



CSC8643: Data Management and Exploratory Data Analysis

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1 Abstract

2 Introduction

3 Business Understanding

3.1 Business Objective

Newcastle University developed a massive open online course titled “Cyber Security: Safety At Home, Online, and in Life” with the primary goal of providing a free and easily accessible resource on the topic of cyber security, specifically on how learners can safeguard their digital data. The course was offered seven times, with the majority of users enrolling during the first and second academic semesters from 2016 to 2018. All course tasks were conducted online and asynchronously.

The main objective of the course was to reach as many learners as possible worldwide, which was facilitated by offering the course for free and making participation asynchronous. The FutureLearn system captured an extensive amount of data, covering a range of variables. Since each user had a unique identifier, it allowed for a wide range of analyses that can be conducted by combining different parameters.

This study aims to analyse the geographic demographics of the learners with the objective of identifying countries with a high number of enrolments. This analysis would provide a better understanding of the data, allowing future course content to be designed with cultural nuance, language preference, and regional challenges in mind. The data could also aid in allocating resources based on the geographic demographics of the learners. For instance, translating the course into different languages could increase enrolments.

In the second round of analysis, the study investigated the engagement of the learners with the course by examining their completion rates relative to their detected country. This analysis could help to identify ways to make the course more relevant to the learners’ differing cultures and increase their engagement. For example, having course administrators who are familiar with the learners’ cultures could be beneficial. The report’s success criteria are to successfully explore the geographic demographics of the user base and to examine the engagement and completion rates of the learners on the course.

3.2 The Project Plan and Data Mining Goals

The project plan entails conducting two rounds of CRISP-DM analysis, with the second round building upon the findings of the first. The utilization of the CRISP-DM structure, a Cross-Industry Standard Process in Data Mining, offers a highly structured approach for a data mining-driven report, encouraging the completion of integral processes and the consideration of important factors.

The analysis aims to delve into the demographics of the learners’ respective countries and discern any patterns that may contribute to an increase in the number of individuals taking the course or improve the engagement levels of current users.

4 Data Understanding

4.1 Collect Initial Data

The FutureLearn system amassed a significant amount of raw data that has been logged in CSV files, and these files have been made available for the purposes of this report. The data is predominantly collected automatically by the FutureLearn system, although certain data points were obtained from the learners themselves. Notably, many of the data points that were requested from the users were optional, such as their country, age range, gender, level of education, and employment status, and this resulted in a low response rate, as illustrated in the table presented below.

	Number who reported:	Percentage who reported:
Gender	3733	10.6 %
Country	3726	10.6 %
Age Range	3620	10.3 %
Highest Education Level	3715	10.6 %
Employment Status	3689	10.5 %
Employment Area	2881	8.2 %

4.2 Describe Data

The data is categorized by each of the 7 runs of the course and by the specific phase in which the data was collected. For instance, during enrolment, the date and demographics of the learner were documented. There are eight separate documents for each run, which include engagement and feedback survey responses. Many of these files contain the unique ID of the learner, allowing for the association of parameters from one file to another. It is important to note that not all runs monitored the same parameters, such as the learner's archetype, which was not determined during the first two runs. ## Explore Data

During the exploration, the data on the country of the learners was initially examined. It was discovered that only 10.6% of the learners indicated their country. However, unlike the other demographic information, the detected country of the learners was automatically detected by the FutureLearn platform upon enrolment.

	Total:	Percentage:
Number of learners	35205	100.0 %
whose country was detected	34310	94.5 %
who self reported their country	3726	10.6 %
whose reported and detected country was correct	3421	9.2 %
whose reported and detected country was incorrect	221	0.6 %
whose country was not Detected	873	2.3 %

4.3 Verify Data Quality

The accuracy of a learner's reported country was assumed to be sufficiently accurate, given that it was automatically collected upon enrollment. To test this assumption, a comparison was made between the reported country and the detected country of learners who reported their country. The analysis revealed that 6.07% of learners who reported their country, provided a different country from the one detected. As a result, it is assumed that the detected country parameter has an accuracy rate exceeding 93%. Factors, such as a learner's use of a VPN or reporting their home nation while residing abroad, could be deemed to influence the accuracy of either parameter.

5 Data Preparation

5.1 Select Data

As I found the accuracy of the reported country to be greater than 93%, and there are over 35 thousand learners whose country was detected, I chose to use that parameter over the reported country as only 3726 learners reported their country, giving a larger data set to work from. I also needed to work with the progress data from the step files provided as well as the learner IDs from each of the files to connect a learner's country and engagement.

5.2 Clean Data

Data cleaning involved the removal of the 2052 duplicate learner IDs and the 39 administrators, as well as users whose country was not detected. Users whose detected and reported countries did not match were retained, as the findings of the analysis were envisioned to be used for targeted advertising, where the detected country was deemed more relevant. Only 2.3% of learners whose country was not detected were excluded, as only 84 of them reported their country.

5.3 Integrating and Constructing Data

For the second round of CRISP-DM analysis, the geographic data from the first round was integrated with additional raw data from the step file, which enabled the incorporation of engagement data from each learner. Once the data was collated and associated with each learner, additional data points were constructed. Specifically, the number of learners from each country and their engagement were used to identify the learners who completed the course. This information was then used to calculate the engagement and course completion percentage for each country.

6 Modelling

6.1 Select Modelling Techniques

6.2 Generate Test Design

6.3 Build Model

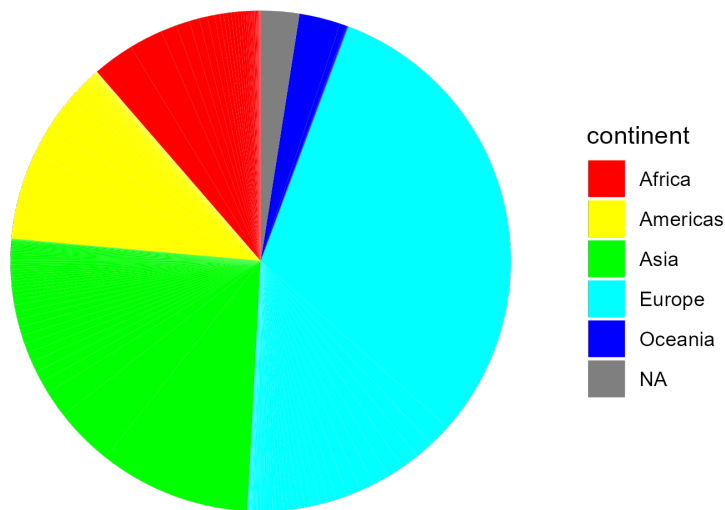
6.4 Assess Model

7 Evaluation

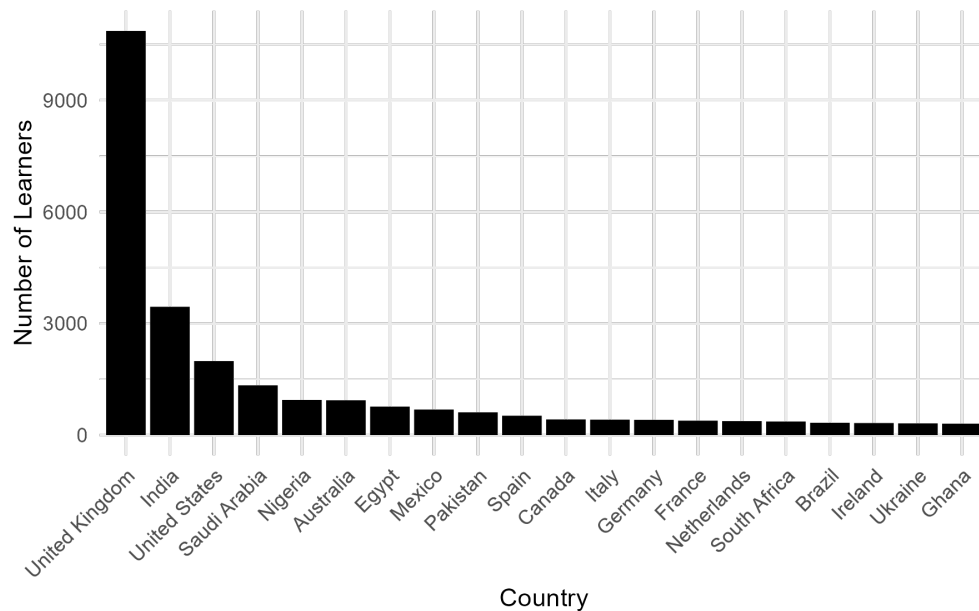
7.1 Evaluate Results

In the first cycle of the CRISP-DM analysis, an investigation was conducted into the countries where the learners were detected. Based on the pie chart, the majority of learners were located in Europe, with Asia and the Americas following in second and third place, respectively. The bar chart below provides a closer look at individual countries. It is observed that the UK had the vast majority of learners, with India and the United States following in second and third place, respectively.

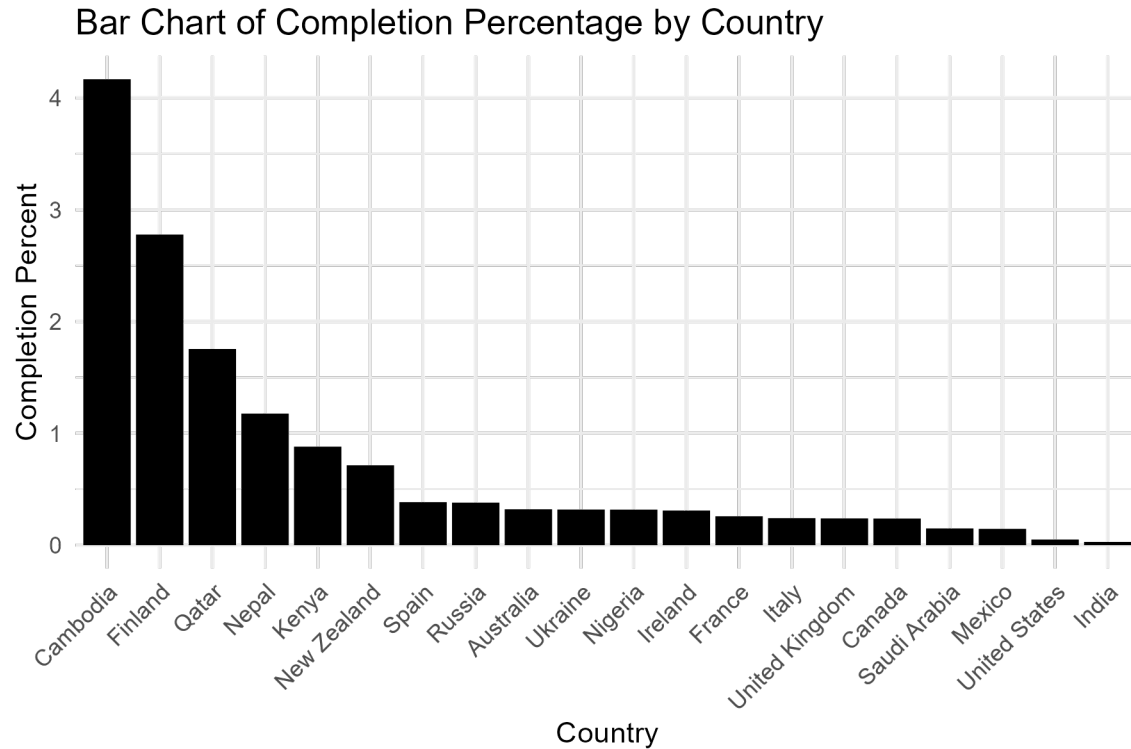
Piechart of learners by Continent



Bar Chart of Learners by Country



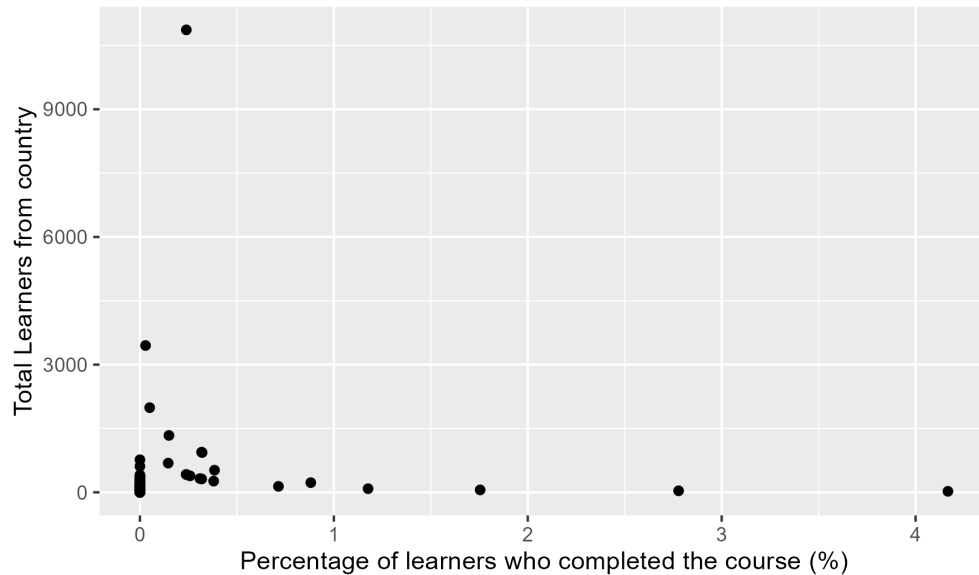
For the second cycle of the CRISP-DM analysis, the number of learners who completed the course from each country was analyzed to gain a better understanding of their engagement with the course. The country with the highest number of learners who completed the course was the UK, with 26 learners, which represents 0.24% of all learners from the UK. The country with the highest completion rate was Cambodia with 4.2%, which was one of their 24 learners.



It was found that the number of learners who completed the course was quite low, with only 0.15% of learners completing it. Therefore, engagement was also analysed. It was observed that 40.2% of learners engaged with the course after enrolment, resulting in a considerably larger dataset when analyzing engagement rather than completion.

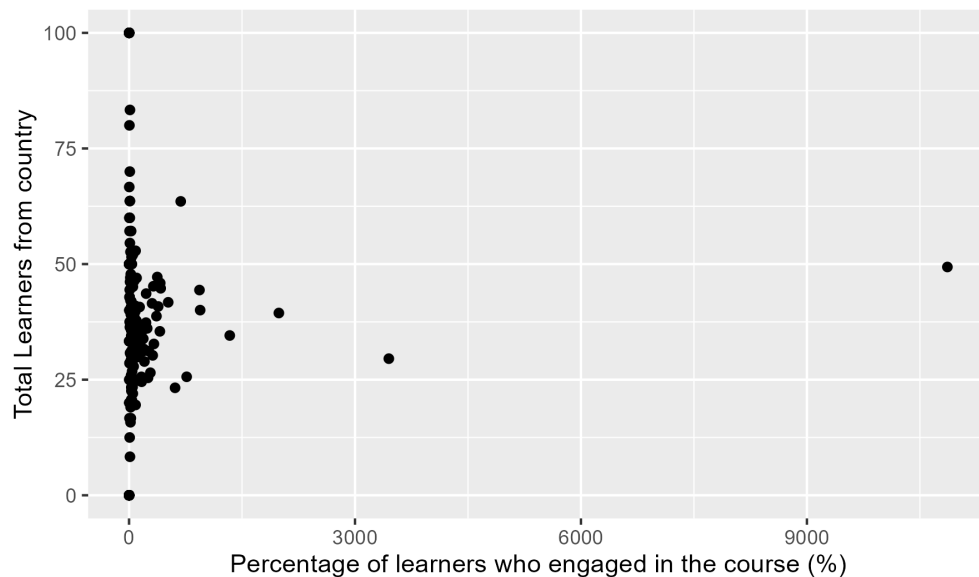
A scatter plot was created for both engagement in the course and completing the course to determine if there was a correlation between the number of learners from a country and their completion or engagement rate. The first scatter plot shows a loose negative monotonic relationship, indicating that as the number of learners from a country increases, the percentage of learners who complete the course decreases. Of the 20 countries that had a learner complete the course, 16 of those countries only had one user complete the course. Therefore, the quality and quantity of the data is insufficient to draw any conclusions.

Scatter plot of percentage of learners who completed in the course vs. total learners from a country



The second scatter plot, there is no correlation between the number of learners from a country and how many users continued to engage with the course after enrolment.

Scatter plot of percentage of learners who engaged in the course vs. total learners from a country



7.2 Review Process

7.3 Determine next steps

8 Deployment

8.1 Plan Deployment

8.2 Plan Monitoring and Maintenance

8.3 Produce Final Report

8.4 Review Project