

SMART ORDER ROUTING IN JAPAN

July 2024

OVERVIEW



Our next generation SOR (MARS) design is a paradigm shift in our trading behavior. It is a mini-algo inside the SOR that evaluates a wide range of options: from posting deeper in the book or at near touch, to crossing the spread; interacting in dark and lit venues. The interaction between parent algo strategy and SOR has been tuned such that the SOR has more discretion when making trading decisions at child order level. We call it SPA logic (SOR Passive Aggressive). SPA is now enabled for several parent algo strategies.

SOR PASSIVE AGGRESSIVE (SPA)



The SPA design allows the SOR to consume various signals along with trading rate expectations to make decisions on passive posting and/or aggressive spread crossing with the aim of minimizing trading cost.

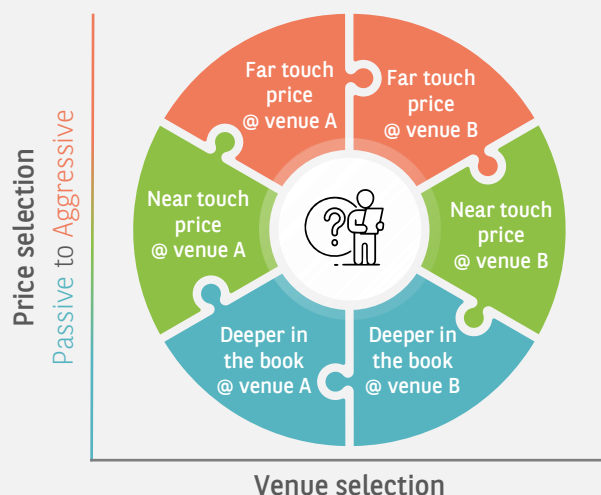
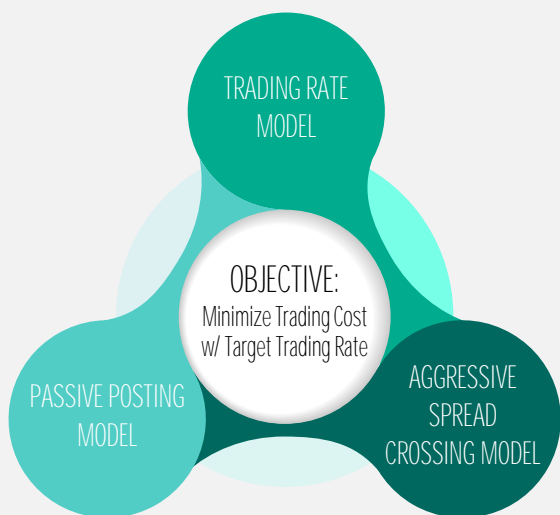
SPA logic integrates a data-driven and cost-aware approach to execution. It seeks to source the best quality liquidity for a target trading rate, and is given full discretion over venue selection, timing, liquidity interaction style, price and quantity.

SPA compares overall costs of passive posting versus aggressive spread crossing, picking the more effective options with respect to execution quality.

These costs depend on factors including but not restricted to parent algo order trading rate, the deviation (if any) from schedule and the expected realized rate from now until order end (all parameters sent by the algo to the SOR). Parent algo strategy passes key parameters such as target rate and filled vs target to SPA.

This results in more patient and selective choices at lower rates. All costs are re-evaluated periodically, while the target rate also adjusts dynamically in real time.

SPA continuously evaluates cost of posting passively deeper in the book, cost of posting at near touch, cost of aggressively spread crossing at far touch across trading venues.



NOTES



- SOR can be accessed in two ways: direct market access (DMA) orders, and underlying slices of the algorithmic trading strategy (DSA) orders.
- Primary exchange in Japan is Tokyo Stock Exchange (TSE).
- Non exchange Lit venues in Japan (Proprietary Trading System) include Cboe Japan ALPHA and Japannext.
- Dark venues include BNP Paribas' Proprietary ALP (Dark) and CBOE Japan BIDS.
- Access to alternative venues are enabled based on client preferences and consent



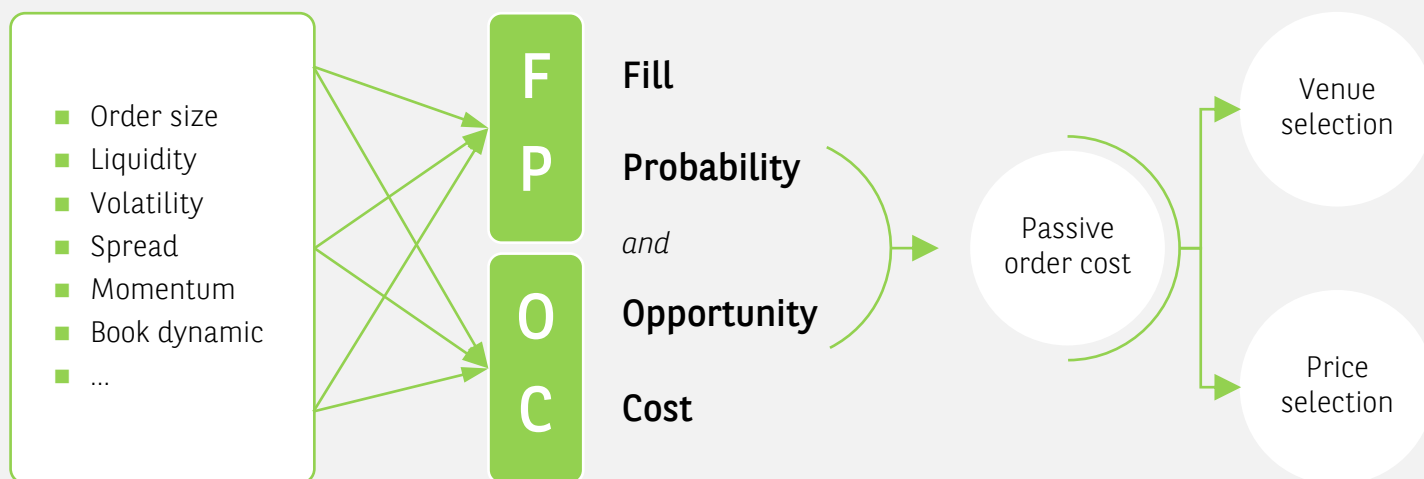
PASSIVE POSTING



To accurately predict passive posting cost, inclusive of signaling and impact, SPA uses gradient boosted trees and multi-layer perceptrons that consist of either classification or regression trees. These trees build compact and powerful prediction models and help us capture the interdependencies amongst 50+ input features, providing us extremely stable prediction quality over time. By exploring multiple price-venue options, SPA obtains a quantitative market-wide view of:

1. Fill Probability (FP): probability of passive order being filled
2. Opportunity Cost (OC): price moving away in the event of order being unfilled

The passive posting cost is then spread capture (weighted by fill probability) combined with opportunity cost when unfilled. The below diagram illustrates how passive posting model works.



AGGRESSIVE SPREAD CROSSING



One of the innovations core to SPA logic is to work out the alpha signal strength needed to manage a particular trading rate. Traditional (and costly) urgency-based takes, e.g. catching up when far behind schedule, are statistically zero-alpha events, with an attached taking cost that is an entire half spread.

SPA maintains real-time updated cost thresholds for spread crossing. As an example, a 2% target rate may correspond to a 20% of the average spread aggressive threshold: this means that a strong alpha of 30% is needed in our favor in such average spread conditions. In practice, we would also go out opportunistically on less alpha combined with a tighter instantaneous spread. To compare to passive cost, we simply take the aggressive threshold at the target rate. Therefore, for the 2% order example, SPA would only submit a passive child order if the total passive cost is at most 20% of spread; otherwise, it waits for purely opportunistic takes.

TRADING RATE



For passive posting, SPA predicts tradeable passive rate which is a participation rate achievable by being purely passive. The passive rate provides strong constraints on price-venue optimization. If the target rate is higher than the tradeable passive rate, SPA will make decision on when to take liquidity in addition to posting passively.

For aggressive spread crossing, the threshold of crossing spread is dynamically decided by target rate. As target rate increases, the threshold increases (a higher threshold is a weaker condition, allowing more signals to trigger spread crossing). However, the total passive cost also typically increases.

RISK CONTROL



- SOR is only available to stocks on the primary exchange not suspended, halted nor under special quotation (to prevent short-term price fluctuation).
- SOR is subject to client level risk controls and BNP Paribas firm level risk controls. Please contact our BNP Cortex Equities' coverage team for further details.
- SOR always respects order limit price and quantity; there is no overfill as a result of simultaneous executions in multiple venues.
- Venue preference is configurable upon request. Please contact our BNP Cortex Equities' coverage team for venue preference and consent letter.
- For an explanation of the order priority/capacity rules applicable to the BNP Paribas ATS, please refer to BNP Paribas Japan Dark Pool Guidelines: <https://www.bnpparibas.jp/en/important-notices/japan-dark-pool-guidelines/>

Please contact our BNP Cortex Equities' coverage team for more details of Cortex Equities Algorithmic Trading Strategies and BNP Paribas Alternative Trading System.

LEGAL NOTICE:

This document/communication may contain "Research" as defined under MiFID II unbundling rules; any such Research is intended either (i) for those firms who are in scope of the MiFID II unbundling rules and have signed up to a BNP Paribas Global Markets Research package, or (ii) for firms that are out of scope of the MiFID II unbundling rules and therefore are not required to pay for Research under MiFID II. Please note that it is your firm's responsibility to ensure that you do not view or use any Research in this document if your firm has not signed up to a BNP Paribas Global Markets Research package, unless your firm is out of scope of the MiFID II unbundling rules. Please note that MiFID II also imposes rules regarding receipt of monetary and minor non-monetary benefits under the broader inducements regime. This document may also be regarded as a minor non-monetary benefit (MNMB) and it is your firm's responsibility to consider its own regulatory obligations in relation to inducements and accepting MNMBs.

This document is CONFIDENTIAL AND FOR DISCUSSION PURPOSES ONLY; it constitutes a marketing communication and has been prepared by a Sales and Marketing function within BNP Paribas and/or its subsidiaries or affiliates (collectively "we" or "BNP Paribas"). As a confidential document it is submitted to selected recipients only and it may not be made available (in whole or in part) to any other person without BNP Paribas' written consent. This document is not a recommendation to engage in any action, does not constitute or form any part of any offer to sell or issue and is not a solicitation of any offer to purchase any financial instrument, nor shall it or any part of it nor the fact of its distribution form the basis of, or be relied on in connection with, any contract or investment decision. To the extent that any transaction is subsequently entered into between the recipient and BNP Paribas, such transaction will be entered into upon such terms as may be agreed by the parties in the relevant documentation.

The information contained in this document has been obtained from sources believed to be reliable, but there is no guarantee of the accuracy, completeness or suitability for any particular purpose of such information or that such information has been independently verified by BNP Paribas or by any person. None of BNP Paribas, its members, directors, officers, agents or employees accepts any responsibility or liability whatsoever or makes any representation or warranty, express or implied, as to the accuracy or completeness of the information, or any opinions based thereon, contained in this document and it should not be used in place of professional advice. Additional information may be provided on request, at our discretion. Any scenarios, assumptions, historical or simulated performances, indicative prices or examples of potential transactions or returns are included for illustrative purposes only. Past performance is not indicative of future results. Investors may get back less than they invested. BNP Paribas gives no assurance that any favourable scenarios described are likely to happen, that it is possible to trade on the terms described herein or that any potential returns illustrated can be achieved. This document is current as at the date of its production and BNP Paribas is under no obligation to update or keep current the information herein. In providing this document, BNP Paribas offers no investment, financial, legal, tax or any other type of advice to, and has no fiduciary duty towards, recipients. Certain strategies and/or potential transactions discussed in this document may involve the use of derivatives which may be complex in nature and may give rise to substantial risks, including the risk of total or partial loss of any investment or losses without limitation and which should only be undertaken by those with the requisite knowledge and experience. BNP Paribas makes no representation and gives no warranty as to the results to be obtained from any investment, strategy or transaction, or as to whether any strategy, security or transaction described herein may be suitable for recipients' financial needs, circumstances or requirements. Recipients must make their own assessment of strategies, securities and/or potential transactions detailed herein, using such professional advisors as they deem appropriate. BNP Paribas accepts no liability for any direct or consequential losses arising from any action taken in connection with or reliance on the information contained in this document even where advised of the possibility of such losses.

As an investment bank with a wide range of activities BNP Paribas may face conflicts of interest and you should be aware that BNP Paribas and/or any of its affiliates may be long or short, for their own account or as agent, in investments, transactions or strategies referred to in this document or related products before the material is published to clients and that it may engage in transactions in a manner inconsistent with the views expressed in this document, either for their own account or for the account of their clients. Additionally, BNP Paribas may have acted as an investment banker or may have provided significant advice or investment services to companies or in relation to investments mentioned in this document. The information in this document is not intended for distribution to, or use by, any person or entity in any jurisdiction where (a) the distribution or use of such information would be contrary to law or regulations, or (b) BNP Paribas or a BNP Paribas affiliate would become subject to new or additional legal or regulatory requirements. Persons in possession of this document should inform themselves about possible legal restrictions and observe them accordingly.

France: BNP Paribas is a public limited company incorporated in France (Registered Office: 16 boulevard des Italiens, 75009 Paris, France, 662 042 449 RCS Paris, www.bnpparibas.com), BNP Paribas is a French credit institution that is authorised to perform banking activities and provide investment services under the law applicable in France and is subject to prudential supervision on a consolidated basis by the European Central Bank ("ECB"), in cooperation with the Autorité de Contrôle Prudentiel et de Résolution ("ACPR").

Executive Order 13959, as amended: BNPP clients and counterparties are responsible for ensuring that they comply with applicable provisions of [Executive Order 13959](#) (and any subsequent official guidance).

Australia: This material, and any information in related marketing presentations (the Material), is being distributed in Australia by BNP Paribas ABN 23 000 000 117, a branch of BNPP 662 042 449 R.C.S., a licensed bank whose head office is in Paris, France. BNP Paribas is licensed in Australia as a Foreign Approved Deposit-taking Institution by the Australian Prudential Regulation Authority (APRA) and delivers financial services to Wholesale clients under its Australian Financial Services Licence (AFSL) No. 238043 which is regulated by the Australian Securities & Investments Commission (ASIC). The Material is directed to Wholesale clients only and is not intended for Retail clients (as both terms are defined by the Corporations Act 2001, sections 761G and 761GA). The Material is subject to change without notice and BNP Paribas is under no obligation to update the information or correct any inaccuracy that may appear at a later date.

Hong Kong – Securities: This communication is prepared and/or distributed by BNP Paribas Securities (Asia) Limited. BNP Paribas Securities (Asia) Limited is a Licensed Corporation regulated by the Securities and Futures Commission for the conduct of Regulated Activity Types 1, 2, 4, and 6 under the Securities and Futures Ordinance. This communication is intended only for the Professional Investors in Hong Kong. Some products or transactions described in this communication may not be authorised in Hong Kong and may not be available to Hong Kong investors.

Singapore – Branch: This communication is distributed in Singapore by BNP Paribas, Singapore Branch, a licensed bank regulated by the Monetary Authority of Singapore. This communication is directed at Institutional Investors and Accredited Investors within the meaning of the Securities and Futures Act 2001 (2020 Revised Edition). Some products or transactions described in this communication may not be authorised in Singapore and may not be available to Singapore investors. This communication may constitute a product advertisement within the meaning of the Financial Advisers Regulations or the Securities and Futures (Licensing and Conduct of Business) Regulations of Singapore, in which case this advertisement has not been reviewed by the Monetary Authority of Singapore. Where this communication is a research report: In relation to the distribution to such categories of investors, BNP Paribas, acting through its Singapore Branch, and its representatives are exempted under Regulation 35 of the Financial Advisers Regulations of Singapore from the requirements in Section 45 of the Financial Advisers Act of Singapore, regarding the disclosure of certain interests in, or certain interests in the acquisition or disposal of, securities, securities-based derivatives contracts or units in a collective investment scheme, referred to in this report. For Institutional and Accredited Investors in Singapore, please contact BNP Paribas, acting through its Singapore Branch (company registration number: S71FC2142G; address: 10 Collyer Quay, 34/F Ocean Financial Centre, Singapore 049315; tel: (65) 6210 1288; fax: (65) 6210 1980) for all matters and queries relating to this report.

South Korea – Securities: BNP Paribas Securities Korea is registered as a Licensed Financial Investment Business Entity under the Financial Investment Business and Capital Markets Act and regulated by the Financial Supervisory Service and Financial Services Commission. This document/communication is distributed by BNP Paribas Securities Korea Co., Ltd. in the Republic of Korea to Professional Investors only and is not intended for investors in Korea who are not Professional Investor within the meaning of the Article 9 (5) (professional investor) of the Financial Investment Business and Capital Markets Act and should not be passed on to any such persons. Some products or transactions described in this document/communication may not be authorised in Korea and may not be available to Korean investors. Information in this document/communication is for general circulation to the intended recipients only and is not a recommendation or investment advice to recipients hereof since it does not take into account the specific investment objectives, financial situation and the particular needs of any particular recipient (“Specific Requirements”). A recipient of this document/communication should seek advice from its/his own financial adviser regarding the suitability of the products or transactions (taking into account the recipient’s Specific Requirements) as well as the risks involved in such products or transactions before a commitment to purchase or enter into any product or transaction is made. This document/communication is being provided in accordance with the procedures required under applicable laws and regulations as well as internal control standards of BNP Paribas Securities Korea.

Taiwan – Securities: This communication is being distributed in Taiwan by BNP Paribas Securities (Taiwan) Co., Ltd who is regulated by the Financial Supervisory Commission, R.O.C. This communication is being distributed to professional investors only. Such information is for your reference only. The reader should independently evaluate the investment risks and is solely responsible for their investment decision. Information on securities that do not trade in Taiwan is for informational purposes only and is not to be construed as a recommendation or a solicitation to trade in such securities. BNP Paribas Securities (Taiwan) Co., Ltd. may not execute transactions for clients in these securities. This publication may not be distributed to the public media or quoted or used by the public media without the express written consent of BNP Paribas.

Japan – Securities: This document is being distributed to Japanese based firms by BNP Paribas Securities (Japan) Limited or by a subsidiary or affiliate of BNPP not registered as a financial instruments firm in Japan, to certain financial institutions defined by article 17-3, item 1 of the Financial Instruments and Exchange Act Enforcement Order. BNP Paribas Securities (Japan) Limited is a financial instruments firm registered according to the Financial Instruments and Exchange Act of Japan (registration No. 2521) and a member of the Japan Securities Dealers Association, TypeII Financial Instruments Firms Association and the Financial Futures Association of Japan. BNP Paribas Securities (Japan) Limited accepts responsibility for the contents prepared by another non-Japan affiliate only when distributed to Japan based firms by BNP Paribas Securities (Japan) Limited. Some foreign securities stated on this document are not disclosed according to the Financial Instruments and Exchange Act of Japan. Please contact your sales representative for details. To ensure fairness and transparency in the markets, the Financial Instruments and Exchange Law has introduced a registration system for credit rating agencies. In accordance with this regulation, financial instruments firms are required to inform customers of the fact that the rating is not registered and the rationale for the registration system, etc. whenever marketing any financial products which are rated by non-registered credit rating agencies. Please refer to Explanatory Note on Non-Registered Credit Rating for BNP Paribas Securities (Japan) Limited (<https://www.bnpparibas.jp/en/important-notice/non-registered-rating-securities-japan-limited/>) for details.

(Disclosure pursuant to Article 37 of Financial Instruments and Exchange Act) Fees, Remunerations and Expenses: The amount of fees, remunerations and expenses is determined based on the type, size, nature etc. of each individual financial instruments transaction. Margin Deposit and other Cash Collateral: In general, margin deposits and other cash collaterals are required for margin trading and future transactions, and additional deposits and other cash collaterals may be required for such transactions afterwards. In those transactions, the transaction amount may exceed the amount of deposit or collateral (a proportion of the transaction amount to the amount of deposit or collateral cannot be calculated since the terms and conditions have not been finalized at this point). The amount of deposit or collateral is determined based on the type, size, nature etc. of each individual financial instruments transaction. In addition, there may be a difference between prices equivalent to a bidding price and an asking price as provided by Financial Instrument and Exchange Act on a certain kind of transactions. Explanation on Important Risk Matters: The following risks may be involved in Financial Instruments which we provide (including listed derivatives and OTC derivatives); 1. Price Fluctuation Risk (“Risk of principal losses” or “risk of incurring losses exceeding initial principal” in Financial Instruments which are directly caused by fluctuation in interest rates, currency values and other indices) 2. Credit Risk (“Risk of principal losses” or “risk of incurring losses exceeding initial principal” in Financial Instruments which is directly caused by changes in business or asset status of the person who provides Financial Instruments or other person(s)) 3. Limit on the period for exercising rights or canceling contracts (Limit on the period for exercising rights in Financial Instruments or limit on the period for canceling contracts related to Financial Instruments.) “Risk of principal losses” means the risk that the total amount of money, etc. which you paid initially for a purchase or other transaction on Financial Instruments may exceed that which you will receive when you sell the Financial Instruments or otherwise close out the transaction. “Risk of incurring losses exceeding initial principal” means the risk that the amount of incurring losses caused by price fluctuation risk and credit risk may exceed the cash collateral including a margin deposit to be paid.