

Missing data? Relevance has it covered

A novel method for predicting with incomplete information

Imagine trying to solve a puzzle with missing pieces. You might think that without all the pieces, the puzzle is unsolvable. But what if you could use the remaining pieces to create a clearer picture despite the gaps? This thought experiment mirrors the challenge of forming data-driven predictions with incomplete information. Traditional methods either discard valuable data or manufacture replacements based on limiting assumptions, leading to unreliable results. We propose a novel technique called Relevance-Based Prediction (RBP), which elegantly navigates the pitfalls of missing data by preserving the remaining information and accounting for the relative importance of observations for which only partial data is available.

How to form data-driven predictions with incomplete information

X1	X2	X3	X4	X5
0.2	0.6	0.8	0.0	0.8
1.0		0.4	0.3	0.6
0.1	0.3	0.0	0.4	0.2
	0.7		0.2	
0.8	1.0	0.9	0.1	0.2
0.6	0.9		0.7	1.0
0.9	0.4		1.0	0.1
0.7	0.4			0.4
0.0	0.7		0.9	0.0
0.0	0.9	0.8	0.1	0.2
	0.5	0.3	0.6	0.8
0.5	0.6	0.8	0.2	0.8

For illustrative purposes only.

RBP is a model-free routine that forms predictions as weighted averages of observed outcomes, with weights based on a precise measure called relevance. The technique leverages fit, which quantifies the reliability of each prediction, and grid prediction, which combines multiple predictions from different combinations of observations and variables. Taken together, these components act like a chef using the best available ingredients to create a dish, even if some ingredients are missing. This method ensures that the final prediction is robust and reliable, much like a well-balanced recipe.

To do this in practice, RBP assigns zero relevance weights to observations with missing information and blends data across a prediction grid where predictive variables are included and excluded in different combinations. As we illustrate in our paper, this process allows for the retention of more observations, accounts for the relative importance of missing data, and provides advance notice of how missing data impacts the reliability of each prediction.

The bottom line is that RBP offers a sophisticated solution to the problem of incomplete information, preserving valuable data and enhancing prediction reliability in a way that is not possible using traditional models. By treating missing information with the care it deserves, RBP transforms the challenge of missing data into an opportunity for more accurate and insightful predictions.


For more on this topic, see our 2025 working paper: **"Prediction with Incomplete Information"** by Megan Czasonis, Mark Kritzman, and David Turkington.

State Street Associates

Our goal is to bridge the worlds of financial theory and practice with innovative investment research for asset managers and owners. We focus on two fundamental drivers of performance to help State Street's clients exceed their performance goals and manage risk:

INFORMATION ADVANTAGE: Our extensive indicator suites provide investors with powerful and practical market intelligence.

RESEARCH ADVANTAGE: We partner with renowned academics to develop impactful new ideas for portfolio construction, risk management, and investment strategies.

Learn more about our thought leadership, publications, interactive tools and indicators at 

Disclaimers and Important Risk Information [2025.01]

This communication is provided only to professional clients or eligible counterparties or their equivalent by State Street Bank and Trust Company or, where applicable and permissible, its bank and non-bank affiliates ("State Street"). State Street Bank and Trust Company is authorized and regulated by the Federal Reserve Board, registered with the Commodity Futures Trading Commission as a Swap Dealer, and is a member of the National Futures Association. State Street Bank International GmbH ("SSBI") is regulated by the European Central Bank ("ECB"), the German Federal Financial Supervisory Authority ("BaFin") and the Deutsche Bundesbank. Details about the extent of SSBI's regulation by the ECB, the BaFin and Deutsche Bundesbank are available from us on request. Products and services described herein may not be available in all jurisdictions or through all State Street entities. Activities described herein may be conducted from offshore. Information provided is of a general nature only and has not been reviewed by any regulatory authority.

This communication is intended for general marketing purposes, and the information contained herein has not been prepared in accordance with legal requirements designed to promote the independence of investment research. It is for clients to determine whether they are permitted to receive research of any nature. Market commentary provided by trading desks is not investment research. This communication is not intended to suggest or recommend any transaction, investment, or investment strategy, does not constitute investment research, nor does it purport to be comprehensive or intended to replace the exercise of an investor's own careful independent review and judgment regarding any investment decision.

This communication is not intended for retail clients, nor for distribution to, and may not be relied upon by, any person or entity in any jurisdiction or country where such distribution or use would be contrary to applicable law or regulation. This communication or any portion hereof may not be reprinted, sold or redistributed without the prior written consent of State Street. This communication and the information herein does not constitute investment, legal, or tax advice and is not a solicitation to buy or sell securities or any financial instrument nor is it intended to constitute a binding contractual arrangement or commitment by State Street of any kind. The information provided does not take into account any particular investment objectives, strategies, investment horizon or tax status.

The views expressed herein are the views of State Street as of the date specified and are subject to change, without notice, based on market and other conditions. The information provided herein has been obtained from sources believed to be reliable at the time of publication, nonetheless, we make no representations or assurances that the information is complete or accurate, and you should not place any reliance on said information. State Street hereby disclaims any warranty and all liability, whether arising in contract, tort or otherwise, for any losses, liabilities, damages, expenses or costs, either direct, indirect, consequential, special, or punitive, arising from or in connection with any use of this document and/or the information herein.

State Street may from time to time, as principal or agent, for its own account or for those of its clients, have positions in and/or actively trade in financial instruments or other products identical to or economically related to those discussed in this communication. State Street may have a commercial relationship with issuers of financial instruments or other products discussed in this communication.

This communication may contain information deemed to be forward-looking statements. These statements are based on assumptions, analyses and expectations of State Street in light of its experience and perception of historical trends, current conditions, expected future developments and other factors it believes appropriate under the circumstances. All information is subject to change without notice.

Participating in trading any financial instrument, including but not limited to foreign exchange, equities, futures, fixed income or derivative instruments, or investments in non-liquid or emerging markets, or digital assets, or participating in securities lending, repurchase transactions or other collateral services present risks, which may include but are not limited to counterparty, collateral, investment loss, tax, and accounting risks. Where applicable, returns may increase or decrease as a result of currency fluctuations. Derivatives may be more volatile than the underlying instruments. Certain foreign exchange business, including spot and certain forward transactions, may not be regulated in all jurisdictions. Past performance is no guarantee of future results.

Please contact your State Street representative for further information. To learn how State Street looks after your personal data, visit: <https://www.statestreet.com/utility/privacy-notice.html>.

© 2025 State Street Corporation – All Rights Reserved

7858151.1.1.GBL

Expiration date: 04/14/2026

Global Markets Research Disclaimer Supplement [2025.01]

Australia: This communication is provided to wholesale clients by State Street Bank and Trust Company (Australian Business Number 70 062 819 630, Australian Financial Services License 239679).

Brazil: The products in this marketing material have not been and will not be registered with the Comissão de Valores Mobiliários - the Brazilian Securities and Exchange Commission ("CVM"), and any offer of such products is not directed to the general public within the Federative Republic of Brazil ("Brazil"). The information contained in this marketing material is not provided for the purpose of publicly soliciting investments from

MISSING DATA? RELEVANCE HAS IT COVERED

investors residing in Brazil and no information in this marketing material should be construed as a public offering or unauthorized distribution of the products within Brazil, pursuant to applicable Brazilian law and regulations.

Israel: State Street Bank and Trust Company is not licensed under Israel's Regulation of Investment Advice, Investment Marketing and Portfolio Management Law, 1995. This communication may only be distributed to or used by investors in Israel which are "eligible clients" as listed in the First Schedule to Israel's Regulation of Investment Advice, Investment Marketing and Portfolio Management Law 1995.

Japan: This communication is made available in Japan by State Street Bank and Trust Company, Tokyo Branch, which is regulated by the Financial Services Agency of Japan and is licensed under Article 47 of the Banking Act.

Oman: State Street Bank and Trust Company is not a bank or financial services provider registered to undertake business in Oman and is not regulated by the Central Bank of Oman or the Capital Market Authority.

Qatar: The information in this communication has not been reviewed or approved by the Qatar Central Bank, the Qatar Financial Markets Authority or the Qatar Financial Centre Regulatory Authority, or any other relevant Qatari regulatory body.

Singapore: This communication is made available in Singapore by State Street Bank and Trust Company, Singapore Branch ("SSBTS"), which has been granted a wholesale bank license by the Monetary Authority of Singapore. SSBTS is also an exempt capital markets services licensee under the Securities and Futures Act 2001 and an exempted financial adviser under the Financial Advisers Act 2001 ("FAA") for certain regulated activities which SSBTS has notified MAS. In Singapore, this communication is only distributed to accredited, institutional investors as defined in the FAA and its regulations. Note that SSBTS is exempt from Sections 36 and 45 of the FAA. When this communication is distributed to overseas investors as defined in the FAA, note that SSBTS is exempt from Sections 26(1)(c), 34, 36, 45, 47 and 48 of the FAA. This advertisement has not been reviewed by the Monetary Authority of Singapore.

South Africa: State Street Bank and Trust Company is authorized in South Africa under the Financial Advisory and Intermediary Services Act, 2002 as a Category I Financial Services Provider; FSP No. 42671.

United Arab Emirates: The information contained within this communication is not intended to lead to the conclusion of any contract of whatsoever nature within the territory of the United Arab Emirates.

United Kingdom: State Street Bank and Trust Company is authorised and regulated by the Federal Reserve Board of the United States, authorised by the Prudential Regulation Authority ("PRA") and subject to regulation by the Financial Conduct Authority and limited regulation by the PRA. Details about the extent of our regulation by the PRA are available from us on request. State Street Bank International GmbH is authorised and regulated by the European Central Bank and the BaFin, deemed authorised by the Prudential Regulation Authority, and subject to regulation by the Financial Conduct Authority and limited regulation by the Prudential Regulation Authority. Details of the Temporary Permissions Regime, which allows EEA-based firms to operate in the UK for a limited period while seeking full authorisation, are available on the Financial Conduct Authority's website.