1. **Analysis, and Interpretation**

Describe in detail the results of your analysis, and interpret your results in the context of your research question and problem. Include and discuss:

* + the proposed solution(s) and details of the analysis plan, and analysis interpretation
  + point out any interesting results **and** any implications of what it means
  + You should ensure that your team spends some time and energy considering the implications of your results and analysis. For example, if your research question is to understand the role of a potential explanatory variable in predicting a response variable, then consider what the "real-world" implications are of that explanatory variable being important (or not).
  + If applicable and reasonable, comment on any societal or ethical considerations of your results and interpretation.

After performing the data wrangling and model fitting on the Google PyTrends time series and the Statistics Canada historical retail and e-commerce sales and GDP values, a comparative study was performed using the results obtained from both the machine learning and the econometric modelling techniques for all three indicators.

|  |  |  |
| --- | --- | --- |
| **Method** | **Prediction Error (RMSE)** | **Parameter Tuning** |
| DFM + ARIMA | 2,828,358 | Number of factors |
| LASSO | 2,379,342 | Penalty parameter |
| PCA + Random Forest | 2,281,435 | Number of trees |
| PCA + XGBoost | 3,410,734 | *In progress* |





|  |  |  |
| --- | --- | --- |
| **Method** | **Prediction Error (RMSE)** | **Parameter Tuning** |
| ARIMA | 390,077 | -- |
| LASSO | 246,766 | Penalty parameter |
| Random Forest | 260,128 | Number of trees |
| XGBoost | 212,289 | *In progress* |

Chart, line chart, histogram

Description automatically generated

Chart, line chart

Description automatically generated

|  |  |  |
| --- | --- | --- |
| **Method** | **Prediction Error (RMSE)** | **Parameter Tuning** |
| DFM + ARIMA | 65,511 | Number of factors |
| LASSO | 84,146 | Penalty parameter |
| PCA + Random Forest | 78,651 | Number of trees |
| PCA + XGBoost | 83,641 | *In progress* |

Chart, line chart

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Chart, line chart

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1. **Conclusion:** presenting the results, conclusion, and directions (or recommendations) for future work
2. **References:**a bibliography of your cited works; you may choose whatever citation style you wish (but stay consistent)
3. H. Choi, H. Varian, **Predicting the present with Google Trends**, *Economic record*, *88 (2012)*, 2-9.
4. Stock, J.H. and Watson, M.W., 2016. **Dynamic factor models, factor-augmented vector autoregressions, and structural vector autoregressions in macroeconomics**. In *Handbook of macroeconomics* (Vol. 2, pp. 415-525). Elsevier.
5. Woloszko, N. (2020). **Tracking activity in real time with Google Trends**, OECD Economics Department Working Papers, No. 1634, OECD Publishing, Paris.
6. Dauphin, M.J.F., Dybczak, M.K., Maneely, M., Sanjani, M.T., Suphaphiphat, M.N., Wang, Y. and Zhang, H., 2022. **Nowcasting GDP-A Scalable Approach Using DFM, Machine Learning and Novel Data***, Applied to European Economies*. International Monetary Fund.
7. Richardson, A., van Florenstein Mulder, T. and Vehbi, T., 2021. **Nowcasting GDP using machine-learning algorithms: A real-time assessment**. *International Journal of Forecasting*, *37*(2), pp.941-948.
8. Logo source: [UBC Logo](https://www.abdn.ac.uk/study/undergraduate/canada-university-of-british-columbia-4250.php), [Statistics Canada](https://crippledscholar.com/2020/05/30/statistics-canada-isnt-collecting-information-on-disability-during-the-pandemic/), [Google Trends](https://towardsdatascience.com/google-trends-api-for-python-a84bc25db88f)
9. **Appendix** (if needed):  If you feel the need to include a technical discussion of methods, how to use the tools developed to perform future analysis, deployment of dashboards, delivery and deployment package for the client, code listings, etc, please place them here.