

# Nowcasting South African GDP using a suite of statistical models

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*The views expressed are those of the authors and do not necessarily represent those of the South African Reserve Bank or Reserve Bank policy.*

# Our paper's contribution

- Develop a large GDP nowcasting model suite
- Compare 'true' real-time nowcasts from our model suite to analyst forecasts & real-time projections from SARB
- Consider how our models perform at forecasting different vintages of data
- Demonstrate usefulness of statistical models in interpreting data surprises & quantifying forecast uncertainty
- We automate data loading, scheduled auto-running and reporting of nowcasts and publication to an internal blog

# Forecast comparison

- Sample of 1995/6Q1 to 2020Q1
- Real time dataset of quarterly GDP and 25 monthly series (M1, M2, M3 data vintages)
- Out of sample forecast performance tested (2015Q1 to 2020Q1), providing nowcasts for 21 quarters
- Compare predictive accuracy of thousands of specifications of models from 9 classes, to AR(1), official forecasts, market analysts
- Q-on-Q annualized convention, 1-step ahead forecast horizon

# Model suite

- ARIMA model
- Indicator model
  - Select top 20 OLS models based on ability to explain GDP, weighted using Bayesian model averaging
- Weighted VAR model
  - 7722 combinations of variables & different model specifications weighted by AIC score
- Exponential smoothing state space model
  - Separately model error, trend and seasonality of GDP
- Pattern sequence model
  - Univariate clustering into subset with equal means
- Bayesian Mixed Frequency VAR
  - Stationary version of Schorfheide & Song (2013)
- Dynamic Factor Model
  - 5 common factors from 18 variables
- Machine learning models
  - Elastic Net and LASSO (Plus MIDAS versions of each)

# Importance of understanding statistical characteristics of GDP data

## Change in mean



— mean (1998 Q2-2008 Q1)    - - - mean (2016 Q1-2019 Q3)

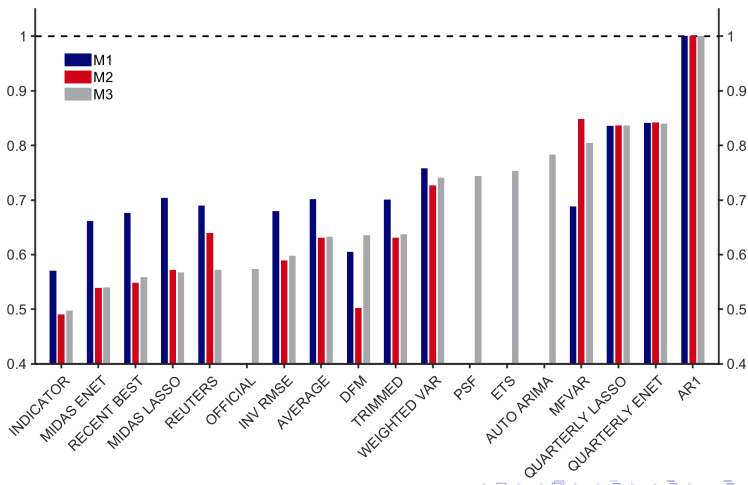
## Change in standard deviation



— mean (1998 Q2-2008 Q1)    - - - mean (2016 Q1-2019 Q3)

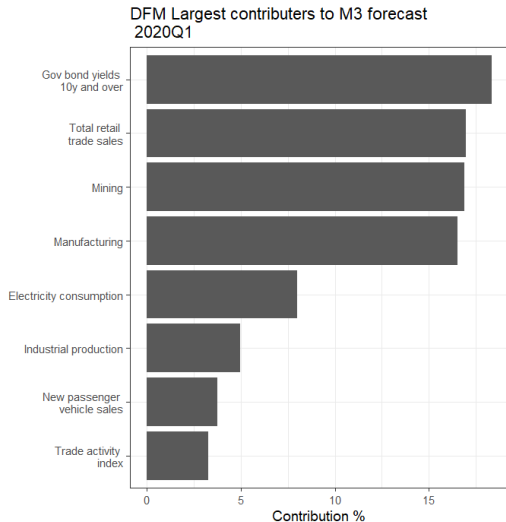
# Some statistical models outperform official nowcasts

Figure: Forecast RMSE relative to AR(1) in real-time



# Which predictors contribute to specific nowcasts?

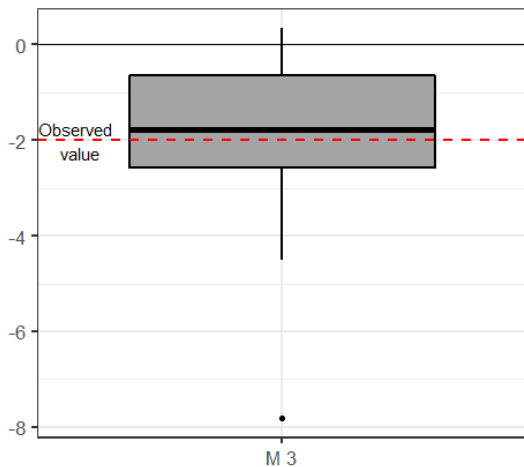
Figure: Example: Forecast decomposition (DFM, 2020Q1)





Model suite can be useful for assessing balance of risks

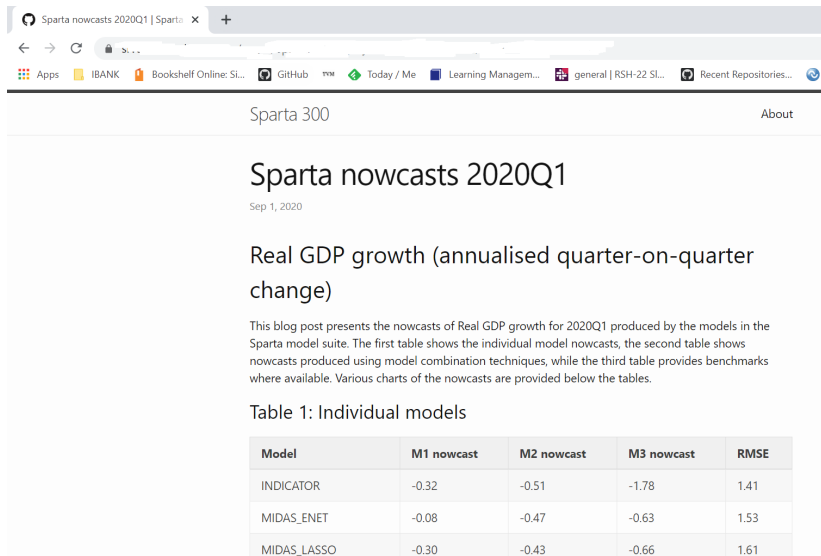
Boxplot of 2020 Q1 forecasts  
for M3 vintage



We automated data loading (programmatically and via Shiny front-end) and model runs

The screenshot shows a Shiny web application interface for 'Sparta Data'. The browser address bar shows '127.0.0.1:3110'. The application has a sidebar with navigation options: 'Data query', 'Home', 'Explorer', 'Visualiser', 'Account', and 'Admin'. The 'Data query' section is active, showing a 'Data set' dropdown set to 'GDP forecast data', an 'Advanced' button, a 'Release' dropdown set to '2020Q1 Storage 3', a 'Description' field, a 'Query Builder' section, and a 'Submit' button. The 'Output' section shows 'MATLAB' selected. The main content area displays a data table with columns for 'TIME\_PERIOD' and various 'M' prefixed categories. A 'MATLAB query' dialog box is open, showing the query: 'sparta\_load("SP8B\_83D", "ROWCMT", "L\_3", "ReleaseDescription", "2020Q1 Storage 3")'. The table shows data for various time periods from 1985-01-01 to 1985-01-01. At the bottom, there is a 'Download' button and a pagination bar showing 'Showing 1 to 28 of 728 entries'.

# We automated reporting (email and blog)



The screenshot shows a web browser window with the following elements:

- Browser tabs: "Sparta nowcasts 2020Q1 | Sparta" and a plus sign for more tabs.
- Address bar: A partially visible URL starting with "Sparta...".
- Navigation icons: Back, forward, and refresh.
- Taskbar: Includes icons for "Apps", "IBANK", "Bookshelf Online: Si...", "GitHub", "Today / Me", "Learning Managem...", "general | RSH-22 SL...", and "Recent Repositories...".
- Page header: "Sparta 300" on the left and "About" on the right.
- Main content area:
  - Section title: "Sparta nowcasts 2020Q1"
  - Date: "Sep 1, 2020"
  - Section title: "Real GDP growth (annualised quarter-on-quarter change)"
  - Text: "This blog post presents the nowcasts of Real GDP growth for 2020Q1 produced by the models in the Sparta model suite. The first table shows the individual model nowcasts, the second table shows nowcasts produced using model combination techniques, while the third table provides benchmarks where available. Various charts of the nowcasts are provided below the tables."
  - Section title: "Table 1: Individual models"
  - Table with 5 columns: Model, M1 nowcast, M2 nowcast, M3 nowcast, and RMSE.

Model	M1 nowcast	M2 nowcast	M3 nowcast	RMSE
INDICATOR	-0.32	-0.51	-1.78	1.41
MIDAS_ENET	-0.08	-0.47	-0.63	1.53
MIDAS_LASSO	-0.30	-0.43	-0.66	1.61

# Summary

- Use statistical model suite & large # series to nowcast GDP
- Assess performance of techniques using 'real-time' data (i.e. data as available) in assessing current state of economy
- We show some models provide more accurate forecasts than official nowcast and market analysts
- GDP volatility has increased markedly over the last 5 years, making GDP forecasting more difficult
- We show that all models developed, as well as SARB's official forecasts, have tended to over-estimate GDP growth
- We also demonstrate usefulness of statistical models for storytelling and risk assessment

## Other take-aways

- As statistical properties of GDP evolve, relative performance of frameworks will change
- We argue maintaining model suites important for uncovering these drivers & ongoing re-assessment of best frameworks
- Our focus is not understanding contribution of methodological changes and/or macro fundamentals to change in statistical properties of GDP
- But GDP over-prediction suggests either
  - Relationship between proxies of fundamentals & measured GDP weakening
  - Info set too limited (i.e. need to add political uncertainty, electricity supply-constraints, or fiscal consolidation proxies)