**Research and Professional Ethics**

Research Proposal for Tony Walsh (sba22238)

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Note: I plan to fully complete the Literature Review as soon as my other projects are completed.

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# Research Title and Topic Area

On January the 31st after a complicated and arduous process the United Kingdom (UK) left the European Union (EU). This process is known as Brexit. Brexit has been a very complicated and controversial issue with major implications for many areas both for the UK and its trading partners.

I have recently finished reading, The road to Unfreedom: Russia, Europe, America by Timothy Snyder (Snyder., 2018). Chapter 3 in his book is titled Integration or Empire where Snyder argues the point that after World War Two (WW2) the major European powers never existed as independent nation states as first, they were crumbling empires and very quickly after they started the process of integration. This has sparked my interest in Brexit.

These areas affected include trade particularly within the EU, immigration which could have an impact on the UK labor market, the end of free movement for UK citizens and political uncertainty in Northern Ireland.

One area most affected by Brexit is agriculture. Some of the ways UK agriculture is affected include:

1. Both the UK and EU have imposed tariffs on importing agricultural goods and products with each other.
2. The UK farmers will no longer receive subsidies from the EU such as under the Common Agriculture Policy (CAP). The UK government will need to step in and provide subsidies.
3. Much of the UK Agriculture sector relies on a migrant workforce. With the changes to immigration regulations there may be labor shortages.

The title of my research proposal is:

**Utilising Machine Learning methods to critically evaluate the effects of Brexit on UK Agriculture trade with the EU to identify strategic advantages for the sector.**

# Research Objectives

My three research objectives for the project are as follows:

1. To identify change in Agriculture trade patterns between the UK and its EU trading partners post Brexit.
2. Develop and validate predictive models for UK Agriculture trade volumes with its EU partners.
3. Identify competitive advantages and opportunities for the UK Agriculture sector going forward.

# Literature Review

## Introduction

Within the field of machine learning there are many different approaches, techniques and models that can be used in any study. There is a body of literature in the area of machine learning dealing with predicting the future from past values called time series analysis. I will review a study of the more valuable time series algorithms looking at what approaches are typically used. There are many case studies looking at using Time Series analysis to predict economic or financial data.

Machine learning has been extensively applied to prediction within the field of agriculture. Different machine learning algorithms have been used to predict future growth in a range of agriculture topics including disease prevention, crop production, soil management and for a range of trade goods. I will review a variety of papers in this field and examine the range of machine learning algorithms used. I will look at a number of studies using machine learning for economic predictions.

Many of these studies compare different algorithms in an attempt to find the approach that works best for a certain area and set of data.

The effects of Brexit are wide ranging. I will look at a number of papers that look at Brexit from a broad view point. Among the articles reviewed is an interesting study using machine learning to predict UK happiness post Brexit. Other topics reviewed include the effect of red tape, the legal system, shortage of manual agriculture workers and food shortages in UK supermarkets.

Trade is a vast area that has many components. I review the UKs main exports/imports and main trading partners. I will examine some literature that examines the effect Brexit has had on UK imports and exports along with the sectors that suffered the most. There are a number of papers calculating the effects of Brexit on UK trade and predicting trade patterns going forward.

Finally, I will look at some articles that examine the effects of Brexit on the UK agriculture sector. The replacement for the Common Agricultural Policy (CAP) is under review by the UK government. A number of papers examine what the replacement might look like and how it might differ from the CAP. I will look at some articles that examine the falling productivity and revenue for UK farms.

## Main Body

### Machine Learning

Time series analysis is a branch of machine learning that analyses data that varies over time. Time series analysis uses algorithms and models to make predictions about the future based on the past or historical data. Time series algorithms are often used to predict trade and financial patterns. An overview of different time series analysis models was outlined by (Korstanje, 2023) he breaks the models into 3 main families. Classical time series models which includes the widely used Autoregressive Integrated Moving Average (ARIMA) family. Supervised models which include Linear Regression and Random Forest. Deep learning models which include LSTM (Long Short-Term Memory) a type of Recurrent Neural Network.

(Rong, et al., 2015) looked at different time series approaches for the forecasting of traffic in Beijing using real life data. The three different models used are ARIMA, Back Propagation neural network model and Nonparametric Regression model. Absolute error (AE), RMSE, error distribution and model portability are used as performance indices. The study found that the three models perform similarly when the time series fluctuate gently. The Nonparametric Regression model performed better when the time series fluctuate dramatically and the study concluded that it was the better choice overall.

A study performed by ( Siami-Namini, et al., 2018) evaluated ARIMA and LSTM in forecasting financial and economic data. They looked at 12 different financial metrics including stock market, housing, and transportation indexes. RMSE was used and in all cases the LTSM performed better. The study looked at the impact of the number of epochs on the results. They found no difference between epoch values in the range of 1 to 100.

A comparison of 3 different algorithms to predict the price in Bitcoin was performed by (Yamak, et al., 2019). They looked at 3 different Algorithms, Autoregressive Integrated Moving Average (ARIMA), Long Short-Term Memory (LSTM) and Gated Recurrent Unit (GRU). Both the LSTM and GRU are types of Recurrent Neural Network (RNN). Using Mean Absolute Percentage Error (MAPE) and Root Mean Squared Error (RMSE) to evaluate the 3 different algorithms they found that ARIMA gave the best results followed by GRU and then LSTM.

A study performed by (Batarseh, et al., 2019) uses a number of machine learning techniques including Linear Regression, Autoregressive Integrated Moving Average, gradient boosting algorithms and K-Means clustering to predict a number of economic factors. The authors find that machine learning approaches predict a range of trade patterns with greater accuracy than traditional approaches.

A working paper by (Gopinath, et al., 2020) look at both supervised and unsupervised machine learning algorithms effectiveness at predicting trade. They show that the supervised machine learning models work well in the short to medium term with the quality of the predictions declining after about 3 to 4 years. Like the study above they find that machine learning models predict trade patterns with a greater accuracy than traditional models.

Another study by (Gopinath, et al., 2021) looked at machine learning forecasting international agriculture trade. They compare traditional supervised machine learning techniques with neural networks. They looked at the flow of 35 different agricultural goods. They find that different algorithms work better for different trade goods. They found that the size of the two economies engaged in trade has the largest factor in reducing the total of root mean squared error.

A review of Machine Learning in agriculture by (Liakos, et al., 2018) where the looked at the existing literature in the areas of crop management, livestock management, water management and soil management. They examine the main machine learning algorithms and their usage in predicting various yield outcomes and the resulting accuracy. They found the most used machine learning models are Support vector machines and Artificial neural networks. They conclude that by using machine learning farm management systems are improving crop production.

An updated review by (Lefteris, et al., 2021) also looked at Machine Learning in agriculture. They only reviewed studies since 2018 and found that crop management was observed to be at the center of attention with 68% of papers. They found that Artificial neural networks were still the most used approach followed by Ensemble methods, support vector machine and decision trees. They conclude that machine learning will “will definitely become a behind-the scenes enabler for the establishment of a sustainable and more productive agriculture.”

Another survey on agriculture and machine learning was performed by (Meshrama, et al., 2021). They broke the agricultural domain down into three distinct stages, pre harvesting, harvesting and post harvesting and looked at machine learning studies for each stage along with methods used and accuracy. They note that in each stage machine learning has been used by researchers to solve complex problems. They also add that one of the main challenges facing researchers in the field is accessing quality data. They add that researchers should create datasets and use different platforms to make them available to others. They conclude that “machine learning algorithms have obtained remarkable outcomes to solve agriculture related problems.”

A recent paper by (Pallathadka, et al., 2023) look at the application of machine learning in a number of areas including crop production, disease prevention and efficient supply chain management. They see machine learning as a key component in increasing productivity in farming. They single out neural networks and deep learning as two models with real world applicability.

### General effects of Brexit

An interesting study on the happiness of Brexit in the UK population using machine learning was performed by (Polyzos , et al., 2020). The Paper looks to measure the unhappiness of Brexit using data from the Gallup World Poll. The authors used data from Gallup World Poll which has data measuring happiness on a scale of 1 to 10. The data was then clustered using a Naïve Bayes machine learning classifier for clustering to work out the happiness of individuals in both the UK and in the EU. This classification was then passed to an artificial neural network to generate a dynamic happiness for each household. The study concludes by predicting that the effects of Brexit will be felt by the UK population starting from 2021.

The International Monetary Fund (IMF) (Giles, 2023) has reported that the UK is likely to be the worst performing G7 economy in 2023. According to the IMF the UK economy is set to shrink by 0.3% in 2023.

Looking at UK food shortages (Jones, 2023) reports that some UK supermarkets have introduced rationing. There weather has been unseasonably cold in Spain causing shortages with tomato and cucumber production down over 20% on the same period last year. However, the general secretary of the Murcia branch of Spain biggest farming association put the UK shortages down to Brexit regulations affecting logistics. He maintains that there are enough raw materials, but bureaucracy is causing problems and he noted that there was a shortage of lorry drivers servicing the UK market.

A report by the Institute of International & European Affairs (Lucey, 2021) stated that the UK needs to import 40% of its food needs with about 70% of this coming from the EU. They understand that regulatory costs may increase UK supermarket prices.

The Farmers Weekly (Case, 2023) is reporting that the new system for border controls for agriculture goods coming into the UK from the EU will be put in place from 31st October 2023. They are quoting one industry leader as saying the controls “will substantially increase food costs”.

The Politico journal (BOSCIA, 2023) is also reporting that increased red tape will send UK food prices higher at least in the short term. When the new border controls are introduced, firms will be hit with hundreds of millions in increased costs due to the delays for goods entering from the EU. There will be a fee for each batch of goods entering the UK. The UK government plans to introduce a trusted trader scheme to stream line the process. William Bain, trade expert at the British Chambers of Commerce, said there is a “strong prospect” of higher inflation due to the new Brexit checks.

Writing about the effect of Brexit on the National Health Service (Dayan, 2023) notes that “Leaving the European Union dealt unfortunate blows to structural weak points which already existed in staffing and financing, and created a new weakness which would later be exacerbated by global shortages in medicine supplies.”

A report in the Guardian (Partington, 2023) outlines how EU raw materials suppliers had grown more cautious about doing business in the UK. This came from a survey of over 100 UK manufacturing companies. This is leading UK companies to look for suppliers close to home and to diversity their supply chains.

A report by the European Central Bank (L’Hotellerie-Fallois & Caffarelli , 2020) accesses the effect on Brexit on the economy and trade. They review a number of studies which find consistently across models that the cost is to be significantly greater for the UK than for the euro area. They note that Ireland will be adversely affected due to its economic ties to the UK. The paper finds that Brexit will curtail trade and investment leading to an increase in the costs of trade and reduce capital investment.

A piece in the Guardian newspaper (O'Carroll, 2023) looks at the effects of the plan to scrap around 4,000 EU laws from the UK statute books. Leading barristers have called this move a “reckless” and “irresponsible” project. This move will remove the precedent set by the courts over that past 47 years. The concern is that this move will dilute workers right while also adding layers of complexity.

### Brexit and Trade

The top exports (Gov.uk, 2023) from the UK are Gas, Cars, Crude/Refined oil, medical products, Power generators, Telecom equipment and Clothing. The top exports markets for the UK are United States, Germany, Netherlands, Ireland, and France. (OEC, 2023) has a dashboard where all these sectors are broken down into smaller pieces.

Looking at the effects of Brexit (Scott, 2021) noted that the only UK sector to possibly benefit from Brexit is manufactures of specialized machine parts. While the list of losers is numerous including Fishing, Agriculture, Manufacturing, and the Financial services industry.

(Krena & Lawlessa, 2022)examine trade between the EU and UK for the first year of Brexit. They found that the impact of Brexit on trade was significant. They found that the UK exports had a shortfall of growth after the Covid pandemic and that the number of imports from the rest of the world to the UK increased substantially. The study estimated that Brexit caused a decrease in trade from the UK to the EU by 16% and from the EU to the UK by 20%.

Another study on UK trade after Brexit (Freeman, et al., 2022) found that although UK exports to the EU went down for 2021, they recovered and they found no overall negative effects due to Brexit. They did however, find a decrease in the imports from the EU to the UK. They conclude that the fact that Brexit had a greater effect on imports as surprising.

A report in the Guardian (Helm, et al., 2022) looked at how trade from the UK is getting bogged down in red tape because of Brexit. The report looked at a number of different industries and the difficulties companies have with exports. The general concessions are that the market for goods is there but there are new obstacles to trade and the costs of imports is rising in part due to the devaluation of sterling.

The Financial times (Strauss, 2023) reports that one of the biggest barriers to UK growth is the post Brexit trading rules. The Bank of England (BoE) predicted initially that the barriers would have an effect long term, but the effects are felt sooner than expected.

(Thissen, et al., 2020) look at the impact of Brexit for UK and EU competitiveness and trade. They show Brexit will affect the competitiveness of a number of diverse sectors. Their analysis shows that the UK is vulnerable due to its reliance on global value chains. They look at increased production costs across the NUTS2 regions (Nomenclature of territorial units for statistics) and find that costs increases are highest in the UK regions. They find that agriculture has a relatively significant increase in associated costs due to Brexit. This will likely increase the inequality across the UK NUTS2 regions.

(Berthou, et al., 2020) look at the Macroeconomic impact of Brexit focusing on trade and migration channels. They find that the overall reduction in UK GPP in the medium term of 2%. They find that any change due to Brexit is sensitive to policy changes.

Writing in the Guardian newspaper (Jolly & Sweney, 2023) report that a number of large car manufacturers are calling for a relaxing of Brexit sourcing rules. The car company Stellantis (Vauxhall, Fiat, Peugeot, Maserati) have warned that they may be forced to shut down some plants unless the rules are changed.

An academic paper by (Vandenbussche, et al., 2022) develop a model to examine the trade between the UK and EU. A key insight of the paper is that every EU country is affected by Brexit both through its direct trade with the UK but also vis indirect exports to the UK via third countries.

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### Brexit and Agriculture

The Guardian (O'Carroll, 2022) looked at the effects of Brexit on UK farmers. The article showed considerable uncertainty among UK farmers. One sheep famer note that they are only “seeing the negative” when referring to Brexit. At the root of the uncertainty is the gradual phasing out of the Common Agriculture Policy (CAP) which has left farmers at least 20% down for 2022.

An academic paper by (Choi, et al., 2020) looked at who benefits from Brexit. The find that farmers will lose over all due to the likely reduction in the UK payments to the CAP equivalent and the friction introduced into UK EU trade. Although it gives the UK government an opportunity to set its own farming policy in line with its national interest. Like other studies they find that the EU27 due to its size will face less disruption.

Euro News (Hanrahan, 2023) reports that UK farmers are having trouble finding enough workers for fruit and vegetable picking. One farmer estimate that they have wasted about 30% of this year’s crop. Among the problems outlined by farmers is the red tape and time it takes to recruit workers.

A report by (Marshall , et al., 2022) look at the issues facing the UK government in replacing the Common Agricultural Policy. The UK government is faced with the challenge of keeping different stakeholders happy. They look at the need to address trade-offs between farmers and environmentalists while delivering value for money for taxpayers. They conclude that the big issue for farmers is the lack of clarity going forward.

Another piece in the Guardian (Partridge, 2023) reports on the difficulties that UK farmers are facing post Brexit. The Farmers’ union president Minette Batters to say ‘volatility, uncertainty and instability are greatest risks to farm businesses. UK farmers are also facing an increase in energy, animal feed and fertiliser prices following the conflict in Ukraine. UK farm production is falling for example egg production has fallen to its lowest level in nine years with about one billion less eggs produced per year. (Partridge & Makortoff, 2022) report that other sectors of UK agriculture including vegetable and fruit growers, and meat and dairy producers are facing a falloff in productivity. There are also concerns that there will be enough seasonal workers for 2023.

The Guardian newspaper reports (Harvey & Horton, 2023) that farmers in the UK will be able to access government funding for up to 280 activities that are good for the environment. These environment items include protection for bog lands and hedgerow conservation. Mark Tufnell, the president of the Country Land and Business Association, said “The move towards payment for environmental delivery is a welcome one – it will benefit the planet, the public and, in time, the farmer”.

Although another article in the Guardian (Horton & Harvey, 2023) reported that only 224 farmers were paid in 2022 under the UK governments post Brexit environment friendly agriculture scheme. Some of this is due to the increased paper work required to access the grants. This represents a large drop as 102,00 farmers received the equivalent payment the year before.

An academic paper (Greer & Grant, 2023) looks at the divergence of UK agriculture policy with EU agriculture policy after Brexit. The Common Agriculture Policy (CAP) was viewed by the UK as a flawed policy. After Brexit, the policies of the UK and EU are diverging. There are attempts in the EU to make the CAP more environmentally friendly. However, there are forces that work against de-Europeanisation in UK agriculture such as the need for UK farmers to compete with EU farmers who have the benefit of receiving CAP payments and the need for UK farmers to export to the EU. Because of Brexit there has been a substantial reduction in the value of food exports to the EU. These factors make it difficult for a major divergence of policies to take place. They authors conclude that the policy is still to be shaped.

A sustainable vision of agriculture was out forward by (Stewart, et al., 2019). They look at Brexit as an opportunity to overhaul the UK agriculture and fisheries systems to be more environmentally friendly and to be more sustainable. They are advocating a bottom-up approach leading to more social equity. They recognize that there will be formidable challenges to their approach from various vested interests. Like other papers they recognize the current uncertainty in UK agriculture policy. The authors recognize that some greening of the CAP has taken place it is far from ideal, and that biodiversity loss occurs in many agriculture and marine systems and that CAP payment disproportionately goes to large land owners. With climate change a resilient agriculture and fisheries ecosystem is needed. The is supported by (Home, et al., 2014) a study on ecological compensation on Swiss lowland farms found that farmers were willing to take part in environmental schemes even if it meant earning less revenue.

An academic paper by (Swinbank, 2022) looked at the UK and its agriculture and food policies one year after Brexit. The UK has signed a number of free trade agreements most notably with Japan, Canada, and Mexico. These free trade agreements will result in reduced tariffs in trade between those countries. Although there is still no trade agreement with the USA. The UK is heading towards a greater liberalization of agriculture and food products. This liberalization is likely to lead to a downward pressure on UK farm prices.

The British Broadcasting Corporation (BBC) (Anon., 2021) wrote about a bee keeper Patrick Murfet who was blocked trying to import 15 million baby bees. He was warned by the Department of the Environment that the bees will be destroyed if brought into the country. Another newspaper article (Capurro, 2023) reports that Ministers have approved the use of the bee killing pesticide thiamethoxam. The comes after the Environment Secretary Therese Coffey has committed to the UK to halving the impact of pesticides on the environment. The European Union’s highest court has banned the chemical and it has been banned in the EU since 2013. Joan Edwards, director of policy and public affairs at The Wildlife Trust said “This is unacceptable when the Government should be implementing fast, meaningful support to help farmers move away from a reliance on toxic pesticides.” An academic paper on bees by (Maderson, 2023) looks at the opportunities and challenges in drafting a new agricultural policy post Brexit that is friendly to bees, other pollinators and the environment. The paper puts forward the case that bee keepers have a unique vies of the British countryside and environmental values have much to contribute to the debate.

## 

## Conclusion

All of the reviewed studies on Time Series analysis utilize the ARIMA algorithm showing its popularity in solving real world problems. It is interesting that the 3 different papers on Time Series find in favor of a different algorithm. A large number of different machine learning algorithms are used in predicting various farm metrics. In general, the research shows that machine learning is a good approach for this area. The two most popular are neural networks and support vector machines. This is not a problem but an opportunity. There are many acceptable approaches, and it is valuable to examine different possible approaches and experiments in relation to UK trade and UK agriculture.

What also came across in the literature was many researchers, for example (Meshrama, et al., 2021), (Pallathadka, et al., 2023) wrote that machine learning could solve real world problems and help with productivity.

There are a number of statistics-based papers published on the effects of Brexit on UK trade. Some of the papers cited here find different results. (Krena, 2022) finds that some of the difference between their paper and the (Freeman, 2022) paper is down to different data sources and different data collection methods. It is important when analyzing data from different sources that they are compatible and the collection methods are the same. This shows that it is important to be very clear in the approach, data and data collection methods use.

What has come up throughout my research (Swinbank, 2022), (O'Carroll, 2022), (Partridge & Makortoff, 2022), (L’Hotellerie-Fallois & Caffarelli , 2020) is that the UK will feel the effects of Brexit more that the mainland EU.

A common theme that emerged from research on UK agriculture is the importance for the UK government to get its CAP replacement up and working. (Partridge, 2023) states that the lack of clarity here is causing uncertainty among farmers. There is a chance for the UK government to put in place a CAP replacement that works for its unique needs. (Marshall , et al., 2022) outlines how with this is a tension between environmental groups and farmers as groups are lobbying for different policies and (Greer & Grant, 2023) show that the UK will need to stay aligned with EU agricultural policies. One study by (Home, et al., 2014) showed that the two groups can work together.

The increase in red tape and regulations is something that was mentioned in a number of articles. Some of the ways that it is affecting the UK is by causing a shortage of fresh vegetables in UK supermarkets both by affecting logistics (Jones, 2023)and also hampering the ability of UK farmers to find seasional workers (Hanrahan, 2023). Along with

Another strong trend that came across from this research as shown by (Helm, et al., 2022), (Thissen, et al., 2020), (BOSCIA, 2023) is that costs will increase both in UK supermarkets and for raw materials for industry with agriculture definitely affected.

Finally, I looked at a number of number of pieces on bees that reflects the Brexit experience so far with red tape stopping the importation of bees, ministers using their power in allowing previously banned chemicals to be used and again the tension between farmers and other stakeholders in the environment.

# Proposed Sampling Strategy

## Population

The population of interest are UK farmers and businesses that are directly involved or related to UK agriculture.

The two main populations of interest are therefore:

1. Farmers, as they are the key stakeholders in UK agriculture. They are the first to experience the impact of Brexit and are therefore impacted directly
2. Secondly of interest are businesses that buy and sell products directly with the agriculture sector. This includes supermarkets, wholesalers, dairy processors, sellers of heavy machinery such as tractors, seed, and fertilizer providers.

The two populations that I will use for this project are UK farmers and retailers in the UK who purchase agricultural goods.

## Sampling Methods

I will use non probability sampling as I will be selecting my sample purposely from the population.

The overall population of UK farmers due to its size, is beyond the capabilities of this research project. Therefore, I will purposively select the largest farmers in the UK with the aim of approaching them directly for this research project. A list of these farmers is available on the internet (BoldData, n.d.).

For the population of UK farmers, I plan to use Judgement sampling as the primary sampling method. I will employ a purposive sampling strategy that contains potentially information rich cases. From those farmers that reply to my request to partake in this study, I will select those who exhibit the potential to provide the richest data. I am aware that different farm types are remarkable diverse. It would be useful for this project to interview a range of different farm types (tillage, sheep, dairy etc).

For the population of UK retailers, I will also use judgement sampling. I have a personal contact who is in a senior position in the UK supermarket industry. For this population I also intend to use snowball sampling as a secondary type of sampling. My personal contact will be able to connect me with a contact for a depth interview in a different supermarket or an expert in food produce procurement.

# Proposed Primary Research Methodology

For my primary research I will be using Qualitive research methods. This approach is most suitable because I will be looking to gain a perspective into the challenges and opportunities presented by Brexit to the individuals affected by this process. In particular I want to identify the changes in UK agriculture trade patterns since Brexit. In order to do this, I need to access and become informed by stakeholders who are directly impacted.

To do this my proposed choice of data collection method are depth interviews. I plan to use the depth interviews to gain insights into the day-to-day challenges facing

Some interesting areas and topics of investigation and questions for the depth interviews include, change in government subsidies and clarity in government subsidies going forward, difference in food quality standards, challenges in finding the right workforce, any difference in red tape or procedures, change in export/import markets and changes in procurement. The literature review has also shown some topics for interesting questions such as the tension between farmers and environmental groups in formatting the UK equivalent to the CAP and with red tape increasing for imports and exports does the scope for more UK products in UK supermarkets.

This primary research will inform the data sets and the approach to be utilized in the secondary research areas.

# Validity Management

The three most applicable components are:

Relevant:

The project is to investigate on the effects of UK trade after Brexit. However, trade and trade agreements are complex. To get interesting results it will be necessary for this project to break UK trade down into some of its component sources. Different trade categories may be affected more or less by Brexit. For example, as part of the Brexit agreement there is essentially frictionless trade between one part of the UK Northern Ireland and one part of the EU Republic of Ireland. Looking at different sectors of UK trade (power, agriculture, cars, tourism, investment) it will be important to pick relevant sector data for the project.

Reliable:

This is a Data Analysis project and as such the quality of the Machine Learning algorithms is vital. I plan to implement a number of algorithms, for example Recurrent Neural Networks, Linear regression, Random Forest, Autoregressive Integrated Moving Average to predict UK trade going into the future. The reliability of these models will be key to the success of the project and significant part of the DAP will be to validate the reliability of the models and approaches used.

Compatible:

This component came up during the literature review. Some of the different in the results of 2 studies were down to different data sources and different collection methods. For any comparison of UK trade with different countries or even UK trade before and after Brexit it is important to compare like with like. It is important that the collection methods and calculation methods when comparing sectors is the same. If not, error will be introduced into the calculations.

# Ethics

Brexit has to date shown to be a contentious issue for many people. However, it is important to state that this project aims to be neutral on Brexit. It is not in the scope of this project to examine attitudes to Brexit. Brexit along with any large-scale change to society will provide opportunities and new ways of doing things. This project aims to find those opportunities and examine them in more detail.

I recognise that as Brexit is a contentious issue particular care, attention and skill will be required for interview preparation and during the in-depth interviews to keep the interview on track. I am fully aware that the manner in which I conduct the interview will influence the quality of the conversation and therefore the outcome. Approaching the interview from a neutral perspective on Brexit aims to ensure that the interview is efficient and productive and inherits as little bias as possible. It will be of importance to have a clear structure to the in-depth interviews. It also will be of importance not to ask loaded questions and to be aware of the potential bias from the interviewee.

The other area that stands out at this stage from an ethical viewpoint is in the interpretation of the results. This project is ultimately a project in Data Analytics. In my presentation of the results, I therefore need to be clear and specific about what these results represent. I am however aware of the potential for misinterpretation and will put in measures to articulate my neutral standpoint and focus on data only.

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