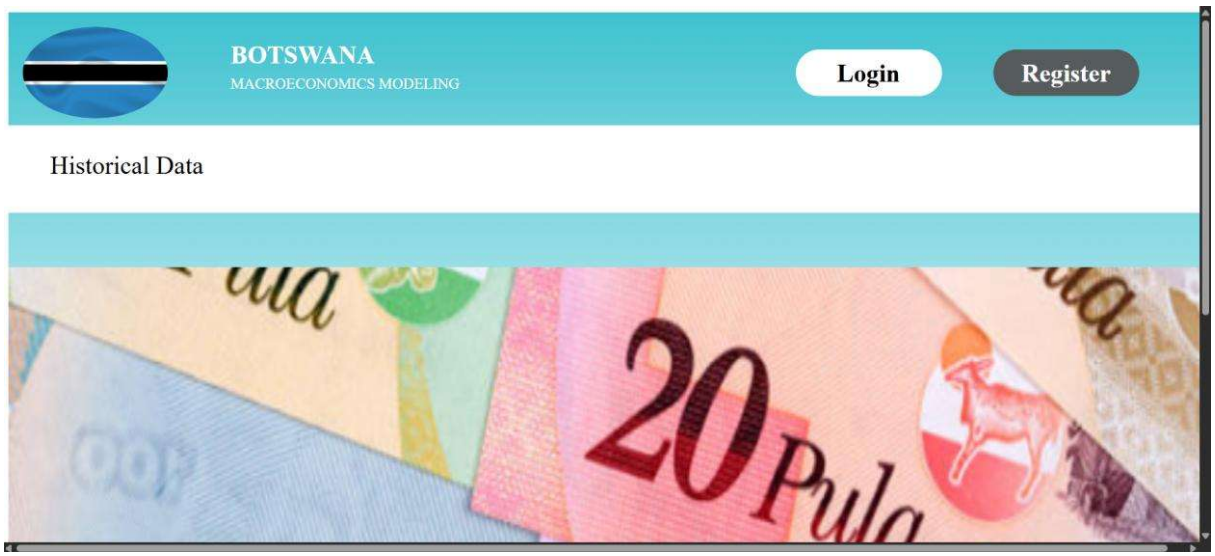
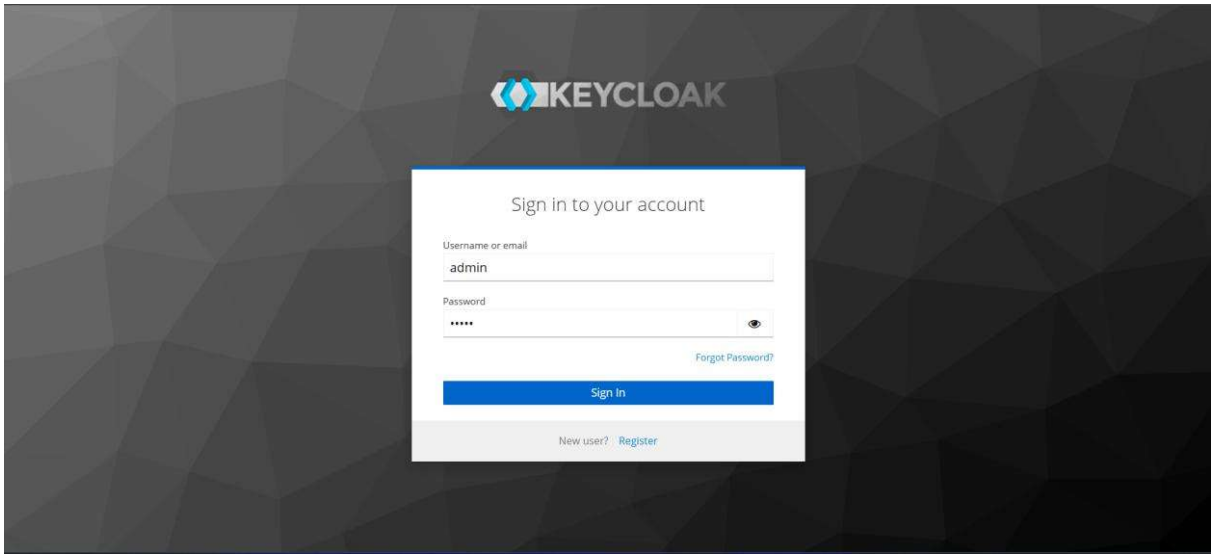
Botswana Macroeconomics Modelling Application User Manual

1. Navigate to the main application.

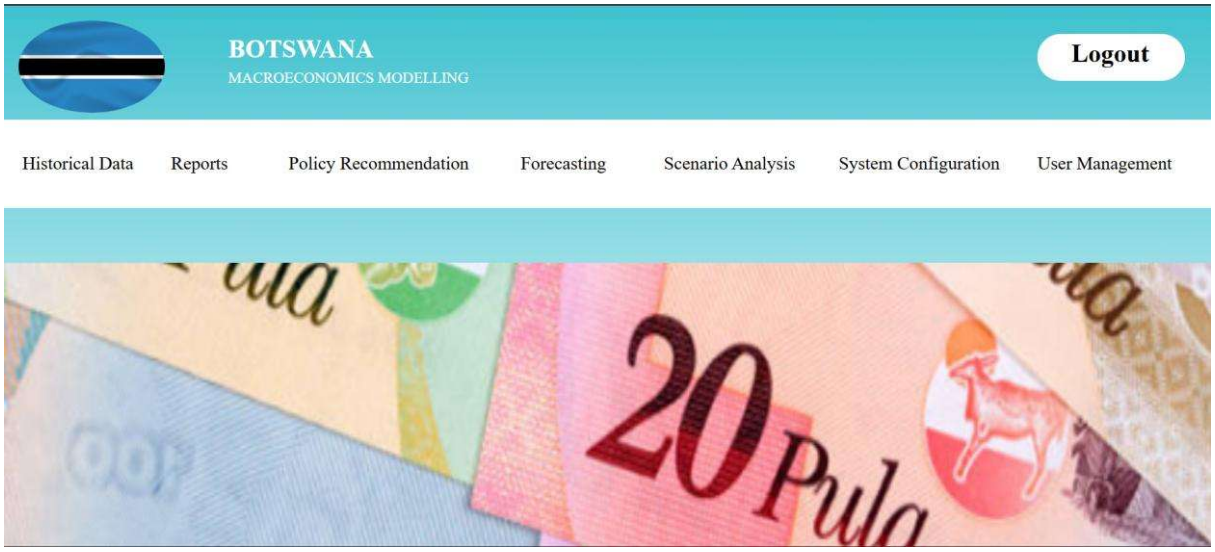


The above dashboard will load.

2. Click login and enter details into Keycloak login screen as shown below.

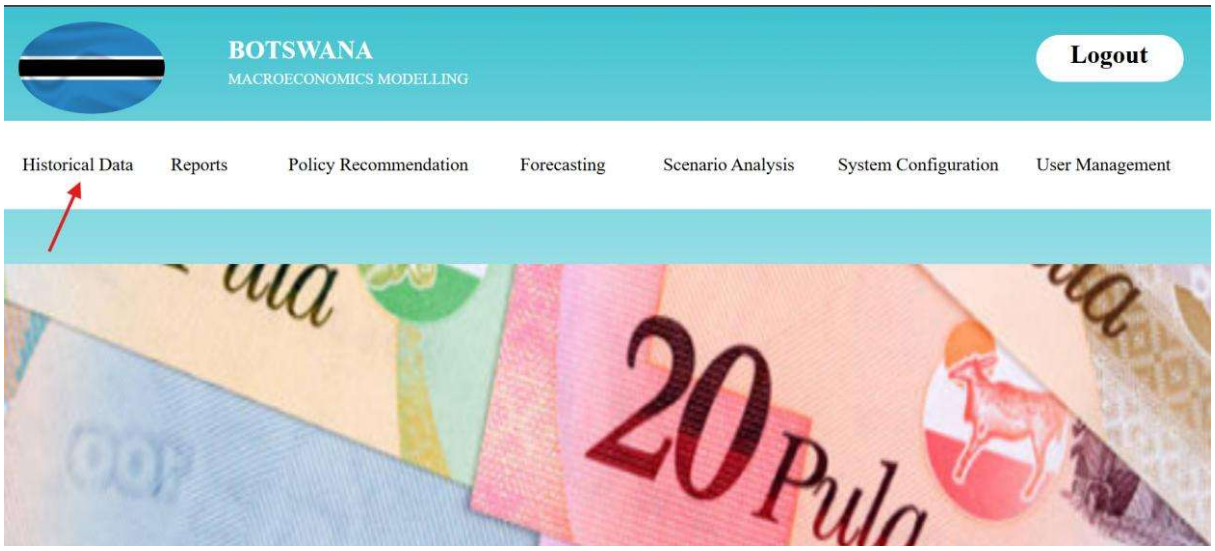


3. Upon clicking sign in you will be redirected to admin dashboard as shown below.

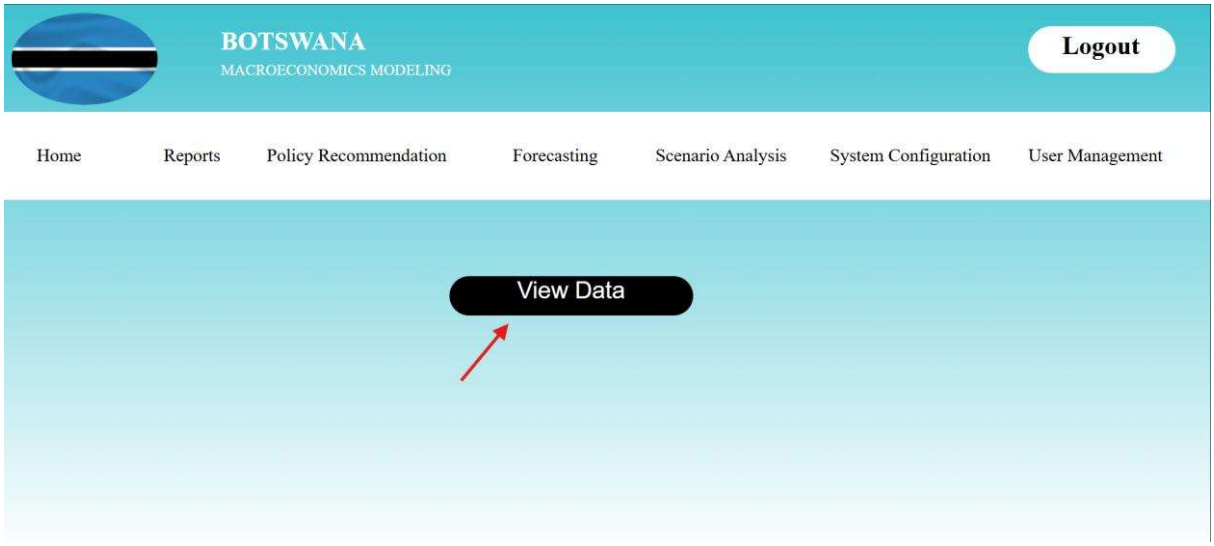


Historical Data

1. Click on Historical Data link in navigation bar.



2. Click on View Data button to view Botswana's historical economic data.

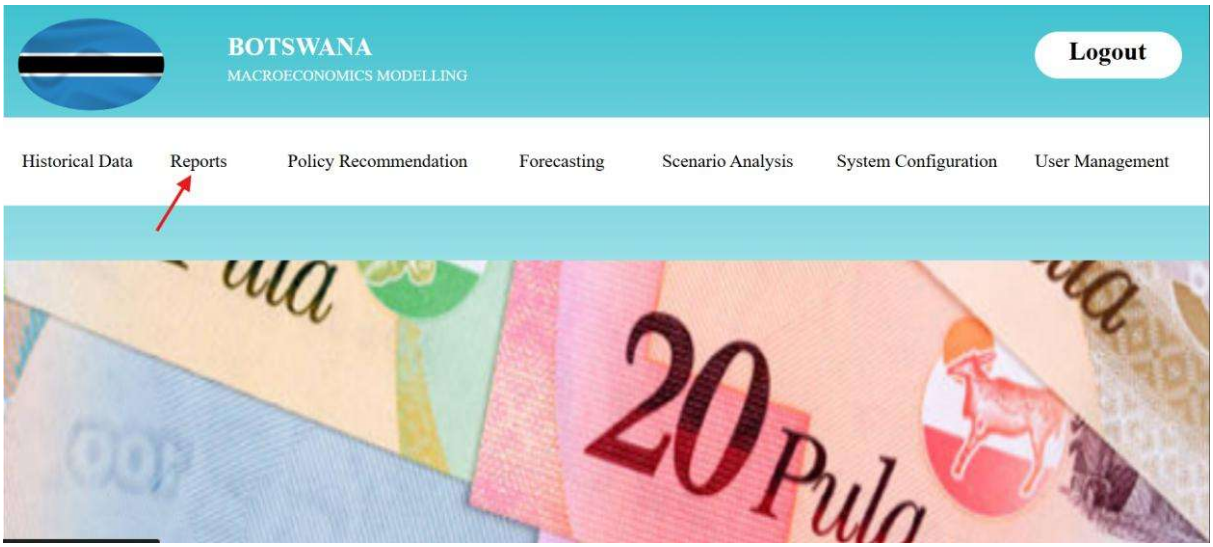


The data will appear as shown below.

Year	GDP ($M)	Unemployment Rate (%)	Inflation Rate (%)	Economic Growth (%)	Quarterly Growth (%)	Income Distribution (Gini Coefficient)	Net Exports (PM)	Govt Expenditure (% of GDP)	Tax Revenue (% of GDP)	Money Supply ($M)	Interest Rate (%)	Rate of Crawl (%)
2000	5790	15.88	9	1.99	-3.4	0.65	766	38.8	24.5	13.75	1000	-0.3
2000	5790	15.88	8	1.99	2.5	0.65	870	38.8	24.5	14.25	1000	-0.3
2000	5790	15.88	8.5	1.99	1.6	0.65	940	38.8	24.5	14.25	1000	-0.3
2000	5790	15.88	7.3	1.99	4.8	0.65	3482	38.8	24.5	14.25	1000	-0.3
2001	5490	18.54	7	0.25	4.1	0.65	900	42.1	24.5	14.25	1500	-1.2
2001	5490	18.54	6.1	0.25	3.2	0.65	1023	42.1	24.5	14.25	1550	-1.2
2001	5490	18.54	5.8	0.25	1.4	0.65	1105	42.1	24.5	14.25	1600	-1.2
2001	5490	18.54	6.1	0.25	-6.7	0.65	4094	42.1	24.5	14.25	1550	-1.2
2002	5440	21.27	5.9	6.07	1.4	0.65	176	45.1	25	14.25	1500	-2.1
2002	5440	21.27	10.1	6.07	2.1	0.65	200	45.1	25	15.25	1650	-2.1
2002	5440	21.27	10.6	6.07	1.2	0.65	216	45.1	25	15.25	1800	-2.1
2002	5440	21.27	10.7	6.07	18.2	0.65	800	45.1	25	15.25	1900	-2.1

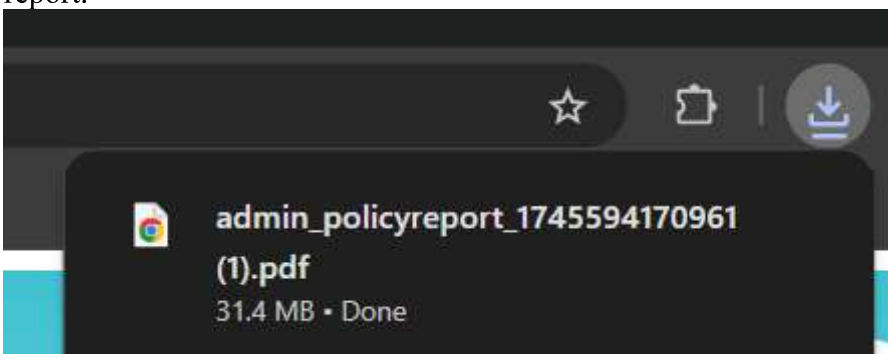
Reports

1. Navigate to the Reports tab as shown below.



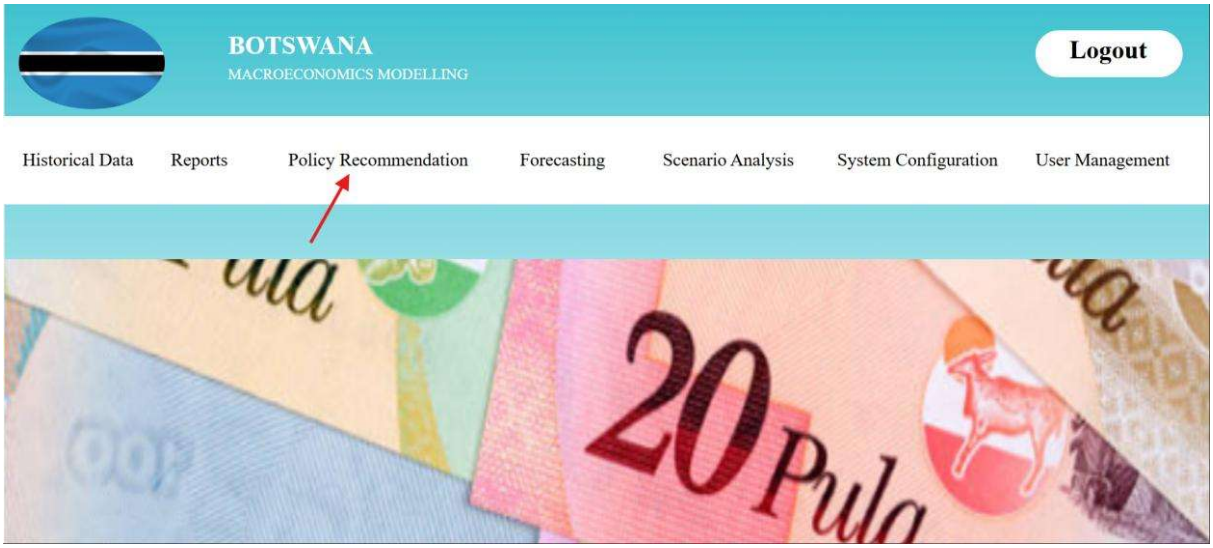
2. Wait a few seconds to view previously uploaded reports as shown below.

Click on the download button as circled above to download the corresponding report.



Policy Recommendation

1. Navigate to the Policy Recommendation page as shown below



2. A how to use section is available on the page that shows how to use the policy recommendation Feature. If no model or dataset is uploaded, the inbuilt model along with Botswana's historical economic data will be used. If only a dataset is uploaded, the inbuilt model will train using it and will produce a policy recommendation. If only a model is uploaded, the uploaded model will be trained using Botswana's economic data. If both model and dataset are uploaded, they will be used for training and outputting a policy recommendation.

How to Use:

This model will output an optimal macroeconomic policy recommendation based on historical economic data.

No Upload: If you choose not to upload any data nor a model, the in-built model will use Botswana's current historical data to generate the policies.

Upload Dataset only: If you choose only to upload a dataset, the in-built model will process this dataset and produce an optimal policy recommendation based on the dataset. See file format for in-built model below.

Upload Model only: If you choose only to upload a model, the dataset used for the model will be Botswana's historical data. Ensure your model caters for the file format shown below.

Upload Both Model and Data: If you choose to upload both a model and a dataset, your model will be trained using your dataset and the optimal policy mix will be recommended.

3. The acceptable file format for uploaded datasets can be found at the bottom of the page.

File Format for in-built model A tab separated csv or txt file with the following columns: Year, GDP, Unemployment Rate, Inflation Rate, Economic growth, Q on Q Economic Growth, Income and Wealth distribution, Net Exports, Govt Expenditure, Tax Revenue, Money Supply, Interest Rate, Exchange Rate of Crawl

4. Any existing previously uploaded models and datasets will automatically load on screen. To download a file, click the adjacent download button as shown below.

Generate Policies

Previously Uploaded Files

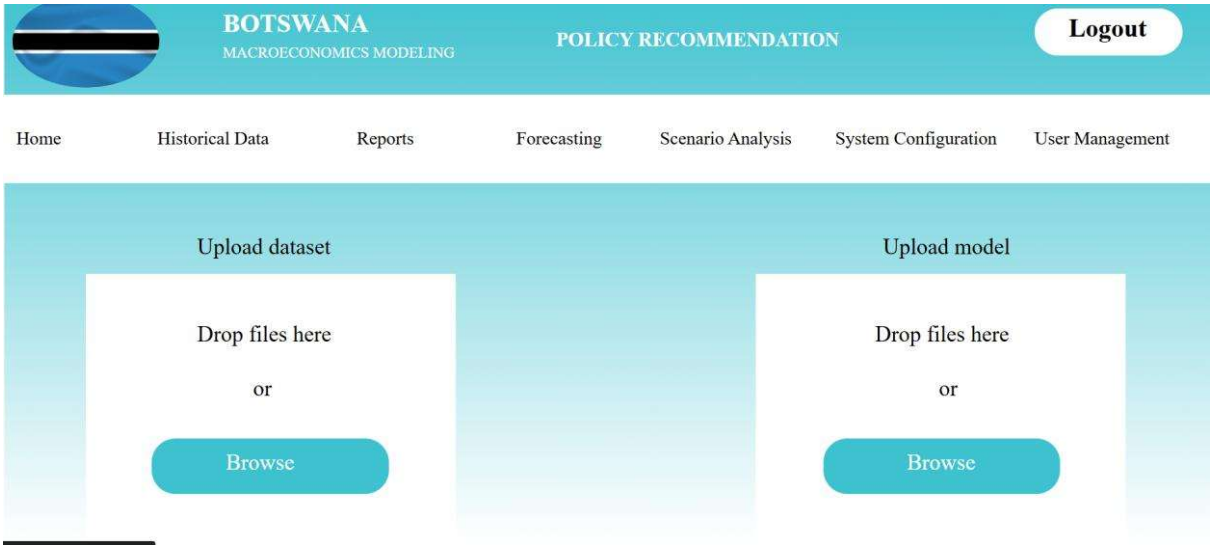
Datasets

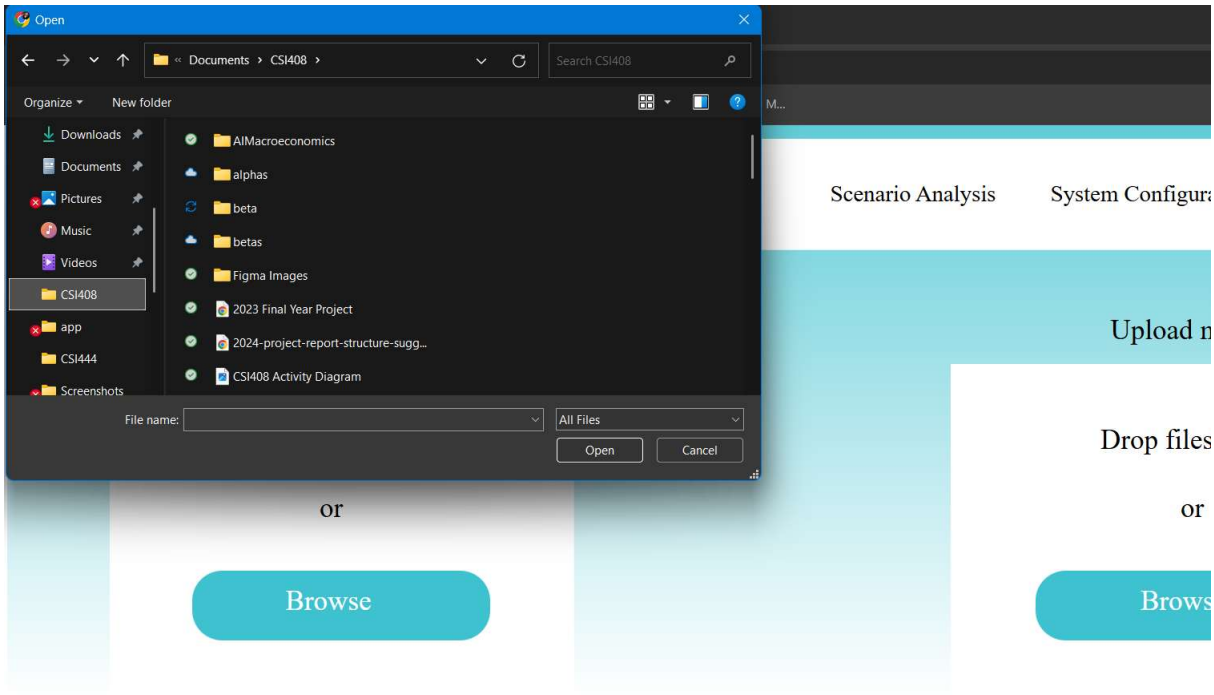
File Name	Action
Economic Indicators.txt	Download
Dummydata.txt	Download

Models

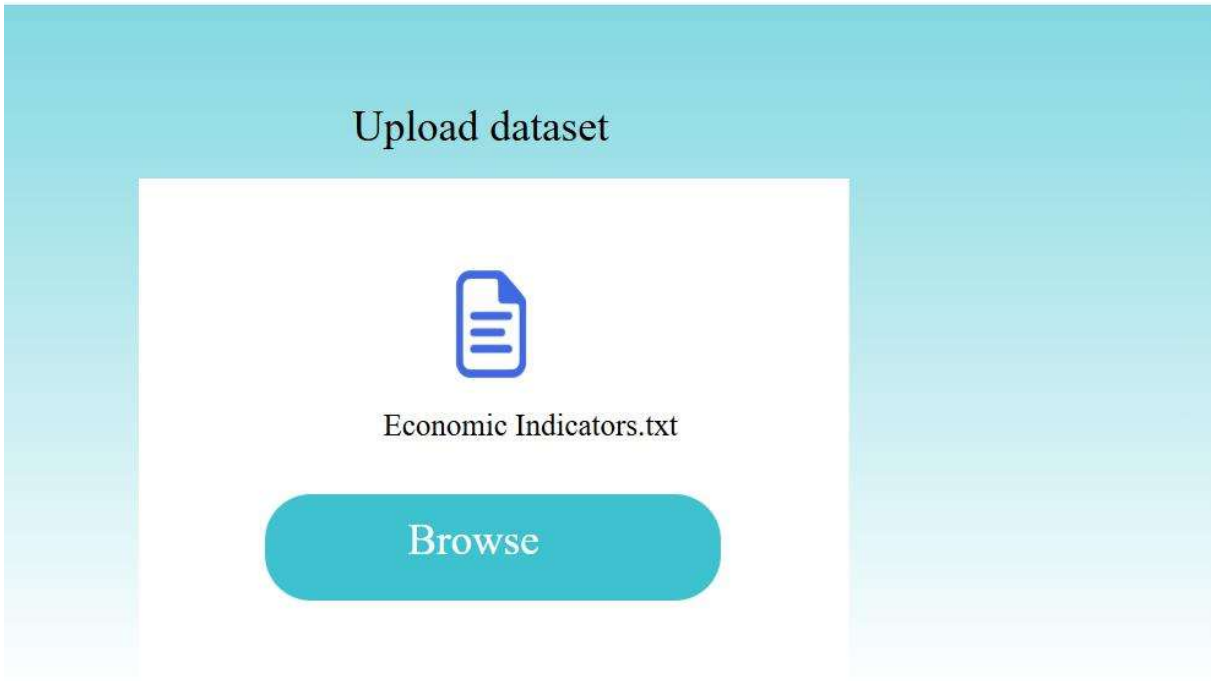
File Name	Action
policy_impact_weights.pkl	Download

5. To upload either a model or dataset, you may either drag and drop a file in the corresponding box, or click the browse button and select a file

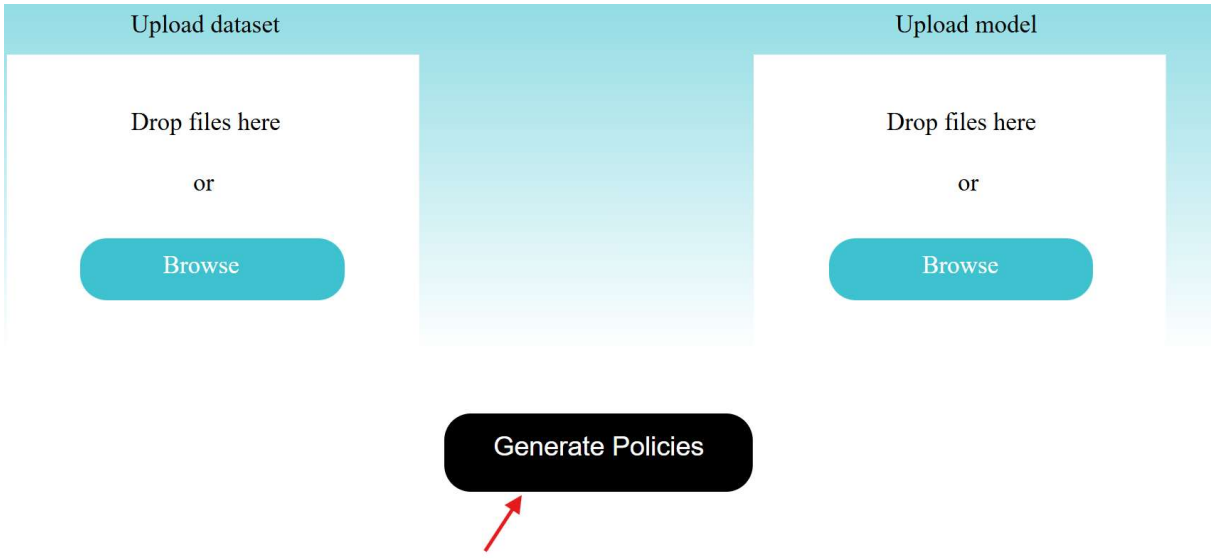




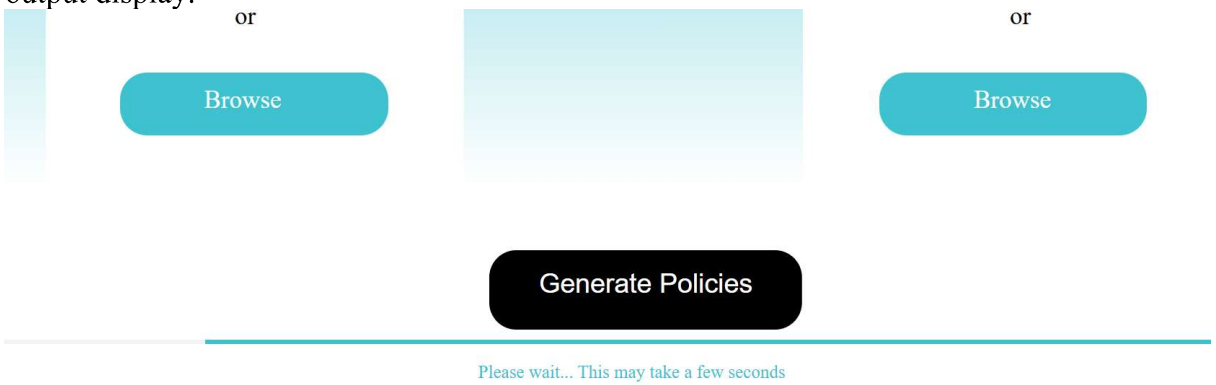
6. Upon selecting a file, it will be displayed in the corresponding field, as well as the file name as shown below.



7. To generate a policy, click on the Generate Policies button.



Allow the model to load and produce an output. Output will be displayed once the loading bar disappears indicating completion of the model training and output display.



8. After generating a policy, scroll down to view the output.

Shap Accuracy Details

GDP ($M): R² Score = 0.9316, RMSE = 712.7946
Unemployment Rate (%): R² Score = 0.9366, RMSE = 0.5033
Inflation Rate (%): R² Score = 0.6952, RMSE = 2.0628
Economic growth (%): R² Score = 0.9869, RMSE = 0.6884
Q on Q Economic Growth (%): R² Score = -0.5219, RMSE = 6.6384
Income and Wealth Distribution (Gini coefficient): R² Score = 0.9725, RMSE = 0.0070
Net Exports (PM): R² Score = -1.3057, RMSE = 2335.3438

Impact Weight of Policy Instruments Against Economic Variables

Policy Instrument	GDP ($M)	Unemployment Rate (%)	Inflation Rate (%)	Economic Growth (%)	Q on Q Economic Growth (%)	Income Distribution	Net Exports (PM)
Govt Expenditure (% of GDP)	0.14709582324179973	0.09197744875588727	0.14926831016224149	0.45226185580889877	0.34501501745178126	0.01581097437241716	0.211974294585393
Tax Revenue (% of GDP)	0.1252103943540418	0.18478234699473736	0.027264834642159515	0.11638807428305785	0.1501452657086704	0.05774727626304965	0.2255081958975968
Money Supply ($M)	0.21061043581961392	0.1237634191434089	0.06394070689669291	0.04420786545125181	0.12384328962314789	0.19572122923555924	0.2418282467129284

Latest Variables:

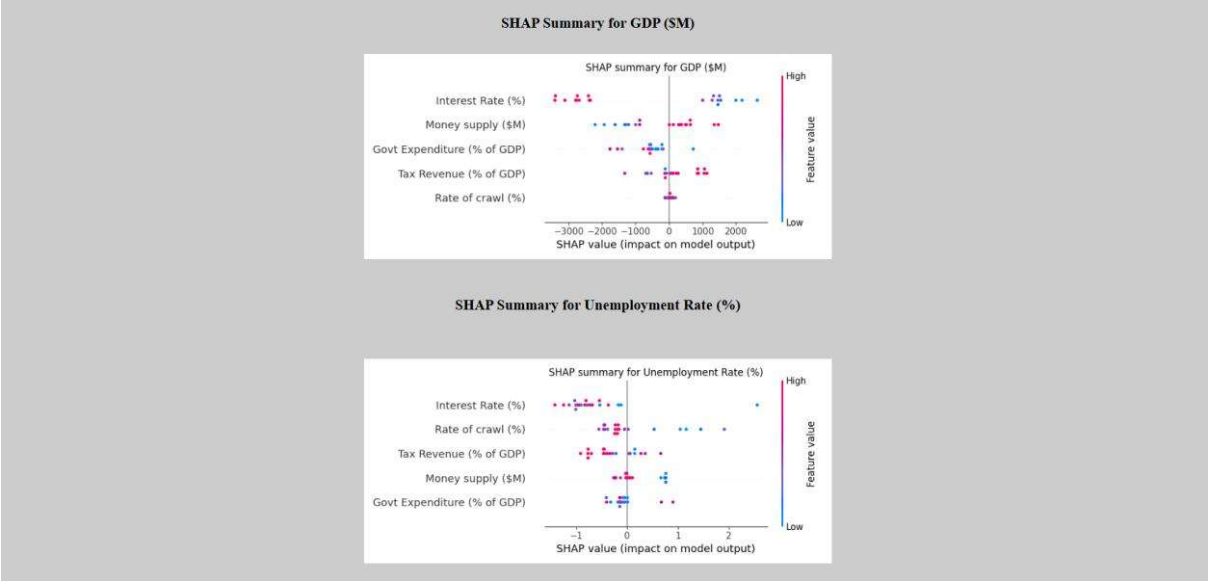
GDP ($M)	Unemployment Rate (%)	Inflation Rate (%)	Economic Growth (%)	Q on Q Economic Growth (%)	Income Distribution	Net Exports (PM)	Govt Expenditure (% of GDP)	Tax Revenue (% of GDP)	Money Supply ($M)	Interest Rate (%)	Rate of Crawl (%)
19400	23.38	3.1	2.73	2.3	0.53	-333	33.1	22	8000	2.4	-1.51

Recommended Policy:

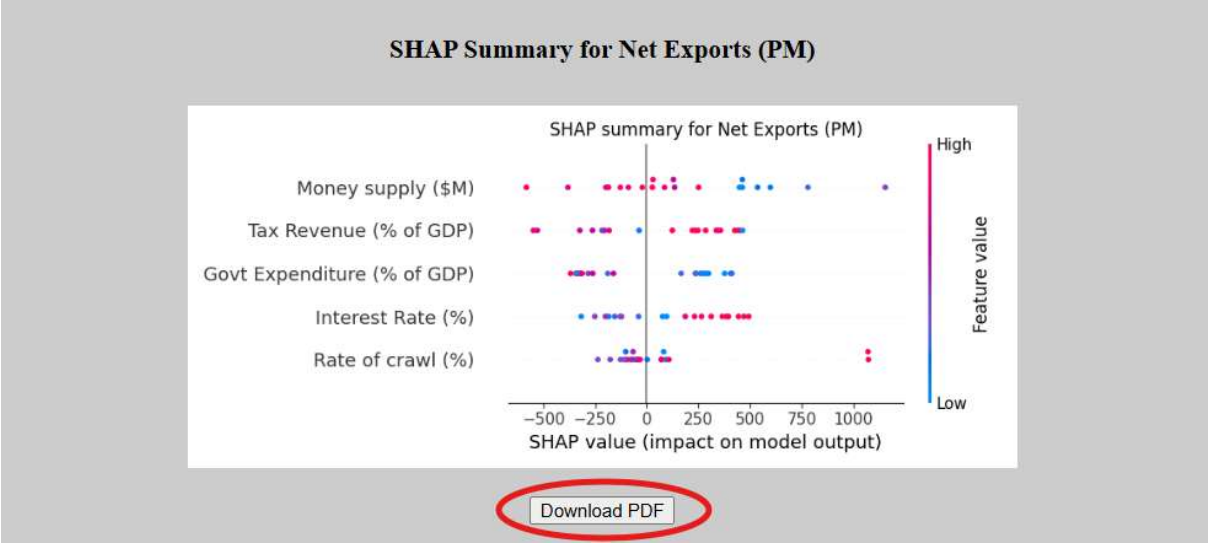
Govt Expenditure (% of GDP)	Tax Revenue (% of GDP)	Money Supply ($M)	Interest Rate (%)	Rate of Crawl (%)
33.37	21.85	8000.08	2.11	-1.85

Policy Impact Predictions:

GDP ($M)	Unemployment Rate (%)	Inflation Rate (%)	Economic Growth (%)	Q on Q Economic Growth (%)	Income Distribution	Net Exports (PM)
19671.37	23.14	3.38	4.93	4.04	0.53	-246.91

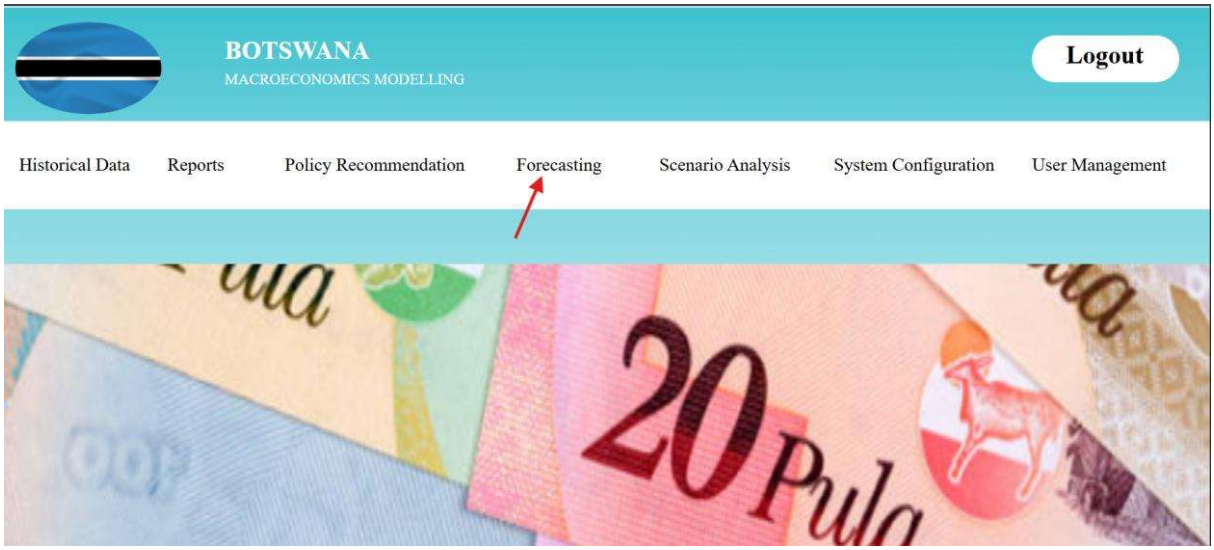


9. To download the report, click on the Download PDF button at the end of the output as shown below.



Forecasting

1. Navigate to the Forecasting page as shown below



2. A how to use section is available on the page that shows how to use the forecasting Feature. If no model or dataset is uploaded, the inbuilt forecasting model along with Botswana's historical economic data will be used. If only a dataset is uploaded, the inbuilt model will train using it and will produce a forecast. If only a model is uploaded, the uploaded model will be trained using Botswana's economic data. If both model and dataset are uploaded, they will be used for training and outputting a forecast.

How to Use:

This model will output an optimal macroeconomic policy recommendation based on historical economic data.

No Upload: If you choose not to upload any data nor a model, the in-built model will use Botswana's current historical data to generate the policies.

Upload Dataset only: If you choose only to upload a dataset, the in-built model will process this dataset and produce an optimal policy recommendation based on the dataset. See file format for in-built model below.

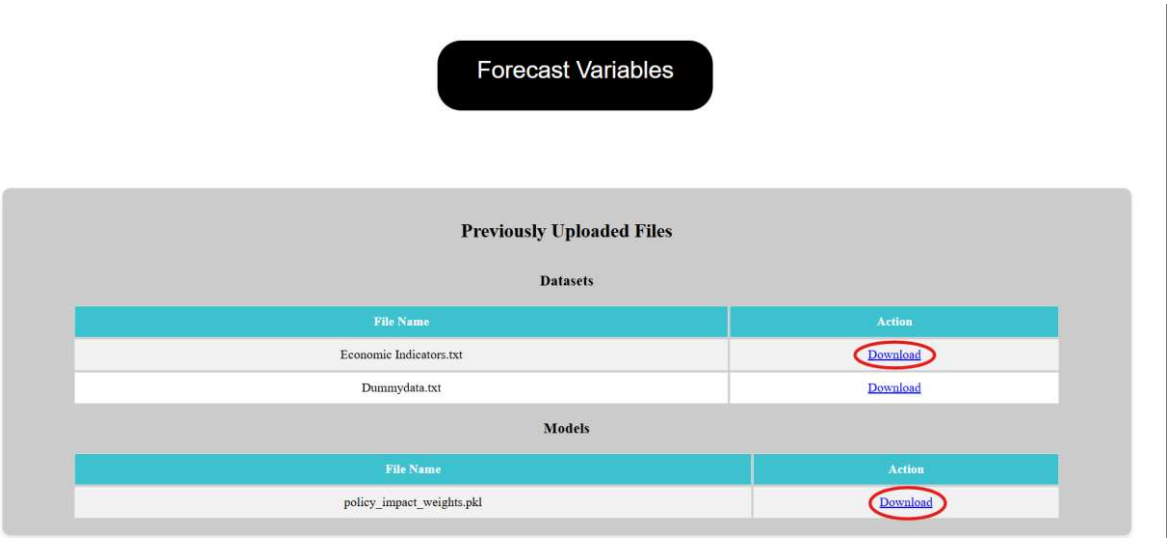
Upload Model only: If you choose only to upload a model, the dataset used for the model will be Botswana's historical data. Ensure your model caters for the file format shown below.

Upload Both Model and Data: If you choose to upload both a model and a dataset, your model will be trained using your dataset and the optimal policy mix will be recommended.

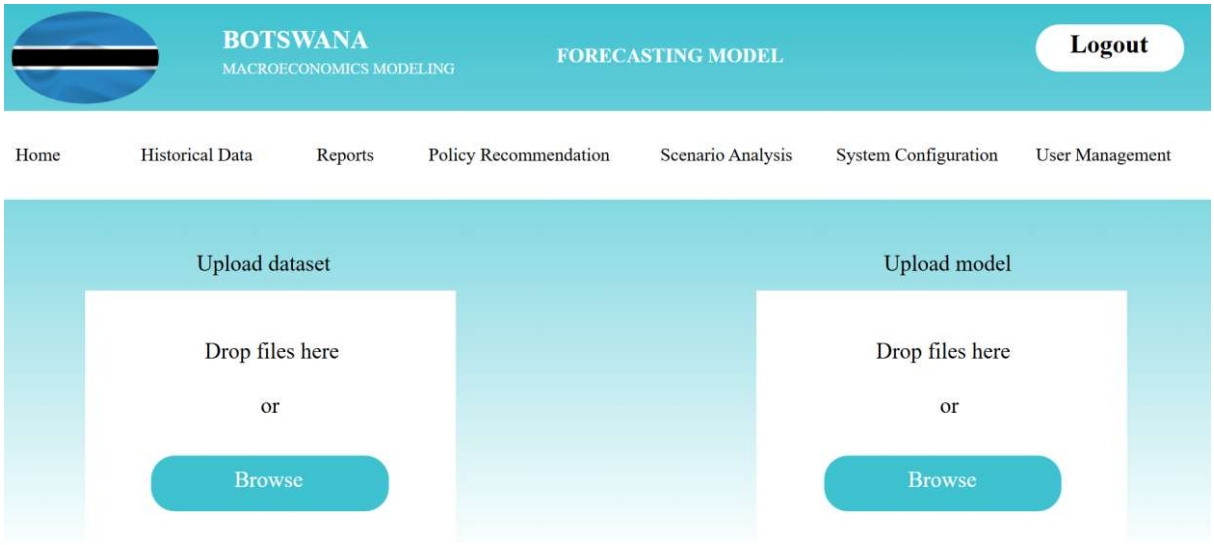
3. The acceptable file format for uploaded datasets can be found at the bottom of the page.

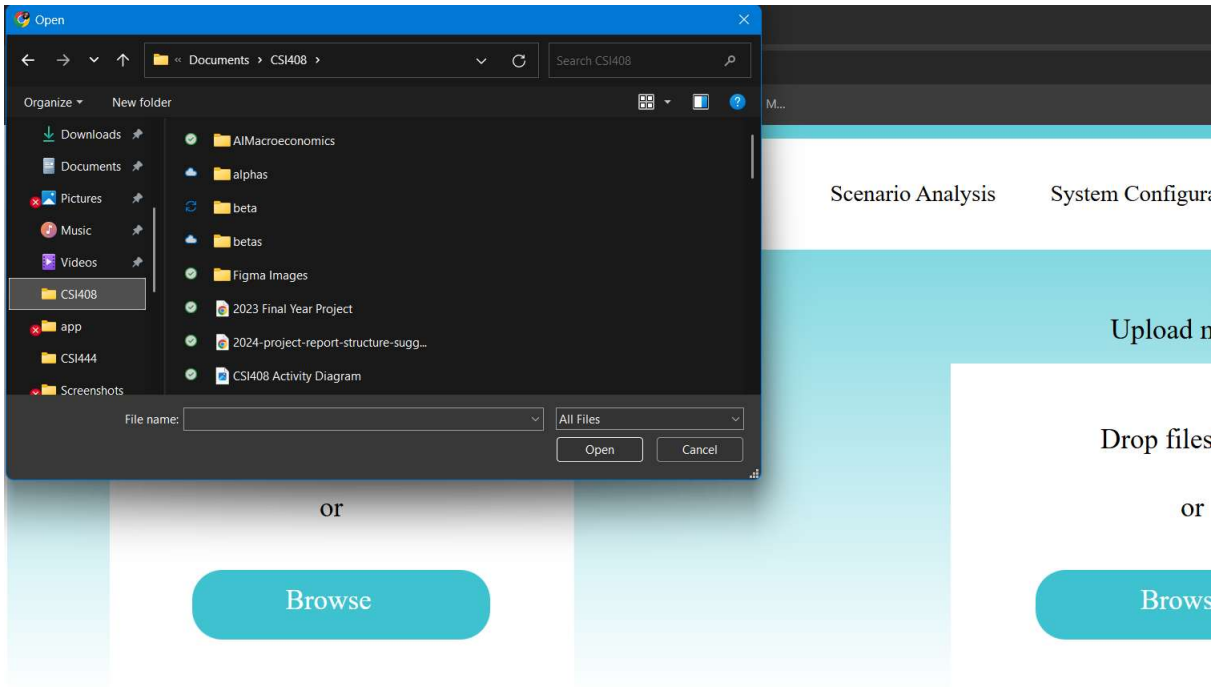
File Format for in-built model A tab separated csv or txt file with the following columns: Year, GDP, Unemployment Rate, Inflation Rate, Economic growth, Q on Q Economic Growth, Income and Wealth distribution, Net Exports, Govt Expenditure, Tax Revenue, Money Supply, Interest Rate, Exchange Rate of Crawl

4. Any existing previously uploaded models and datasets will automatically load on screen. To download a file, click the adjacent download button as shown below.

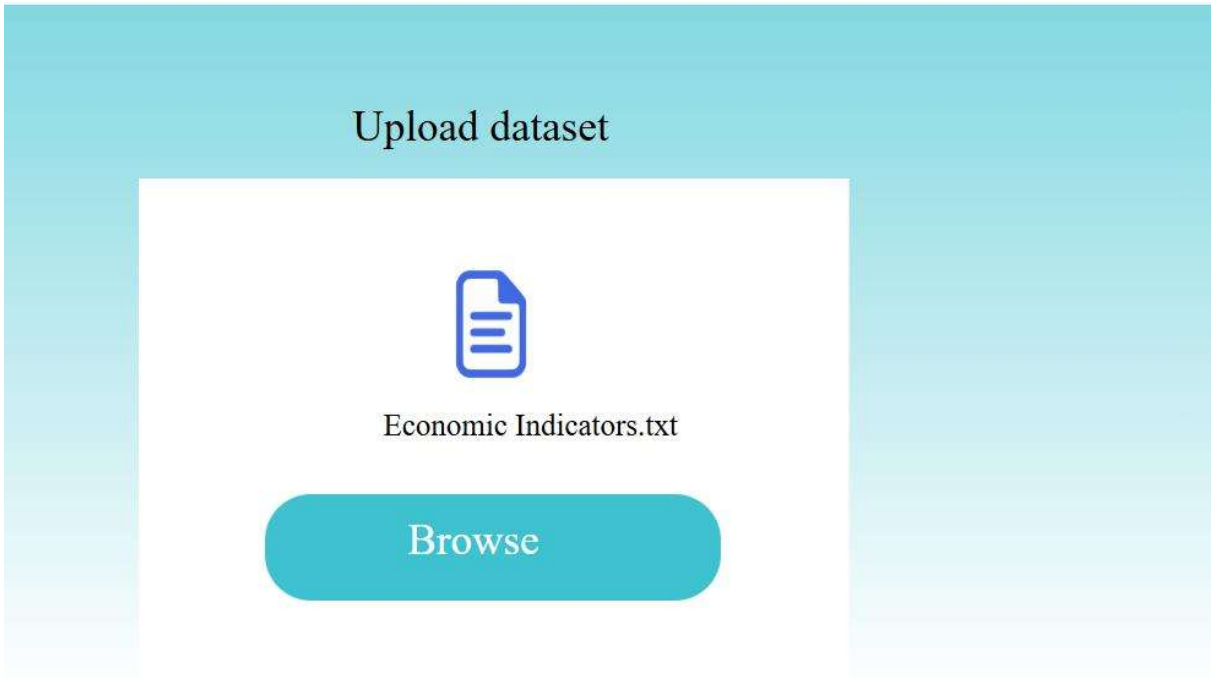


5. To upload either a model or dataset, you may either drag and drop a file in the corresponding box, or click the browse button and select a file

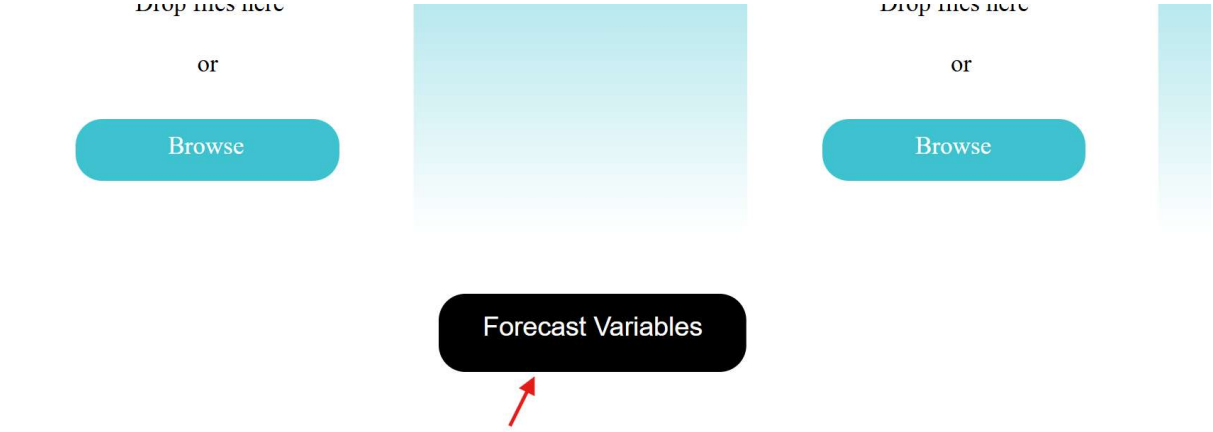




6. Upon selecting a file, it will be displayed in the corresponding field, as well as the file name as shown below.

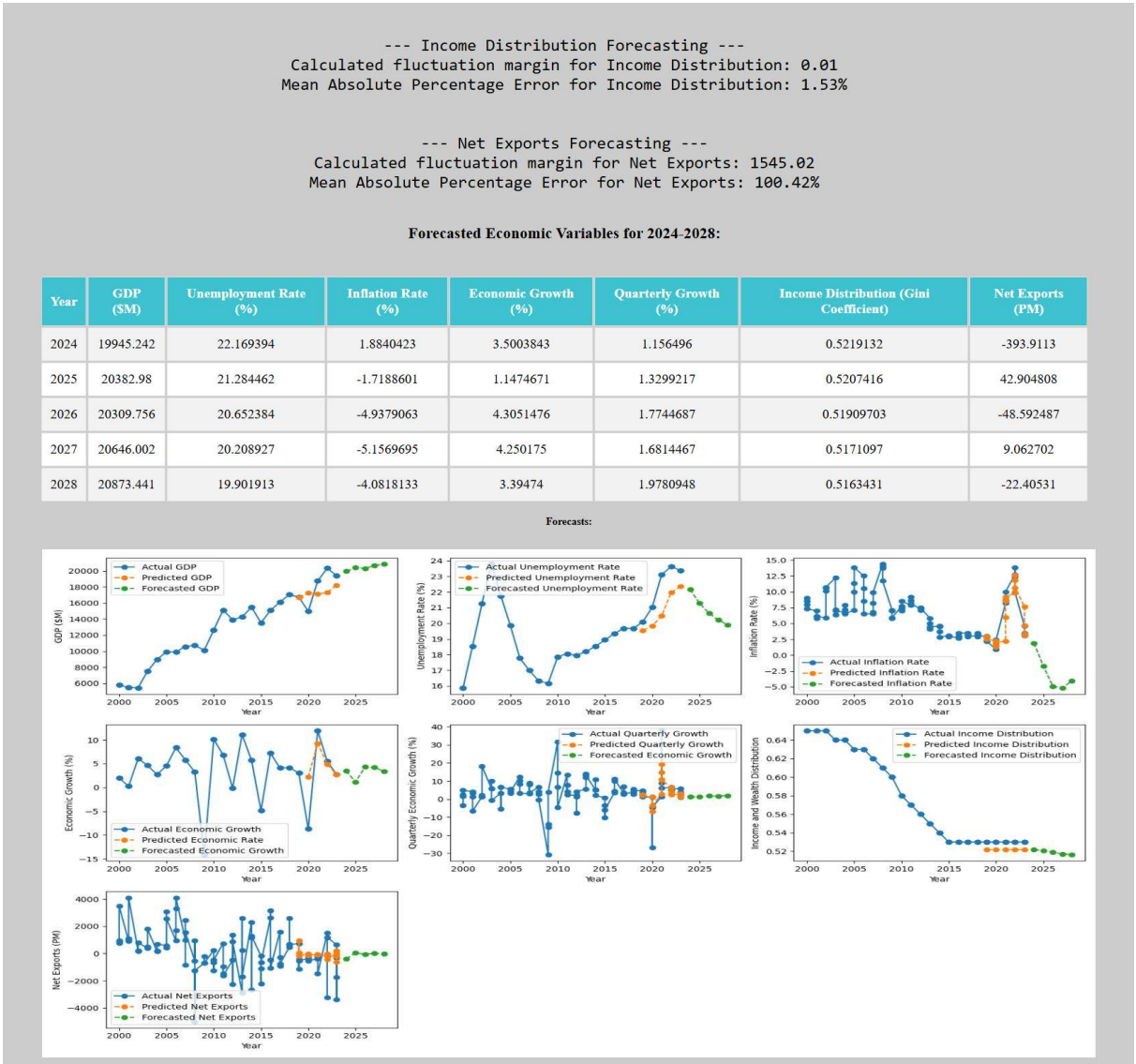


7. To generate a forecast, click on the Forecast Variables button.



Allow the model to load and produce an output. Output will be displayed once the loading bar disappears indicating completion of the model training and output display.

8. After generating a forecast, scroll down to view the output.



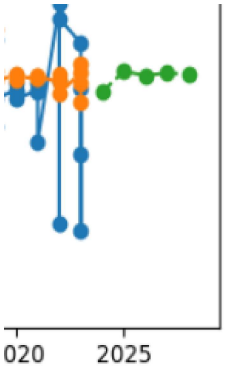
```
--- Income Distribution Forecasting ---
Calculated fluctuation margin for Income Distribution: 0.01
Mean Absolute Percentage Error for Income Distribution: 1.53%

--- Net Exports Forecasting ---
Calculated fluctuation margin for Net Exports: 1545.02
Mean Absolute Percentage Error for Net Exports: 100.42%
```

Forecasted Economic Variables for 2024-2028:

Year	GDP ($M)	Unemployment Rate (%)	Inflation Rate (%)	Economic Growth (%)	Quarterly Growth (%)	Income Distribution (Gini Coefficient)	Net Exports (PM)
2024	19945.242	22.169394	1.8840423	3.5003843	1.156496	0.5219132	-393.9113
2025	20382.98	21.284462	-1.7188601	1.1474671	1.3299217	0.5207416	42.904808
2026	20309.756	20.652384	-4.9379063	4.3051476	1.7744687	0.51909703	-48.592487
2027	20646.002	20.208927	-5.1569695	4.250175	1.6814467	0.5171097	9.062702
2028	20873.441	19.901913	-4.0818133	3.39474	1.9780948	0.5163431	-22.40531

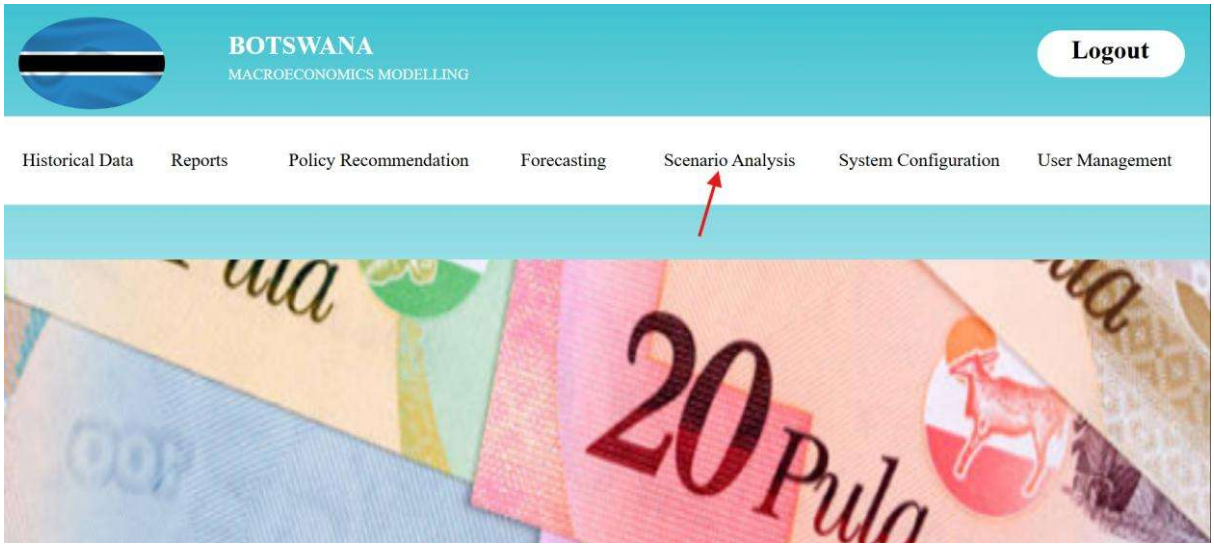
Forecasts:

9. To download the report, click on the Download PDF button at the end of the output as shown below.



Scenario Analysis

1. Navigate to the Scenario Analysis page as shown below.



2. A how to use section is available on the page that shows how to use the scenario analysis Feature. If no model or dataset is uploaded, the inbuilt scenario analysis model along with Botswana's historical economic data will be used. If only a dataset is uploaded, the inbuilt model will train using it and will produce a prediction. If only a model is uploaded, the uploaded model will be trained using Botswana's economic data. If both model and dataset are uploaded, they will be used for training and outputting a prediction.

How to Use:

This model will output an optimal macroeconomic policy recommendation based on historical economic data.

No Upload: If you choose not to upload any data nor a model, the in-built model will use Botswana's current historical data to generate the policies.

Upload Dataset only: If you choose only to upload a dataset, the in-built model will process this dataset and produce an optimal policy recommendation based on the dataset. See file format for in-built model below.

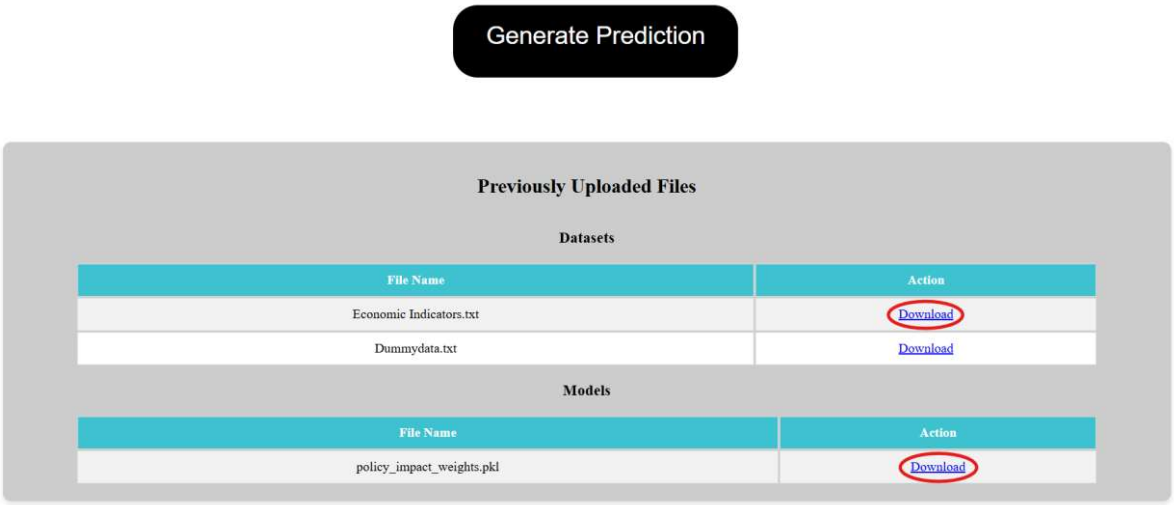
Upload Model only: If you choose only to upload a model, the dataset used for the model will be Botswana's historical data. Ensure your model caters for the file format shown below.

Upload Both Model and Data: If you choose to upload both a model and a dataset, your model will be trained using your dataset and the optimal policy mix will be recommended.

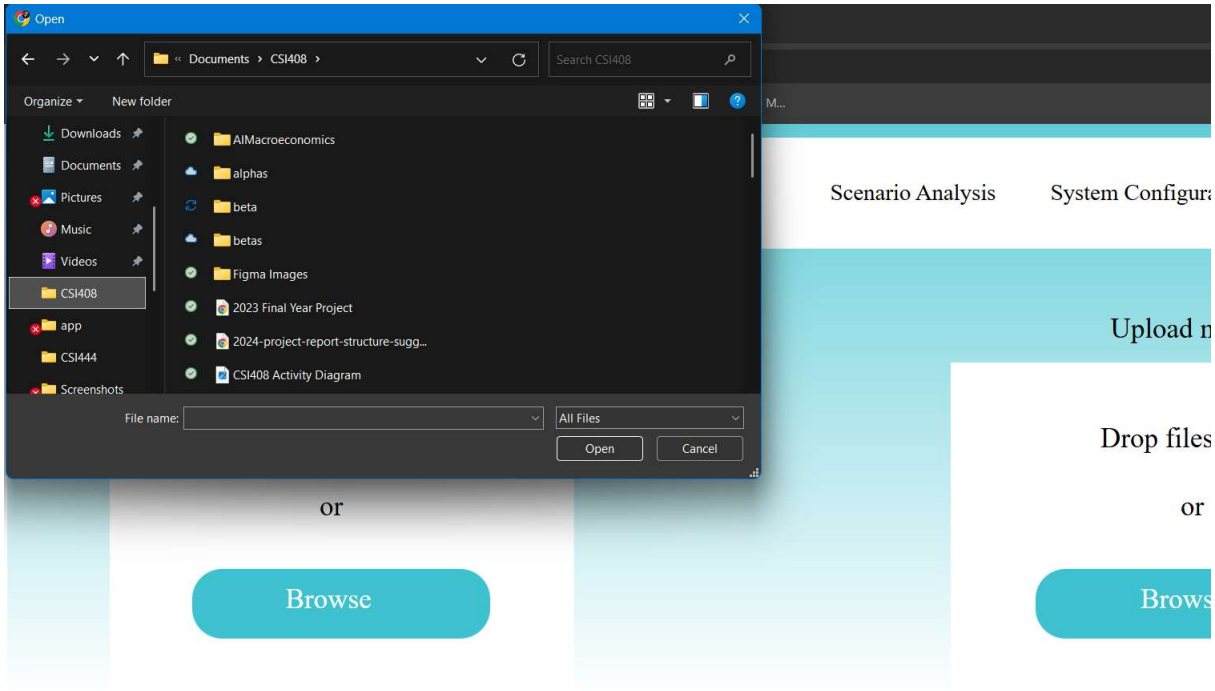
3. The acceptable file format for uploaded datasets can be found at the bottom of the page.

File Format for in-built model A tab separated csv or txt file with the following columns: Year, GDP, Unemployment Rate, Inflation Rate, Economic growth, Q on Q Economic Growth, Income and Wealth distribution, Net Exports, Govt Expenditure, Tax Revenue, Money Supply, Interest Rate, Exchange Rate of Crawl

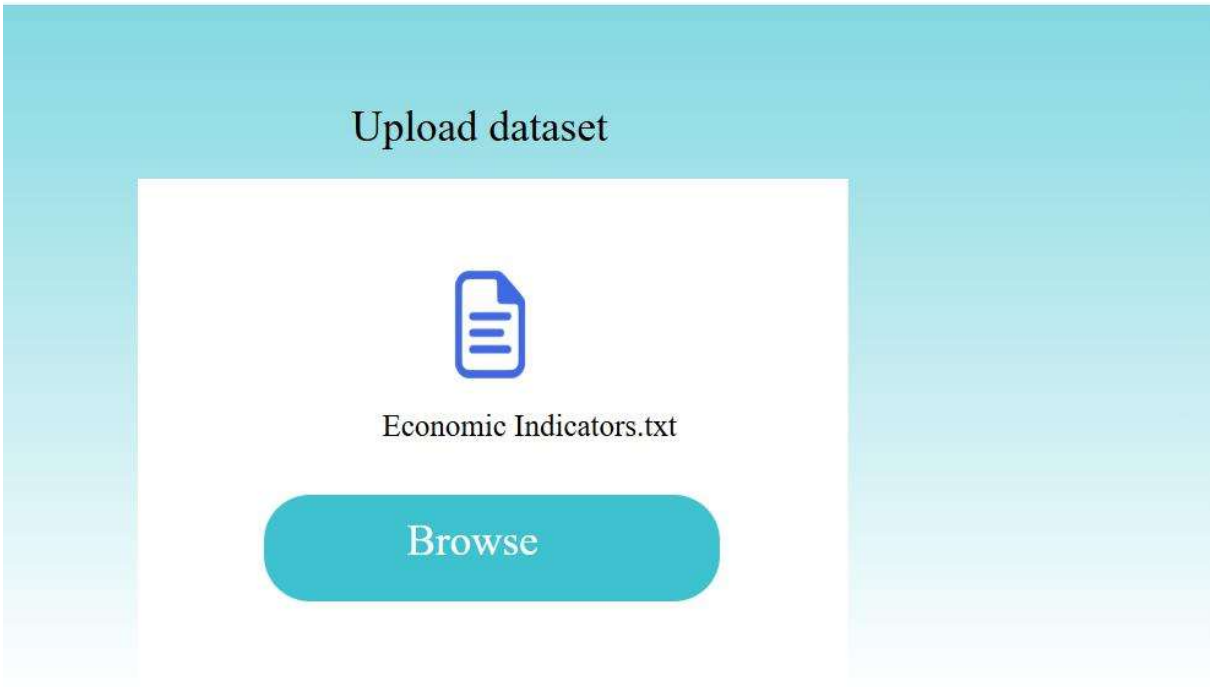
4. Any existing previously uploaded models and datasets will automatically load on screen. To download a file, click the adjacent download button as shown below.



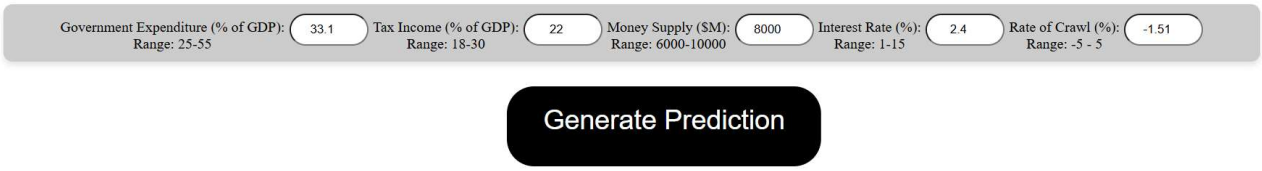
5. To upload either a model or dataset, you may either drag and drop a file in the corresponding box, or click the browse button and select a file



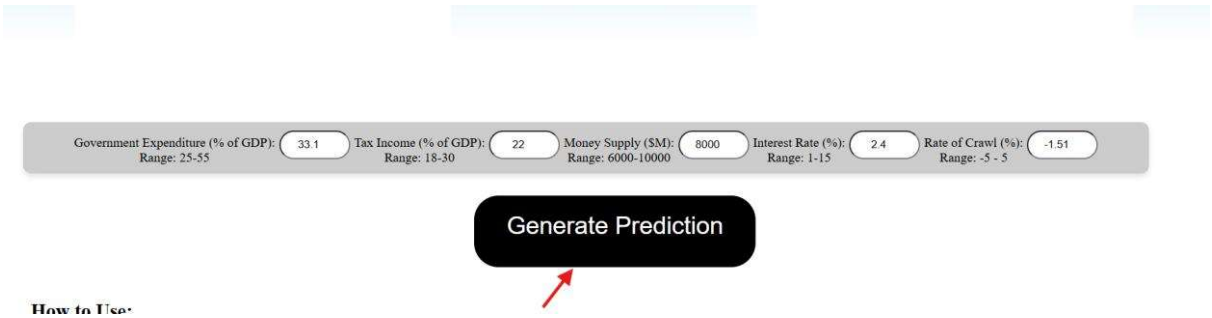
6. Upon selecting a file, it will be displayed in the corresponding field, as well as the file name as shown below.



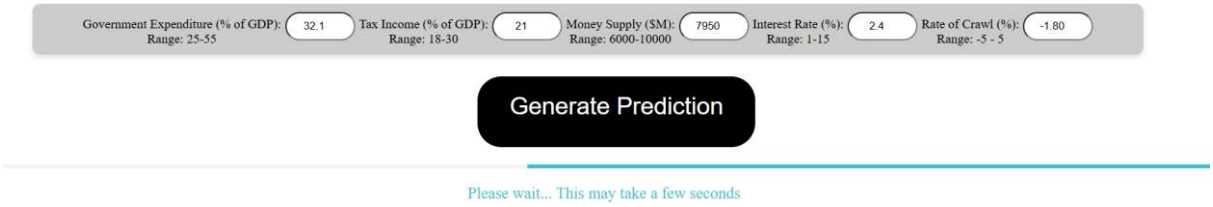
7. The input field for the policy being tested can be found above the Generate Predictions button as shown below. The corresponding acceptable ranges for the inputs are shown next to the input field. If values out of range or of the wrong type are entered, the Generate Prediction button will not be enabled.



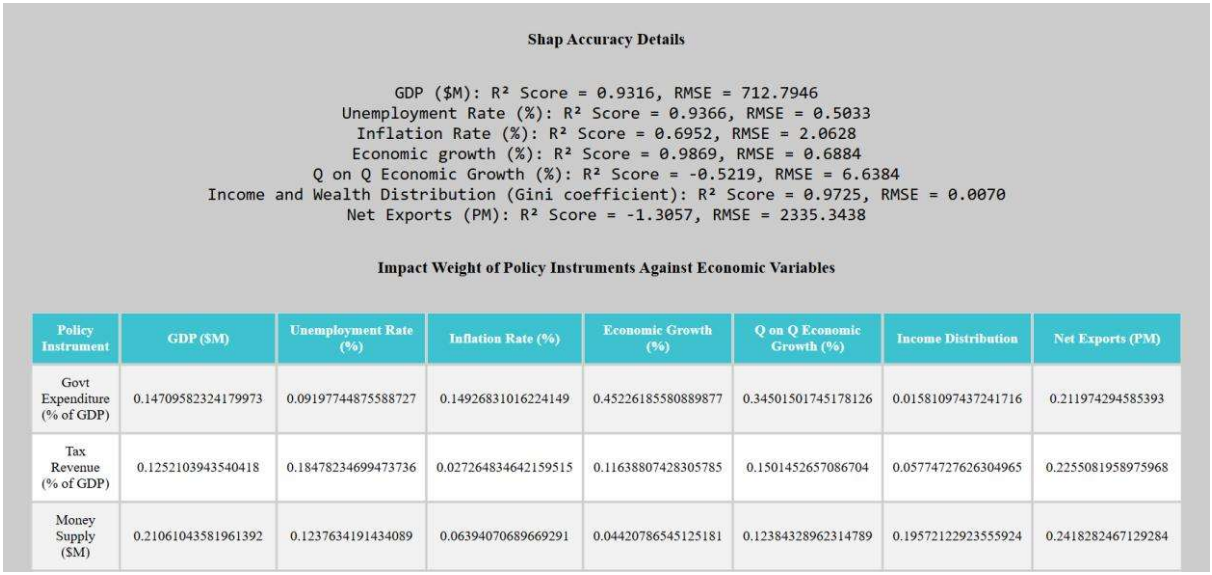
8. To generate a prediction based on the inputted policy, click on the Generate Prediction button.



Allow the model to load and produce an output. Output will be displayed once the loading bar disappears indicating completion of the model training and output display.



9. After generating a prediction, scroll down to view the output.



Shap Accuracy Details

GDP ($M): R² Score = 0.9316, RMSE = 712.7946
Unemployment Rate (%): R² Score = 0.9366, RMSE = 0.5033
Inflation Rate (%): R² Score = 0.6952, RMSE = 2.0628
Economic growth (%): R² Score = 0.9869, RMSE = 0.6884
Q on Q Economic Growth (%): R² Score = -0.5219, RMSE = 6.6384
Income and Wealth Distribution (Gini coefficient): R² Score = 0.9725, RMSE = 0.0070
Net Exports (PM): R² Score = -1.3057, RMSE = 2335.3438

Impact Weight of Policy Instruments Against Economic Variables

Policy Instrument	GDP ($M)	Unemployment Rate (%)	Inflation Rate (%)	Economic Growth (%)	Q on Q Economic Growth (%)	Income Distribution	Net Exports (PM)
Govt Expenditure (% of GDP)	0.14709582324179973	0.09197744875588727	0.14926831016224149	0.45226185580889877	0.34501501745178126	0.01581097437241716	0.211974294585393
Tax Revenue (% of GDP)	0.1252103943540418	0.18478234699473736	0.027264834642159515	0.11638807428305785	0.1501452657086704	0.05774727626304965	0.2255081958975968
Money Supply ($M)	0.21061043581961392	0.1237634191434089	0.06394070689669291	0.04420786545125181	0.12384328962314789	0.19572122923555924	0.2418282467129284

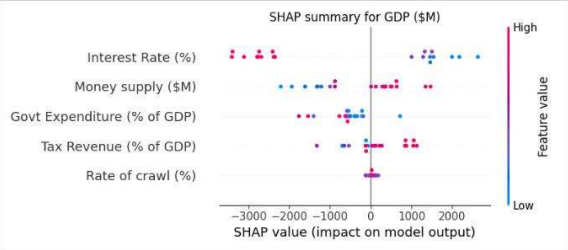
Latest Variables:

GDP ($M)	Unemployment Rate (%)	Inflation Rate (%)	Economic Growth (%)	Q on Q Economic Growth (%)	Income Distribution	Net Exports (PM)	Govt Expenditure (% of GDP)	Tax Revenue (% of GDP)	Money Supply ($M)	Interest Rate (%)	Rate of Crawl (%)
19400	23.38	3.1	2.73	2.3	0.53	-333	33.1	22	8000	2.4	-1.51

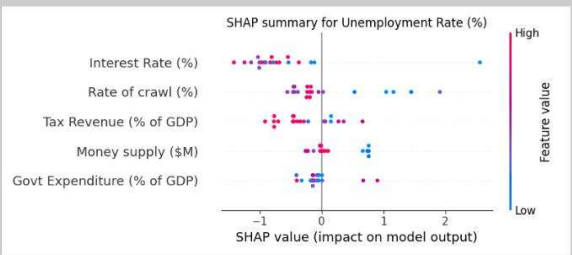
Policy Impact Predictions:

GDP ($M)	Unemployment Rate (%)	Inflation Rate (%)	Economic Growth (%)	Q on Q Economic Growth (%)	Income Distribution	Net Exports (PM)
19359.47	23.29	2.97	-0.28	0.33	0.53	-7.29

SHAP Summary for GDP ($M)

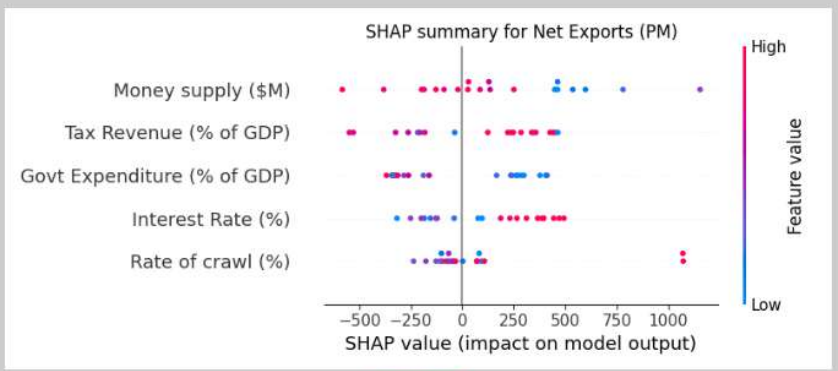


SHAP Summary for Unemployment Rate (%)



10. To download the report, click on the Download PDF button at the end of the output as shown below.

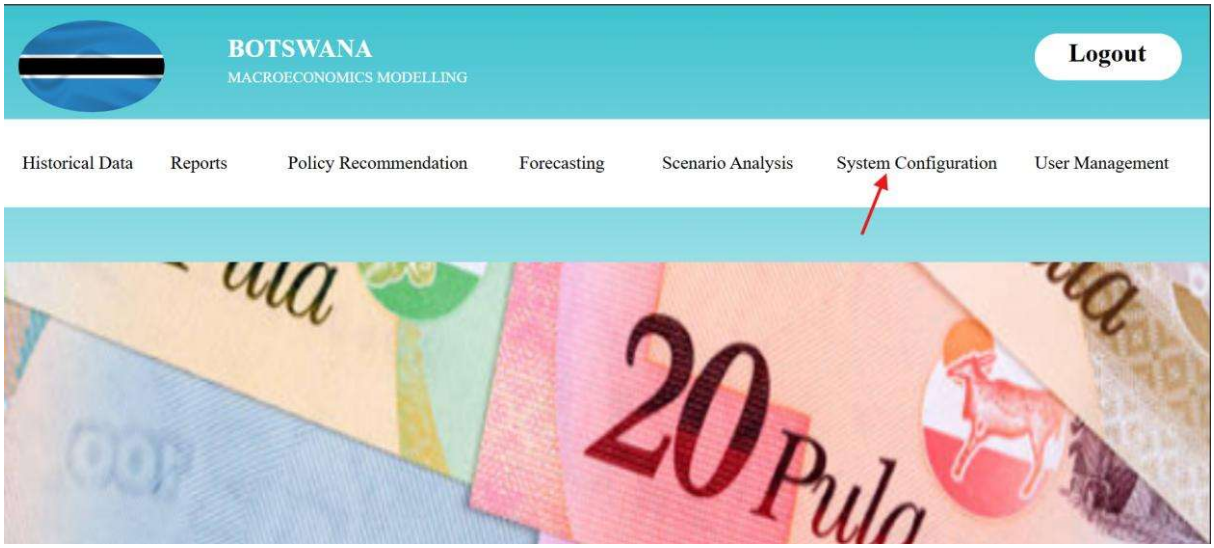
SHAP Summary for Net Exports (PM)



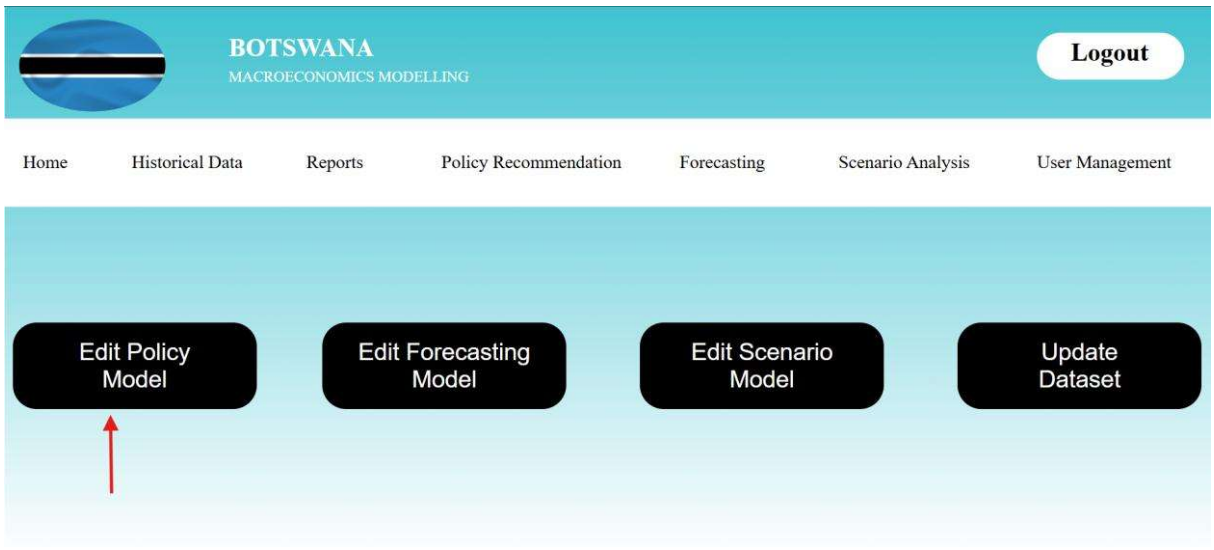
Download PDF

System Configuration

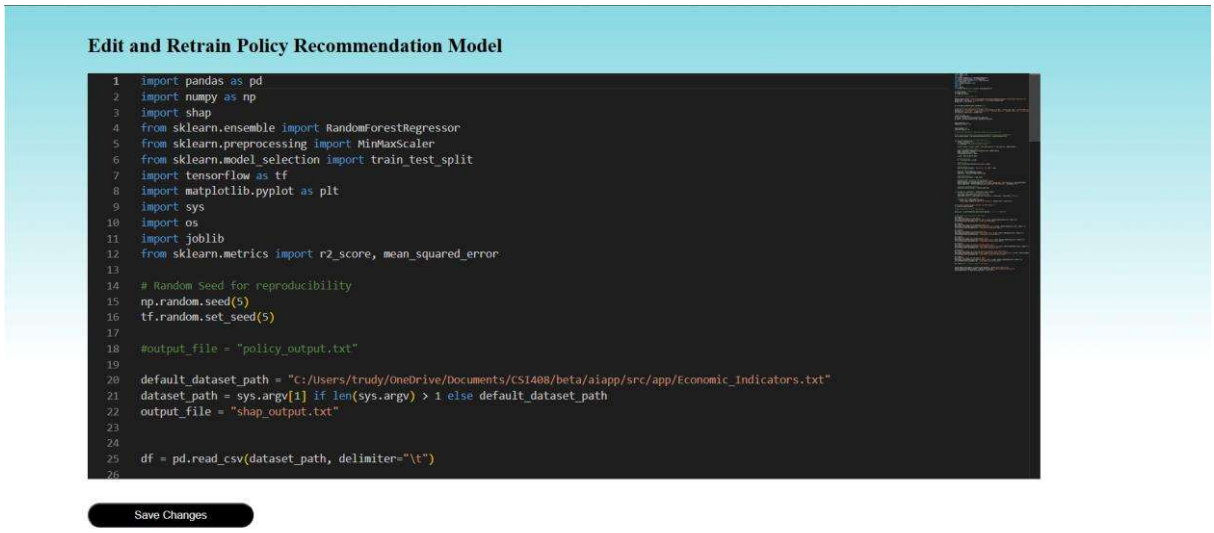
1. Navigate to the System Configuration page as shown below.

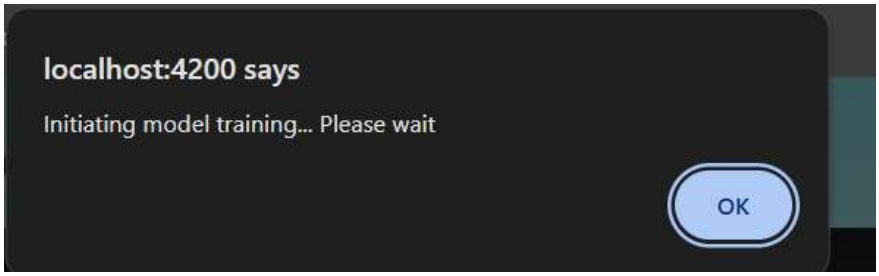


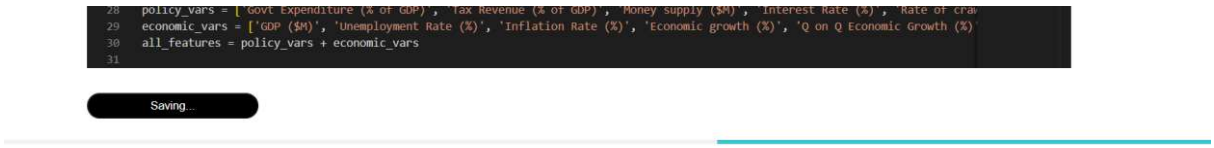
2. To edit a model script, click on the corresponding edit button.



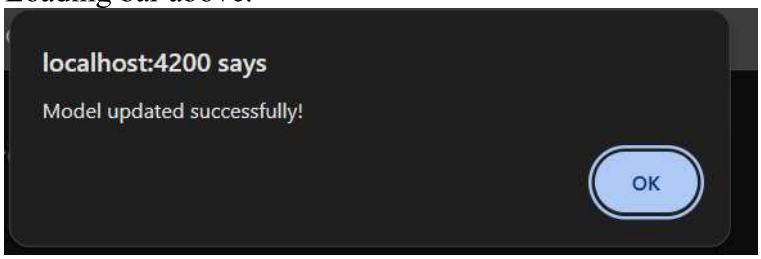
3. An IDE for editing the model itself will be displayed. Make appropriate changes and then click save changes. An alert message displaying saying model training has been initiated will appear. Then the loading bar will be displayed. After processing, a message displaying whether or not the retraining and saving were successful will be displayed.



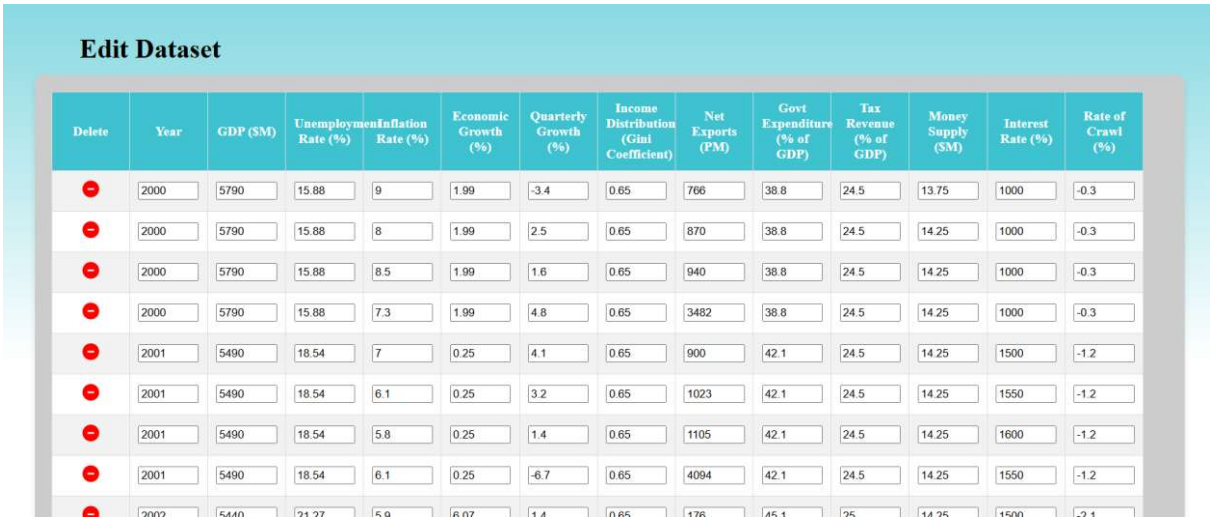




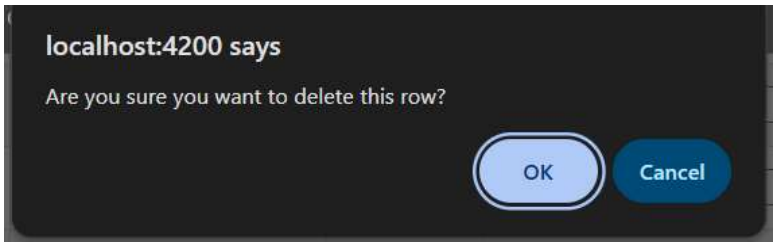
Loading bar above.



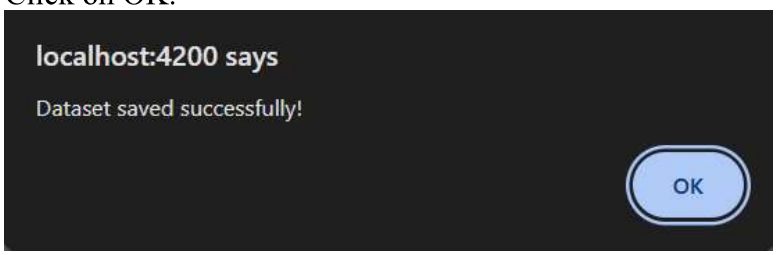
4. To edit the dataset, click on the update dataset button.



To delete a row of data, click on the red delete button in the corresponding row, a message asking if you are sure you want to delete the data will be displayed. Click OK to delete the row.



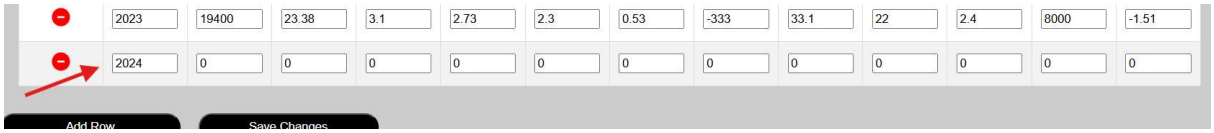
Click on OK.



The dataset has been saved successfully.

To add a row of data, click on the Add Row button at the bottom of the dataset and input the appropriate values.

New row of values is added as shown below.



Then click save changes to add the new row of data to the dataset.