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22 April 2024

Dear Michelle and Bim,

We write in response to your joint letter, dated 1 February 2024, regarding the Bank of England's (the Bank), including the Prudential Regulation Authority (PRA), work on delivering safe and responsible Artificial Intelligence (AI) and Machine Learning (ML) within our regulatory remit. The Annex in this letter provides more detailed materials in support of this update.

As the Government's AI White Paper[1] sets out, AI/ML are rapidly developing technologies with the potential to enhance the financial services sector in the UK and globally. To support the safe adoption of AI/ML, we have spent the past few years working to explore the adoption and use of these technologies by financial services firms, and their potential implications for our statutory objectives and regulatory framework, which we outline in more detail in this letter.

Our work highlights that AI/ML is already being widely adopted in many parts of the financial sector to improve firms' operational efficiency, better detect fraud and money laundering, and enhance data and analytics capabilities. We have engaged extensively – and will continue to do so – with the tech sector, academia, and financial services firms to keep up with the rapid pace of technological change. Thus far, we have been

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[1] **www.gov.uk/government/publications/ai-regulation-a-pro-innovation-approach/white-paper**.

able to meet our statutory objectives while supporting the safe and responsible adoption of AI/ML in financial services. Given the rapid pace of innovation and the evolution of use cases, we will keep our approach under continuous review.

The Bank and the PRA's statutory objectives and approach to regulation

The Bank's statutory objectives[2] are to maintain monetary and financial stability in the UK. The Bank's Monetary Policy Committee[3] (MPC) and the Financial Policy Committee[4] (FPC) have secondary objectives to support the UK Government's economic policy, including its objectives for growth and employment. The PRA's objectives[5] are to promote the safety and soundness of the firms we regulate and to contribute to securing an appropriate degree of protection for insurance policyholders. The PRA has two secondary objectives: to facilitate effective competition between firms, and to facilitate the international competitiveness of the UK economy (in particular the financial services sector) and its growth in the medium to long term. As of 2 January 2024, the PRA is responsible for the prudential regulation and supervision of around 1,330 banks, building societies, credit unions, insurers, and major investment firms. The Bank also regulates certain financial market infrastructures[6] (FMIs) – further details are provided in the Annex, including reference to the Bank's secondary objective to facilitate 'innovation in the provision of FMI services' as outlined under the Financial Services and Markets Act (FSMA) 2023.[7] As a result, the Bank and the PRA's focus is on understanding how to support the safe and responsible adoption of AI/ML in financial services from a macro-financial and prudential perspective, given the potential benefits – including driving innovation – that AI/ML could bring to firms.

The Bank and the PRA adopt a technology-agnostic approach to supervision and regulation of AI/ML. Our core principles, rules, and regulations therefore do not usually mandate or prohibit specific technologies. However, technology-agnostic does not mean technology-blind; risks may arise that relate to the use of specific technologies (such as AI/ML) and have an adverse impact on our statutory objectives, and we actively work to understand and address these. Certain technologies may also raise novel challenges for firms and regulators, which may mean it is difficult for firms to understand how existing rules apply to that technology. In those cases, we may issue guidance or use other policy tools to clarify how the existing rules and relevant regulatory expectations apply to those technologies.

The Bank and PRA, jointly with the Financial Conduct Authority (FCA), have undertaken a programme of work over many years to explore the risks of AI/ML and we

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[2] **www.bankofengland.co.uk**.
[3] **www.bankofengland.co.uk/about/people/monetary-policy-committee**.
[4] **www.bankofengland.co.uk/about/people/financial-policy-committee**.
[5] **www.bankofengland.co.uk/prudential-regulation/publication/2024/april/pra-business-plan-2024-25**.
[6] **www.bankofengland.co.uk/financial-stability/financial-market-infrastructure-supervision/who-are-we**.
[7] **www.legislation.gov.uk/ukpga/2023/29/contents**.

believe our regulatory framework has proven to be well equipped to capture regulated firms' use of AI/ML. Feedback we received from discussion paper (DP)5/22 – Artificial Intelligence and Machine Learning[8] confirms this; we published a summary of this feedback in feedback statement (FS)2/23 – Artificial Intelligence and Machine Learning.[9] While we believe our approach is consistent with the UK Government's principles-based regulatory framework, we will keep it under review given rapid developments in AI/ML in financial services.

Our current and future work on the safe and responsible adoption of AI/ML in financial services

AI/ML could make the financial services sector as a whole and individual financial markets more efficient, accessible, and tailored to consumer needs, bringing important benefits to consumers, financial services firms, financial markets, and the wider economy. However, greater AI/ML adoption could also pose risks to the Bank and the PRA's objectives. We therefore have a close interest in encouraging its safe and responsible adoption in financial services.

The Bank and the PRA – in collaboration with the FCA – have been exploring the implications of the use of AI/ML in financial services for many years. This includes our work on better understanding the adoption and use of ML in financial services,[10] first published in 2019 with a follow-up in 2022. From 2020 to 2022, the Bank and the FCA ran the AI Public-Private Forum (AIPPF),[11] examining the challenges of using AI/ML within financial services, as well as opening dialogue between the public and private sectors on this topic. In 2022, the Bank, PRA, and FCA published DP5/22, which sought views on whether the existing regulatory framework is sufficient to address the risks and harms associated with AI/ML. In October 2023, we published FS2/23, a feedback statement summarising respondents' views to our discussion paper. In December 2023, the FPC noted that it had been briefed on the continued adoption of AI/ML in financial services[12] and its potential financial stability implications, and that the committee will further consider these potential risks in 2024.

Though we have undertaken substantive work over recent years, the adoption of AI/ML remains an area of focus for the Bank and the PRA, particularly in light of recent innovations in this space (eg, Large Language Models (LLMs) and Generative AI (GenAI)). We have been exploring four potential areas where further clarification on our regulatory framework could be beneficial that are relevant to AI/ML: (1) Data Management; (2) Model Risk Management; (3) Governance; and (4) Operational Resilience and Third-Party Risks (further details outlined in the Annex). We are

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[8] **www.bankofengland.co.uk/prudential-regulation/publication/2022/october/artificial-intelligence**.
[9] **www.bankofengland.co.uk/prudential-regulation/publication/2023/october/artificial-intelligence-and-machine-learning**.
[10] **www.bankofengland.co.uk/report/2019/machine-learning-in-uk-financial-services**.
[11] **www.bankofengland.co.uk/research/fintech/ai-public-private-forum**.
[12] **www.bankofengland.co.uk/financial-policy-summary-and-record/2023/december-2023**.

planning on running the third instalment of the comprehensive 'ML in UK financial services' survey, to ensure our understanding of AI/ML adoption remains up to date, particularly given the ongoing developments in capability and adoption. Given the rapid pace of innovation and widespread use cases, we are also undertaking deeper analysis on the potential financial stability implications of AI/ML over the course of this year. This analysis will be considered by the FPC. Underpinning all of this, we will continue to engage directly with stakeholders on these topics, which may include establishing a new AI Consortium. More detail on our work is outlined in the Annex.

The five principles outlined in the guidance and the importance of regulatory collaboration

We welcome the Government's five principles to guide the regulation of AI/ML, as outlined in Implementing the UK's AI Regulatory Principles: Initial Guidance for Regulators,[13] which we consider are broadly consistent with our approach to regulating the use of AI/ML. Some of the principles are more relevant to our regulatory remit than others. We outline our approach to these five principles in detail in the Annex.

The guidance and the Government's White Paper response[14] outline the need for greater regulatory collaboration. We agree that regulatory collaboration in this space is essential, as it is for other technological developments such as quantum computing. Indeed we have been working closely with the FCA and other regulators in support of the safe adoption of AI/ML within financial services. As well as getting benefits from combining the knowledge and experience of UK regulators, regulatory cooperation is essential in cross-cutting issues such as AI/ML, given the prospect for matters in the purview of one regulator to impact on the objectives of another. Reflecting the importance of wider regulatory cooperation to the Bank's work on AI/ML, in 2024, the Bank will work together with the Digital Regulation Cooperation Forum (DRCF) on selected AI/ML projects – for example, conducting joint research to better understand cross-sector adoption of generative AI technology.
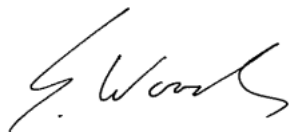
Conclusion

The Bank and the PRA support the Government's aim to establish a framework for the regulation of AI that is pro-innovation, proportionate, trustworthy, adaptable, clear, and collaborative. At the current time, and as set out in this letter, we believe we have in place a regulatory framework, grounded in our statutory objectives, that will appropriately support the delivery of the benefits that AI/ML can bring, while addressing the risks, in line with the principles set out in the Government's White Paper.

We hope that this letter, and the Annex providing detailed materials in support of this update, are helpful to you.

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[13] **www.gov.uk/government/publications/implementing-the-uks-ai-regulatory-principles-initial-guidance-for-regulators**.
[14] **www.gov.uk/government/publications/ai-regulation-a-pro-innovation-approach/white-paper**.

Yours sincerely,

Sam Woods
Deputy Governor, Prudential Regulation

Sarah Breeden
Deputy Governor, Financial Stability

Annex: Supporting materials

AI's applicability within the scope of our regulatory responsibilities

1. We outlined AI's applicability within the scope of our regulatory responsibilities in the cover letter above. Further regulatory responsibilities of relevance include:

    a. Subject to the Financial Stability objective, which is to protect and enhance the stability of the financial system of the UK, the Bank's FPC[15] is to exercise its functions with a view to supporting the economic policy of His Majesty's Government, including its objectives for growth and employment.

    b. Supervising certain FMIs,[16] such as payment systems, central counterparties (CCPs), and central securities depositories (CSDs). The Bank's financial stability objective continues to underpin all the work overseeing CCPs, CSDs, and payment systems. The FSMA 2023 framework has introduced new obligations and accountabilities for the Bank in respect of its CCP and CSD functions. This includes a new secondary objective requiring the Bank, so far as reasonably possible, to act in a way which facilitates innovation in the provision of FMI services (including in the infrastructure used for that purpose). This is with a view to improving the quality, efficiency, and economy of their services. FSMA 2023 also introduces the requirement that when exercising its FMI functions (as defined in statute) in a way that advances the Financial Stability objective (and subject to that), the Bank must have due regard to: (1) specified regulatory principles in section 30E of the Banking Act 1998;[17] (2) the effect that the Bank's regulation will or may have on the financial stability of other countries or territories in which CCPs and CSDs are established or provide services; and (3) the desirability of regulating CCPs and CSDs in a way that is not determined by whether the users of their services are located in the UK or elsewhere.

Steps taken to address the AI principles set out in the guidance

2. The five principles, as established in the UK Government's Implementing the UK's AI Regulatory Principles: Initial Guidance for Regulators,[18] emphasise: (1) safety, security, and robustness; (2) appropriate transparency and explainability; (3) fairness; (4) accountability and governance; and (5) contestability and

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[15] www.gov.uk/government/publications/remit-and-recommendations-for-the-financial-policy-committee-autumn-statement-2023/financial-policy-committee-remit-and-recommendations-autumn-statement-2023.
[16] www.bankofengland.co.uk/financial-stability/financial-market-infrastructure-supervision/who-are-we.
[17] www.legislation.gov.uk/ukpga/1998/11/section/30E.
[18] www.gov.uk/government/publications/implementing-the-uks-ai-regulatory-principles-initial-guidance-for-regulators.

redress. We consider these principles broadly consistent with our regulatory approach, which we outline in further detail below.

3. **Safety, security, and robustness,** as defined by the UK Government, establishes that 'AI systems should function in a robust, secure, and safe way throughout the AI life cycle, and risks should be continually identified, addressed and managed'. The Bank and the PRA, alongside the FCA, flagged relevant concerns in DP5/22, including those related to outsourcing and third-party risk management (TPRM). Our policies on outsourcing/TPRM put the onus on regulated firms to manage risks from their suppliers where third-party businesses services support important business services. For example, our policies address some specific risks from cloud computing, which often provides the underlying IT infrastructure on which AI applications are developed and deployed (see SS2/21 – Outsourcing and third-party risk management[19]). We expect firms and FMIs to identify and manage the risks from "'off-the shelf' machine learning models, including samples of the data used to train and test the models, open-source software, and machine learning libraries developed by third party providers". The outsourcing and third party risk management policy[20] for FMIs similarly notes that examples of non-outsourcing third party arrangements may include machine learning libraries developed by third party providers.

4. **Appropriate transparency and explainability**, as defined in the guidance, emphasises that "AI systems should be appropriately transparent and explainable".

    a. The Bank and the PRA, alongside the FCA, flagged the potential risks that a lack of transparency and explainability with AI/ML models could pose to the financial system in DP5/22. SS1/23 – Model Risk Management principles for banks[21] lists explainability and transparency as factors that should be considered when assessing the complexity of a model. The principles are designed such that increased complexity requires more oversight by banks, prioritising validation activities and risk controls to these more complex models. These principles apply to all models used by banks,[22] not just AI models, and to their use of third-party models. SS1/23[23] does not require banks to make their machine learning

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[19] **www.bankofengland.co.uk/prudential-regulation/publication/2021/march/outsourcing-and-third-party-risk-management-ss**.

[20] **www.bankofengland.co.uk/paper/2023/policy-on-outsourcing-and-third-party-risk-management-for-fmis**.

[21] **www.bankofengland.co.uk/prudential-regulation/publication/2023/may/model-risk-management-principles-for-banks-ss**.

[22] SS1/23 uses a model definition that has a broad scope, including qualitative model outputs in the definition. This is intended to ensure that recommendation systems in client services and other AI/ML that deliver qualitative outputs are within the scope of SS1/23.

[23] **www.bankofengland.co.uk/prudential-regulation/publication/2023/may/model-risk-management-principles-for-banks-ss**.

algorithms more interpretable or explainable. We also do not define either concept, but rather expect regulated banks to do so. Banks are expected to establish policies and procedures that determine how this is done using risk-based model tiering.

    b. Beyond the requirements outlined above, there are specific requirements for the processing of personal data to be fair and transparent under UK GDPR,[24] which also apply to financial services firms. Data controllers must provide data subjects with various information about their data processing activities, including profiling activities and the existence of any automated decision-making (Articles 13 and 14, UK GDPR). Where decisions producing legal or similarly significant effects are being taken, the notice must in addition include meaningful information about the logic involved in the decision, as well as the significance and the envisaged consequences of such processing for the data subject.

    c. We recognise, however, that the growing complexity of AI/ML models, such as LLMs, challenge the concepts of explainability and transparency.

5. **Fairness**, as defined in the guidance, emphasises that 'AI systems should not undermine the legal rights of individuals or organisations, discriminate unfairly against individuals or create unfair market outcomes. Actors involved in all stages of the AI life cycle should consider descriptions of fairness that are appropriate to a system's use, outcomes and the application of relevant law'. This principle, as described, is more relevant to the FCA, given its consumer protection objective, and other consumer-facing regulators. We set out the Bank's statutory objectives in the cover letter above and Paragraph 1 in the annex. Where fairness is deemed relevant to our remit (eg, prudential soundness), we would expect firms to define fairness for themselves, with justification. Nonetheless, the Bank is subject to the Equality Act 2010,[25] which requires the Bank to have due regard to the need to eliminate discrimination between those with protected characteristics and others. This is relevant whenever the Bank is carrying out a public function (eg, monetary policy, prudential regulation, including policymaking and supervision, financial stability, and the issuance of bank notes).

6. **Accountability and governance**, as defined in the guidance, emphasises that "governance measures could be put in place to ensure effective oversight of the supply and use of AI systems, with clear lines of accountability established across the AI life cycle". These requirements are principally covered by the Senior Managers and Certification Regime (SM&CR), which is implemented through the PRA Rulebook and related Supervisory Statements. Alongside this,

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[24] **www.legislation.gov.uk/eur/2016/679/contents**.
[25] **www.legislation.gov.uk/ukpga/2010/15/contents**.

a framework for Model Risk Management (SS1/23) draws on these rules to set specific expectations in relation to model risk.

    a. The SM&CR is an individual accountability regime that aims to promote the safety and soundness of regulated financial firms. Under this regime, regulated firms are required to ensure that one or more of their Senior Managers (ie, a key decisionmaker within the firm) have overall responsibility for the main activities, business areas, and management functions of the firm. This means any material use of AI/ML in relation to an activity, business area, or management function of a firm out to be set out as falling within the scope of a Senior Manager's responsibilities. These individuals can be held accountable if there is a regulatory breach within their area of responsibility; and, if they failed to take reasonable steps to prevent it, they could face an enforcement action. The Senior Managers Regime (SMR) requirements are set out in the PRA Rulebook (eg, for Capital Requirement Regulation (CRR) firms Allocation of Responsibilities,[26] Senior Management functions[27] etc.) and for Solvency II firms some are listed under Insurance – Allocation of Responsibilities[28] and Insurance – Senior Manager Functions.[29] The supervisory statements provide a source of guidance on the SM&CR (eg, SS28/15 – Strengthening individual accountability in banking[30] and SS35/15 – Strengthening individual accountability in insurance[31]) set out the PRA's expectations on strengthening individual accountability in banking and insurance. Specifically for international banks, SS5/21 – International banks: The PRA's approach to branch and subsidiary supervision[32] states the PRA expectations on the accountability of SMF for branches and subsidiaries. Currently, technology systems are the responsibility of the SMF24 (Chief Operations Function), while SMF4 (Chief Risk Function) has responsibility for the overall risk management of a firm including the setting and managing of its risk exposures. These are outlined in the PRA Rulebook Senior Management Functions Part Rules 3.4 and 3.8.[33] In DP5/22, the Bank and the PRA explicitly sought feedback on whether there should be a dedicated SMF for AI. Respondents highlighted that existing firm governance structures (and regulatory frameworks such as

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[26] **www.prarulebook.co.uk/pra-rules/allocation-of-responsibilities/22-04-2024**.
[27] **www.prarulebook.co.uk/pra-rules/senior-management-functions/22-04-2024**.
[28] **www.prarulebook.co.uk/pra-rules/insurance---allocation-of-responsibilities/22-04-2024**.
[29] **www.prarulebook.co.uk/pra-rules/insurance---senior-management-functions/22-04-2024**.
[30] **www.bankofengland.co.uk/prudential-regulation/publication/2015/strengthening-individual-accountability-in-banking-ss**.
[31] **www.bankofengland.co.uk/prudential-regulation/publication/2015/strengthening-individual-accountability-in-insurance-ss**.
[32] **www.bankofengland.co.uk/prudential-regulation/publication/2021/july/pra-approach-to-branch-and-subsidiary-supervision-ss**.
[33] **www.prarulebook.co.uk/pra-rules/senior-management-functions/22-04-2024**.

the SM&CR) are sufficient to address AI risks, which was outlined in FS2/23.

b. The PRA Rulebook sections General Organisation Requirements[34] and Conditions Governing Business[35] provide an overview of governance rules for banks and insurance firms respectively. Specifically, General Organisation Requirements Section 2.1 establishes high-level requirements on governance, and rules regarding risk management and controls. Section/Part 5.1 establishes governance requirements for management bodies (ie, Boards) and the requirements to ensure effective and prudent management of the firm. In the PRA Rulebook on Risk Control,[36] Section 2.1A focuses on high level governance requirements for effective procedures for risk management. Risk Management provisions are outlined for insurance firms under 'Conditions Governing Business' Section 3. Finally, SS5/16 – Corporate governance: Board responsibilities[37] establishes expectations for Boards, particularly Section 4 – Risk Appetite, Risk management, and Internal controls; Section 6 – Roles of executive and non-executive directors; and Section 9 – management information and transparency.

c. The PRA's SS1/23 – Model Risk Management (MRM) principles for banks[38] also establishes that the PRA expects 'strong governance oversight with a board that promotes a 'MRM' culture from the top through setting clear model risk appetite'. For example, banks should identify a relevant Senior Management Function/Functions (SMF(s)) most appropriate within the bank's organisational structure and risk profile to assume overall responsibility for the MRM framework, its implementation, and the execution and maintenance of the framework. The accountable SMF(s)'s responsibilities regarding MRM may include: establishing policies and procedures to make operational the MRM framework and ensure compliance; assigning the roles and responsibilities of the framework; ensuring effective challenge; ensuring independent validation; evaluating and reviewing model results and validation and internal audit reports; taking prompt remedial action when necessary to ensure the bank's aggregate model risk remains within the board approved risk appetite; and ensuring sufficient resourcing, adequate systems, and infrastructure. In addition, SS1/23 requires banks to provide a comprehensive model inventory, which includes AI/ML models.

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[34] www.prarulebook.co.uk/pra-rules/general-organisational-requirements/22-04-2024.
[35] www.prarulebook.co.uk/pra-rules/conditions-governing-business/22-04-2024.
[36] www.prarulebook.co.uk/pra-rules/risk-control/22-04-2024.
[37] www.bankofengland.co.uk/prudential-regulation/publication/2016/corporate-governance-board-responsibilities-ss.
[38] www.bankofengland.co.uk/prudential-regulation/publication/2023/may/model-risk-management-principles-for-banks-ss.

7. **Contestability and redress**, as defined in the guidance, emphasises that 'where appropriate, users, impacted third parties and actors in the AI life cycle should be able to contest an AI decision or outcome that his harmful or creates material risk of harms.' This principle, as described, sits more within the domain of consumer-facing regulators. As such, the Bank and the PRA have not taken action to implement it in practice at this point. Under UK GDPR Article 22,[39] consumers have the right not to be subject to decisions based solely on automated processing, including profiling which have a legal or similarly significant effect on them. These provisions protect individuals from this type of processing and gives them specific rights in those cases.

Summary of guidance issued / plan to issue

8. As outlined in the cover letter above, the Bank and the PRA's technology-agnostic approach to regulation does not usually mandate or prohibit specific technologies. We may issue guidance or use other policy tools to clarify how existing rules and relevant regulatory expectations apply to those technologies. Thus far, we have not issued AI-specific guidance or other policy tools. The principle of proportionality also informs our thinking and approach to AI, including any potential future regulatory interventions. This is one of the regulatory principles under FSMA 2000 that the PRA and the Bank must have regard to in discharging our general functions, which including making rules. The Section 30E of the Banking Act 1998[40] apply these principles to the Bank when exercising our FMI functions. These only apply to FMI entities (CCPs and CSDs), but not to payment systems or firms.

9. Chapter 4 of DP5/22 set out current legal requirements and guidance considered to be the most relevant to mitigating the risks associated with AI/ML domestically and internationally, with the appendix setting out key legal requirements that are considered relevant to the use of AI systems and processes. They were broken down into Data – Appendix 3 – and Model Risk Management – Appendix 4. Appendix 5 sets out a list of selected relevant publications from a variety of sources including international bodies and UK based institutions. The appendices have a broad range of applicable rules and guidance. A non-exhaustive overview of these rules, regulations, and guidance include:

   a. **Data Management**: The current regulatory framework at the Bank and the PRA aims to address the specific risk components of the data lifecycle. Relevant regulations, guidance, and policy tools include:

      i. The Basel Committee on Banking Supervision's (BCBS) Principles for effective risk data aggregation and risk reporting (BCBS 239)[41]

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[39] **www.legislation.gov.uk/eur/2016/679/article/22**.
[40] **www.legislation.gov.uk/ukpga/1998/11/section/30E**.
[41] **www.bis.org/publ/bcbs239.pdf**.

contains principles aimed at strengthening prudential risk data aggregation such as ensuring the accuracy, integrity, completeness, timeliness, and adaptability of data. The PRA expects the UK's globally systemically important banks to adhere to these principles.

ii. With respect to insurance firms, Rule 12.1 of the Technical Provisions Part[42] and Rule 4.3 of the Conditions Governing Business Part[43] of the PRA Rulebook for Solvency II firms require firms to have internal processes and procedures in place to ensure the completeness, accuracy, and appropriateness of the data used in the calculation of their technical provisions.

iii. In addition, Section 6.1(c) of the Conditions Governing Business Part[44] of the PRA Rulebook outlines the requirement for insurance firms to "assess the sufficiency and quality of the data use in the calculation of technical provisions", while Rule 11.4 of the Solvency Capital Requirements – Internal Models Part,[45] in relation to the internal model, states "data used for the internal model must be accurate, complete, and appropriate".

iv. Where UK financial services firms use AI to process personal data, firms may have regulatory obligations under UK GDPR and the Data Protection Act 2018.[46] The Information Commissioner's Office (ICO) has responsibility for enforcing compliance with data protection requirements. UK data protection legislation applies standards for data privacy and security in respect of personal data.

v. Firms also need to consider their obligations under The Money Laundering, Terrorist Financing and Transfer of Funds (Information on the Payer) Regulations 2017.[47] The Payment Services Regulations 2017[48] (PSRs) are focused on security and quality of data transfers to third parties.

vi. Other relevant requirements and guidance not mentioned above include: Corporate governance principles for banks (BCBS 328); Principles for Financial Market Infrastructures (PFMI).[49]

vii. There are several Supervisory Statements setting out our expectations on firms' use of data for models, including AI/ML models. For example, SS1/23 – Model Risk Management

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[42] www.prarulebook.co.uk/pra-rules/technical-provisions/22-04-2024.
[43] www.prarulebook.co.uk/pra-rules/conditions-governing-business/22-04-2024.
[44] www.prarulebook.co.uk/pra-rules/conditions-governing-business/22-04-2024.
[45] www.prarulebook.co.uk/pra-rules/solvency-capital-requirement---internal-models/22-04-2024.
[46] www.legislation.gov.uk/ukpga/2018/12/contents/enacted.
[47] www.legislation.gov.uk/uksi/2017/692/contents/made.
[48] www.legislation.gov.uk/uksi/2017/752/contents.
[49] www.bis.org/cpmi/publ/d101.htm.

principles for banks has expectations on the data quality management procedures including the rules and standards for data quality, accuracy and relevance, and the specific risk controls and criteria applicable to reflect the higher level of uncertainty associated with use of alternative or unstructured data or information sources; SS11/13 – Internal Ratings Based (IRB) approaches[50] sets out expectations on data used in IRB models that provide input into the regulatory capital requirements for credit, which includes firms' data management approaches, the data and reporting systems used for IRB model management and capital requirements reporting, internal audit or other independent materials relating to IT or data systems, among others.

b. **Model Risk Management (MRM):** Our AIPPF final report noted that MRM is increasingly becoming important as a primary framework for some firms to manage and mitigate potential AI-related risks. Relevant regulations, guidance, and policy tools include:

   i. SS1/23 – Model Risk Management principles for banks created a unified approach to MRM under a single supervisory statement where previously there was fragmentation. These principles are designed to identify, monitor, and control the risks associated with both simple and complex models, including AI models. The supervisory statement is relevant to all banks and building societies with internal model approvals, covering a large amount of the UK banking sector, albeit a limited number of firms (23). Specifically, the supervisory statement includes expectations on effective MRM for dynamic models (eg, models able to adapt, recalibrate, or otherwise change autonomously in response to new inputs). In line with our approach to artificial intelligence and machine learning these principles are technology-agnostic and should cover future developments in AI/ML models. These principles only apply to banks with internal model approval, and they do not apply to insurers. We will consider at a later stage if the principles could be extended to insurers and banks not currently in scope.

   ii. Corporate governance principles for banks (BCBS 328)[51] states that it is the responsibility of a bank's risk management function to ensure that the board and management are aware of the 'assumptions used in, and potential shortcomings of the bank's risk

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[50] **www.bankofengland.co.uk/prudential-regulation/publication/2013/internal-ratings-based-approaches-ss**.
[51] **www.bis.org/bcbs/publ/d328.pdf**.

models and analyses' (paragraph 119). The guidelines also stress that 'risk identification and measurement should include both quantitative and qualitative elements' (paragraph 114).

    iii. SS5/18 – Algorithmic Trading[52] and Commission Delegated Regulation (EU) 2017/589[53] which set out existing expectations and requirements for algorithmic trading, including the implementation of 'kill switch' functionality in the control framework.

c. **Governance:** Good governance is essential for supporting the safe and responsible adoption of AI/ML. In addition to the relevant regulations, guidance, and policy tools outlined under 'Accountability and governance', we highlight:

    i. Rule 6 of the PRA's Fundamental Rules[54] states that '[a] firm must organise and control its affairs responsibly and effectively'.

    ii. The PRA Rulebook contain provisions in respect of compliance, internal audit, financial crime, risk control, outsourcing, and record-keeping. These provisions include Senior Managers Arrangements, Systems, and Controls (SYSC) 4.1.1 and Rule 2.1 of the General Organisational Requirements Part of the PRA Rulebook[55] which both state: '[a] firm must have robust governance arrangements, which include a clear organisational structure with well defined, transparent and consistent lines of responsibility, effective processes to identify, manage, monitor, and report the risks it is or might be exposed to, and internal control mechanisms, including sound administrative and accounting procedures and effective control and safeguard arrangements for information processing systems'. Governance provisions for insurance firms are outlined in the PRA Rulebook Conditions Governing Business Part.[56] The general rules, guidance, and principles are relevant to a firm's use of AI.

    iii. Solvency II Article 258 (General governance requirements – Commission Delegated Regulated (EU) 2015/35),[57] which applies to all insurers, and requires firms to 'ensure that the members of the administrative, management, or supervisory body collectively possess the necessary qualifications, competency, skills, and professional experience in the relevant areas of the business in

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[52] **www.bankofengland.co.uk/prudential-regulation/publication/2018/algorithmic-trading-ss**.
[53] **www.legislation.gov.uk/eur/2017/589/contents**.
[54] **www.prarulebook.co.uk/pra-rules/fundamental-rules/22-04-2024**.
[55] **www.prarulebook.co.uk/pra-rules/general-organisational-requirements/22-04-2024**.
[56] **www.prarulebook.co.uk/pra-rules/conditions-governing-business/22-04-2024**
[57] **www.legislation.gov.uk/eur/2015/35/contents/adopted**.

order to effectively manage and oversee the undertaking in a professional manner'.

d. **Operational resilience and third-party risks:** The Bank, the PRA, and the FCA have developed and implemented a coordinated regulatory and supervisory framework to strengthen the operational resilience of the UK financial services sector. Relevant regulations, guidance, and policy tools were largely outlined in 'Safety, security, and robustness' above. Of additional relevance are:

   i. SS1/21 – Operational Resilience: Impact tolerance for important business services[58] sets out the PRA's expectations for the operational resilience of firms' important business services. The PRA expects firms to identify important business services considering the risk their disruption poses to financial stability (where applicable), the firm's safety and soundness and, in the case of insurers, policyholder protection.

10. In DP5/22, the Bank and the PRA were keen to gather feedback from stakeholders as to whether additional clarification of existing legal requirements and guidance in respect of AI may be helpful, if the current regulatory framework could benefit from extension to better encompass AI/ML, and how the supervisory authorities may best support the safe and responsible adoption of AI/ML in UK financial services. Although the responses did not display clear evidence of the need for an AI-specific framework, there are a few areas where respondents indicated that clarification of how existing guidance would apply to AI/ML models would be useful. These include Data Management, Model Risk Management, Governance, and Operational Resilience and Third-Party Risks. These responses were summarised in FS2/23. We have addressed some of the areas covered in DP5/22 and will continue to consider addressing the areas not covered so far.

a. **Data Management:** The current regulatory landscape for data management is fragmented. This is reflected in the responses to our DP5/22. Firms considered that several different regulations or guidance would apply to data and data management in the context of AI/ML. For large banks, they are of the order of 10 pieces of regulation that variously touch on data governance in various ways, but there are no overarching data governance requirements. We are therefore considering options to address these challenges.

b. **Model Risk Management:** SS1/23 – Model risk management principles for banks will come into effect in May 2024.

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[58] **https://www.bankofengland.co.uk/prudential-regulation/publication/2021/march/operational-resilience-impact-tolerances-for-important-business-services-ss**

c. **Governance:** In DP5/22, the Bank and the PRA explicitly sought feedback on whether there should be a dedicated SMF for AI under the SM&CR. Respondents highlighted that existing firm governance structures (and regulatory frameworks such as the SM&CR) are sufficient to address AI risks, which was outlined in FS2/23. The previously referenced SS1/23 includes expectations for governance, in which firms must identify the relevant SMF(s) to assume overall responsibility for the firms MRM framework. It also requires firms to provide a model inventory, which includes AI/ML models.

d. **Operational Resilience and Third-Party Risks:** The Bank, the PRA, and the FCA are currently assessing their approach to critical third parties to the financial sector, which has included publishing a consultation paper. The aim of the proposed requirements and expectations is to manage the potential risks to the stability of, or confidence in, the UK financial system that may arise due to a failure in, or disruption to, the services that a CTP provides to one or more firms or FMIs. Although this regime is not specific to AI/ML, the concept of services a CTP provides is broad enough to encompass considerations around the systemic use of a common AI/ML model (eg, data bias, model robustness). The adoption of ML may lead to the emergence of critical third-party providers of AI services to the financial sector. If that were to be the case, these systemic AI providers could be captured by the proposed regime for CTPs if they were designated by HM Treasury.

Current and future work we are doing to understand, assess, and manage risks posed by AI/ML

11. We outlined our current and future programme to understand, assess, and manage the risks posed by AI/ML in our cover letter, and in the previous responses. These risks have also been highlighted in relevant publications, which will be explored in the next section as they were conducted jointly with the FCA: Machine Learning in UK financial services (2019); Machine Learning in UK financial services (2022); DP5/22 – Artificial Intelligence and Machine Learning; FS2/23 – Artificial Intelligence and Machine Learning; and AI Public-Private Forum: Final report.

12. In December 2023, the Bank's FPC was briefed on the continued adoption of AI/ML in financial services,[59] including recent developments in LLMs, along with their potential financial stability implications. Our engagement with financial firms has highlighted that although many are experimenting with the use of LLMs, most use cases identified to date are relatively low risk. These include

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[59] **www.bankofengland.co.uk/-/media/boe/files/financial-policy-summary-and-record/2023/fpc-summary-and-record-december-2023.pdf**.

information search and retrieval and the generation of outputs for internal use. Nonetheless, wider adoption of AI and ML could also pose system-wide financial stability risks, for example by amplifying herding or broader procyclical behaviours or increasing cyber-risk and interconnectedness. Given the rapid pace of innovation and potentially widespread use cases, the impact of AI/ML (including LLMs) on financial stability needs careful monitoring and consideration. This is an area of ongoing work for the Bank in 2024 and, working alongside other relevant authorities both domestically and internationally, we would seek to ensure that the UK financial system is resilient to risks that may arise from widespread adoption of AI/ML.

13. We also continue to analyse the implications of technological developments more broadly beyond AI/ML, such as developments in quantum computing, and how these could interact with one another. For example, advances in quantum computing could pose risks to public key cryptography widely used to secure data and systems today[60]. However, quantum computers are able to decrypt messages without access to the private key, which therefore presents a number of cyber security risks. These could interact with the aforementioned cyber-risks related to AI. The Bank will continue to build on its established framework to enhance the cyber and operational resilience of the financial sector, including the FPC's cyber stress tests, SS1/21 – Operational Resilience: Impact tolerance for important business services, and through its participation with the Cross Market Operational Resilience Group (CMORG).[61] The Bank recently published Financial Stability in Focus: The FPC's macroprudential approach to operational resilience,[62] which includes references to the impact of AI on the operational resilience of the UK's financial system.

14. In 2024, the Bank, the PRA, and the FCA are planning on running the third instalment of the 'ML in UK financial services' survey, while we are considering establishing a follow-up industry consortium to the AIPPF. Future details on these programmes will be forthcoming.

Interactions with our remit and other regulators, including collaboration

15. As outlined in the cover letter, we have worked closely with the FCA on several initiatives exploring the adoption of AI/ML by firms in the UK financial services sector and the implications for our specific remits, particularly where they overlap or are complimentary.

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[60] Public key cryptography uses a pair of public and private keys to encrypt messages in a way which is all but impossible to decrypt using conventional computers without access to the private keys. See **https://www.bankofengland.co.uk/-/media/boe/files/letter/2024/letter-from-the-governor-to-harriett-baldwin.pdf**

[61] See **https://www.bankofengland.co.uk/-/media/boe/files/prudential-regulation/letter/2023/thematic-findings-2022-cyber-stress-test.pdf**; See **https://www.bankofengland.co.uk/financial-stability/operational-resilience-of-the-financial-sector**

[62] **www.bankofengland.co.uk/financial-stability-in-focus/2024/march-2024**.

a. In 2019, the Bank and FCA conducted and published a joint survey to better understand the current use of ML in UK financial services.[63] The survey identified that financial services firms were increasingly using ML and needed effective and evolving risk management controls if they were to use it safely and harness the benefits.

b. In 2020, the Bank and FCA launched the AIPPF to further the dialogue on AI innovation and to explore whether principles and guidance could support the safe adoption of these technologies within financial services. The AIPPF brought together a diverse group of experts from financial services, the tech sector, and academia, along with public sector observers from other UK regulators and government. The AIPPF final report was published in February 2022,[64] and explored the barriers, challenges, and risks related to the use of AI in financial services and potential ways to address them and identified the primary drivers of AI risk in financial services relate to three key stages of the AI lifecycle: data, models and governance.

c. Building on the 2019 survey, AIPPF final report and wider domestic and international discussion about the use of ML in financial services, the Bank and FCA conducted a second survey in 2022 which determined that UK financial services firms are continuing to adopt machine learning at pace.

d. Alongside the survey, the Bank, PRA and FCA published DP5/22, examining the use of AI/ML in financial services, and sought views on whether there are gaps and/or how additional intervention might support the safe and responsible adoption of AI in UK financial markets. FS2/23 was published in October 2023 summarising the responses received.

e. There are several regulatory coordination structures relating to the use of AI generally. The Bank is represented on the DRCF's quarterly regulators' roundtable. In 2024, the Bank will work together with the DRCF on selected AI/ML projects. The Bank is also a member of the Information Commissioner's Office's AI and Regulators Working Group and is represented on the Alan Turing Institute's Standards Hub Regulators' Forum.

f. The Bank and the PRA are also members of several international fora, providing opportunities to discuss the challenges of AI/ML and its implications for financial service with peer regulators internationally.

Current and future capabilities to address AI risks within our regulatory remit

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[63] **www.bankofengland.co.uk/report/2019/machine-learning-in-uk-financial-services**.
[64] **www.bankofengland.co.uk/research/fintech/ai-public-private-forum**.

16. Our current prudential policy development on AI/ML is primarily led by the Bank's Fintech Hub and Prudential Policy Directorate (PPD). Overall resourcing would be challenging to precisely capture as, while work is led from these areas, delivering a regulatory framework that guards against the risks of and supports the safe adoption of AI/ML draws on staff from across the institution. As the Bank is technology-agnostic, its work on AI/ML benefits most significantly from this more general policy development work, drawing on those working on topics such as Model Risk Management, Data, Operational Resilience and Third-Party Management, Governance, and front-line supervision, financial stability analysis, among others, to assess AI/ML and their implications for financial services. To provide one example, the 2022 joint Bank-PRA-FCA Discussion Paper was supported by a cross-Bank and PRA working group of around 40 colleagues, providing expertise on prudential policy, data, banking supervision, insurance supervision, FMI supervision, supervisory risk specialists, advanced analytics, and legal expertise.

17. The Bank and the PRA use AI, where appropriate, to support and enhance their capabilities. For example, the Bank uses AI for predictive analytics, the study of non-linear interactions between variables, and analysis of larger and richer datasets, which can potentially help forecast GDP growth,[65] bank distress,[66] and financial crises prediction.[67] The Bank is also exploring how AI-enabled text analysis of newspapers can help improve economic forecasting[68] and how AI can create 'faster indictors', which may enable real-time economic analysis. The PRA successfully introduced a cognitive search tool with AI capabilities that helps supervisors gain more insights from firm management information by extracting key patterns from unstructured and complex datasets. The PRA is also developing other AI tools for its staff to assist in their work.

    a. In 2018, the Bank established the Fintech Hub to examine how technology is changing financial services, particularly in the UK. AI/ML is a key area of focus for the Hub, which has led key projects such as the ML in UK financial services[69] surveys, the AIPPF, DP5/22, FS2/23, and works with other regulators both domestically and internationally.

    b. As of September 2023, there were 82 data scientists across the Bank most of which were in the Monetary Policy area, which includes the Data and Analytical Transformation (DAT) Directorate (37), and the PRA (30).

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[65] **www.bankofengland.co.uk/working-paper/2021/forecasting-uk-gdp-growth-with-large-survey-panels**.

[66] **www.bankofengland.co.uk/working-paper/2019/predicting-bank-distress-in-the-uk-with-machine-learning**.

[67] **www.bankofengland.co.uk/working-paper/2020/credit-growth-the-yield-curve-and-financial-crisis-prediction-evidence-from-a-machine-learning**.

[68] **www.bankofengland.co.uk/working-paper/2020/making-text-count-economic-forecasting-using-newspaper-text**.

[69] **www.bankofengland.co.uk/report/2022/machine-learning-in-uk-financial-services**.

There are a further 10 data scientists in the FMI Directorate (FMID). FMID supervises FMIs in the UK, as well as owns and analyses some of the largest structured datasets in the Bank, which provide important insights to the Bank's policy committees: the Financial Policy Committee (FPC), the Prudential Regulation Committee (PRC), and the Monetary Policy Committee (MPC).[70] The datasets are also regularly used in the Financial Stability Report, research papers, and speeches. The FMID team also works and collaborates with other data scientists embedded in different business areas of the Bank, which makes it possible to apply basic machine learning tools on FMID data.

c. In 2014, the Bank established the Advanced Analytics (AA) Division, which now forms part of DAT. It acts as a centre of expertise for ML and AI and works with all areas of the Bank. Part of its role is to ensure that the Bank's research functions make best use of modern analytical methods to optimally support the Bank's policy committees and operations. AA staff have published several Staff Working Papers and journal articles using these methods. Close to 20 FTE work in AA.

d. In 2021, the PRA established a dedicated RegTech, Data and Innovation Division (RDID) to deliver a wide-ranging programme of work to bolster the PRA's efficiency, effectiveness, and data culture, through a phased investment in tools, technology, processes, and skills.[71] This includes building targeted machine learning tools to support front-line supervision, for example, to help process large quantities of unstructured data. Resources in this area have ramped up over the past few years, currently around 35 FTE, of which roughly one quarter are involved in building specialist machine learning-related tools and the associated digital skills work for all PRA staff.

e. Several staff within the PRA outside RDID are involved in building these capabilities, supported by enablement technologies being delivered as part of the Bank's wider Data & Analytics agenda and expertise in the use of machine learning and natural language processing in other areas of the Bank. As well as being valuable for performing supervision, this work helps PRA staff develop and maintain skills needed to understand AI tools used by firms.

f. Our resourcing model aims to make knowledge of AI/ML more mainstream across the Bank and the PRA. For example, we have a dedicated and mandatory curriculum in which supervisors learn the

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[70] Trade Repository (TR) Data Collections: **www.bankofengland.co.uk/financial-stability/trade-repository-data**.

[71] Further details can be found in the PRA Business Plan 2022-23: **www.bankofengland.co.uk/prudential-regulation/publication/2022/april/pra-business-plan-2022-23**.

fundamentals of emerging technologies such as AI, dedicated optional courses on understanding in greater detail the technology and use-cases behind AI adoption and practical trainings on leveraging AI for usage in colleagues' day-to-day work.

g. The Bank/PRA have also previously held "fintech weeks", where regulated firms and other companies are invited to discuss the latest developments, themes, and trends in technology adoption. The Bank/PRA are holding our next fintech week, "PRA Innovation Week", in Q2 2024. This will cover topics surrounding the broader innovation landscape, including some talks on AI adoption in financial services.

18. The Bank recently established a cross-organisation AI taskforce to ensure that it makes progress using AI, and particularly generative AI, tools effectively, safely, and responsibly. The taskforce has three main aims. The first is to identify particularly promising use cases for AI/ML and to run pilots exploring their use in the Bank. Second, it is tasked with developing appropriate guardrails to ensure that risks from using AI are controlled. Part of this is the establishment of an ethical framework for using AI/ML models (as well as other quantitative models) responsibly. Third, it seeks to identify training needs and to grow a culture where these models are understood and can be used effectively. The work of the taskforce and developments of these capabilities is scrutinised by the Bank's internal management and risk committees.

19. The Bank recognises that it has much to learn from others about the effective use of AI/ML. It will continue to actively engage with external organisations to better understand data and analytics best practice, share experience, and work on joint projects where appropriate. The Bank will also consider how to establish a technology environment to enable experimentation in innovative technologies and ensure that the resulting tools can be put into production. At this stage we do not anticipate a change in resourcing related to the regulation of the use of AI/ML by our regulated firms. As always, the Bank and PRA will reprioritise analytical and supervisory resources as warranted by developments.