquarie.
- Heatmaps and Scatterplots: Identified areas with high-risk units that had low success but high withdrawal rates.
- Tree maps: Provided course-level success distributions.

These additions pushed the dashboard to the next level, not only functioning for descriptive analysis but also serving for diagnostic and predictive purposes. These features enabled users to explore details from an institutional-level focus to deeper data points, which improved data storytelling in academic analysis.

Persona Alignment and User Experience:

The design was personalised for both personas involved in the project:

- **Unit Convenor's View:** Primarily focused on data analysis regarding specific units—the WAMs for those units, withdrawal rate, and mode of attendance.
- **Course Director View:** Provided program-level data related to retention, completion, and progression.

With Qlik's associative filter technique and use of coloured selections (green for active areas, white for similar areas to active areas, and grey for areas not to include), both personas could easily engage with data. Such a user-friendly design enabled collaborative conversations between unit-level users and program-level users.

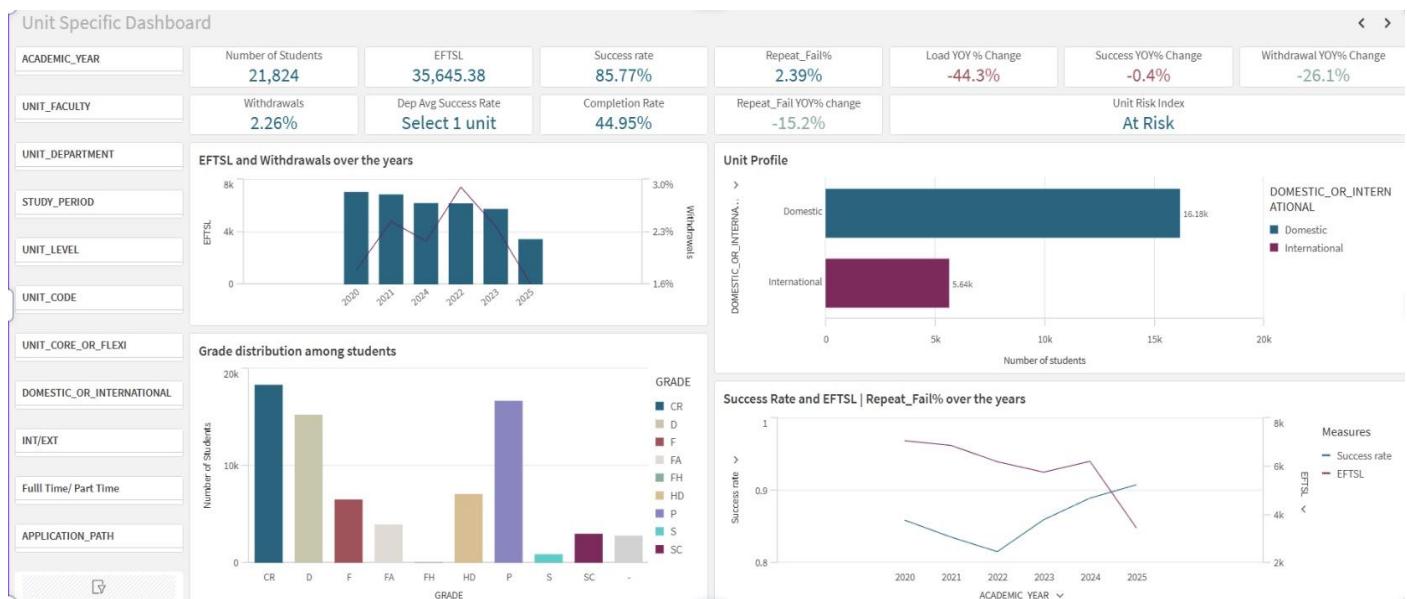
Persona 1 – Unit Convenor Analysis

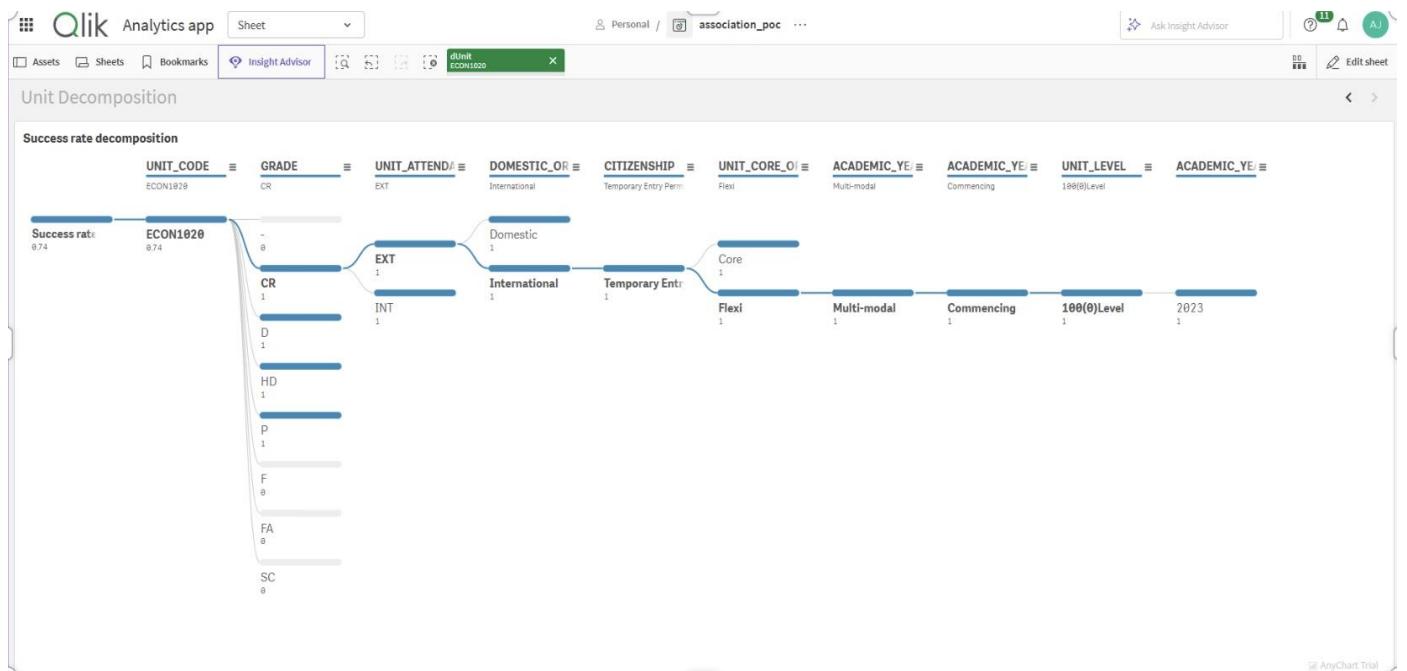
Purpose

Focus on micro-level analytics for individual unit management.

Unit Convener Dashboard Overview:

The Unit Convener Dashboard functions as an integrated analysis tool intended to facilitate informed decision-making based on evidence. It collates significant academic indicators to enable unit convenor access to information pertaining to enrolment trends, student results, and related unit-level data. The dashboard integrates with the overarching goal to promote data-driven teaching methods within the student success and retention framework.





The dashboard's main goal is to give unit conveners the ability to assess each unit's health using measurable and comprehensible metrics. Success Rate, Equivalent Full-Time Student Load (EFTSL), Withdrawal Rate, Completion Rate, and Year-over-Year (YoY) performance trends are all presented in an integrated manner. The dashboard makes it easier to comprehend how delivery methods, instructional strategies, and assessment designs affect students by combining these metrics into a unified analytical context.

Key Insights

EFTSL and Student Outcomes (2020–2025): The Load–Performance Trade-Off

During the analysis spanning over five years for these three most highly enrolled units (ECON1020, ACST 1001, ACCG 1000), there was a definite inverse relationship between Equivalent Full-Time Student Load (EFTSL) and success. The point was that the maximum value for EFTSL was recorded in 2022, indicating the maximum enrollment numbers recorded for these years. During these maximum numbers, there was a minimum recorded value for student success. As enrollment numbers steadily dropped between 2023-2025, there was a steadily increasing value recorded for student success. During these three units, there was a periodic phenomenon wherein maximum sizes negatively influenced academic success due to strained teaching capacities. Maximum sizes negatively influenced teaching capacities to deliver due to less availability or scope for engaging with students. In subsequent smaller sizes between 2023-2025, there was an improvement in teaching capacities to deliver due to considerable individual focus. The trade-off between Success & EFTSL makes an important revelation for units to note. They need to proportionally invest maximum resources to achieve maximum enrollment numbers to ensure continued teaching delivery quality & academic success.

EFTSL vs Withdrawals (2020–2025): When High Load Drives Disengagement

During the same period, withdrawal trends has similar variations to those found in enrolment load. The withdrawal trend peaked in 2022 with around 3%, which was in line with maximum EFTSL. The trend suggests that when classes grew substantially, increased academic pressure or lack of access to academic learning facilities made them withdraw. The probable cause for increased withdrawal was early drop-out or lack of adaptability due to increased numbers. From 2023 to 2025, there was a sharp fall in withdrawal to around 1%, which shows improvement in retention trends. It suggests that with a balanced workload, academic resources allocation per student, and maintaining small cohort sizes in classes enabled those who withdrew to stay or adapt to learn. Trends further suggest that there remains a connection between load retention after analyzing 'Success Rate' that when there's a huge load in academic terms, assessment or learning suffers. Maintaining manageable numbers in classes will achieve improved retention.

Success Rate by Attendance Mode (2020–2025): The External Learning Gap

In terms of the five-year period, there was a steady decline in success rates for external students since 2021. Meanwhile, there was improvement for internal and multi-modal students. The difference in numbers suggests an increasing difficulty for external enrolled students who tend to find learning largely online. The drop in success rate in 2021 could be expected due to adjustments following the COVID-19 period. While other modes benefited from BL and improved academic support structures from 2023 onwards, external students did not. This could indicate that existing structures are not meeting the needs of off-campus groups. In summing up, there exists a trend related to a delivery mode gap. In efforts to improve trends, teaching teams should focus on online participation gaps, online consultation opportunities, and assessment access for independent students. These areas can substantially reduce existing gaps in success rate and retention trends related to external students.

COMP1350 Core Unit Analysis (2020–2025): Persistent Performance Instability

The reason for choosing COMP1350 was its steady decline in student results over five years. Looking across these years, there's evident instability in student results for the Core component regardless of stability in student numbers. The success rate for the unit (71.2%) remains lower than that for the faculty (~78-80%), but what's far more alarming is that there's been a massive jump of over 330% in Repeat_Fail%. Although there was a massive decline (-42.4%) in EFTSL in 2024, there was a temporary improvement in success rate (by 20%), probably due to lower student numbers that allowed for more focused teaching efforts. But these improvements are not retained in 2025. Clearly, the problem does not lie with enrolment numbers.

Although there was a 56% drop in withdrawals, the completion rate remains very low (1.25%), which suggests that there are students who are staying enrolled but not engaging before completing unit requirements. The distribution of grades shows a preponderance of grades recorded with a 'Pass' result, few grades recorded with 'Distinctions,' which suggests that surface-level learning is happening. These results raise questions concerning whether or not there are issues with delivery or design to address or whether there are requirements that are simply too challenging or inappropriate for these students' skill level.

Analytical Visualisations

Underneath KPI, there are a set of interactive visualisations that enable longitudinal analysis:

- EFTSL and Withdrawals over Time: Focuses on trends in student load and withdrawal over time.
- Unit Profile: Describes composition characteristics within the cohort, both domestically and globally. Helps conveners appreciate differences in demographics.
- Grade Distribution: The data shown includes patterns related to grades like HD, D, CR, P, or F. These patterns show whether grades are normally distributed or not.
- Success Rate and EFTSL per Period: Combines assessment data with enrolment load to reveal trends between class sizes and student success outcomes.
- Decomposition Tree: Offers diagnostic insight into which factors are playing the major role in successful outcomes. In the example scenario, the subjects that feature are those with grades awarded, attendance type, and type of student. These are shown to play a major role in determining the grades in subjects like ECON1020.

Interpretive and Strategic Value

The Unit Conveners' Dashboard not only encompasses descriptive analytics but also integrates both diagnostic and comparative features. These allow conveners to identify signs indicative of reduced participation, measure the impact introduced by teaching interactions, or create focused academic support plans. The integration of trend analysis, demographic analysis, or causality analysis develops a richer understanding of unit behaviour aligned with institutional objectives to improve learning outcomes and participation ratios.

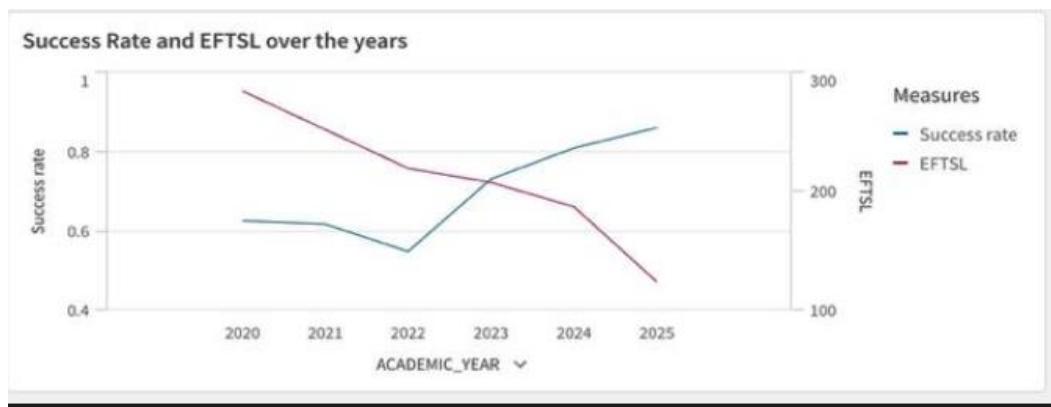
Summary

Overall, the Unit Convener Dashboard operates as an integrated performance-monitoring system that transforms raw academic and enrolment data into meaningful visual intelligence. It empowers unit conveners to make informed, data-driven decisions aimed at improving curriculum delivery, enhancing student success, and strengthening overall academic quality assurance.

Recommendations

Example Visualization Insights

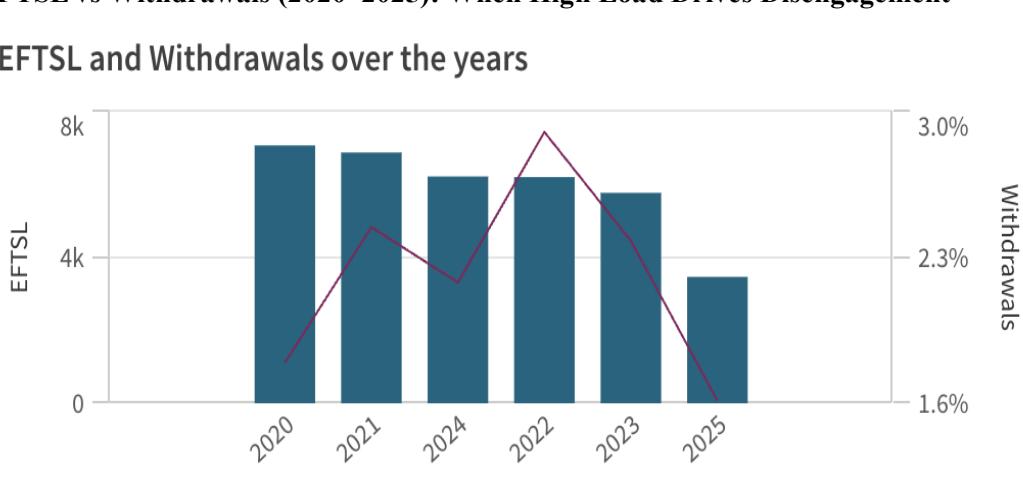
1. EFTSL and Student Outcomes (2020–2025): The Load–Performance Trade-Off



(ACST1001 example)

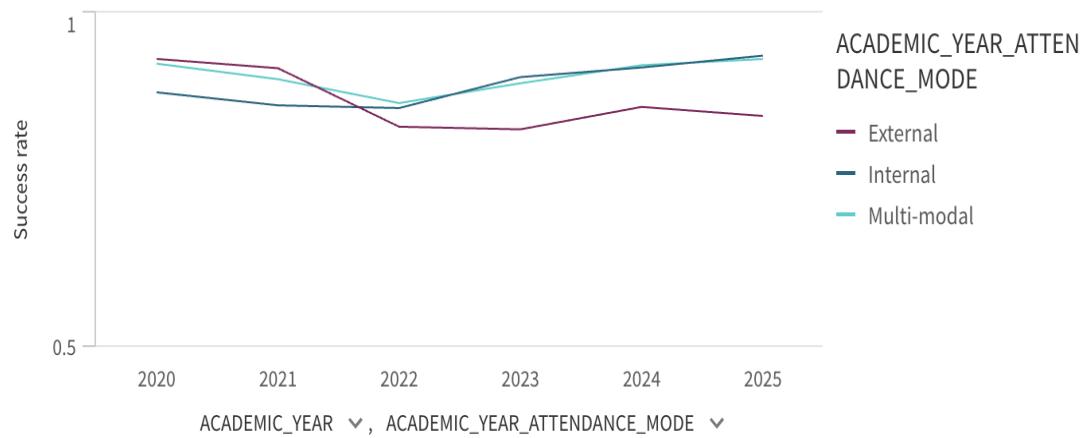
2. EFTSL vs Withdrawals (2020–2025): When High Load Drives Disengagement

EFTSL and Withdrawals over the years

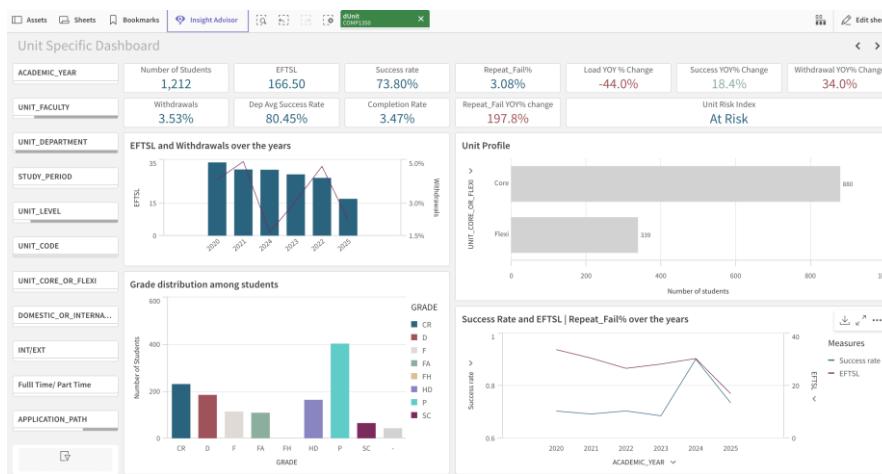


3. Success Rate by Attendance Mode (2020–2025): The External Learning Gap

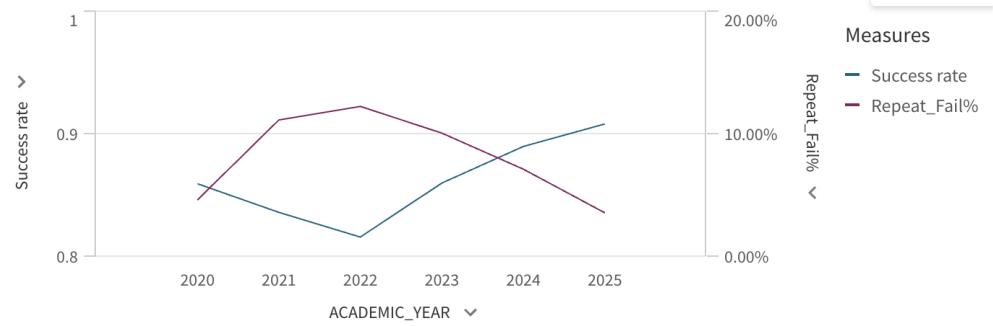
Success rate vs Attendance type



4. COMP1350 Core Unit Analysis (2020–2025): Persistent Performance Instability



Success Rate and EFTSL | Repeat_Fail% over the years



(COMP1350)

Persona 2 – Course Director Analysis

Purpose

Focus on macro-level program analytics for overall course management, student progression, and completion trends.

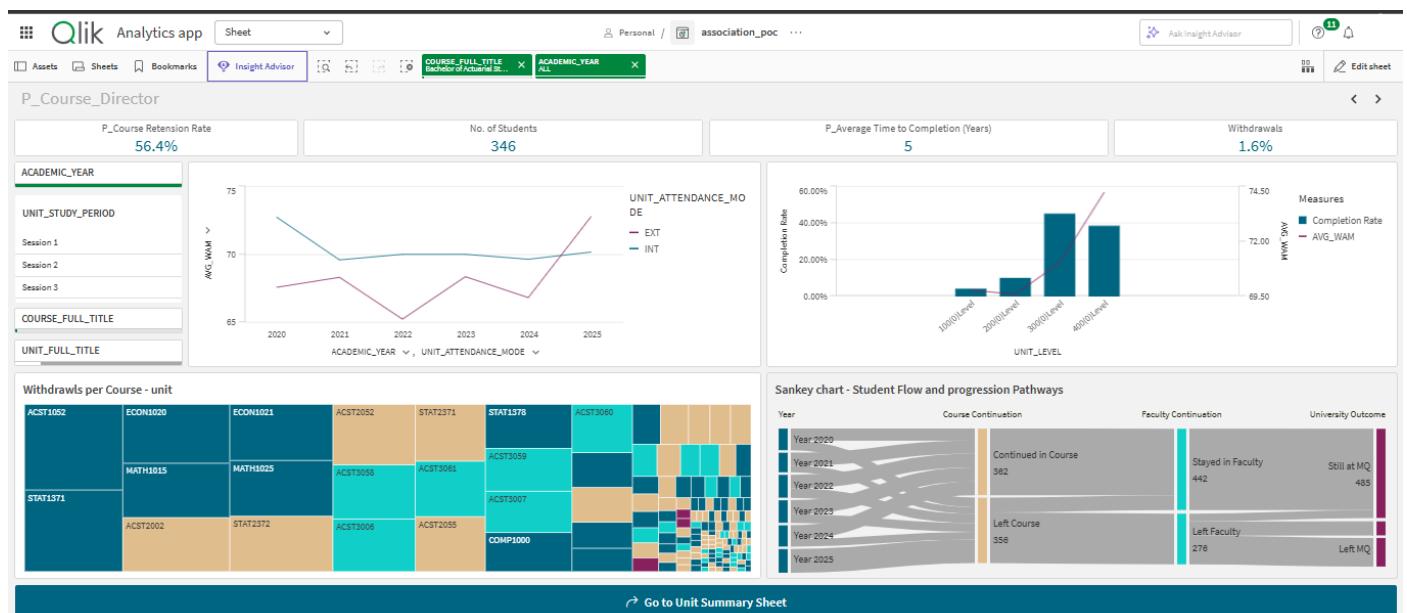
Dashboard Purpose

The Course Director dashboard provides a **strategic, top-down view of course performance** from 2020 to 2025. It enables the Course Director to monitor retention, completion, withdrawals, and academic progression across cohorts, delivery modes, and unit levels.

The dashboard helps identify structural bottlenecks, inequities between internal and external delivery, and opportunities for curriculum or support redesign that improve long-term student outcomes.

The **Course Director dashboards** consist of two complementary views.

- The **first dashboard** provides a program-level overview of retention, withdrawals, completion, and progression trends across academic years, delivery modes, and unit levels, helping identify systemic performance patterns.
- The **second dashboard** offers a detailed, unit-level breakdown of success, fail, and withdrawal rates, allowing the Course Director to pinpoint high-risk units, quantify academic bottlenecks, and prioritise areas for early intervention.



Course_Director_Table_View_2

UNIT_CODE	UNIT_FULL_TITLE	UNIT_LEVEL	Total Enrollemts	Unique Students	UNIT_CORE_OR_FLEXI	Success rate	Withdrawals	P_Completion Rate	P_Fail Rate	Avg_WAM
Totals			709	125	85.73%	2.7%	5.6%	11.6%	68.62	
ACCO1001	Accounting and Governance	100(0)Level		1	Flexi	100.00%	0.0%	0.0%	0.0%	86.21
ACCO1000	Accounting in Society	100(0)Level		16	16	Flexi	100.00%	0.0%	0.0%	71.14
ACST4002	Actuarial Control Cycle 1	400(0)Level		1	1	Flexi	100.00%	0.0%	100.0%	0.0%
ACST4005	Actuarial Data Analytics	400(0)Level		1	1	Flexi	100.00%	0.0%	0.0%	89.52
ACST3061	Actuarial Statistics	300(0)Level		1	1	Flexi	100.00%	0.0%	0.0%	87.04
ACST3061	Actuarial Statistics	300(0)Level		17	17	Core	88.24%	0.0%	29.4%	71.58
ACCO2065	Blockchain for Business	200(0)Level		1	1	Flexi	100.00%	0.0%	0.0%	41.96
STAT1250	Business Statistics	100(0)Level		1	1	Flexi	100.00%	0.0%	0.0%	57.42
MATH1010	Calculus and Linear Algebra I	100(0)Level		2	2	Core	50.00%	0.0%	50.0%	33.60
MATH1015	Calculus and Linear Algebra I (Advanced)	100(0)Level		34	34	Core	91.18%	2.9%	0.0%	66.61

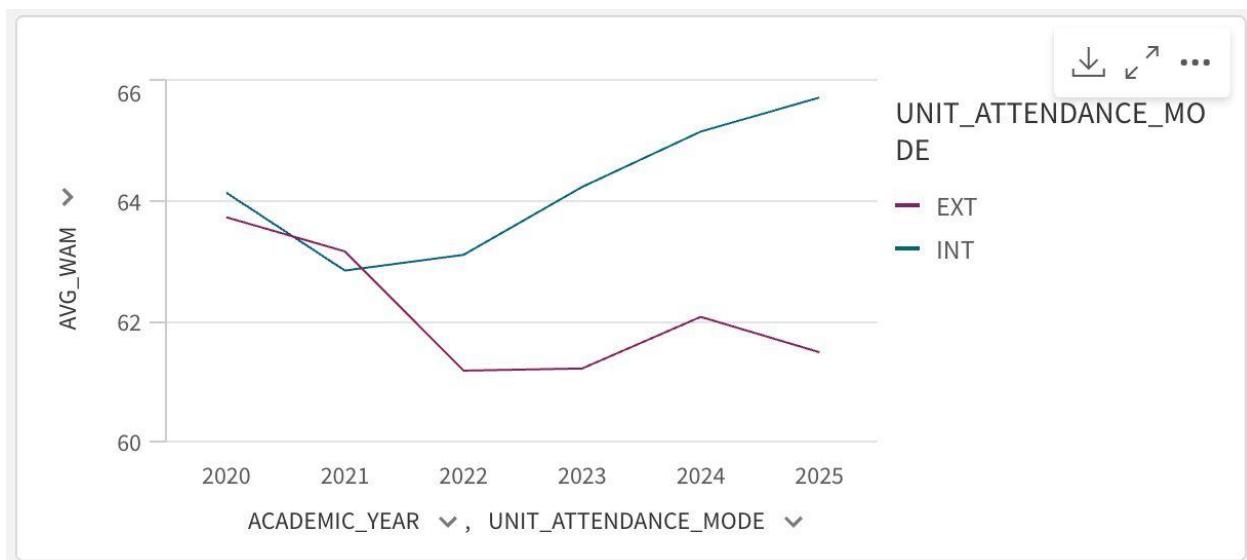
Go to Student sheet

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Key Insights

Learning-Mode Performance Gap: The Post-Pandemic Divergence

Line Chart – Average WAM by Academic Year (Internal vs External)



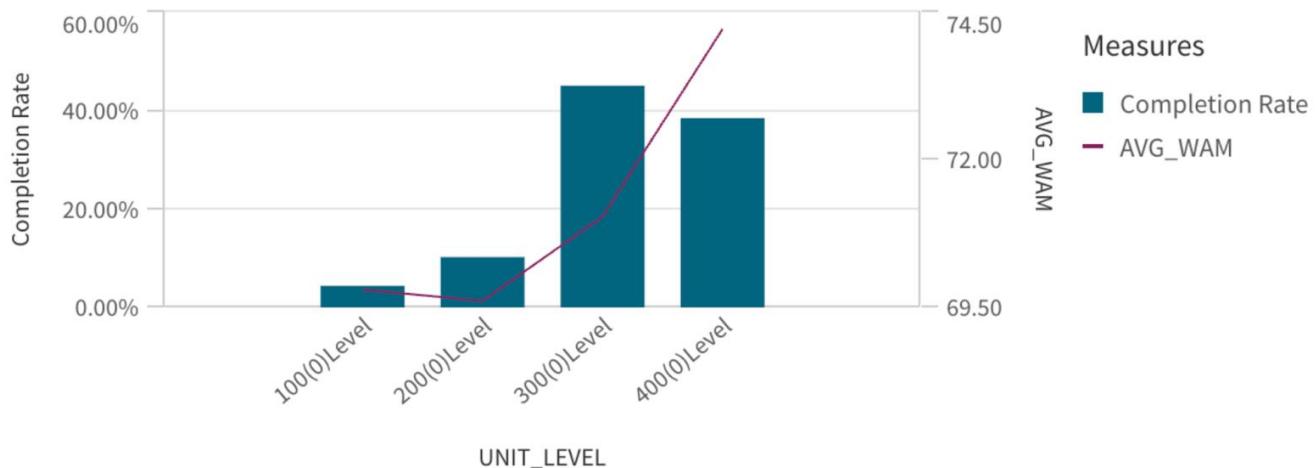
- Across the five-year span, a clear divergence emerges between internal and external cohorts.
 - After the 2021–2022 disruption, both groups experienced a fall in WAM; however, internal students recovered steadily, reaching averages above 65 by 2025, while external students plateaued at 61–62.
 - This sustained **4–5-point gap** reflects inequities in learning experience and assessment feedback between face-to-face and online modes.
 - Despite stable enrolments, withdrawal among external students rose from 3 % to almost 10 % by 2025, indicating growing disengagement.

These findings confirm that delivery mode—not student capability—is driving outcome differences.

Insight: Online cohorts require intentional engagement design—such as live virtual drop-ins, consistent feedback turnaround, and real-time communication—to match internal performance trends.

Completion and WAM by Unit Level: Early-Year Bottlenecks

Combo Chart – Bars: Completion Rate by Unit Level; Line: Average WAM (Dual Axis)

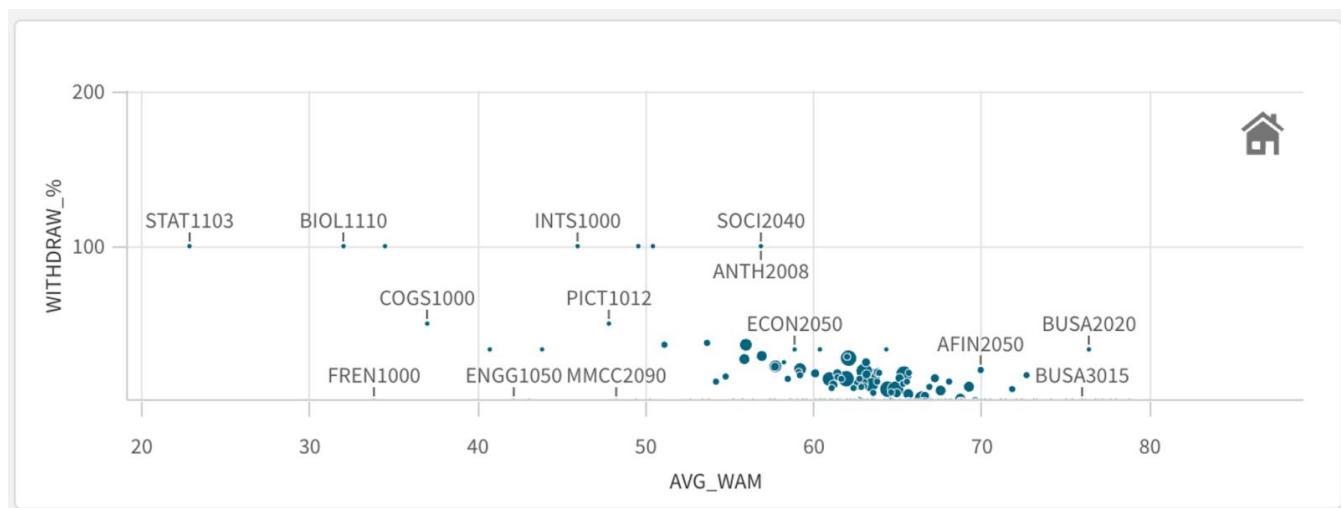


- Completion and performance increase steadily with academic level. **1000- and 2000-level units record the lowest completion rates (5–10 %) and the weakest WAM (~69–70), whereas 3000- and 4000-level units achieve 40–55 % completion and WAMs > 73.**
- This pattern signals that **attrition is concentrated in foundational years**, where students often lack quantitative or analytical readiness.
- Tool-tips showing session-wise enrolment also reveal **Semester 1 overload**, where most students cluster, compounding early-year stress.

Insight: Foundational support, bridging workshops, structured tutoring, and balanced semester loads—will deliver the greatest retention gains.

Academic Difficulty and Withdrawal: The Performance–Disengagement Link

Scatter Plot – X: Average WAM | Y: Withdrawal Rate | Size: Enrolments

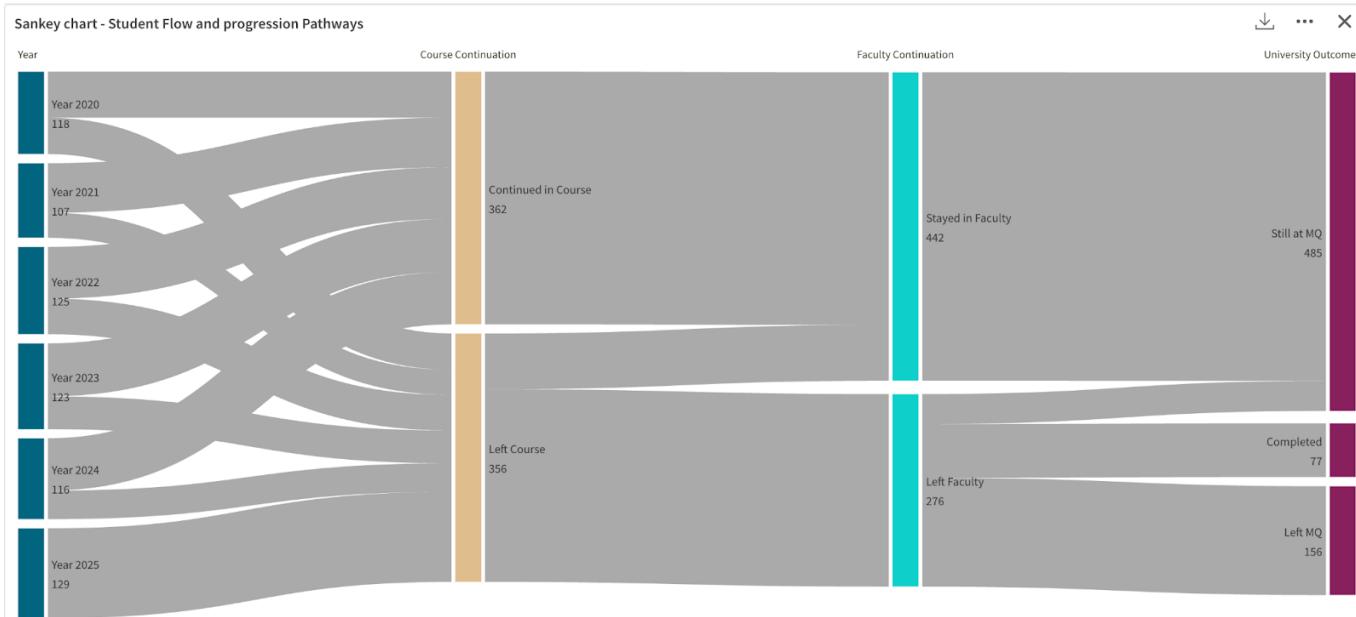


- The scatter plot shows a strong **negative correlation between WAM and withdrawal ($\approx r = -0.7$)**. Units such as STAT1103 and BIOL1110 sit in the **high-withdrawal/low-WAM quadrant**, with withdrawal > 100 % and WAM < 30.
- Mid-range units (ECON2050, AFIN2050) have moderate withdrawals (30–50 %) and WAM ~ 60, forming a visible “risk band.”
- Conversely, high-WAM units (BUSA2020, BUSA3015) show negligible withdrawals. This confirms that **academic difficulty, not course structure, drives disengagement**.

Insight: Prioritising curriculum redesign, formative assessment, and additional academic help in low-WAM units can meaningfully reduce withdrawals.

Student Movement and Retention Pathways

Sankey Chart – Course > Faculty > University Continuation Flow

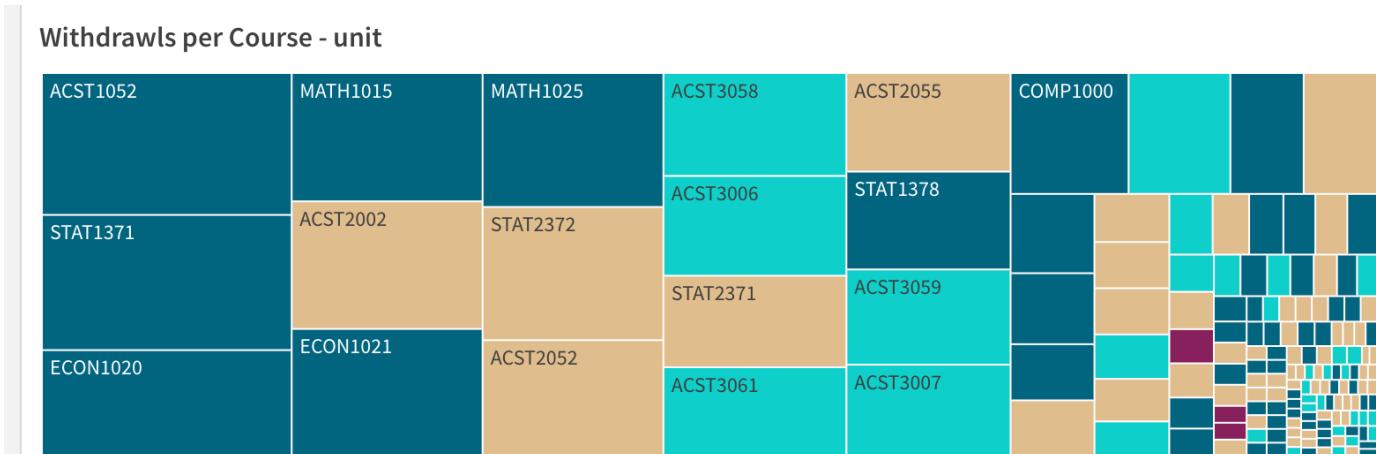


- The Sankey reveals that of ~720 students tracked, **362 continue** in the course and **356 exit**. Yet, a majority of those who leave **stay within the faculty (442)** or **remain enrolled at MQ (485)**, with only 156 departing the university entirely.
- This demonstrates that attrition reflects **course-fit issues rather than institutional dissatisfaction**. Students often migrate internally, suggesting unclear progression pathways or changing career interests.

Insight: Strengthening course advising, flexible double-degree options, and credit recognition will retain these students within the course rather than losing them to transfers.

Withdrawal Concentration by Unit: The Gateway Effect

Treemap – Tile: Unit Code/Title | Size: #Withdrawals | Color: Unit Level



- The treemap identifies **1000-level “gateway” units** as the main sources of attrition.

- Dark-blue tiles (1000-level) dominate, with ACST1052, MATH1015, STAT1371, and ECON1020 showing both the **largest enrolments and highest withdrawals**.
- Withdrawals reduce drastically at 2000- and 3000-levels (beige and cyan), confirming that early disengagement drives the overall pattern.
- Many of these at-risk units are **service or quantitative units taught by other departments**, amplifying delivery and alignment challenges.

Insight: Coordinated redesign of first-year quantitative units and embedded academic support can produce the most significant uplift in success and retention metrics.

Recommendations

1. **Make preparatory courses a mandatory prerequisite before commencement**
 - Convert existing preparatory or bridging courses into **mandatory prerequisites** for all incoming students before they commence their degree.
 - This ensures every student enters with the essential quantitative, analytical, and communication foundations required for success in first-year gateway units.
 - Making these courses compulsory will help standardise entry readiness, minimise early academic shock, and significantly reduce first-year attrition rates.
2. **Establish a structured peer-tutoring and mentoring program for early academic support**
 - Create a **formalised peer-mentoring system** where high-performing second- and third-year students provide **one-on-one academic assistance and small-group mentoring** to first-year cohorts, particularly in high-withdrawal foundational units.
 - This initiative strengthens the early-intervention framework, fosters belonging, and helps new students develop confidence and consistency through peer guidance from those who have successfully completed the same units.

Example Visualization Insights

- **Course-Level Insights: Performance & Progression Trends**

Displays year-wise retention and withdrawal differences between internal and external cohorts, with KPI cards summarising average completion time and overall withdrawal %.
Shows external mode as the key risk area.

- **Impact of Learning Mode on Average WAM**

Dual-line chart comparing internal vs external WAM over time, illustrating a 4–5-point gap post-2022 and slower recovery for external students.

- **Completion and Performance by Unit Level**

Combo bar-and-line visual displaying completion rates and WAM by unit level, revealing early-year attrition and improvement at advanced levels.

- **Unit-Level Performance Table and Fail Rate Distribution**

Tabular and bar visuals summarising quantitative bottlenecks (e.g., ACST3058 and ACST1402) and highlighting the course's overall academic stability.

Summary

The Course Director dashboard provides a **strategic, macro-level perspective** of program performance.

It reveals that attrition is concentrated in early-year and external delivery cohorts, while advanced units show strong completion and success.

By reinforcing admission prerequisites, offering early mentoring, and refining online assessment and feedback structures, the course can enhance both **equity and academic efficiency** across all modes of delivery.

Conclusion

In this project, Qlik Sense was shown to provide Macquarie Business School with insights derived from institutional data. These dashboards allowed for data integration across enrolment and retention data for 2020-2025. The project clarified data collectively. The dashboards intended for unit convenors or course directors helped them see data across various levels. They could establish how data related to teaching.

At the unit level, there was evidence to suggest that larger groups are related to lower success rates. Moreover, there was a significant difference found to exist between withdrawal ratios for online or external students compared to internal students. In other words, online or external students tend to withdraw in larger numbers.

At the university course level, there was a need to address attrition in foundational ‘gateway’ units like ACST1052, MATH1015, or STAT1371 because these pointed to academic transition as an intervention point. At the same time, persistence in these courses was quite high because those who left these courses did not leave the university.

From a technological point of view, the associative data model and graphical extensions (decomposition tree, Sankey chart, and heatmap) in Qlik Sense improved the accuracy of analysis. Also, validation using yellow bars ensured reliable connections between data sets, supporting data integrity.

The project thus ultimately promoted a data-informed model of academic governance wherein data analytics could inform decision-making across multiple levels, from course corrections to institutional policy. Future improvements could incorporate prediction models for identifying which students are at risk or real-time monitoring dashboards.

In short, this project has illustrated how visual analytics can close the data decision gap when aligned to pedagogical needs. In other words, educational decision-making can now become more informed based on data analysis.