Impact of Brexit on International Student Enrolment in the UK Universities

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by

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ABSTRACT

The impact of Brexit on international student enrolment in the UK universities became a serious topic of discussion and concern. The purpose of this dissertation is to make an extensive study of the patterns and trends in the enrolment of international students in the UK universities in the post-Brexit period. This study presents a detailed assessment on how Brexit has influenced students' migration to the UK using a sophisticated methodology that includes statistical testing, time-series analysis, and predictive modelling. Our study intends to evaluate international student enrolment patterns, analyse variations between enrolling students from EU nations and non-EU nations, and employ predictive methods to forecast enrolment trends in the future. The PG enrolments from countries including India, Pakistan, Bangladesh, and Nigeria, which experienced statistically significant changes, are said to have been deeply influenced by Brexit. meanwhile, a number of universities have reported drops in UG enrollments from the EU. Future trends were determined using predictive models, such as linear and polynomial regression. In assessing the statistics from 2020, the polynomial model projected a possible 50% decrease in UG enrolment from the EU by 2025. The reverse trend is also estimated, with an impressive growth in non-EU enrolment in PG courses between 2021 and 2024. A divergence in the pattern of international student enrolment is observed due to Brexit, creating both a window for more non-EU students, and a challenge for the diversity of EU students to go down.

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List of Abbreviations

EU	European Union
non-EU	non-European Union
UK	United Kingdom
HESA	Higher Education Statistics Agency
IES	International Education Strategy
DfE	Department for Education
FCDO	Foreign and Commonwealth Development Office
UCAS	the Universities and Colleges Admission Services
PG	Postgraduate
UG	Undergraduate
HE	Higher Education
GR	Growth Rate
ARIMA	Auto Regressive Integrated Moving Average
SARIMA	Seasonal Auto Regressive Integrated Moving Average

Contents

Chapter 1

Introduction

'Universities and institutions make deliberate attempts to offer a variety of academic, extracurricular, and distinctive experiences through international education. In order to better prepare their students for a world which is interconnected on a worldwide basis, they want to improve their understanding and productivity' [1] . International education opens doors to different cultures and viewpoints, enriching both students and the institutions they attend.' It is more than just academics; it is about preparing individuals to thrive in a globalized world, driving innovation and building stronger economic ties between countries. The United Kingdom stands out as an important centre for international academics, known for integrating many cultures and promoting cross-cultural contacts. The top universities provide a wide range of degrees, supported by an abundance of scholarships and an efficient admissions procedure, giving candidates an outstanding academic trajectory. The UK's reputation as an ideal location for wide student development and professional success has been strengthened by its dedication to safeguarding individual religious liberties, its architectural delights, and its rich cultural heritage' [2]. Hence, 'numerous top universities in the United Kingdom are becoming increasingly popular among overseas students, and thousands of worthy people are choosing to continue their education overseas.' [3]

'Brexit is the term used to refer to the UK's exit from the European Union. It is a combination of the words "Britain" and "exit". The UK held a referendum on its European Union membership on June 23, 2016,asking whether it should stay in or leave. Although it was close, 51.89% of the people chose to leave the UK. On January 31, 2020 the UK departed the EU' [4]. Brexit has had a broad impact on the UK, affecting a variety of sectors, including education. it has significantly changed the higher education environment in the United Kingdom, particularly in terms of patterns of student enrolment from both European Union and non-European Union countries. The new immigration and visa regulations significantly altered students' preferences for the UK as a study destination. 'Due to Brexit, students from the European Union are no longer classified as domestic students in the UK; they are now considered international students and are supposed to pay nearly double the tuition fees of domestic students. Also, their admission criteria have been leveled to match that of international students and to re-

main in the UK after finishing their studies, they need to switch to a different visa' [6]. For UK institutions, this may be a major issue, because international students contribute financially, diverse perspectives, and raise the institution's status internationally. 'The Higher Education Statistics Agency (HESA), has been recognised as the authoritative source for efficient statistics and analysis on higher education in the UK. It is established in 1993 and affiliated with Jisc. By actively collaborating with higher education institutions across the UK's countries, HESA creates a strong and accessible repository of data that empowers the data enthusiasts' [5].

'In March 2019, the United Kingdom's government unveiled its International Education Strategy (IES). The IES delineates two key objectives planned to be achieved by the year 2030. Firstly, it aims to escalate the annual value of educational exports to £35 billion. Secondly, it aspires to augment the annual enrolment figures of international students in higher education (HE) institutions within the UK to 600,000' [7]. Remarkably, 'the United Kingdom has recently achieved its ambitious target of enrolling 600,000 international students in higher education institutions, accomplishing this milestone a decade ahead of the projected timeline outlined in the International Education Strategy. The UK government continues to prioritize the implementation of IES, and significant advancements have been made in executing the action items outlined in the IES. The Department for Education (DfE) is working on green skills and technology programmes in line with international plans like Maritime 2050 with a primary focus on sustainability and climate change. In the realm of girls' education, the Foreign and Commonwealth Development Office (FCDO) has made major financial commitments and partnered with organisations to empower girls and young women, particularly in Rwanda and Pakistan. The Turing Scheme, which will receive £110 million in funding for the academic year 2022–2023, aims to increase chances for UK students to study and work abroad with a focus on social mobility. The programme is gaining more interest year after year' [7].' Another initiative, the Warm Welcome Scholarship Scheme, provides 68 scholarships for the academic year 2022–2023 to those who have moved to the UK. In the meantime, Study UK, which is supported by GREAT and the British Council, tries to promote UK education in significant markets including China, India, and the USA. Last but not least, the UK government executed a remarkable agreement on mutual recognition with India to support graduates from UK universities in India in their academic and professional pursuits. These broad initiatives, which address sustainability, gender equality, global mobility, and academic recognition, demonstrate

the UK's holistic approach to international education' [7]. 'The UK government announced the Graduate Route, a new post study work visa for international students, on September 11, 2019. With this visa, graduates can stay in the UK for two years after finishing their course, or three years if they have a PhD or doctorate degree' [8].

'The Erasmus+ programme, initiated in 1987 and expanded in 2014, supported educational exchanges between the UK and other countries. Under the Erasmus+ programme, 29,797 higher education students, mostly from France, Germany, and Spain, were hosted in the UK during the 2018–19 academic year. In contrast, 10,133 UK students went abroad for study placements with Spain, France, and Germany being the most popular destinations. Following Brexit, the UK stopped participating in Erasmus+ programme, with high expenses being the main justification. The Turing Scheme has been established as an alternative, concentrating only on outbound UK students, which caused concerns about a possible decline in inbound international students. The Welsh Government launched the Taith programme in February 2022, allocating £65 million to fund educational exchanges from 2022 to 2026. This programme aims to make student mobility easier for both incoming and outgoing students. The Scottish Government revealed their intentions to create its own international exchange scheme' [8].

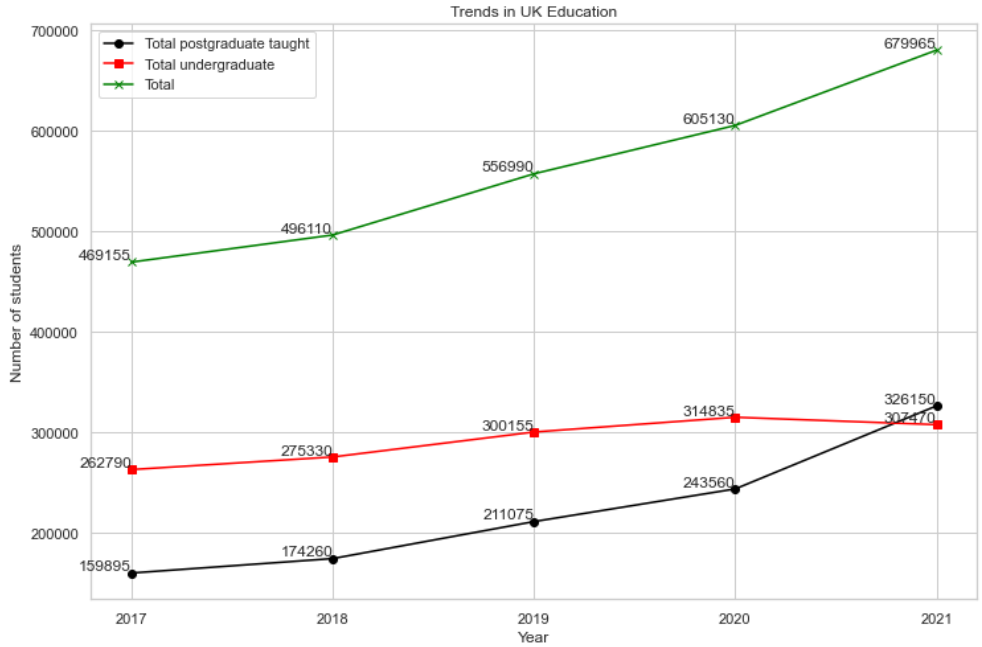


Figure 1: **International student enrolment in UK**

It is evident from the figure :1 that the United Kingdom has been experiencing a consistent uptrend in attracting international students over the years. Notably, when dis-aggregating the overall international student numbers into postgraduate and undergraduate categories, there is

a marked shift in trends post-2020. During the pre-Brexit time, the number of postgraduate and undergraduate students going parallel to each other. But in 2021, there is an unexpected change in statistics. There we have to understand the impact of Brexit.

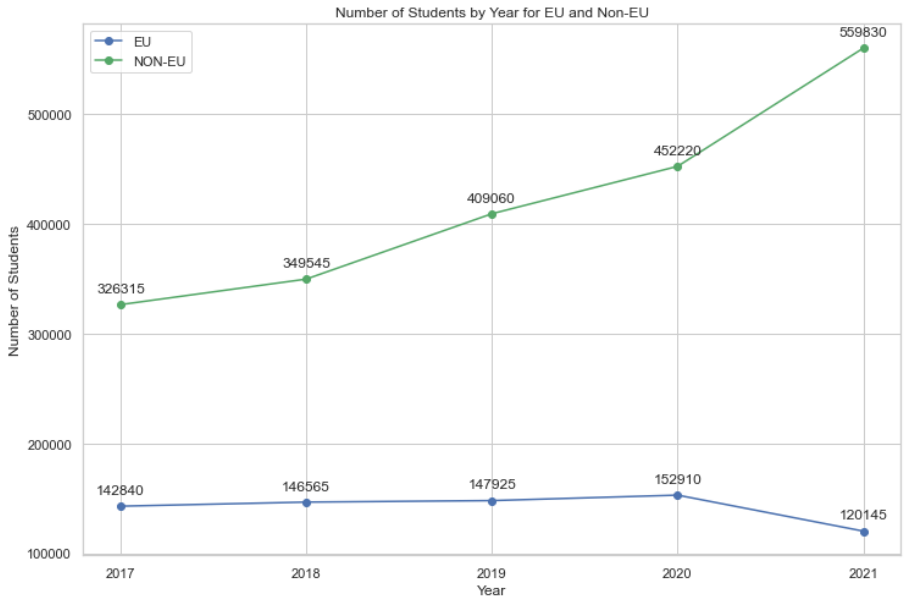


Figure 2: **Student enrolment from EU and Non-EU**

While the overall count of international students in the UK demonstrates an upward trajectory, a deeper analysis reveals varying impacts on different student demographics. The advent of Brexit has led to a decline in student enrolment from the European Union. The figure :2 is the visualization of student enrolment from EU and non-EU.The divergence in the year 2020 is a significant change that need serious attention and research in this field. 'The UK government's strategic focus on the implementation of the International Education Strategy (IES) has promoted a more welcoming environment for international students at large, particularly benefiting those from non-EU countries' [7]. When compared to the enrolment data in England, the total number of international students at the 30 universities in Northern Ireland, Wales, and Scotland is in the low thousand level. This numerical disproportion shows that the effects of Brexit on the enrolment of international students are likely to take different forms across these regions. So, in our study, we are more focusing on the universities in England.

1.1 Objectives

1. To conduct an evaluation of impact of Brexit on the enrolment patterns of International students in universities across the United Kingdom

2. To analyse the variations in the in-flow of students from both European Union and Non-European Union nations.

3. To employ predictive modelling techniques to forecast future enrolment trends of international students in UK Universities.

1.2 Structure of Thesis

This paper explores the study of 'Impact of Brexit on International student enrolment in the UK universities'. The study has been categorized as:
Chapter 1: Provides an introduction to the topic and defining the objectives.
Chapter 2: Discussing the papers related to our topic in Literature review and mentioning research questions.
Chapter 3: Describing the data and methods used for the analysis.
Chapter 4: Explaining the Observations and results of the analysis with discussing the research questions.
Chapter 5: Concluding the study with mentioning recommendations, limitations and further work for the future.

Chapter 2

Literature review

Brexit has created a wide range of ambiguities and challenges for the UK's higher education system, affecting international relationships, financing, and enrolment trends. There are numerous research works done regarding the impact of Brexit in UK higher education. This literature review aims to analyse multiple research papers to understand the consequences of Brexit on international student mobility, qualifications obtained, research funding, and the changing perceptions of the United Kingdom as an attractive destination for international students.

'An audit of international student mobility to the UK, work done by Prazeres and Findlay assessed pre and post-Brexit patterns using the HESA data and came to the conclusion that the Brexit vote decreased the number of EU students choosing the UK for higher education. They mostly attribute this decline on uncertainty around tuition fees and amendments to immigration rules' [9]. On the other hand, 'the journal 'International Student Applications in the United Kingdom after Brexit' by Amuedo-Dorantes and Romiti, concentrate primarily on the post-Brexit scenario providing evidence for the reduction in EU student enrolment through the analysis of UCAS application data. Their analysis goes a step further by measuring the influence of factors like tuition costs and visa requirements' [10]. 'Although a growth in Chinese enrolment has somewhat offset the drop in EU enrolment in the UK, the report warns that an excessive dependence on China has potential risks. It shows that the drop in students from other countries like India and Pakistan, due to strict visa policies, highlights the need for a diverse strategy to adapt to geographical and policy changes' [9]. Also,In their investigation, 'Amuedo-Dorantes and Romiti noticed that non-EU student applications have remained mostly steady, or have even raised in some cases. It suggests that rather than having an overall negative impact on international students, the impact of Brexit is mostly driven by changes in the UK's attractiveness as a study destination for EU students' [10]. Even though, the two studies used different data sources, they came to to the same conclusion: Brexit has caused a noticeable fall in the number of Eu students enrolling in higher education. 'The same concerns about the effects of Brexit on UK higher education are also expressed in Mayhew's research, which particularly notes difficulties in attracting faculties from the EU and a potential loss of access to EU talent. The paper suggests reducing these risks by establishing a sector-specific

agreement that permits free movement and has particular provisions for EU workers and students' [11].

'Hubble and Bolton used a broader perspective, looking at the financial and cultural benefits made by international students and highlighting in particular the difficulties caused by Brexit in terms of immigration rules and funding. They discussed about how the inconsistencies surrounding these regulations can put off future international students, which might have an effect on the financial stability and cultural variety of UK universities' [8]. ' Marginson explores deeper into the details, investigating how Brexit could affect academic partnerships and EU financing. According to his theory, Brexit might endanger not only the flow of EU students because of higher tuition costs, but also the crucial research funding and collaborations that UK universities have long enjoyed with their European counterparts. Marginson argue that the loss of such funds and partnerships might have a cascading effect on the UK's competence and desire as a study location. Both studies underline the risks and challenges that Brexit poses, but Marginson expands the topic to take into account the subsequent impacts on the academic and research environment, giving a more complete picture of the possible losses that may be sustained' [12]. The study by Corbett and Hantrais explores the various issues that Brexit presents for the UK's higher education system, with a special focus on academic research and financial stability.' The authors argue that not only in terms of student mobility but also in terms of academic partnerships and research funding. Additionally, they highlighted the significant economic consequences of the fall in the enrolment of overseas students, which has been continued in research funding in the post Brexit period. Reduced enrolment of international students might put a burden on university budgets, because they are a major source of income for UK universities. Beyond student counts, this study provide a detailed examination of the academic research and financial stability of the UK's higher education industry after Brexit' [13].

'Both Falkingham with his team and Gromek Broc examine the psychological impacts of Brexit on overseas students, paying particular attention to their future plans and enrolment concerns' [14] [15]. ' 'Falkingham use a mixed-methods approach to investigate how overseas students' intentions to remain in the UK after finishing their academic programmes have been influenced by the Brexit environment. They reveal that there is a sense of anxiety among students, especially those from the EU, as a result of the current uncertainties, mostly those

relating to visa rules and the UK's future relationship with the EU. this uncertainty has an unforeseen impact, as many EU students show a lesser desire to stay in the UK after graduation' [14]. While agreeing with this viewpoint, 'Gromek Broc expands the discussion to include future applicants, suggesting that this environment of insecurity and unpredictability may serve as a discouragement for future overseas applications as well. A major aspect that can deter potential students from ever considering the UK as a study destination. Both findings together imply that Brexit's uncertain impact affects present and prospective international students' psychological well-being and future goals in addition to policy and financial reasons' [15].

'Tu and Nehring in their study investigates how these people manage their transition from education to employment through in-depth interviews with Chinese graduates who either stayed in the UK or went back to China. The study reveals the ongoing uncertainty young graduates experience over their career options, which is caused by quick socioeconomic developments in both China and the UK. The unclear post-Brexit situation makes this uncertainty even worse. The study argues for a more welcoming post-study work policy for overseas students in the UK, particularly in context of the uncertain Brexit situation' [16]. Another article by Highman examines the 'UK universities' post-Brexit global marketing approaches, concentrating on their extensive collaborations with top European organisations. The study, which was conducted in 12 UK universities, attempts to determine which types of institutions are more likely to develop such strategic relationships and how they select their collaborators. The paper highlights how universities uniquely balance competition and collaboration, unlike traditional businesses that focus solely on competition for profit. Also, explores how UK institutions are establishing strategic international collaborations to sustain their prominence in the post-Brexit environment' [17]. 'The study of Pigden and Jegede focuses on the needs of combined honours degree students in UK institutions, especially in the context of post-Brexit challenges. The authors points out that International students are essential to the future success of UK higher education institutions. The performance of UK institutions in the post-Brexit future, will be significantly influenced by their capacity to draw and keep these students' [18]. The article shares a distinctive viewpoint on the recruitment strategies of universities in the United Kingdom for international students. This study conveys the important role that urban environments play in attracting international students and influencing these strategies.' As Brexit introduces additional uncertainties, urban environment can provide the UK universities with

beneficial approaches to manage Brexit related challenges. Thus, by studying how geographic and urban factors might be utilised in a shifting political environment to maintain or even increase the number of international students, this paper adds a significant contribution to the literature' [19]. The study by Corbett and Gordon provides an in-depth review of how the UK's higher education and research sector is navigating the post-referendum situation within the context of Brexit. 'More than 18 months after the UK voted on EU membership, the study focuses into two major issues: the EU's university sector's response to Brexit and the UK's efforts to globalising its academic realm as a response to domestic concerns brought on by the vote. This research discusses whether or not the academic and research sectors in the UK and Europe have drastically divided or have managed to keep up their cooperative relationship. The paper suggests that while there are initiatives to regulate and minimise the internal consequences of Brexit, its associated uncertainties continue to cause difficulties for both educational systems of the UK as well as EU' [20].

In this section we reviewed a range of publications about the effect of Brexit on the UK higher education. The discussion several times demonstrates that 'Brexit has had an adverse impact on the UK's higher education system, like reduced EU student enrolment, difficulties with faculty recruitment and research funding' [9] [11] [12]. While some gaps are being filled by non-EU students. 'The psychological impacts, affecting both present and aspiring students' future plans and even the UK's attractiveness as a popular study destination' [15]. These studies points to the importance of strategic adaptation in the UK higher education industry to address the various difficulties imposed on by Brexit. It is important to take a closer look at recent initiatives form the UK government, such as the 'International Education Strategy, the Turing Scheme to replace the Erasmus+ programme, and the Warm Welcome Scholarship scheme' [7] [8]. We must examine the most recent enrolment statistics on hand in order to assess how effective these strategies are. In this dissertation, we are going to investigate on patterns and trends in international students' enrolments at UK institutions, including those from both EU and non-EU areas, as well as trends in international students' enrolments by individual nations.

2.1 Research questions

Based on the review of literature, we employ various modeling methods to predict and forecast trends and patterns, aiming to answer the following research questions:

Q1 : What is the impact of Brexit on the enrolment of International students in the UK universities?

Q2 : How does the impact of Brexit on international student enrolment vary across different countries and educational disciplines?

Q3 : How will Brexit impact future enrolment pattern in higher education institutions?

Q4 : In the post-Brexit period, has there been a change in the preference of international students while choosing the UK universities?

Chapter 3

Methodology

This chapter includes the processes of data collection, data preparation, feature selection, and selecting the most appropriate models. All analytical tasks were carried out using Python.

3.1 Data collection

All the data was sourced from the 'Higher Education Statistics Agency (HESA)' [21]. The data is organized into two main categories. First, the HE student enrolments based on domicile and the region of the higher education provider, distinguishing between Postgraduate and Undergraduate students enrolments from EU countries and those from non-EU countries. Another significant data-set sourced focuses on international student enrolments at UK universities. The data collected separately for Postgraduate and Undergraduate student enrolment across Universities in England, Scotland, Wales, and Northern Ireland. There was a grand total 96 of data-sets collected for different categories.

3.1.1 Student enrolment: domicile-based data

In the initial stages, we procured raw data-sets detailing enrolments of both PG and UG students from EU nations.These data-sets contain 33 rows and 6 columns. In parallel, we also gathered data-sets for PG students from non-EU countries, which consisted of 207 rows and 6 columns. The data-set for UG students from these non-EU regions was slightly more compact, containing 197 rows and 6 columns. For all these data 6 columns represents the Domicile, region of HE provider: England, Scotland, Wales, and Northern Ireland, then Total United Kingdom. We have a similar data-set for each academic year spanning 2014/15 to 2021/22,this total contributes 32 data-sets.

3.1.2 Student enrolment: University-based data

The raw files for university enrollments in the UK's major regions have been described, including details on the number of rows and columns in each data-set. In England, the data-set tracking postgraduate student enrolment contains 210 rows and 13 columns, while the undergraduate student data-set has 240 rows and 13 columns. Northern Ireland's data-sets are significantly

smaller, with both PG and UG enrolment data-sets having just 7 rows but maintaining the 13-column structure. In Scotland, both PG and UG enrolment data-sets have 21 rows and 13 columns each. Finally, Wales has a data-set of 11 rows and 13 columns for PG enrolment and a slightly larger data-set for UG enrolment with 14 rows and 13 columns. Each data-set maintains a consistent structure with 13 columns. These columns represents the student counts from England, Scotland, Wales and Northern Ireland. Additionally columns represent for the data on students from the European Union, those from outside the European Union, and a category for students whose origin is not known. The data-sets also provide columns that aggregate this data into a 'total UK' count, a 'total non-UK' count, and a 'grand total' that include all students. Each kind of data-set over the 8 years, from 2014/15 to 2021/22 contributes to 64 data-set in this University based data.

3.2 Data preparation

We aim to create two data-sets from the 32 files described in 'Student enrolment: Domicile based data'. The first data-set focuses on student enrolment from European countries, while the second targets Non-EU countries. For the European data-set, we'll utilize 16 data-sets specific to EU countries. Make modifications in each file such as, remove the last row labelled as 'total', exclude last column titled 'Total United Kingdom', then remove any rows where all columns have zero value. Subsequently, merge these data-sets into a single file. The final data-set will consist of 30 rows and 65 columns. Columns 2 to 33 will represent Postgraduate (PG) students enrolment from 28 EU countries in England, Wales, Scotland, and Northern Ireland from 2014 to 2021. The remaining columns (34 to 65) will represent Undergraduate (UG) students from EU countries for the same years.

A second data-set has been created by focusing on those Non-European countries that send a minimum of 5000 students across England, Wales, Scotland and Northern Ireland in the academic year 2021/22. The data was prepared by filtering the countries with threshold value set to 5000, then exclude the last row and the last column as they contain sum values in 16 data-set of Non-EU countries. Finally, we combine the files into a single consolidated data, detailing PG and UG student enrolment from 15 different non-European countries across England, Wales, Scotland, and Northern Ireland. The columns from 2 to 33 capture the Postgraduate student enrolment spanning from 2014 to 2021. The subsequent columns, (34 to 65) cover the Under-

graduate student enrolment for the same time-frame.

Next two data-sets are prepared by using the 64 files described in Student enrolment: University-based data, corresponding to the data of 288 educational Institutions in the UK. Majority of Institutions are located in England, So we are creating a separate data-set for England, and another one for Institutions across 3 other nations in the UK. For the 3rd data-set the university selection is based on:

1. Filter the universities with a minimum of 500 international students during the academic year 2016/2017.

2. From this subset, narrow down to the top 20 universities that showing the highest growth in international student enrolment from 2016 to 2021.

After shortlisting 20 universities,we filter them across 16 data-sets, each detailing both postgraduate and undergraduate student enrolment. These 16 files will then be merged into a single consolidated file. In the consolidated file retain only the columns representing EU and non-EU student enrolments spanning the years 2014 to 2021. The final data-set have 21 rows and 33 columns. For the 4th data-set, describing student enrolment from the three other UK regions (Northern Ireland, Wales, and Scotland), modify the remaining 48 raw data files in the following manner:

1. Omit the universities that have no non-UK students enrolled.

2. Exclude open University from the data.

3. Retain only the columns that pertain to EU and non-EU student enrolment.

After the modifications, merge the 48 data-set into one unified file with 30 rows and 34 columns. The columns 3 to 18 will detail the enrolment of both EU and non-EU Postgraduate students. Meanwhile, columns 19 to 34 will illustrate the enrolment figures of EU and non-EU Undergraduate students across the 29 selected Universities from Northern Ireland, Wales, and Scotland. All the data was prepared using python and Microsoft Excel.

As we prepared our data-set with significant variables only, we don't have to perform feature selection process like correlation analysis, principal component analysis, etc. By focusing

on important variables, we can minimize the issues of over-fitting of data. We have chosen four variable for university based data- postgraduate students from European Union and non-European Union. Similarly undergraduate students from European Union and non-European Union. Domicile based data contain postgraduate students and undergraduate students from England, Wales, Scotland, and Northern Ireland. The distinction between Postgraduate and Undergraduate student enrolments from the European Union and Non-European Union countries is another significant feature. This will help us to identify if the impact of Brexit varied depending on the level of study.

3.3 Model selection

The analytical process of the topic required an appropriate selection of statistical and machine learning models to ensure accuracy in findings and relevant to the research questions.

Statistical t-test: 'The t-test, also known as the t-statistic is a popular method to determine if the average values of two groups are significantly different. We can identify if these differences are significant or not in terms of statistics by running a t-test according to the nature of the group. There are different kind of t-test, namely one sample test, two sample test, and paired t-test. In one sample test only one group compared against a standard value, while two sample test is performed when the two groups are independent. For two dependent group, paired t-test is carried out' [22].

We are going to use two sample independent t-test and the expression is given by,

$$t = \frac{(\bar{X}_1 - \bar{X}_2)}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}}$$

$\bar{X}_1, \bar{X}_2$ = mean values of pre-Brexit group and post-Brexit group.

$$\bar{x}_1 = \frac{1}{n_1}\sum_{i=1}^{n_1} x_i \qquad \bar{x}_2 = \frac{1}{n_2}\sum_{j=1}^{n_2} x_j$$

s_1^2, s_2^2 = variance of pre-Brexit group and post-Brexit group.

$$s_1^2 = \frac{1}{n_1 - 1}\sum_{i=1}^{n_1}(x_i - \bar{x}_1)^2 \qquad s_2^2 = \frac{1}{n_2 - 1}\sum_{j=1}^{n_2}(x_j - \bar{x}_2)^2$$

n_1, n_2 = Size of pre-Brexit group and post-Brexit group

'The p- value is calculated using the t-distribution, the calculated t- values and the degrees of freedom. The degrees of freedom is is calculated as, $(n_1 + n_2 - 2)$. If the p-value is less than 0.05, then the difference between the two group is statistically significant' [23].

Growth rate analysis: 'A quantitative method for evaluating the pace at which a particular statistic changes over a given time period is growth rate analysis. These growth rates may take the form of positive or negative values, corresponding to a rise or a decrease in the relevant variable, respectively' [24]. In this study the growth rate analysis will provide a detailed information regarding the enrolment trend in different universities. To find the growth rate we used the following expression,

$$\text{GR} = \left(\frac{\text{Final period value} - \text{Initial period value}}{\text{initial period value}} \right) \times 100$$

Final value is the enrolment number at the end period and initial value is the enrolment number at beginning of the period.

Linear regression model: 'A linear regression model aims to describe the relationship between a dependent variable, y, and an independent variable, X. The method involves analysing the data and fitting a linear equation to it. The general representation of a linear regression line is in the form,

$$y = a + bX$$

Where X is the independent variable, y is the dependent variable, b is the slope and a is the intercept' [25]. In our study we are using the data for 20 universities in England, which have more than one predictor variable. So, implementing multiple linear regression is the best option. 'The multiple linear regression is represented by,

$$y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + ... + \beta_k x_k + \epsilon$$

Where y is the variable to be forecast, $x_1, x_2, ..xk$ are the predictor variables, and the coefficients $\beta_1, \beta_2, ..\beta_k$ measure the marginal effect of the predictor variables' [26]. 'The mean absolute error and R-squared errors are used to determine the accuracy of the model. For that, we used the equations,

$$MAE = \frac{1}{N}\sum_{n=1}^{N}|y_n - \hat{y}_n| \qquad , \qquad R^2 = 1 - \frac{\sum_{n=1}^{N}(y_n - \hat{y}_n)^2}{\sum_{n=1}^{N}(y_n - \bar{y})^2}$$

Where y is the target variable, $\bar{y}$ is the mean value and $\hat{y}$ is the predicted y value' [27].

Polynomial regression model: 'A polynomial regression can be adapt in a situation where linear regression model fails to provide an adequate fit to a set of observations. Polynomial regression is a type of linear regression. It is used to make predictions if the dependent variable can be written as a linear function of powers of the independent variable. The relationship can be expressed for n observations in the form of,

$$y = \beta_0 + \beta_1 X + \beta_2 X^2 + \beta_3 X^3 + ..\beta_n X^n$$

Where $\beta_1, \beta_2, ..$ are the regression coefficients, X is the independent variable, and y is the dependent variable' [28]. 'The accuracy of the model is determined by calculating the R-squared error.

$$R^2 = 1 - \frac{\sum_{n=1}^{N}(y_n - \hat{y}_n)^2}{\sum_{n=1}^{N}(y_n - \bar{y})^2}$$

Where y is the target variable, $\bar{y}$ is the mean value and $\hat{y}$ is the predicted y value' [27].

Time-series exponential smoothing model: 'Identifying the time varying nature of the data, especially for university-specific enrolment, the time-series exponential smoothing method was chosen. Exponential smoothing is one of the most successful forecasting methods. Forecasts obtained with the use of exponential smoothing techniques are weighted averages of past data, with the weights dropping exponentially with time. So this method provides a fast, better forecast for time-series data. In the exponential smoothing method, we specifically selected additive method in the Holt-Winters' seasonal method, as it capture seasonality. The method includes the forecast equation and three smoothing equations, one for the level l_t, one for the trend b_t, and one for the seasonal component s_t with corresponding smoothing parameters α, β^* and γ' [29].

'The four expressions for the additive method is given by,

$$\hat{y}_{t+h|t} = l_t + hb_t + s_{t+h-m(k+1)}$$

$$l_t = \alpha(y_t - s_{t-m}) + (1-\alpha)(l_{t-1} + b_{t-1})$$

$$b_t = \beta^*(l_t - l_{t-1}) + (1 - \beta^*)b_{t-1}$$

$$s_t = \gamma(y_t - l_{t-1} - b_{t-1}) + (1 - \gamma)s_{t-m}$$

The level equation shows a weighted average between the seasonally adjusted observation $(y_t - s_{t-m})$ and the non seasonal forecast $(l_{t-1} + b_{t-1})$ for time t' [29]. 'ARIMA and SARIMA models are excellent popular methods for forecasting. These models trying explain the auto correlations in the data. ARIMA known for analysing non-seasonal data, while seasonal data analysed by the seasonal ARIMA. In our research we opted not to include these models. The primary reason is the limited sample size of our data-set. Using our current available data we are unable to find the necessary p, d, q values for the models. Executing an analysis using these models is not feasible' [30] [31]. The careful model selection process was adopted to meet the unique needs of our project. Each model was chosen based on its potential to provide the accurate and insightful results.

Chapter 4

Analysis

The Analysis chapter will discuss the observations and results of the analysis and addressing the research questions.

4.1 T-test analysis

The T-est analysis provides a foundational understanding of the impact of Brexit on student enrolment from different non-EU countries in the UK universities.The method is employed for the comparative analysis of student enrolment in different universities in the pre and post Brexit period. The pre-Brexit period is considered as 2014-2019 and post-Brexit period is considered as 2020 and 2021. Also, same method used in the domicile based data to find the countries with significant difference between the two time period. This initial analysis give preliminary insights whether the Brexit had significant impact on student enrolment. Following the t-test the visualization of region-wise data is carried out using basic statistical approach, which provide more clear understanding about the impact of Brexit. The p-values obtained from the t-test provide a statistical basis to identify countries where student enrolments have been significantly affected after post-Brexit.

We have used a two sample independent t-test and the expression is provided by,

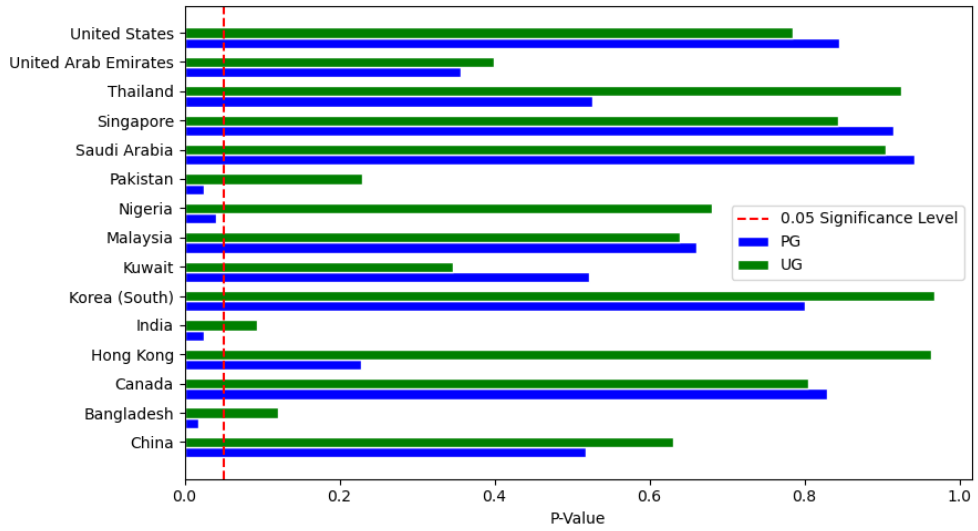
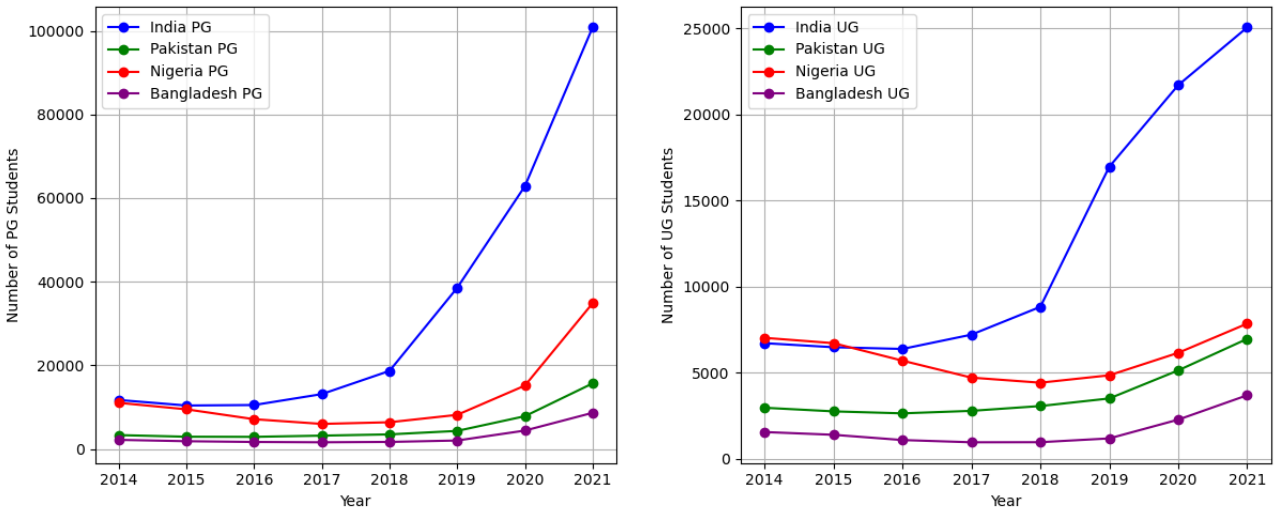


Figure 3: **PG & UG student enrolment from non-EU countries: Pre and Post Brexit comparison**

In figure :3 there is 4 countries, India, Pakistan, Bangladesh and Nigeria have p-value below the 0.05 threshold, indicating a significant difference in the PG student enrolments between the two periods leading to the point that these countries might have experienced a considerable impact due to Brexit. For other countries including China, the enrolment trend is not much affected.The leading country for sending students to the UK is China. However, China's growth pattern has not undergone any significant modifications. So, China is less influenced by Brexit than other countries.

The UG student enrolment does not showing any countries with significant impact of Brexit. But considering the p-values , the same countries mentioned for PG enrolment except Nigeria showing least values, which indicating that enrolment numbers for these Asian countries varied significantly. It is a preliminary analysis in identifying the impact, also, it required deeper analysis to find the trends and pattern.



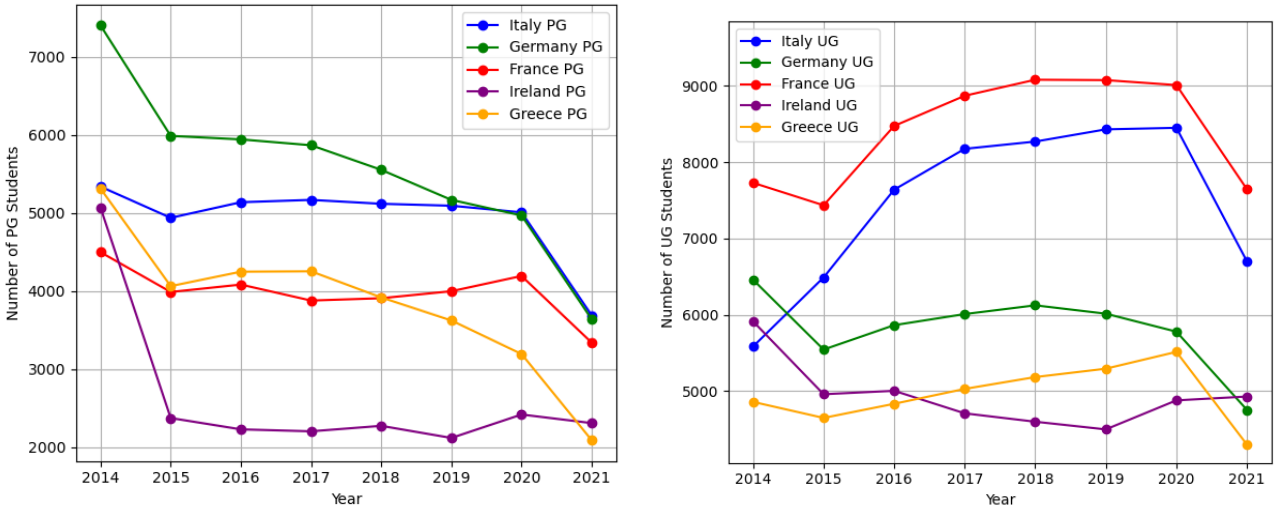
(a) **PG students enrolment trend** (b) **UG students enrolment trend**

Figure 4: **Yearly student enrolment growth of top 4 Brexit influenced countries**

Figure:4 (a) shows a considerable rise in Indian students enrolling starting in 2018, with the biggest increase seen during the academic year 2020–21. Over the previous eight years, the patterns for Nigeria, Pakistan, and Bangladesh have been mostly similar. Figure:4(b), the yearly UG enrollment has a similar pattern, but the actual numbers are far smaller than the PG enrolment. These data highlight the dominant role of these countries in sending students to pursue higher education at the UK universities.

Figure :5(a) indicates a clear impact of Brexit on student enrolment from EU countries. Ireland

is the only country that has maintained stability both before and after Brexit. All other nations display a significant reduction in student counts in 2021. After experiencing a major decline in student numbers in 2015, all nations maintained consistency until the implementation of Brexit. The figure: :5(b), UG enrolment trend of students from EU nations.The UK enrols more undergraduate (UG) students than postgraduate (PG) students, mainly from France and Italy. Except for 2015, Ireland's enrolment trend has remained steady. Furthermore, the number of students coming to the UK after 2020 has dramatically decreased. These two findings show that Brexit has had an unfavourable impact on students from the EU, including both PG and UG students.



(a) **Yearly PG student enrolment** (b) **Yearly UG student enrolment**

Figure 5: **Yearly student enrolment of top 5 European Union countries**

In Figure :6, an analysis of 20 universities in England offers a clear perspective on post-graduate student enrolment. Notably, every university observed a marked discrepancies in the recruitment of non-EU students. Most of the universities having p value very close to zero indicating significant impact of Brexit. But only few universities, especially located in London areas experienced difference in enrolment numbers. Still there are universities with notable changes in attracting both EU and non-EU students. It is clear that the trend of student recruitment changed mainly for non-EU students.

Another trend in this area indicates that EU students are more likely to be enrolled in under-graduate degrees at universities in the UK. Most of the universities have p-value between 0.1 and 0.4 for UG students from EU regions, means the change in enrolment pattern is almost same for these universities. Refer the appendix for the visualization (Appendix 1).

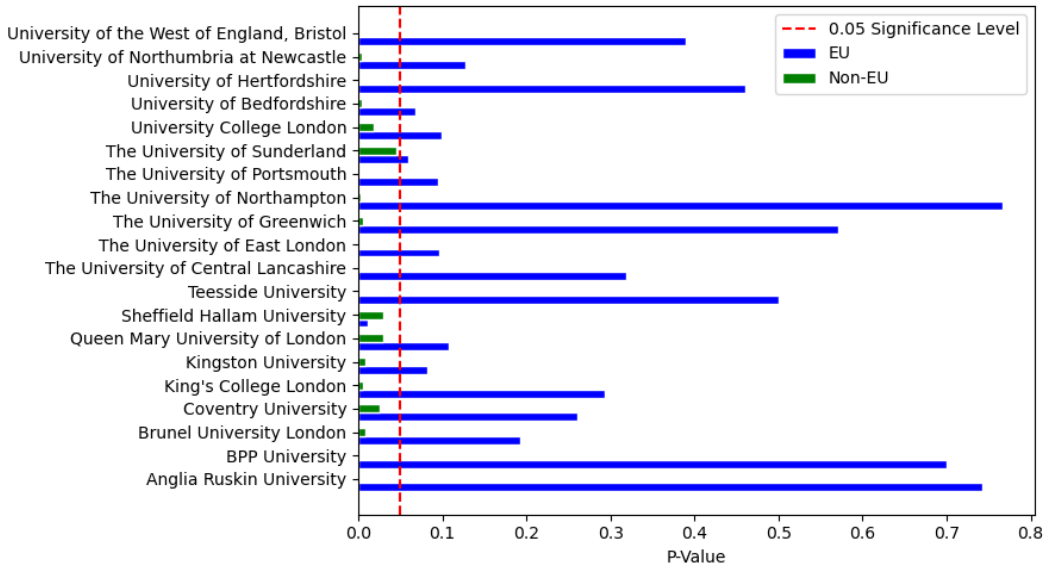


Figure 6: **PG student enrolment from EU & non-EU countries: Pre and Post Brexit comparison**

4.2 Growth trend analysis

The growth trend analysis provides details on the shifts in university enrolment trends following Brexit. We are calculating the growth rate after Brexit, so that, our beginning period is taken as 2020 and end period taken as 2021. Here we considered the universities having at least 50 European Union and non-European Union students in 2014 and applied the equation that we discussed in the methodology for both postgraduate and undergraduate students from EU and non-EU regions.

As depicted in Figure :7, there are observable changes in student intake from both EU and non-EU regions at both postgraduate (PG) and undergraduate (UG) levels. This figure distinctly presents two separate enrollment trajectories for each university. Of the 20 universities analysed, only Kingston University demonstrated an upward trajectory in postgraduate student enrollment from EU nations. In contrast, the University of Bedfordshire and Anglia Ruskin University experienced the most substantial declines in this segment, with reductions of 65% and 51%, respectively. The enrolment trend for undergraduate (UG) students from EU regions mirrors that of postgraduate students across universities. A significant portion of the universities reported a 25% to 50% decline in EU UG student enrollment. Brunel University London recorded the steepest decrease, with a 70% reduction. When comparing between education levels, it is evident that the inflow of UG students from EU countries to UK universities has been more adversely impacted than their postgraduate students. The decline is consistent across

most of the Universities.

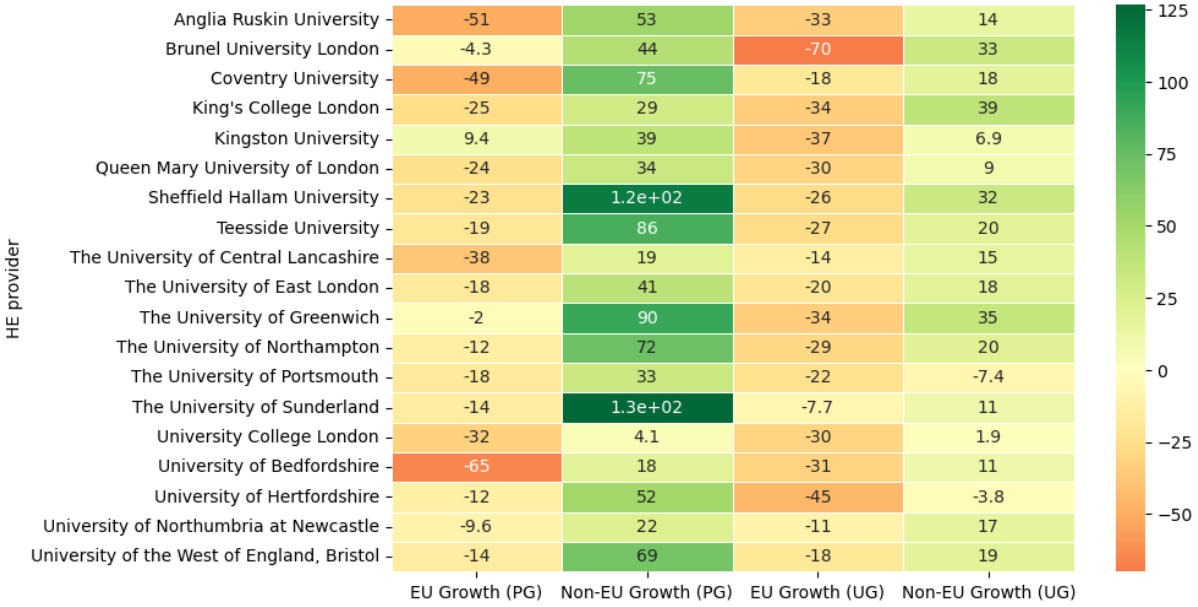


Figure 7: **PG & UG enrolment growth in the 20 selected Universities after Brexit**

A contrasting trend is observed for incoming students from non-EU countries, with all universities on the list experiencing an upward trajectory in enrolment. University College London stands out as the sole institution with a negative growth rate in single digits. Impressively, nearly half of the universities reported growth rates exceeding 50%. Specifically, The University of Sunderland and Sheffield Hallam University recorded substantial increases, with growth rates of 130% and 120% respectively after Brexit. A notable portion of these students are opting for universities located outside of London. The enrolment numbers for undergraduate students from non-EU countries display a modest upward trend, there are exceptions, such as the University of Hertfordshire and The University of Portsmouth. It is important to note that there are more undergraduate students coming to the UK, attending both universities inside and outside the London area. In relative terms Postgraduate student enrolment has increased exponentially after the Brexit.

4.3 Predictive models

4.3.1 Linear regression model

Through this analysis we are trying to create a model that can be forecast the future enrolment. To create an accurate model, we separated the data into training data and testing data. The

data from 2014 to 2019 is taken as training data and the data from 2020 to 2021 is taken as test data. The analysis performed for both PG and UG level of study. Finally, we predicted the test data with the model created using the training data. Subsequently, the predicted values were compared with the actual enrolment data by calculating the error to assess the efficiency and accuracy of the predictive model.

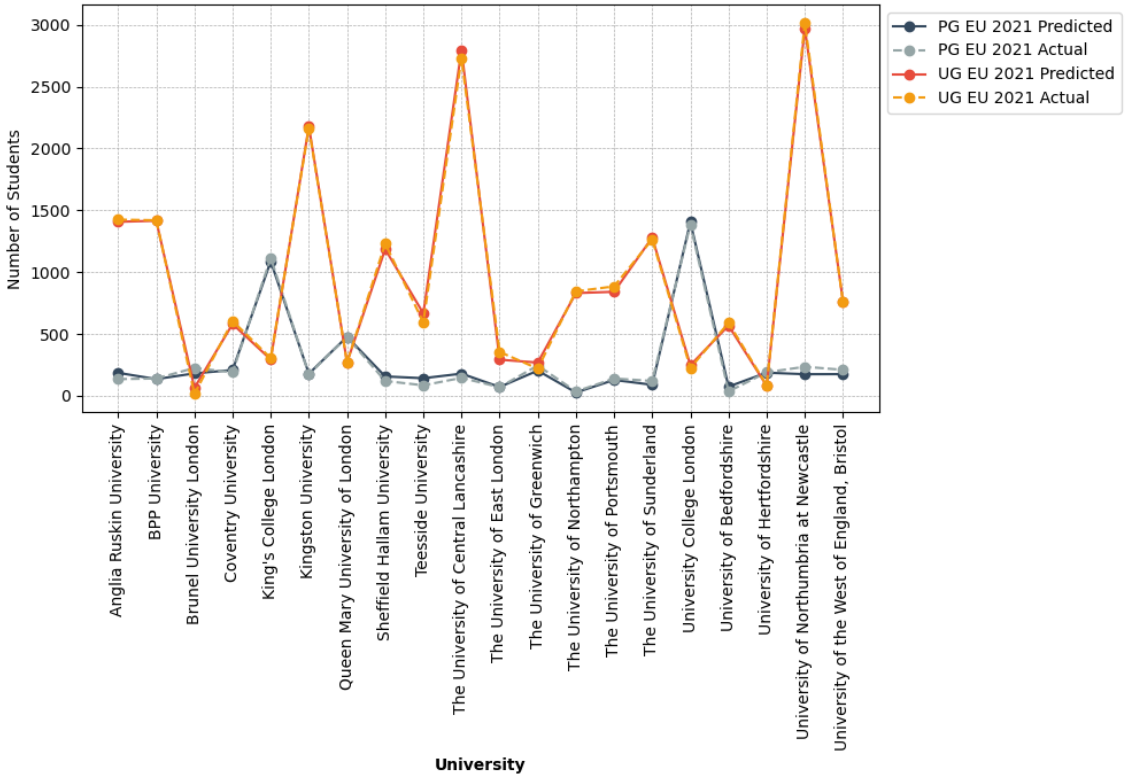


Figure 8: **Predicted vs actual enrolment for EU students in 2021**

Figure :8 illustrates the comparison of predicted versus actual enrolment numbers in 2021 for EU students. The model demonstrates better precision in forecasting postgraduate student enrolment, achieving the R-squared error value of 0.9591. It exhibits even more superior performance for undergraduate students, with an R-squared value of 0.9937. These values indicating the model's capability for accurately predicting enrolment trajectories in subsequent periods. Furthermore, the figure provide insights into universities that are particularly attractive to EU students. Notably, Kingston University , The University of Central Lancashire, and the University of Northumbria at Newcastle are the preferred choices for postgraduate students. Conversely, King's college London and University college London are the only two colleges having more than 500 UG students. Refer the appendix for the visualization of predicted versus actual enrolment for non-EU students in 2021.

Table 1: **Comparison between the predicted and actual values of UG student enrolment from EU and non-EU in top 10 selected universities**

University	EU 2020		Non-EU 2020		EU 2021		Non-EU 2021	
	Predicted	Actual	Predicted	Actual	Predicted	Actual	Predicted	Actual
University of Northumbria at Newcastle	3308	3380	8404	8385	2973	3015	9805	9785
The University of Central Lancashire	3390	3165	5226	5325	2794	2730	5977	6100
Kingston University	3385	3425	6203	6195	2179	2165	6609	6620
BPP University	2550	2600	1069	1100	1415	1420	917	1015
Anglia Ruskin University	2104	2135	1086	1070	1407	1425	1258	1225
The University of Sunderland	1362	1370	2304	2385	1280	1265	2524	2640
Sheffield Hallam University	1391	1670	1833	1745	1185	1230	2303	2295
The University of Portsmouth	1068	1140	2773	2445	841	885	2935	2265
The University of Northampton	1226	1190	1389	1375	830	845	1719	1655
University of the West of England, Bristol	952	925	2372	2420	763	760	2748	2875

Table:1 representing the comparison of UG student enrolment from both European Union and non-European Union for 2020 and 2021. The predictions are generally very close to actual values which indicating that the model is suitable for forecast. The common trend observed for all universities is that the European Union students enrolled in 2021 is lower than the previous year. All universities experienced similar fall in the enrolment numbers. But during this time non-European Students showing more interest in the UK universities after 2020. University of Northumbria at Newcastle, The university of Central Lancashire, and Kingston University are in the top positions in recruiting both European and non-European Union students.

Table 2: **Comparison between the predicted and actual values of PG student enrolment from EU and non-EU in top 10 selected universities**

University	EU 2020		Non-EU 2020		EU 2021		Non-EU 2021	
	Predicted	Actual	Predicted	Actual	Predicted	Actual	Predicted	Actual
University College London	2036	2035	9494	9565	1406	1385	9964	9960
King's College London	1471	1480	5717	5580	1087	1115	7334	7210
Queen Mary University of London	627	625	3252	3410	477	475	4281	4560
Coventry University	378	375	3825	3765	208	190	6248	6590
The University of Greenwich	251	250	3105	3295	203	245	5297	6265
University of Hertfordshire	220	215	5740	6395	187	190	8248	9705
Anglia Ruskin University	234	275	2763	2870	185	135	4565	4385
Brunel University London	221	235	3059	2635	181	225	5149	3785
The University of Central Lancashire	226	235	2963	2985	179	145	4245	3560
Kingston University	205	160	3265	3125	178	175	3917	4355

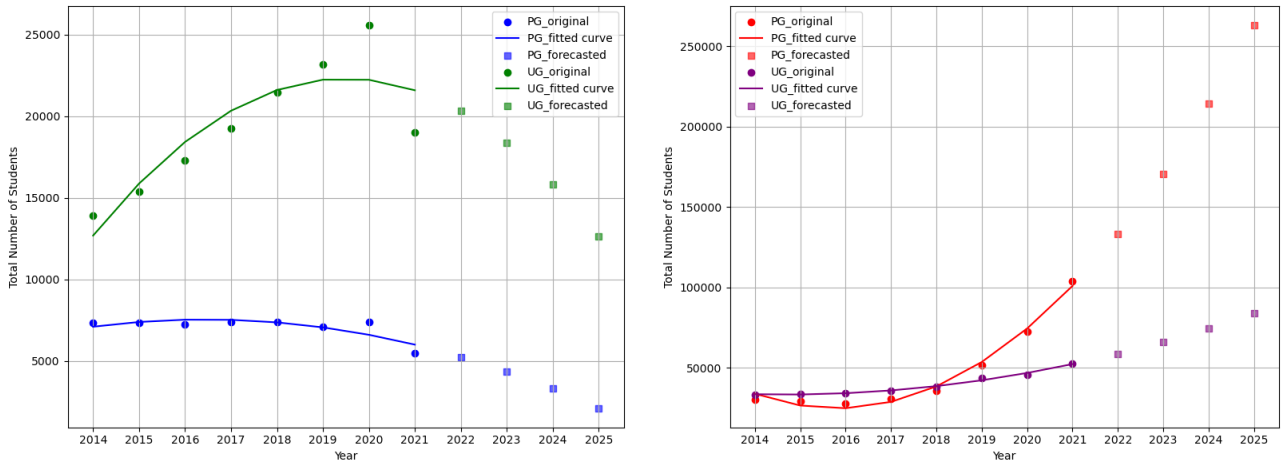
Table :2 is the PG student enrolment from EU and non-EU regions. The table shows that in 2021 the Coventry University and University of Hertfordshire became more popular

among non-EU students. As compared to the UG enrolment the immigration of PG students from European Union is significantly low. More EU postgraduate students concentrated on universities in London. The location not influenced in the case of non-EU students. The hike in non-EU enrolment is reflected in all universities across England. The model successfully predicted the enrolment trend in each university with high accuracy.

With the implementation of new policies and regulations in the existing system, the annual inflow of international students exhibits variability, creating challenges for accurate forecasting using a linear model. Still,the model is capable of identifying linear trends and enabling precise projections for subsequent time periods.

4.3.2 Polynomial regression model

The Polynomial regression model performs better at forecasting future trends than the previous model since it captures the underlying patterns more precisely. The analysis is performed on the data of 20 universities in England. The feature X in this analysis represent the years from 2014 to 2021, while y represents the total number of students enrolled in each year. The observations we plotted in two graphs for European Union and non-European Union with total number of PG and UG students enrolling each year in these universities. Then the polynomial curve fitted on these points using the trained polynomial regression model. Finally, we extended the plot for future forecasting with step size given as 4. The trained model is used to predict the future enrolment numbers up to the step size. Here we plotted the future trend till 2025.



(a) **PG & UG students from EU region** (b) **PG & UG students from non-EU region**

Figure 9: **Fitting the curve and forecasting the future for student enrolment**

The demonstrated figure :9(a) gives a detailed analysis of the number of students enrolled

in undergraduate and postgraduate programs from the European Union. We find significant variations in the numbers for both groups over time. The polynomial model accurately predicts the pattern of the PG student count up to 2020 with a 0.65 accuracy. Forecasting the future also takes into account the fact that enrolment began to decline after 2020. On the other hand, a polynomial model with a 0.79 accuracy shows that UG enrolments will continue to rise until 2020. After 2020, this growth tendency abruptly declines. According to predictions based on these trends, the number of undergraduate students might likely decrease by half by 2025 as compared to 2020 statistics.

The figure :9(b), providing interesting insights about the student enrolment from non-European Union regions. In contrast to enrolments from the EU, non-EU enrolments exhibit a strikingly steady growth pattern over time. This recurrent pattern is characterised by a strong and continuous upward trend, demonstrating a constant and growing interest from non-EU students in seeking educational opportunities in the UK universities.

The near-perfect R-squared error values of 0.99 for both the postgraduate (PG) and undergraduate (UG) classifications further validate the trend's consistency. These results imply that the polynomial regression model is nearly perfect in the representation of the non-EU enrolment patterns. The student enrollment is anticipated to double between 2021 and 2024, evidenced by the exponential rise of PG student enrolment.

4.3.3 Forecasting: Exponential smoothing model

The exponential method helps in predicting and forecasting the future enrolment numbers individually for specific universities. We have used the data from 2017 to predict and forecast the student enrolment. Using the additive method we fitted the model and predicted the future enrolment for 2022 and 2023. Finally we visualized the trend pattern for top 5 universities in student enrolment in the academic year 2023.

Figure :10 highlights the enrolment trends of PG students from EU regions across the top 5 universities. From 2014 to 2020, most universities had consistent enrollment numbers, but a decline is observable from 2020 onwards, with the exception of Northumbria University at Newcastle and the University of Greenwich. Importantly, four of these top institutions are based in London.Despite the general decline, University College London and King's College London remain the most preferred, each of them with over 1000 PG students. Predictions for 2023 suggest that these two universities will continue to be the top choices for PG students.

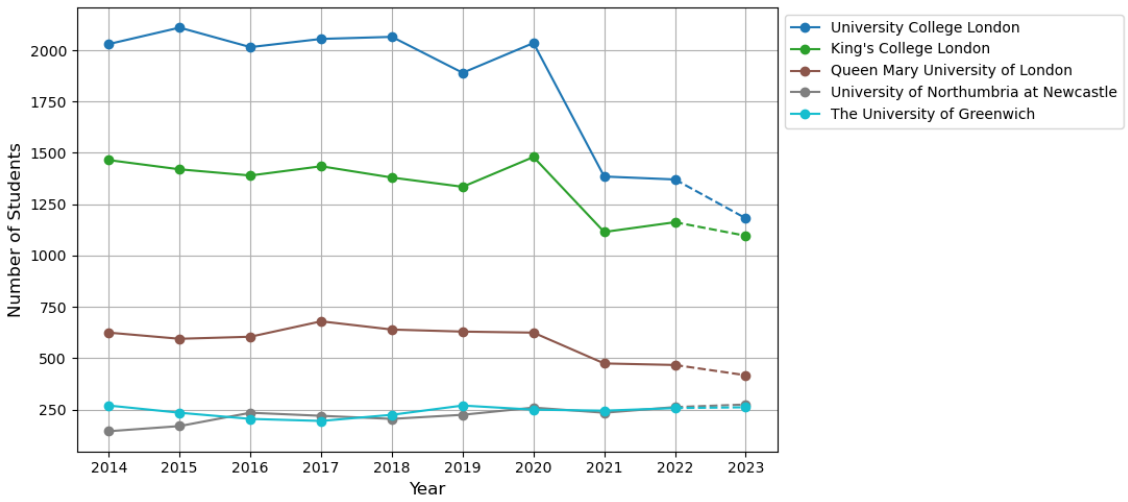


Figure 10: **Enrolment of PG students from EU region in top 5 universities**

Figure :11 shows a significant increase in PG enrolments for each of the five universities after 2020. It is interesting to note that University College London's growth rate appears to have slowed down following Brexit. It is clear that the university's ranking has little influence on the PG students who are not EU citizens. Teeside University, Coventry University, and University of Hertfordshire are three of the five institutions with the lowest rankings; even though non-EU PG students are progressively choosing these universities.

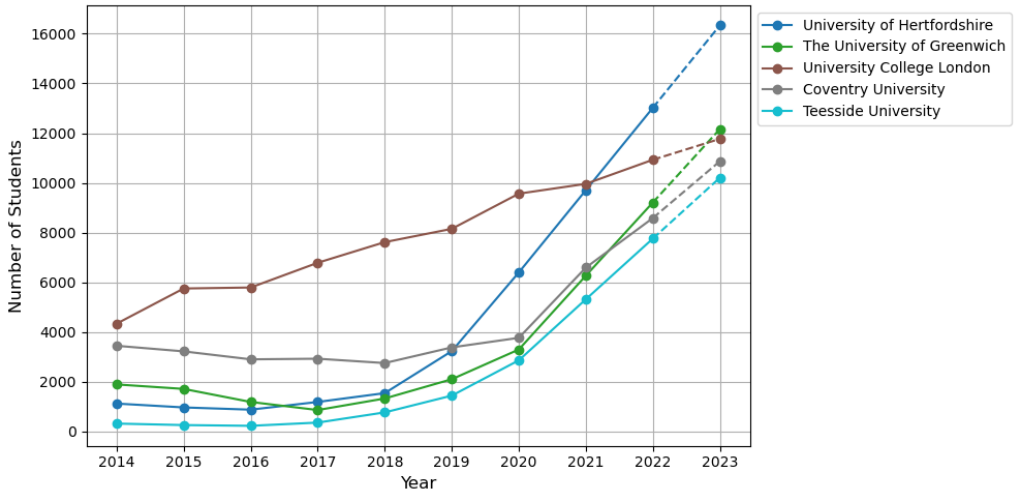


Figure 11: **Enrolment of PG students from non-EU region in top 5 universities**

The forecasts indicate that each of these top 5 universities will break the 10,000 PG student level by 2023, despite the fact that no university attained this goal in 2021. Particularly, the University of Hertfordshire stands out with a forecasted enrolment of 16,335 students.

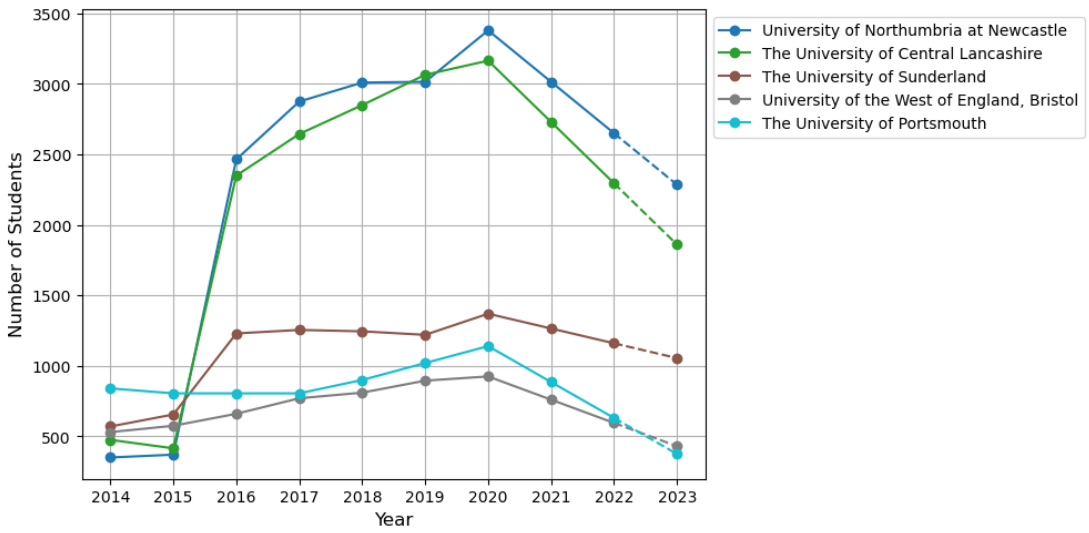


Figure 12: **Enrolment of UG students from EU region in top 5 universities**

Figure :12 replicates the pattern observed in enrolment of PG students from EU regions. Every university reflects a drop in student numbers after Brexit. The University of Northumbria at Newcastle and The University of Central Lancashire continue to occupy the top two enrolment positions while showing substantial reductions. We can infer that Brexit is responsible for the decline of EU students. Because every university maintained consistency with a modest increase in enrolment for the period 2016–2020. Following Brexit, a large portion of EU students withdrew from all universities. The predicted values indicate that this trend will remain for subsequent years.

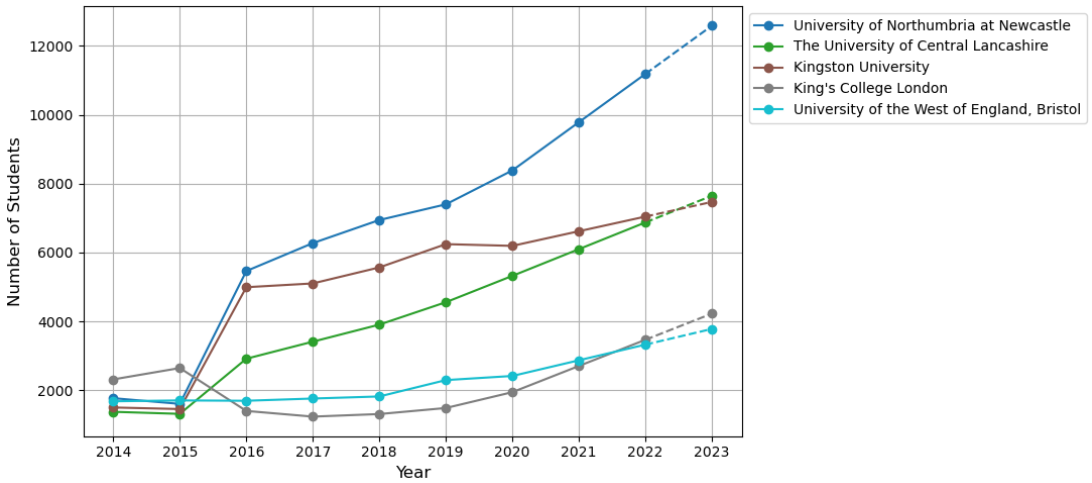


Figure 13: **Enrolment of UG students from non-EU region in top 5 universities**

Figure :13 shows a gradual increase in student enrolment across most universities, with the University of Northumbria at Newcastle standing out as having an unusually fast rate of

progress. The number of UG students enrolling at UK institutions is significantly less than that of PG students from non-EU regions. By 2023,only the University of Northumbria in Newcastle is expected to have more than 10,000 students, according to the prediction. This trend suggests that UG students choices have not been considerably affected by Brexit. In the post-Brexit time, most universities keep following the same trajectory as they did in the pre-Brexit period. Figure 11 helps to us realise that, unlike EU students, non-EU students selecting postgraduate courses at UK institutions.

4.4 Results

Based on the in depth analysis on our university-specific and domicile-based data, the following conclusions have been drawn:

Q1: What is the impact of Brexit on the enrolment of International students in the UK universities?

Brexit has had a considerable influence on the enrolment of international student enrolment in the UK universities, Particularly Postgraduate students from non-EU regions. India, Pakistan, Bangladesh and Nigeria- showed significant difference in PG enrolment pattern, with India likely to see a substantial increase in enrolment from 2018. In the case of EU region, Germany, Italy, and France, the top countries sending students to the UK, showing unpredicted fall for both postgraduate and undergraduate enrolment as a result of Brexit. The undergraduate students impacted more than postgraduate students, with several universities exhibiting a downward trend in UG student enrolment.

Q2: How does the impact of Brexit on international student enrolment vary across different countries and educational disciplines?

The impact of Brexit on international student enrolment varies across countries and educational disciplines. In terms of PG enrolments, India, Pakistan, Bangladesh and Nigeria showed significant changes, with India undergoing an exponential rise in enrolment pattern from 2018. But, China and other countries did not show much difference in their enrolment trends. The enrolment of EU students, both PG and UG, declined across most of the UK universities, whereas non-EU student enrolments have been on an upward trajectory, especially for postgraduate programs.

Q3: How will Brexit impact future enrolment pattern in higher education institutions?

According to the polynomial regression model's predictions of future enrolment trends, there may be a 50% reduction in UG enrolment from the EU by 2025 as compared to the statistics from 2020. In contrast, non-EU student enrolment is expected to continue its upward trajectory, possibly doubling between 2021 and 2024. The pattern suggests a growing interest among non-EU students in pursuing education in the UK, while EU student's interest has shrunk to only a few universities.

Q4: In the post-Brexit period, has there been a change in the preference of international students while choosing the UK universities?

Yes, preferences among international students have changed after Brexit. The location of the university has not much effect on the preferences of non-EU students, even if several London based universities, such as University College London and King's College London, continue to be top choices for PG students from the EU. Also, since Brexit, non-EU student enrolment at universities outside of London, such the University of Sunderland, University of Hertfordshire and Sheffield Hallam University, has increased significantly. Most non-EU students choose their university based on tuition costs and simple admission process, thereby preferring lower ranking institutions.

5 Conclusion

The analysis performed on university based data and domicile based data to find the impact of Brexit on international student enrolment shows that Brexit build a serious impact in the enrolment trends and patterns in the UK universities. Starting with a statistical study, we examined the variations in the in-flow of students from both European Union and non-European Union nations. Finally we employed predictive modelling techniques like exponential smoothing method and polynomial regression model to forecast the future enrolment trends of international students in the UK universities. The unusual downward trend in both postgraduate and undergraduate students from European region after 2020 pointing towards a negative impact of Brexit. Although there has been a fall in the undergraduate student enrolment, the trend indicates that the students desire is to join middle or lower ranked institutions in the future. Forecasting trends suggest that EU student enrolment will go down by fifty percent for both PG and UG levels of study in the five years following Brexit (2020–2025). The observations indicating that the international education strategy initiated by the UK government does not seem to be effective in reducing the aftereffects of Brexit on EU students. It is important to point out that these strategies influenced the students outside the European Union.The number of international students from non-European Union countries, such as India, Pakistan, Bangladesh, and Nigeria has increased considerably in the post-Brexit period. It is important to remember the unexpected rise in postgraduate students from India and a similar trend that has been recognised since 2018 for undergraduate students. This reveals the fact that India playing a significant role in changing the enrolment pattern. The preference of university is also changed among non-EU postgraduate students. The most preferred universities after Brexit shortlisted by the growth rates of student enrolment, which mainly include low ranked Universities such as university of Sunderland, Sheffield Hallam University, Teeside University, and others. The choice of university among undergraduate students changed to London-based Universities with a slight preference also given to the institutions with lower ranks. According to the forecasting methods, many of the EU students enrolled in the UK universities will be replaced by non-EU students by the year 2025. If the trend persists like this, then the UK universities will experience a shortage of potential students from European union countries.

This analysis pointing out the significant findings that will help the universities and the UK government to reform the rules and regulations to keep the United Kingdom as a top study destination for international students.

5.1 Recommendations

Implementing new strategies that focusing on attracting more European Union students and controlling the in-flow of non-European Union students to the UK universities are essential reduce the impact of Brexit.

- Financial support: Offering more Scholarships with high amount will break the financial barrier between the UK and EU students. For non-EU students, provide the regional scholarships and the amount according to their previous academic performance. This will help the universities to attract more potential students from different countries.

- revision on international education strategy: The current strategy not yet effective to keep EU students. A revision with top priority for EU-specific issues will minimize the aftereffects of Brexit.

- 'Collaborations with EU institutions: Starting joint research works and sharing the syllabus between institutions will strengthen the network. This transparency will help in improving the immigration of students' [**?**].

- Collaboration of universities with companies: Encourage campus recruitment by creating relationships between universities and companies, which eases choosing the best future career for talented students.

- Policy changes: It is necessary to implement more strict policies in international student enrolment (focusing on non-EU students) to slow down the abnormal growth trend.

5.2 Limitations

We have collected data for a short period of time, particularly, the data available from 2014 to 2021 only. Due to the limited sample space we were unable to incorporate complex analytical methods like ARIMA, SARIMA, SARIMAX. Also influenced time series models' predicting performance too. The accuracy of the Brexit study was restricted by the one year data, which is only available for post-Brexit period (2021 data). Postgraduate and undergraduate enrolment from European Union as well as non-European Union are main four variables we focused in our analysis. Because of this, we did not take into account other factors like subject of study, mode of study, etc. We focused on selected 20 universities in the England ,so that we were

unsuccessful to analyse the trends and patterns in other countries like Scotland, Wales, and northern Ireland.

5.3 Further work for the future

The analysis can be done by expanding the time frame in the future, which produce more precise results and complex analytical methods can be implemented to capture the trends and patterns. Thus it become more easier to forecast the future. This study could be enhanced by incorporating the evaluation of graduation rates, thus able to find the correlation between the number of student enrolment and gradation rate. An improved understanding of students' interests in institutions and courses may be possible in the future by merging interviews and surveys in this work. The study of the impacts of Brexit throughout the UK has been made possible by expanding the work beyond England to other countries like, Scotland, Wales, and Northern Ireland. Add more features in the analysis to conduct a more thorough investigation into the topic and help the government and educational institutions to make efficient policy changes.

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APPENDIX

1)

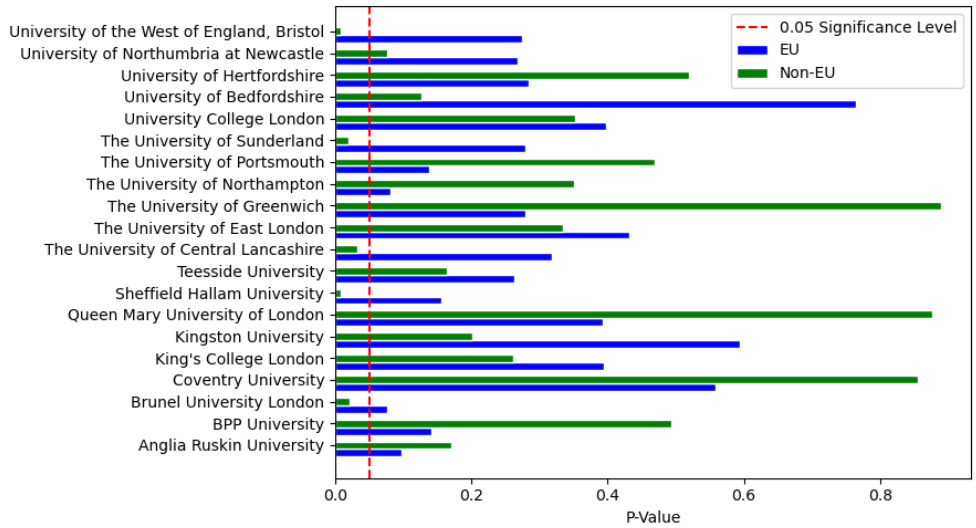

Figure 14: UG student enrolment from EU & non-EU countries: Pre and Post Brexit comparison

2)

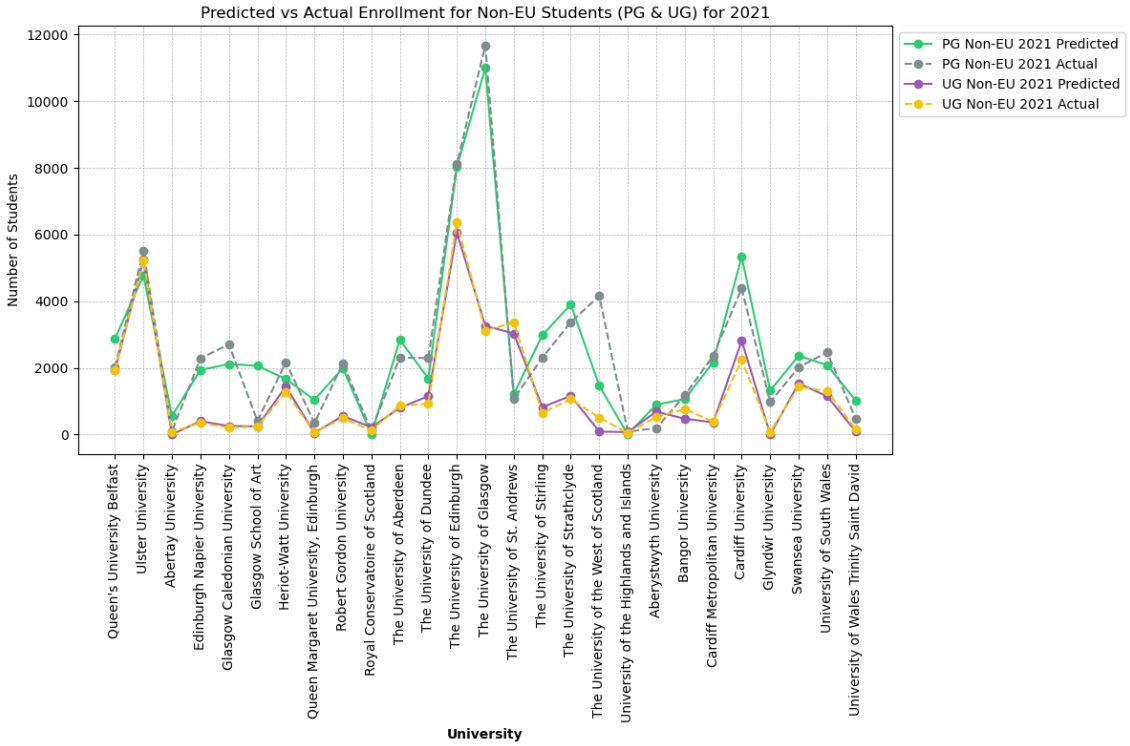

Figure 15: Predicted vs actual enrolment for non-EU students in 2021