# Utilizing Data Analytics for Small Businesses to stay ahead of inflation

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## 1 Summary

Data analytics is essential in the area of developing technology for analyzing the data from a given large data collection and providing valuable insight for the industry's development. Industries like healthcare, agriculture, manufacturing, finance, banking, and others employ data analytics extensively. Emerging technologies like AI, machine learning, and IoT are also an advantage for improving data analysis accuracy while maintaining data quality. Various Data Visualization tools are available in the market to present the analyzed data in a more simplified way for easy understanding of the summary in one glance.

The abrupt increase in the cost of goods and services is perhaps the most prevalent issue affecting small businesses. There are two primary reasons why inflation may occur; Demand-pull, when there is a rapid increase in demand for products or services, and cost-push, when the cost of input products or services increases, inflation happens. Small businesses found it difficult to meet the annual profit benchmark due to sudden increases in inventory costs, high wages, rising raw material costs, and supply chain disruptions. Additionally, there has been a decline in repeat business due to a lack of timely availability of goods and services.

Using data analytics tools, AI algorithms, and data visualization techniques, this paper primarily focuses on providing a user interface to track past, present, and future inflation data by comparing the price of products in markets, expected price increases, and to compare the price of sellers to buy the best cheap products. Business owners will be able to more accurately prepare for the effects of inflation in this cutthroat environment with the use of created tools.

## 2 Background

The entire nation's economy is impacted by inflation. According to Ibrahim, Maram [2019] inflation may have an effect on the government, small enterprises, and the typical person's day-to-day activities. The cost of living, the cost of doing business, and the price of food, energy, commodities, goods, and services are all affected by rising costs, which reduces the purchasing power of consumers [2]. Small business owners are subsequently affected by the loss of clients who made regular purchases, price increases for input goods and services, salary increases, and product scarcity. Therefore, it is essential for small firms to plan for inflation. Failure to do so could result in a large loss of earnings, and data shows that many firms have shut down in the period due to inflation as they are unable to endure the competitive market after the pandemic [1].

The information for the studies mentioned above can be gathered through survey data, market-based measurements, analysts' forecasts, banks, financial institutions, imports, exports, GDP, and money supply [3]. The starting components for the data analyses that were determined from the preceding studies can be obtained from surveys, market-based indicators, economists' forecasts, and money supply. With the help of third-party programs like NumPy 1.24.1 and pandas 1.5.2, the raw form of the data can be filtered using the Python 3.7.0 programming language to extract only the information we need for our studies. The ideal instrument for analyzing previous trends and sales patterns in order to predict price increases in the

future so that consumers can stock up on goods in advance is artificial intelligence (AI) [9]. The predictive analysis aids in placing an emphasis on prediction and quick evaluations of the data, according to Gartner. Additionally, clients are far more likely to understand the information when it is provided to them visually or graphically.

One difficulty is gathering a lot of data without knowing the business aim, which can waste time and space [6]. Flexible automation utilizing AI still faces significant challenges that call for appropriate data collection and a grasp of business objectives [4]. The speed, size, and diversity of the final data are problems for data visualization, according to Shadare [5].

The literature demonstrates that different consequences of inflation on small enterprises may exist. This study will contribute by demonstrating how to anticipate future inflation, purchase goods, and services by evaluating market trends, and set product prices by evaluating the price ranges of competitors.

# 3 Proposed Work

The use of data analytics to beat inflation is the main topic of this study. This can be done by gathering data from numerous sources, filtering it using Python, NumPy, and pandas, and then utilizing artificial intelligence to determine historical trends, product prices, and selling prices that can resist inflation. Using data visualization technologies, this project should create the final data collected in the form of graphs and pictorial representations to offer strategies to improve small businesses during inflation without suffering significant profit loss.

## 3.1 Aims and Objectives

This study's goal is to determine inflation effects on small businesses through data collection and analyze those using modern technologies to extract useful information from it for the small business growth with the competitors. Objectives: sub-objectives listed below to attain fundamental goal:

- What is the current inflation rate in the country?
- Up to what extent does a small business get affected due to inflation?
- How to reduce the impact of demand-pull and cost-push inflation?
- How to predict the expected rise in price?
- How to analyze different sellers' price ranges?
- What is the maximum and minimum percentage of rise in price by competitors?

## 3.2 Rationale

To come up with an inflation figure the UK office for national statistics will keep track of prices for different items in an imaginary goods basket and keep on updating the basket. Each month's price rise is compared with this to calculate the rise in price. It can be measured through the consumer price index (CPI) and producer price index (PPI). As per the latest evaluation, CPI shows a huge rise in percentage in the UK [7]. Some of the key factors for the price rise in the UK are due to the soaring cost of energy, the war in Ukraine, and pushback from the Covid-19 pandemic. The British retail Consortium (BRC) reported fresh food hit 15 percent of inflation in December.

Inflation mostly affects small businesses because they must pay higher prices for goods, services, and energy. They must pay the workforce hefty wages due to the rising cost of labor. Therefore, in order to maintain their profit, they must raise the price of their goods, which may have an adverse effect on them by causing them to lose customers who transfer their business to larger stores where there may be fewer prices, offers, and discounts that small business owners in difficult financial circumstances cannot offer.

To address this problem, small business owners should have a thorough understanding of their competitors' market selling prices as well as the top buyers and sellers in their neighborhood who are offering the lowest costs. This can be done by properly analyzing data using AI, and the resulting report can be

utilized to examine the impending inflation for them to keep vigilant. Additionally, the report containing the price points of many sellers will assist customers in swiftly identifying the products that are offered and have the best price match. Thirdly, they will be able to determine the price increase necessary for each product so that they can retain their profitability by using the feature established for product prices in the various marketplaces.

Since this is the main issue that small businesses are currently dealing with, the suggestion can undoubtedly assist them in coping with the losses they will incur in the near future and even help them make more money during inflation.

## 3.3 Methodology

The first step in conducting research is to examine the market's commercial objectives, such as expected profit, products sold, customer happiness, and services, as well as the various sources from which these data can be gathered for further analyses. Researchers should also be aware of the current state of inflation and the growth in prices for a variety of goods and services. Data from forecasts by economists, banks, or other financial institutions can be obtained by quantitative analyses [8]. To understand the data and achieve the project's goal in the beginning, various statistics and hypothesis testing can be used. In order to do qualitative analysis, a variety of surveys, questionnaires and interviews are conducted with diverse markets, customers, business owners, and regular people.

Using Python software and its third-party programs like NumPy and pandas, the acquired data must be automated into a usable format for future studies. A team member who develops automation can assist in achieving this.

Thirdly, three categories can be created using the data from the extracted sheet in order to use AI algorithms [9]. One is for examining historical trends and foretelling a price increase in the future. The next algorithm is used to compare the prices of various sellers to assist owners in choosing products with the best value, and the last algorithm can be used to compare product prices in various marketplaces to determine the appropriate product prices.

Finally, using certain data visualization tools, the data from these many algorithms are translated into UI for a better pictorial depiction of reports with graphs and charts for easy understanding of the users of this application.

## 3.4 Programme of Work

The proposed work packages will give a clear overview of different segments of projects for implementation along with the time required to complete each module.

**Work Package 0 – Publication of PhD proposal.**

Submit a Ph.D. proposal paper to De Montfort University with specific aims and objectives, as well as the procedures, tools, and materials needed to complete the research. Send this suggestion to a higher-level committee for consideration, additional research, and execution.

**Investigators involved:** Professor Shengxiang Yang, Professor Daniela Romano, Dr Sarah Greenfield

**Timing:** 12 months.

**Deliverables:** Submission of the journal paper for further investigation and improvements to the higher degree committee.

**Work Package 1 – Literature Review.**

The Ph.D. applicant will gather different data from multiple sources and increase the research's worth by reading journals, conference papers, IEEE, and other internet resources.

**Investigators involved:** Professor Shengxiang Yang, Professor Daniela Romano, Dr Sarah Greenfield

**Timing:** 6 months.

**Deliverables:** Collecting the required information for the establishment of the proposal.

**Work Package 2 – Identification of various data collection sources.**

Both quantitative and qualitative analysis are used in the project to gather the data. Banks, the market, consumers, finance, and economists are some of the sources used to gather data.

**Investigators involved:** Professor Shengxiang Yang, Professor Daniela Romano, Dr Sarah Greenfield

**Timing:** 6 months.

**Deliverables:** Possible collection of all required data from the mentioned sources for the purpose of further analyses.

**Work Package 3 – Data analysis using software.**

Python, NumPy, and pandas can be used to filter out collected data in an usable fashion before using AI algorithms to achieve goals. The Ph.D. candidate can use this software and attempt to gain a thorough understanding of how it works.

**Investigators involved:** Professor Shengxiang Yang, Professor Daniela Romano, Dr Sarah Greenfield

**Timing:** 9 months.

**Deliverables:** The usable data collected into a readable format.

**Work Package 4 – Building AI algorithm.**

According to the research study, this proposal has three key goals. The applicant must develop AI algorithms for each goal in order to track and evaluate the data and produce accurate comparisons, forecasts, and rise percentages.

**Investigators involved:** Professor Shengxiang Yang, Professor Daniela Romano, Dr Sarah Greenfield

**Timing:** 6 months.

**Deliverables:** The value from data extracted using the AI.

**Work Package 5 – Implementing data visualization.**

The Ph.D. applicant must choose the most appropriate tool from among the many data visualisation options available on the market in order to convert the extracted data into a visual representation for easier comprehension. This includes choosing the graphs, charts, and tables, as well as taking into account the volume and complexity of the data generated.

**Investigators involved:** Professor Shengxiang Yang, Professor Daniela Romano, Dr Sarah Greenfield

**Timing:** 6 months.

**Deliverables:** The UI/GUI experience for the customers.

**Work Package 6 – Documenting all observation into final project.**

The completed work includes all necessary information, implementation, suggestions for improvement, and research references. The final report will then be delivered to the department's faculty at De Montfort University for review and approval before being accepted for publication in the journal. So that other research applicants can do this as part of their studies and expand its reach in the future.

**Investigators involved:** Professor Shengxiang Yang, Professor Daniela Romano, Dr Sarah Greenfield

**Timing:** 3 months.

**Deliverables:** Report submission to De Montfort University and Publishing the research paper.

# 4 Professional, Legal, and Ethical issues

The primary issues with data harvesting are customer privacy and security. Customers who share their data to gain deeper insights into their needs and inform decisions may be concerned about their privacy. Participants should be made aware of the precise purpose of the data collected from them of well as the requirements to ensure the security of the data. Better transparency and ongoing cyber attack awareness for data collection are necessary since if any of the information supplied by them leaks, it could affect the trust of customers. It is necessary to gather survey data without coercing anyone to fill out any questionnaire responses in the most equitable way possible. It's crucial to know whether the information gathered from economists, banks, or financial institutions is sensitive. if sensitive need to take proper measures to encrypt them without any failure.

# 5 Relevance to Beneficiaries

As this proposal covers the most pertinent programming languages, the newest tools, and GUI/UI experience, the researchers will first benefit from having a better understanding of and guidance for the study paper. The established approach can help those small business owners to gain better insight into their sales in the near future, which benefits not only the academics as this work presents an idea to help small businesses remain ahead of inflation [10]. Additionally, future scholars who are interested in the development and study in this field might use this publication as a reference.

# 6 Research Management Plan

One of the key steps in carrying out the Ph.D. proposal is the research management strategy. If the planning is successful, the work will be of excellent quality and will satisfy all of the proposal's objectives.

The work must be coordinated in accordance with the planned work packages for data collection, analysis, implementation, review, and report submission on the part of the Ph.D. researcher. Once every two weeks, the candidate and the mentor must meet to discuss the status of the work and to solicit suggestions for any necessary additional modifications. The major objective of this is to maintain a record of the work and advancements made at each step while preventing chaos until the due date. Each work package must be finished on schedule as this is a 3-year project to avoid running into any risks. It is usually preferable to set aside some extra time to mitigate risk in unforeseen circumstances. Software crashes are one of the risks, thus all work must be uploaded to one drive. Code crash is another significant danger, so it's best to always have some unit test cases and automate bug testing.

# 7 Justification of Resources

- Research candidate: Throughout the completion of all job packages, a candidate with a thorough understanding of the complete research is required. The applicant needs a foundational understanding of data analytics tools, Python and related packages, artificial intelligence, and data visualization tools. It's also important to have an accurate understanding of the objectives and business domain expertise.
- Research Guide: Another important source needed for the proposal is a research guide in computing and engineering media. They must assess each work's package and make any necessary modifications after analyzing the situation for the project's success.
- Access to resources and tools: Online journals, conference papers, and article resources must be available. In addition, the candidate must have access to and permission to use python software, AI, and data analytics tools. Another crucial element is having access to the university library.
- Hardware: For project planning and presentation, a Windows 10 PC is enough. To print reports, a printer can be a benefit.

- Software:The programming languages utilised are NumPy 1.24.1, pandas 1.5.2, and Python 3.7.0. Data analytics tools include PowerBI and Zoho. PyTorch,caffe and tensor flow for AI. Phocas software is useful for data visualization. Having Putty, Postman, and Anaconda installed on the system is also preferable.

## References


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# ANNEX A – Gantt chart

The tasks in this three-year PhD proposal have been broken down into six work packages, as was previously specified. This study proposal has finished work package zero, and the actual project implementation now starts with additional analyses of the literature review, data collecting, analysis, implementation, and final report submission.

| Tasks | Project plan | | |
|---|---|---|---|
| | Description | Deliverables | Duration in months |
| WP1 | Detailed literature review and understanding of the goals and objectives of the project | Report | 6 |
| WP2 | Identification of various data collection sources(Quantitative and Qualitative analyses) | Questionnaire | 6 |
| WP3 | Software development for the collected data | Code samples and output | 9 |
| WP4 | Implementation of AI Algorithm | Result data set | 6 |
| WP5 | Data Visualization tools | GUI/UI interface | 6 |
| WP6 | Documentation and final report | Report | 3 |

Fig 1: Table representation

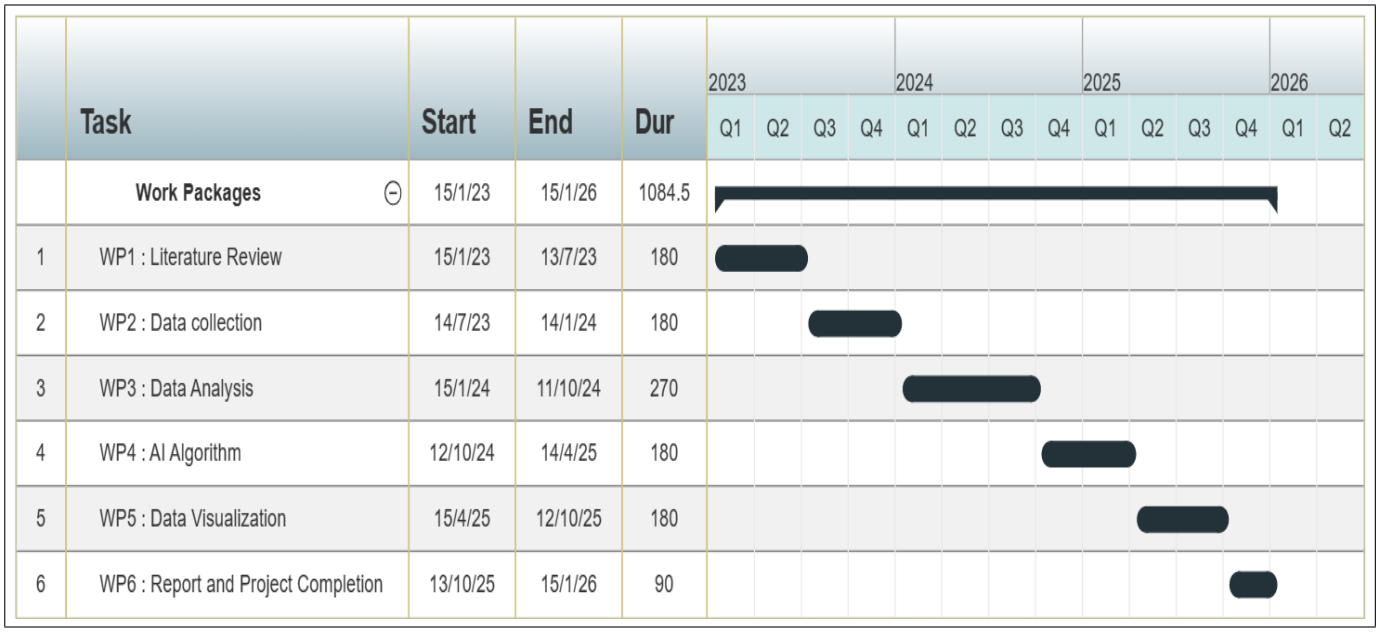


Fig 2: Gantt chart representation