

APPROACHABLE AND SCALABLE WEB APPLICATION SOLUTIONS USING SHINY FOR PYTHON AND R SHINY IN PHARMACEUTICAL INDUSTRY

Vikash Jain,
Head of Statistical Programming US
Genpro Research

Denny Sebastian
Data Analyst
Genpro Research

INTRODUCTION

Web dashboards play a critical role in the pharmaceutical industry by providing real-time data, visualizations, and insights to support informed decision-making and drive operational efficiency. Some of the common ways in which web dashboards are used in the pharmaceutical industry:

- **Clinical trial management:** To track the progress of clinical trials, monitor patient enrollment and assess the effectiveness of treatments.
- **Sales and marketing:** To monitor sales trends, track the performance of marketing campaigns, and analyze the impact of promotions on product sales.
- **Supply chain management:** To monitor the supply chain of pharmaceutical products, track inventory levels
- **Regulatory compliance:** To help organizations track and manage compliance with regulations such as FDA requirements.
- **Business intelligence:** To analyze large amounts of data to gain insights into key business metrics, such as customer behavior and financial performance.

TOOL TO DEVELOP DASHBOARDS

There are several tools used to develop dashboards in the pharmaceutical industry, some of the most popular are:

- **Tableau:** It is a data visualization tool that helps to create interactive dashboards, reports, and charts.
- **Power BI:** It is a cloud-based business analytics service provided by Microsoft, used to create interactive data visualizations and dashboards.
- **R Shiny:** R Shiny is an open-source package in the R programming language that provides a framework for building web-based interactive applications. It allows users to create dynamic dashboards and web apps with interactive graphics, tables, and other user-friendly features

SHINY FRAMEWORK

Shiny is an open-source web application framework for building interactive web applications using R.

- Shiny allows users to create and deploy web applications using R code without requiring any web development skills
- Shiny provides a high-level API for creating web applications in R
- Shiny applications can be created using a combination of R code and HTML, CSS, and JavaScript
- The framework offers various user interface widgets, such as sliders, drop-down menus, and tables, for users to interact with the data
- Shiny also provides tools for deploying applications to the web, including options for hosting on shinyapps.io, RStudio Connect, or a private server
- The framework is widely used in pharmaceutical, academia, industry, and government for data visualization, data analysis, and decision-making

PYTHON DASHBOARD FRAMEWORKS

Python Dashboard frameworks is a collection of tools and libraries used to develop and design interactive dashboards using the Python programming language.

- **Plotly-Dash:** A high-level framework for building dashboards and web applications.
- **Dash:** A web-based framework for building data dashboards and applications.
- **Streamlit:** A framework for building data dashboards and applications in Python, based on the Flask web framework.
- **Flask Framework:** A framework for building responsive, modern dashboards and web applications in Flask.
- **Shiny Framework:** A framework for building data dashboards in R, but can also be used with Python.

PYTHON DASH FRAMEWORK

- The **Plotly-Dash** and **Dash** are similar and both are open-source Python frameworks for building web applications.
- **Plotly-Dash** is built on top of the Plotly library, which provides interactive and animated charts and graphs
- **Dash** is built on top of the Flask web framework and uses a more basic set of plotting libraries.
- Dash apps are created using a combination of Python code and HTML/CSS/JavaScript components, making it easy to customize the look and feel of the app
- It provides a variety of pre-built components such as sliders, dropdowns, and graphs that can be easily customized to create interactive and dynamic dashboards
- This framework is not well-suited for building large-scale applications due to its limited scalability

PYTHON DASH AND R SHINY

Python Dash and **R Shiny**, both frameworks offer a wide range of features and capabilities, including data visualization, data manipulation, and interactive user interface elements

- Both frameworks **Python Dash** and **R Shiny** offer fast and efficient web application development
- R Shiny supports a wide range of data visualization and statistical packages such as **ggplot2**, **dplyr**, and **tidyr**, which can be used to create complex and customized visualizations.
- Python Dash is more suitable for projects that require machine learning or data manipulation
- R Shiny is more suitable fit for projects that require heavy statistical analysis or complex data visualizations

SHINY FOR PYTHON

At the recent [RStudio Conference](#), RStudio's CTO Joe Cheng announced Shiny for Python.

- RStudio integrated the widely popular web framework Shiny into Python.
- Python Shiny helps users to take advantage of the power and simplicity of Python
- library is still in alpha, it has several issues, and further enhancements can be expected
- Shiny apps can build and run in [Shinylive](#) web browser.
- Install and Configure Shiny in Python

```
pip install shiny  
Import shiny  
shiny create my_app  
shiny run --reload my_app/app.py
```

MIGRATION OF R PROGRAMMING

- The migration of R in clinical programming has been driven by;
 - Flexibility
 - Ease of use,
 - Extensive user community,
 - Open-source nature
 - Compatibility with other programming languages
- R has extensive collection of libraries and packages provides a broad range of functions and tools for clinical programming, including those for data cleaning, data manipulation, and data visualization.
- R can be used freely, and its source code can be easily accessed and modified. This allows for customization and tailoring of R to specific clinical research needs.

VALIDATION OF RESULTS

Clinical programming requires a high degree of accuracy and precision, and sometimes the use of R increases the risk of errors in code that can cause deviations in clinical outcomes.

- **Ensuring accuracy:** Validation helps to confirm the accuracy of the results produced by the analysis, which is crucial for making informed decisions about patient care.
- **Maintaining credibility:** By validating the results, healthcare providers can demonstrate the rigor of their methods and build trust with patients and other stakeholders.
- **Preventing errors:** Validation helps to identify errors or biases in the data analysis, reducing the risk of incorrect conclusions being drawn.
- **Improving quality:** Regular validation of results can help to improve the quality of data analysis, ensuring that it remains relevant and reliable over time.

DATA COMPARISON TOOL

- Data Comparison Tool is developed to compare the SDTM datasets generated from R and SAS
- Tool has an option to upload R and SAS datasets from user location
- Tool has the feature to draw comparison summaries at different levels
- Tool has the feature draw graphs from the comparison results to visualize the data deviations
- Data Comparison Tool is developed using R shiny and python shiny framework
- The tool has two tabs as follows,
 - **Comparison Summary:** Provides comparison summary results of the uploaded files
 - **Graphs:** Provides the grouped summary graphs of the uploaded files.

R – DATA COMPARISON TOOL

Data Comparison Tool

Import SAS SDTM Data

Browse Data

cm.sas7bdat

Upload complete

Import R SDTM Data

Browse Data

cm.RData

Upload complete

Compare Data Sets

Comparison Summary

Graphs

Select Summary Level

Comparison Summary

Show

10

entries

Search:

statistic	value
All	All
Number of by-variables	0
Number of non-by variables in common	24
Number of variables compared	21
Number of variables in x but not y	1
Number of variables in y but not x	0
Number of variables compared with some values unequal	19

R – DATA COMPARISON TOOL

Data Comparison Tool

Import SAS SDTM Data

Browse Data

cm.sas7bdat

Upload complete

Import R SDTM Data

Browse Data

cm.RData

Upload complete

Compare Date Sets

Comparison Summary

Graphs

Select Summary Level

Difference By Observations

Show

10

entries

Search:

var.x	var.y	..row.names..	values.x	values.y	row.x	row.y
All	CMSCAT	All	All	All	All	All
CMSCAT	CMSCAT	1	PRIOR ANTIPSYCHOTIC MEDICATION	MEDICATIONS	1	1
CMSCAT	CMSCAT	4	MEDICATIONS	CURRENT ANTIPSYCHOTIC MEDICATION	4	4
CMSCAT	CMSCAT	5	MEDICATIONS	PRIOR ANTIPSYCHOTIC MEDICATION	5	5
CMSCAT	CMSCAT	6	MEDICATIONS	PRIOR ANTIPSYCHOTIC MEDICATION	6	6
CMSCAT	CMSCAT	7	MEDICATIONS	CURRENT ANTIPSYCHOTIC MEDICATION	7	7

PYTHON – DATA COMPARISON TOOL

Data Comparison Tool

Import SAS SDTM Data

Browse...

cm.sas7bdat

Upload complete

Import R SDTM Data

Browse...

cm.RData

Upload complete

Compare Date Sets

Comparison Summary

[Graphs](#)

id	studyid_df1	studyid_df2	domain_df1	domain_df2	usubjid_df1	usubjid_df2
0	TRID-02	TRID-02	CM	CM	TRID-02-801-390	TRID-02-801-010
1	TRID-02	TRID-02	CM	CM	TRID-02-801-390	TRID-02-801-010
2	TRID-02	TRID-02	CM	CM	TRID-02-801-390	TRID-02-801-010
3	TRID-02	TRID-02	CM	CM	TRID-02-801-390	TRID-02-801-019
4	TRID-02	TRID-02	CM	CM	TRID-02-801-390	TRID-02-801-019

CONCLUSION

- Pharmaceutical industry use both R and Python languages together to maximize their analytical capabilities.
- Dashboards are important in the pharmaceutical area because they provide a clear and concise overview of the critical information that is required to make informed decisions.
- Dashboard helps to improve decision-making, streamline processes, and increase efficiency.
- Shiny makes it easy to build interactive web applications and dashboards
- Integrating Shiny to Python is undoubtedly a positive development for the web framework and RStudio (Posit)

THANK YOU

Any Questions ?