CAPSTONE PROJECT SUMMARY
Interactive Web Data Dashboard Built in Python for Banks and Investment Banks

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Introduction

In today's fast paced and highly competitive digital economy, the need to process data and to efficiently deliver it to the end-user is one of the most crucial components of information reporting. Interactive reporting allows end-users to be able to filter and select specific or desired information from the report and utilize them to support the decision-making process.

As this demand is ever increasing, software companies are creating numerous business intelligence products such as Tableau, Spotfire, QlikView, Power BI, etc. In addition, many financial companies' reporting units require their employees to able to understand and work on these products as a basic necessity. However, these products can be quite expensive and complex to both the employer and employee when the need to create advanced charts such as Sankey, Sunburst, etc.

Therefore, the main objective of this project is to create a free and easy to use web-based tool that can conduct industry analysis and peer comparison study based on publicly available financial data with select timeframes. When creating the dashboard for the abovementioned analysis tool, I have used the following multinational financial companies and their publicly available information:

- Citigroup Inc
- Bank of America Corporation
- Goldman Sachs Group
- JPMorgan Chase & Co
- Morgan Stanley

It is also important to note that pertaining to client confidentiality requirements, the client for this project shall be left anonymous.

Data Source and Methodology

For the above firms, I have used 10-K filings of each company from fiscal years 2010 to 2019. All relevant information for each company is obtained from EDGAR, the United States of America's Securities and Exchange Commission system that stands for Electronic Data Gathering, Analysis, and Retrieval. Additionally, each company's website was used with information in many different formats such as pdf, HTML, etc.

The most important advantage of this project is that it is based purely on the Python programming language. The main reason of selecting Python over other programming languages is the fact that is relatively easy to learn and use for people with non-programming background. To extract information from 10-K filings, I have used the python modules such as:

- Re/Regular Expression: This is an expression that is used to search a string or set of strings. Basically, a defined search.
- Pandas: An analysis tool created by Wes McKinney that enables data manipulation from numerical sources of data, tables and time series.
- Beautiful Soup: Another tool used to pull data or parse HTML and XML documents

As I am looking at tabular data, these modules have powerful functions for processing and presenting tabular data.

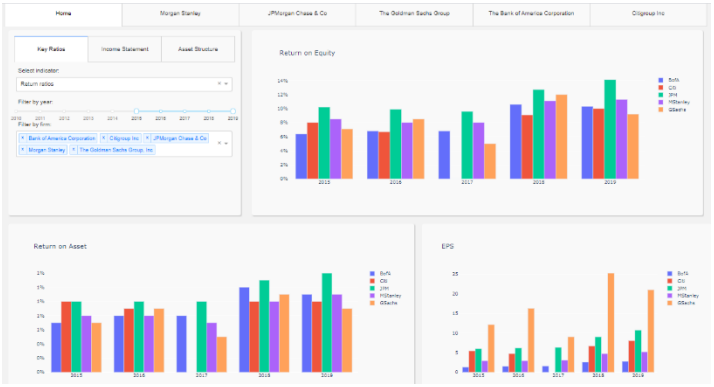
In order to create interactive charts, I looked for modules on Python that are dedicated for this purpose. As a result, I found out that most commonly used modules for creating interactive dashboards are comprised of Bokeh and Plotly modules.

- Bokeh: This is an interactive visualization library for web browsers. The main advantages of using this library are its on point construction of graphics and its strength to maintain interactivity even when using large or live datasets.
- Plotly: Another commonly used Python library for web browsers that makes high quality, interactive graphs.

I chose the Plotly module to create a dashboard because it has a productive Python framework for building web applications which is Dash. The primary modules are used to create an interactive chart, which means that users can select and filter series, values, and are able to zoom in or out and hover through the graphs.

Result and Usage

This dashboard consists of 6 pages. Each page has a control board which is located in the top left side. In order to maintain user friendly interface, each page contains only 3 charts.



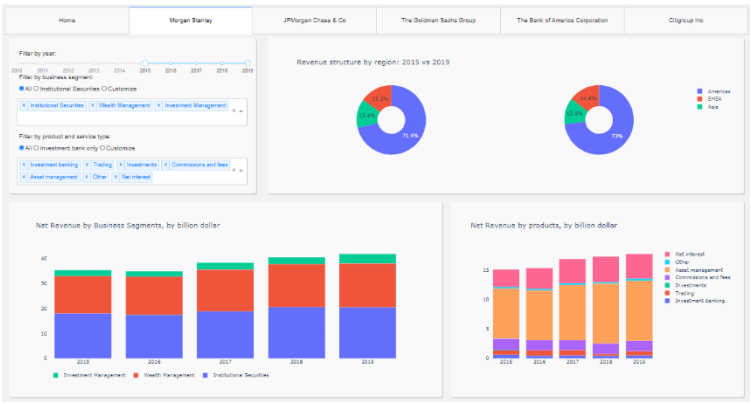
The home page shows a comparison of the selected firm's information. Users can select from three different tabs which are key ratios, income, and balance. Each tab contains 2 type indicators *(return ratios, margin ratios and CAR)* which allows user to select their desired information.

In the home page, users are able to select key ratios such as Return of Assets (ROA) and Return on Equity (ROE) for deeper analysis purposes. For example, if the user requires a 10 years comparison of Morgan Stanley and Goldman Sachs, the user can filter the duration by selecting 2010, 2019 and only selecting the above companies in the Filter by Firm section.

Below table shows the indicators which are in the home page. Additionally, users can filter by year and firms.

Tabs	**Key Ratios**		**Income Statement**		**Balance**	
Indicators	Return Ratios	Margin Ratios and CAR	Income	Expense	Asset	Liability
Chart 1	ROE	SG&A margin	Total revenue	Total non-interest expense	Total Asset	Total liability
Chart 2	ROA	Net income margin	Net interest income	Interest tax expense	Trading Securities	Short-term borrowings
Chart 3	EPS	TIER I ratio	Net income	Interest expense	Total Loans	Market Capitalization

The remaining 5 pages contain each firm's revenue structure. Users can see and analyze the revenue sources by region, segments, and products each in different graphs presented in the three boxes per page. Also, it allows filtering by year, segments, and products.



For the lower left box, the user can hover the mouse over each bar to view more detailed information regarding net revenue for the three business segments. In addition, the lower right box can display a further breakdown of each business segment by its product type.

The dashboard is available for use and analysis at http://tserendorj.pythonanywhere.com/home, which is a free public server.

Conclusion

With rapidly developing digital economy, an essential part of information reporting is not only to process data but also to deliver it to end-users in an engaging manner. Correspondingly, a broad range of business intelligence products are accessible, however, the products come a high price per license and require a certain level of expertise. This line of thought gave me an incentive to create cost efficient, interactive reporting tool where end-users can filter on specific criteria and access the information, they want with precision they need.

Therefore, primary purpose of this project is to provide a free dashboard analysis tool that is based on Python programming language. Users can also assess with other business intelligence tools for comparative reasons. Within the scope of completing this project, I was able to sharpen my programming skills and also develop business intelligence better. In addition, I have better understanding and knowledge of multinational financial firms.

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