

This is currently a shiny application hosted
in EC2 . Data is fetched from quandl API
and can access only freely available data

Stress Testing model

Model to predict and analyse inter correlation between Macro
variables and metric of choice

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STRESS TESTING MANUAL

MACRO ECONOMIC DATA

In this tab we pull in data from the sources available through the Quandl API. We check the data and plot and also view metadata of the said filed to decide whether or not it is suitable for analysis

STEP 1: INPUT SECTION

Get the codes for data series from <https://www.quandl.com/search?type=all>.

Input Section

Enter Data Name:
FRED:GDPFRED:GNP

Get Transformation
NULL

Get Frequency
NULL

View Metadata

Choose Variable to show Description
FRED:GDP

Download History File

Select Format
CSV

Download

Figure 1: Macroeconomic Data Input Section

ENTER DATA NAME

Here we input the codes for the data as available in Quandl API. The linked to the data is written on the application which is <https://www.quandl.com/search?type=free>. This will give us a view of all the databases that are available in the free section. On this screen on the quandl website we also have filters on the left hand site as shown below. Once we click on a database name, we get to see the available series in the database. Also we see the code as highlighted in the following screen shot.

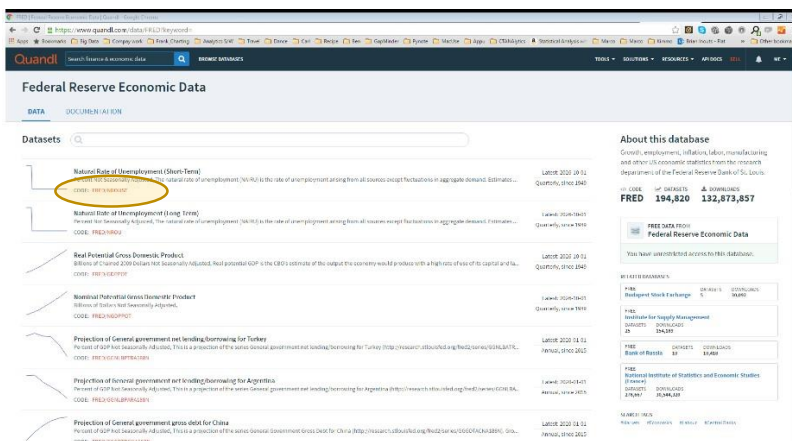


Figure 2: Quandl site data list

We should use these codes to fetch data from the quandl api. We can use multiple terms also separated only by a comma and without any quotes.

GET TRANSFORMATION

In the tool we can set the following transformations. The corresponding values in the parameter field in the following table is to be selected from the dropdown

Transformation	Parameter	Effect	Description
None	NULL	NA	Sends back actual data
Row-on-row change	diff	$y'[t] = y[t] - y[t-1]$	A parameter that will transform the data to show the difference between days.
Row-on-row % change	rdiff	$y'[t] = (y[t] - y[t-1])/y[t-1]$	A parameter that will transform the data to show the difference between days divided by the previous day.
Row-on-row % change from latest value	rdiff_from	$y'[t] = (y[n] - y[t])/y[n]$	A parameter that will transform the data to show the percentage difference between the latest value and all subsequent values (where $y[n]$ is the latest observation).
Cumulative sum	cumul	$y'[t] = y[t] + y[t-1] + \dots + y[0]$	A parameter that will calculate the sum of all preceding data returned.
Start at 100	normalize	$y'[t] = (y[t]/y[0]) * 100$	A parameter that will normalize the data to the oldest datapoint returned.

GET FREQUENCY

Parameters to indicate the desired frequency. When you change the frequency of a dataset, Quandl returns the last observation for the given period e.g. By collapsing a daily dataset to monthly, we will get a sample of the original dataset where the observation for each month is the last data point available for that month. The values that can be selected are none, daily, weekly, monthly, quarterly and annual. If none is selected, then we get back the default data collection frequency of the variables.

STEP 2: OUTPUT

Next we get the output which consists of two sections

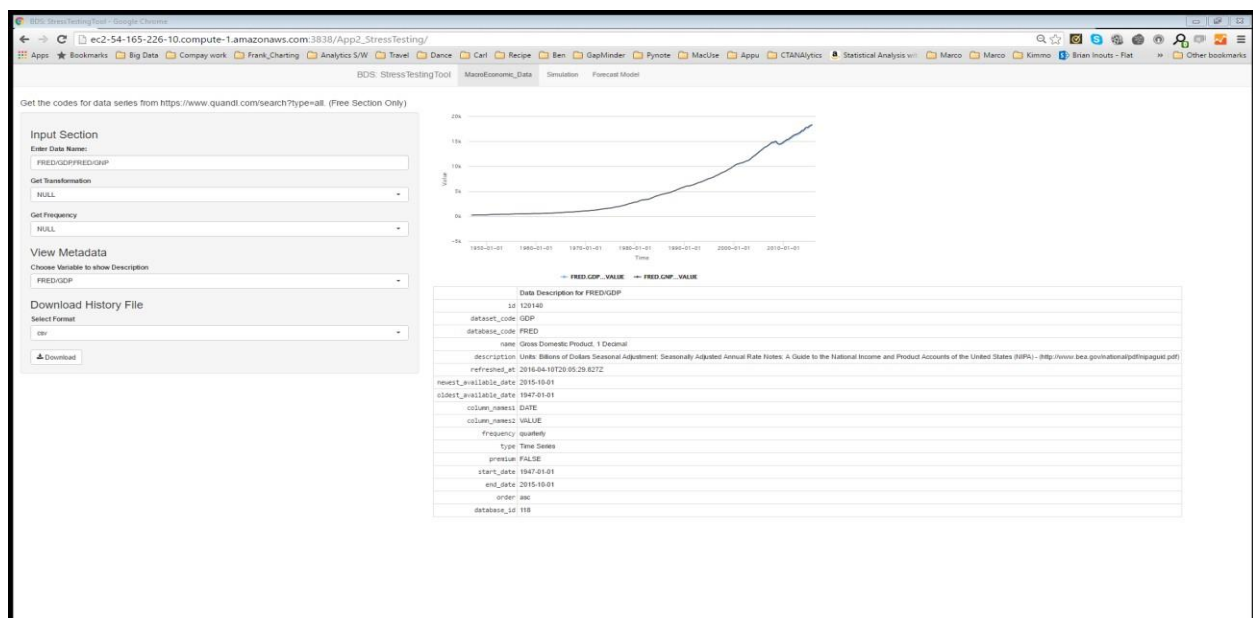


Figure 3: Output Macroeconomic data

TIME SERIES PLOT

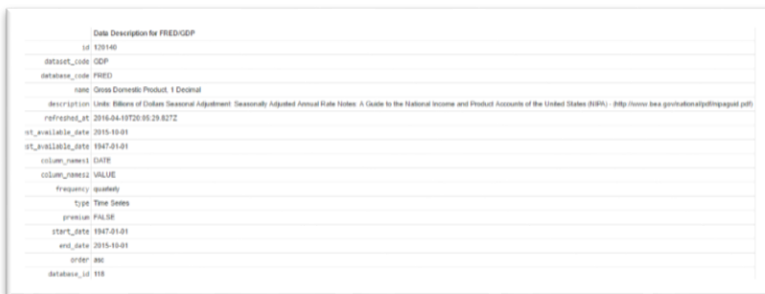
In the right hand panel of the application, we first get a time series plot of the entire dataset available for the all the series input in the input text box captioned “Enter Data Name”. The time is plotted on the x axis and values on the y axis.

ISSUES

Since we have not asked the time interval for which we want the data, this outputs the entire series available at the source. Apart from that if the series entered vary widely in scale then the plot will become improper to view at since the bigger variable in magnitude might use up the entire Y axis scale.

STEP 3: VIEW METADATA

Once the above step is complete we see a new dropdown appear in the “View Metadata” Section. In this dropdown we have a list of the series names that we had input in the text box captioned “Enter Data Name”. On changing the series names in this dropdown we get details of the sent data series in the right hand side in the table below the time series plot. Here we can get a brief idea of the dataset, period, any transformation or adjustment done on the data, definition etc.



Data Description for FRED:GDP	
id	120140
dataset_code	GDP
dataset_year	FRED
name	Gross Domestic Product: 1 Decimal
description	Units: Billions of Dollars (Seasonal Adjustment: Seasonally Adjusted Annual Rate Notes: A Guide to the National Income and Product Accounts of the United States (2018) - http://www.bea.gov/nationalaccounting/gdp.pdf)
refreshed_at	2016-04-09T20:00:29.627Z
yt_available_date	2015-10-01
st_available_date	1947-01-01
column_names1	G402
column_names2	VALUE
frequency	quarterly
type	Time Series
previous_id	104158
start_date	1947-01-01
end_date	2015-10-01
units	100
dataset_id	118

Figure 4: Data Description Section

STEP 4: DOWNLOAD HISTORY FILE

All the data series can be downloaded for the full time period as per chosen frequency and transformation in xls or csv format (as chosen in the dropdown)



Download History File

Select Format

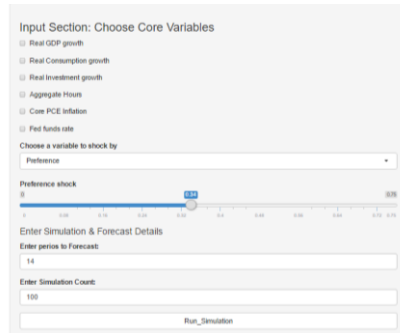
csv

Download

Figure 5: Download History File

SIMULATION: CORE VARIABLES

INPUT SECTION: CHOOSE CORE VARIABLES



The screenshot shows a web form titled "Input Section: Choose Core Variables". It contains several sections:

- A list of six core variables, each with a checkbox:
 - ☐ Real GDP growth
 - ☐ Real Consumption growth
 - ☐ Real Investment growth
 - ☐ Aggregate Hours
 - ☐ Core PCE Inflation
 - ☐ Fed funds rate
- A dropdown menu labeled "Choose a variable to shock by" with "Preference" selected.
- A slider labeled "Preference shock" with a value of 8. The slider range is from 0 to 0.25, with major ticks every 0.05.
- A section titled "Enter Simulation & Forecast Details" containing:
 - A text input field labeled "Enter periods to Forecast:" with the value "14".
 - A text input field labeled "Enter Simulation Count:" with the value "100".
 - A button labeled "Run_Simulation".

Figure 6:Core Variables Simulation Input

Currently we have 6 core variables in the system. Namely,

1. Real GDP growth
2. Real Consumption growth
3. Real Investment growth
4. Aggregate Hours
5. Core Inflation
6. Fed Funds Rate

These are all given as check boxes. We check those variables for which we want to regenerate the simulation.

The idea is to use a shock variable from the following (in the dropdown names "Choose a variable to shock by")

1. Preference
2. Labour Supply
3. Investment
4. Productivity
5. Wage Mark up
6. Price Mark up
7. Government Spending
8. Interest Rates
9. Inflation Objective

to create a stressed situation or reflect current policy changes. Below the dropdown we have a slider that helps us to choose the magnitude of the shock. Below that we enter the number of periods for which we want to simulate or forecast and then the number of simulations per period.

CHANGE INITIAL PARAMETERS

Here we change the initial parameters of the DGSE model based on Smets Wouters, to more reflect the current economy, policy, labour and consumer behaviour pattern. The initial parameters currently given are

1. Discount factor
2. Capital depreciation rate
3. Investment adjustment cost
4. Capacity utilisation cost
5. Relative risk aversion
6. Habit formation intensity
7. Labour elasticity with respect to wage
8. Labour disutility
9. Capital share in output
10. Indexation for non-optimising workers
11. Wage mark-up
12. Probability of missing wage change signal
13. Indexation for non-optimising firms
14. Probability of missing price-change signal
15. Weight given by monetary authority to inflation

The magnitude of each of the above is represented by a slider and the user can change it according to context of use

OUTPUT

IMPULSE RESPONSE CHART

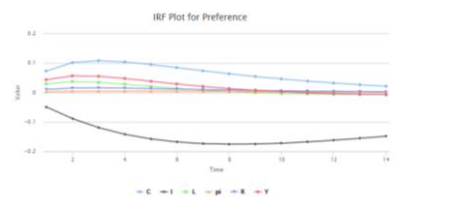


Figure 7: Impulse Response Function

This gives us a impulse response or change in the core variable across the forecast period with respect to the shock and initial parameters.

The legends are as follows

1. Y represents GDP or aggregate production growth
2. C represents Real consumption growth
3. I represent Real Investment Growth
4. L represents aggregate hours of labour
5. R represents Fed rate
6. Pi represents inflation

SIMULATION PROGRESS

On clicking the Run_Simulation button we see a simulation complete notification in the output section

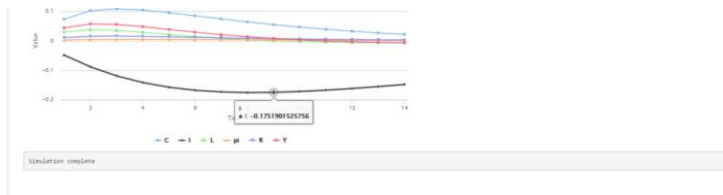
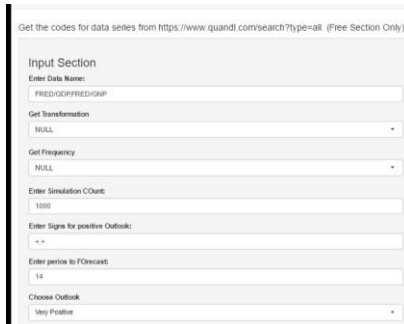


Figure 8: Simulation progress

SIMULATION: NON CORE VARIABLES

In this Tab we generate and modulate the simulations.

STEP 1: INPUT SECTION



Get the codes for data series from <https://www.quandl.com/search?type=all>. (Free Section Only)

Input Section

Enter Data Name:
FREDGEFFREDGAP

Get Transformation:
NULL

Get Frequency:
NULL

Enter Simulation Count:
1000

Enter Signs for positive Outlooks:
+ +

Enter period to Forecast:
14

Choose Outlook:
Very Positive

Figure 9: Simulation Input Section

ENTER DATA NAME

Here we input the codes for the data as available in Quandl API. The linked to the data is written on the application which is <https://www.quandl.com/search?type=free>. This will give us a view of all the databases that are available in the free section. On this screen on the quandl website we also have filters on the left hand site as shown below. Once we click on a database name, we get to see the available series in the database. Also we see the code as highlighted in the [figure 2](#).

GET TRANSFORMATION

In the tool we can set the following transformations. The corresponding values in the parameter field in the following table is to be selected from the dropdown

Transformation	Parameter	Effect	Description
None	NULL	NA	Sends back actual data
Row-on-row change	diff	$y'[t] = y[t] - y[t-1]$	A parameter that will transform the data to show the difference between days.
Row-on-row % change	rdiff	$y'[t] = (y[t] - y[t-1])/y[t-1]$	A parameter that will transform the data to show the difference between days divided by the previous day.
Row-on-row % change from latest value	rdiff_from	$y'[t] = (y[n] - y[t])/y[n]$	A parameter that will transform the data to show the percentage difference between the latest value and all subsequent values (where $y[n]$ is the latest observation).
Cumulative sum	cumul	$y'[t] = y[t] + y[t-1] + \dots + y[0]$	A parameter that will calculate the sum of all preceding data returned.
Start at 100	normalize	$y'[t] = (y[t]/y[0]) * 100$	A parameter that will normalize the data to the oldest datapoint returned.

GET FREQUENCY

Parameters to indicate the desired frequency. When you change the frequency of a dataset, Quandl returns the last observation for the given period e.g. By collapsing a daily dataset to monthly, we will get a sample of the original dataset where the observation for each month is the last data point available for that month. The values that can be selected are none, daily, weekly, monthly, quarterly and annual. If none is selected, then we get back the default data collection frequency of the variables.

ENTER SIMULATION COUNT

This is the number of paths we would want the tool to simulate

ENTER SIGNS FOR OUTLOOK

Here we enter the signs in a comma separated string for each of the input series name in the “Enter Data Name” textbox. Plus(+) sign means that increase in the variable signifies a better economy e.g. GDP, whereas Minus(-) sign means that increase in variable signifies worse economy e.g. inflation, unemployment rate, etc.

ENTER PERIODS TO FORECAST

This is the number of periods we ultimately would want to forecast the metric of our choice. This is also the number of periods for which the macro variables are simulated.

CHOOSE OUTLOOK

This is a 5-point scale i.e. Very Positive, Positive, Neutral, Negative and Very Negative. Here we respectively take 5%-tile, 25%-tile, 50%-tile, 75%-tile and 100%-tile values of the simulations in every period to forecast the metric or show the forecasted economy if the sign for the series is “-” and the reverse order if the sign is “+”.

STEP2: SELECT PLOT AND DATATABLE VIEW



Figure 10: View for forecast and datatable

Based on the macro series chosen in the first drop down, we view the forecast plot (for the chosen forecast periods and outlook as in previous section).

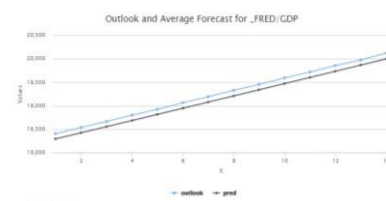


Figure 11: Forecast Plot

Based on the second drop down we can either see the period wise simulation for the series chosen in the above dropdown

Show10entire

	Start	Period_1	Period_2	Period_3	Period_4	Period_5	Period_6	Period_7	Period_8	Period_9	Period_10	Period_11	Period_12	Period_13	Period_14
1	1	18372.30	18553.50	18543.17	18633.99	18808.86	18946.79	19042.89	19187.72	19277.83	19464.38	19714.39	19791.67	19886.18	19946.11
2	2	18362.54	18399.76	18490.13	18648.76	18766.57	18886.14	18996.13	19184.58	19294.13	19464.87	19640.28	19739.79	19795.97	20024.74
3	3	18323.22	18379.23	18568.88	18727.40	18851.94	18976.21	19039.68	19275.07	19342.46	19462.41	19633.14	19688.21	19813.91	19964.83
4	4	18278.68	18432.33	18568.82	18689.69	18799.72	18887.83	19035.07	19151.43	19376.52	19423.36	19719.71	19787.28	19993.34	19961.93
5	5	18283.74	18488.73	18601.58	18709.26	18724.26	18867.75	18966.10	19211.05	19315.44	19550.27	19607.50	19711.73	19905.36	20042.47
6	6	18258.84	18437.03	18548.47	18684.54	18779.56	18896.08	19110.96	19206.79	19368.11	19444.42	19587.89	19742.40	19887.51	20045.65
7	7	18276.96	18335.23	18565.23	18726.69	18799.30	18873.79	19157.94	19254.30	19401.31	19545.51	19580.98	19733.80	19918.58	20088.86
8	8	18312.20	18512.80	18561.49	18654.83	18783.22	18866.38	19134.24	19212.45	19327.28	19437.28	19596.70	19679.48	19910.42	20057.41
9	9	18291.72	18388.90	18519.75	18682.39	18840.38	19029.24	19054.76	19225.94	19395.43	19559.42	19599.04	19824.98	19888.04	19980.73
10	10	18225.07	18404.63	18575.59	18656.61	18837.16	19046.10	19196.26	19287.14	19389.27	19530.14	19631.14	19760.91	19871.96	19948.89

Showing 1 to 10 of 1,000 entries

Previous12345...100Next

Figure 12: Simulation Table

Or we can see the forecast table

Show16entire

	Period	Prediction	Standard Error
1	1	18293.68	48.35400
2	2	18423.36	82.96555
3	3	18553.83	116.96589
4	4	18684.38	150.41623
5	5	18815.28	183.21280
6	6	18946.48	215.32377
7	7	19077.83	246.77768
8	8	19209.30	277.63704
9	9	19340.84	307.87953
10	10	19472.45	337.88684
11	11	19604.10	367.43734
12	12	19735.77	396.79485
13	13	19867.47	425.75532
14	14	19999.18	454.84745

Showing 1 to 14 of 14 entries

Previous1Next

Figure 12: Forecast Table

STEP 3: SELECT DISTRIBUTION VIEW

Select Distribution View

Choose Variable to show Histogram

PREDGDP

Enter Period

5

Figure 11: Distribution Inputs

Based on the macro series chosen in the dropdown and the period number entered as a integer in the next textbox (which should be less than the user input number of forecasts, since simulation runs till that many periods into the future), we can get the distribution of the simulated variables for that variable in the particular forecast period

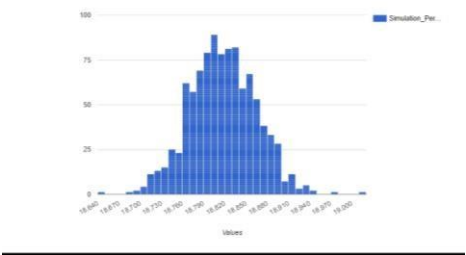


Figure 13: Distribution Plot

STEP4: DOWNLOAD SIMULATION FILE

Download Simulation File

Choose Simulation File

FRED/GDP

Select Format

CSV

Download

Figure 14: Download Data Section

Based on the variable selected in the first drop down and the file format in the next dropdown we can download the generated simulation for all forecast periods into a csv or xls file format.

FORECAST MODEL

This section is used to forecast any metric of our choice based on the macro variables and based on our hypothesis of the economy and policy, we can check how the metric of our choice should behave based on the simulated forecasts we have generated. This follows a best fitting arimax model.

INPUT SECTION FOR INDEPENDANT VARIABLE

SELECT CORE VARIABLES

Input Section for Independent Variable

Select Core Variables

☒ Real GDP growth
Enter Data Name:
FRED:GDP

☒ Real Consumption growth
Enter Data Name:
FRED:PCECCSG

☐ Real Investment growth
Enter Data Name:
FRED:IRV

☐ Aggregate Hours
Enter Data Name:
FRED:LNH000000

☐ Core PCE Inflation
Enter Data Name:
RATEININFLATION_USA

☐ Fed Funds rate
Enter Data Name:
FORTHFEDF_M

Choose Simulation:
5

Figure 15: Select core Variables

Here we first check the core variables that we want in our model. Below this we have a slider which gives us the simulation number based on which we want to forecast the metric. Also beside every check box, we have a default code for the series representing the core variable. If we want to substitute that series with any other, we should just change the code in the input text box.

SELECT NON-CORE VARIABLES

Select Non Core Variables

Enter Data Name:
FRED:IRV/FRED:BBBRC3A14B0BEA

Get Transformation:
NULL

Get Frequency:
NULL

Enter Signs for Outlook:
+, -

Choose Outlook:
Very Positive

Remove all Previous file

Figure 16: Select Non Core Variables

As previously done we input the codes of the non-core variables for which we generated simulation for in the previous section, and the corresponding transformation and frequency, that we want to include in the model. Please note these should be same as the section [in Simulation of non Core variables](#), else the program will not find the simulation of the non core variables.

INPUT SECTION FOR DEPENDANT VARIABLE

Input Section for Dependant Variable

Input Variable or upload:
☐ Input
☐ Upload

Figure 17: Input Section for Dependant Variable

Here we have two options, one is using a series that is available in the database. In that case we select Input and enter the code of that series in the input text box that appears on checking the input textbox.

Input Section for Dependant Variable

☒ Input
☐ Upload

Enter Date Name:
 FREDNRoust

Figure 18: Input Series for Dependant Variable

In this case it will automatically adjust the dates and run the time series.

However, if we want to input our own metric, we must create a csv in the following format, the first column should be dates in YYYY-MM-DD format and the second column should be magnitude of the metric. The metric header should be the name of the metric and the date field should have header DATE. This file should have the same frequency and the dates as shown in the topmost output table

Show 10 entries

Search

	DATE	FREDNRoust - VALUE	FREDBBOURSA144NBEA - VALUE	FREDGDP - VALUE	FREDPECCOM - VALUE
1	1929-01-01			4472	
2	1930-01-01			4725	
3	1931-01-01			4710	
4	1932-01-01			4372	
5	1933-01-01			3889	
6	1934-01-01			3520	
7	1935-01-01			3952	
8	1936-01-01			3897	
9	1937-01-01			3568	
10	1938-01-01			3528	

Showing 1 to 10 of 338 entries

Previous

1

2

3

4

5

...

34

Next

Fit plot for FREDNRoust

Figure 19: Independent Variables Table

***Please note that there can be many blanks in this table. What is currently done is the missing values are imputed before the modelling step with the last value or lags and then any row containing blanks after the imputation step, is deleted. Ideally the next step should be to either add code to allow user to select dates or allow user to choose imputation method**

OUTPUT

MODEL FIT

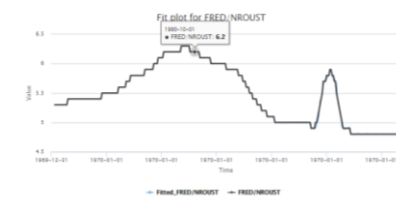


Figure 20: Model Fit

This plot shows us visually how good the model fits the actual data in the forecast period.

SUMMARY OF MODEL FIT



Figure 21: Model Fit Summary

Here we get some details regarding the developed model in terms of parameter estimates of the input variables, the standard error, significance of the model and the AIC

FORECAST PLOT

Now by changing the simulation # for the core variables and outlook dropdown for the non-core variables in the input section we can generate the forecasts for our chosen metric

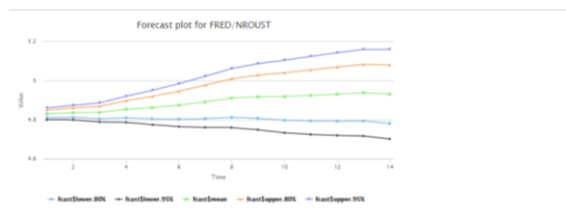


Figure 22: Forecast Plot

CURRENT DRAWBACKS

1. All macro variables share same settings like transformation, frequency, sign etc. Allowing user to customize these for every variable should give a better model.
2. [Drawback2](#): Part in italics