Using only the 45 sources of local PDF files and the attached Mock-up file.

Complete the objectives:
1: Taking inspiration from the type of questions that are in the attached "2025_26_Digital_Finance_MockExam" file, create at least 4 sample questions for each of the topics discussed in lecture and exercise based on the PDF slides.
Topics were: DigitalFinance_Introduction, Introduction_Banks, Payment Systems, BitcoinBlockchain, Other Cryptocurrencies, ICOs and Regulations, Asset Pricing With Cryptocurrencies, RoboAdvice_Introduction, RoboAdvice_MarketOverviewAndCustomization, Marketplace Lending, Crowd Investing, AI in Finance, Digital Transformation.
2: For the number of questions per topic use this ratio: base case number of questions = 4. So if only 1 PDF slide file covers "Introduction_Banks" there should be 4 questions for this topic, but since 'RoboAdvice' is covered in two lecture slide files 'VL7' and 'VL8': it should have 8 questions.
3: Have a variety of questions as is in the MockExam file, including MCQ questions where possible. But make sure to strictly follow the pattern of questions in the MockExam - [1 point is supposed to take 1 minute to answer], so no questions should be taking more than 8 minutes to answer.
4: At the end of the document, make sure to include the answers so I can check for my self if my answers were correct.

Now I'll create the comprehensive practice exam document with all questions and answer key:

DIGITAL FINANCE - PRACTICE EXAM

Winter Term 2025/2026
Prof. Dr. Sebastian Müller
TUM School of Management

SECTION 1: DIGITAL FINANCE INTRODUCTION (4 Questions)

Question 1 (6 points)

Digital Finance combines technological applications with financial services. Name and briefly describe **three key technologies** that are foundational to Digital Finance, explaining how each technology contributes to the transformation of the financial industry.

Question 2 (MCQ - 2 points)

Which of the following best describes the primary objective of the European Central Bank's monetary policy?

- A) To maximize employment regardless of inflation
- B) To maintain price stability with inflation rates below, but close to, 2% over the medium term
- C) To promote stock market growth
- D) To ensure all citizens have access to banking services

Question 3 (4 points)

Explain the concept of **sustainable finance** and name the three pillars of ESG (Environmental, Social, Governance). For each pillar, provide one specific example of a factor that investors might consider.

Question 4 (MCQ - 2 points)

According to the course materials, which statement about Germany's equity culture is most accurate?

- A) Over 40% of Germans own stocks, similar to the United States
- B) Germany has one of the highest stockholding rates in Europe
- C) Germany has a relatively low equity culture with stockholding rates around 18-19%
- D) Stock ownership in Germany has been declining since 2000

SECTION 2: INTRODUCTION TO BANKS (4 Questions)

Question 5 (6 points)

Describe the **three main functions of banks** in the traditional financial system. For each function, explain why it is important for the economy and provide one example.

Question 6 (4 points)

What are **NeoBanks**? Explain how they differ from traditional banks and discuss one potential advantage and one potential disadvantage for customers.

Question 7 (MCQ - 2 points)

Which of the following is NOT typically considered a core banking function?

- A) Maturity transformation
- B) Risk transformation

- C) Manufacturing physical currency
- D) Information production

Question 8 (4 points)

Discuss how **FinTech companies** are challenging traditional banks. Name two specific areas where FinTech competition is strongest and explain why traditional banks might struggle to compete in these areas.

SECTION 3: PAYMENT SYSTEMS (4 Questions)

Question 9 (6 points)

Compare and contrast **traditional payment systems** (e.g., credit cards, bank transfers) with **digital payment systems** (e.g., PayPal, mobile payments). Discuss three key differences and explain how digital payment systems have transformed consumer behavior.

Question 10 (MCQ - 2 points)

What is the primary advantage of SEPA (Single Euro Payments Area)?

- A) It eliminates all transaction fees for European payments
- B) It standardizes euro payments across Europe, making cross-border payments as easy as domestic payments
- C) It provides insurance for all electronic transactions
- D) It converts all currencies to euros automatically

Question 11 (4 points)

Explain the concept of **Central Bank Digital Currency (CBDC)**. What are two potential benefits and two potential risks of implementing a retail CBDC?

Question 12 (4 points)

Describe how **contactless payment** technology works. Discuss one security feature that protects consumers and one reason why adoption rates vary across countries.

SECTION 4: BITCOIN/BLOCKCHAIN (4 Questions)

Question 13 (8 points)

Based on the IMF's criteria for money (store of value, unit of account, medium of exchange), evaluate whether Bitcoin should be considered a currency. Discuss Bitcoin's performance against each criterion and provide a reasoned conclusion.

Question 14 (MCQ - 2 points)

What is the maximum number of Bitcoins that will ever exist?

- A) 10 million
- B) 21 million
- C) 50 million
- D) Unlimited - new Bitcoins are mined indefinitely

Question 15 (6 points)

Explain how **blockchain technology** works in the context of Bitcoin. Your answer should include: (a) the role of blocks, (b) the concept of mining, and (c) how transactions are verified.

Question 16 (MCQ - 2 points)

Which of the following is a major environmental concern associated with Bitcoin?

- A) Bitcoin transactions require physical delivery of gold
- B) The proof-of-work mining process consumes enormous amounts of energy
- C) Bitcoin mining produces radioactive waste
- D) Bitcoin servers require rare earth minerals

SECTION 5: OTHER CRYPTOCURRENCIES (4 Questions)

Question 17 (6 points)

Compare **Proof-of-Work (PoW)** and **Proof-of-Stake (PoS)** consensus mechanisms. Explain how each works, and discuss one major advantage and one major disadvantage of each approach.

Question 18 (4 points)

Explain the concept of **smart contracts** in the Ethereum ecosystem. Provide one example of how smart contracts can be used in a real-world application.

Question 19 (MCQ - 2 points)

What distinguishes **stablecoins** from other cryptocurrencies?

- A) They are controlled by central banks
- B) They are designed to maintain a stable value, typically pegged to fiat currencies
- C) They cannot be traded on exchanges
- D) They use a unique consensus mechanism called "stability mining"

Question 20 (4 points)

Describe the **pegging mechanisms** used by stablecoins. Explain at least two different approaches (e.g., fiat-collateralized, crypto-collateralized, algorithmic) and discuss the risks associated with one of them.

SECTION 6: ICOs AND REGULATIONS (4 Questions)

Question 21 (6 points)

Explain what an **Initial Coin Offering (ICO)** is and how it differs from an **Initial Public Offering (IPO)**. Discuss three key differences in terms of regulation, investor protection, and market structure.

Question 22 (MCQ - 2 points)

According to the Howey Test, when is a digital asset considered a security?

- A) When it is traded on an exchange
- B) When there is an investment of money in a common enterprise with the expectation of profits from the efforts of others
- C) When it is backed by physical assets
- D) When it pays dividends

Question 23 (6 points)

Discuss the **regulatory landscape for cryptocurrencies** in either the EU (MiCA regulation) or the USA (GENIUS Act). Explain the main objectives of the regulation and name three specific requirements or provisions.

Question 24 (MCQ - 2 points)

What does the EU's MiCA regulation primarily focus on?

- A) Banning all cryptocurrency trading
- B) Establishing comprehensive rules for crypto-assets not yet regulated under EU financial law
- C) Creating a European cryptocurrency to replace the euro
- D) Taxing cryptocurrency transactions at 50%

SECTION 7: ASSET PRICING WITH CRYPTOCURRENCIES (4 Questions)

Question 25 (6 points)

According to Griffin and Shams (2020) "Is Bitcoin Really Untethered?", explain the **"pushed" hypothesis** regarding Tether's influence on Bitcoin prices. Discuss the evidence they found to support this hypothesis.

Question 26 (4 points)

Calculate the **Sharpe Ratio** for Bitcoin given the following monthly data:

- Average monthly return: 15%
- Risk-free rate: 0.1% per month
- Standard deviation of returns: 45%

Show your calculation and interpret the result.

Question 27 (MCQ - 2 points)

What proportion of Bitcoin users were estimated to be involved in illegal activity according to Foley et al. (2019)?

- A) Approximately 5%
- B) Approximately 10-15%
- C) Approximately 25-26%
- D) Over 50%

Question 28 (4 points)

Discuss why **Bitcoin returns exhibit high volatility**. Name and explain two factors that contribute to this volatility and discuss the implications for Bitcoin as an investment asset.

SECTION 8: ROBO-ADVICE INTRODUCTION (4 Questions)

Question 29 (6 points)

Define **Robo-Advisors** and explain their core functionality. Discuss three ways in which robo-advisors differ from traditional financial advisors in terms of service delivery, cost structure, and client interaction.

Question 30 (MCQ - 2 points)

What is the typical fee structure for robo-advisors compared to traditional financial advisors?

- A) Robo-advisors charge 2-3% annually, traditional advisors charge 0.25-0.5%
- B) Both charge approximately the same fees
- C) Robo-advisors charge 0.25-0.5% annually, traditional advisors charge 1-2% or more
- D) Robo-advisors are always free

Question 31 (6 points)

Explain the concept of **Smart Beta** investing. Discuss whether smart beta strategies should be classified as active or passive investing, providing one argument for each classification.

Question 32 (MCQ - 2 points)

Which of the following is NOT a typical feature of robo-advisory services?

- A) Automated portfolio rebalancing
- B) Algorithm-based asset allocation
- C) Face-to-face meetings with financial planners
- D) Tax-loss harvesting

SECTION 9: ROBO-ADVICE MARKET & CUSTOMIZATION (4 Questions)

Question 33 (8 points)

Discuss the **Efficient Market Hypothesis (EMH)** and explain what the existence of market anomalies means for its validity. Provide two examples of well-known market anomalies and explain how robo-advisors might exploit these anomalies.

Question 34 (4 points)

Explain the role of **factor investing** in robo-advisory portfolios. Name and describe at least three factors that are commonly used in systematic investment strategies.

Question 35 (MCQ - 2 points)

According to McLean and Pontiff (2016), what happens to return predictability after academic publication of stock return predictors?

- A) It increases significantly
- B) It remains unchanged
- C) It declines
- D) It becomes negative for all predictors

Question 36 (4 points)

Describe the **customization capabilities** of modern robo-advisors. How do they incorporate individual investor preferences (e.g., risk tolerance, ESG preferences) into portfolio construction?

SECTION 10: MARKETPLACE LENDING (4 Questions)

Question 37 (6 points)

Explain the **marketplace lending (peer-to-peer lending) business model**. Describe the roles of borrowers, lenders, and the platform, and discuss how marketplace lenders differ from traditional banks in terms of credit assessment and risk management.

Question 38 (4 points)

Discuss why companies might choose to conduct an IPO during **bullish markets** rather than bearish markets. Provide two specific reasons related to valuation and investor demand.

Question 39 (MCQ - 2 points)

What is a key advantage of marketplace lending platforms over traditional banks?

- A) They are backed by government deposit insurance
- B) They can offer faster loan approval through algorithmic assessment
- C) They eliminate all credit risk for lenders
- D) They only lend to AAA-rated borrowers

Question 40 (4 points)

Explain the concept of **credit scoring algorithms** used by marketplace lending platforms. How do these algorithms differ from traditional credit scoring, and what data sources might they incorporate?

SECTION 11: CROWD INVESTING (4 Questions)

Question 41 (8 points)

Compare and contrast **Business Angels** and **Venture Capital firms** as sources of startup funding. Discuss the differences in terms of investment size, stage of investment, value-added services, and decision-making process. As a startup founder, which source would you prefer and why?

Question 42 (MCQ - 2 points)

Which type of crowdfunding involves contributors receiving equity in the company?

- A) Donation-based crowdfunding
- B) Reward-based crowdfunding
- C) Equity crowdfunding (crowdinvesting)
- D) Debt crowdfunding

Question 43 (4 points)

Describe the main **risks and challenges** associated with equity crowdfunding from an investor's perspective. Discuss at least three specific risks.

Question 44 (4 points)

Explain the concept of **signaling in crowdfunding campaigns**. Provide two examples of credible signals that can increase the likelihood of campaign success and explain why they are effective.

SECTION 12: AI IN FINANCE (4 Questions)

Question 45 (6 points)

Distinguish between **Artificial Intelligence (AI)**, **Machine Learning (ML)**, **Deep Learning (DL)**, and **Neural Networks (NN)**. Explain how these concepts are related and provide one example of how each is applied in finance.

Question 46 (MCQ - 2 points)

What is "overfitting" in the context of AI models?

- A) A model that performs well on unseen data but poorly on training data
- B) A model that performs well on training data but poorly on unseen data
- C) A model that uses too few features for predictions
- D) A model that cannot handle high-dimensional data

Question 47 (6 points)

Explain the concept of **look-ahead bias** in financial modeling with AI. Provide an example of how look-ahead bias might occur in a trading strategy model and discuss why it is problematic.

Question 48 (MCQ - 2 points)

According to the course materials, what is a major limitation of using Generative AI (like ChatGPT) in financial research?

- A) It cannot process text data
- B) Low replicability and potential for hallucinations (generating false information)
- C) It is too expensive for academic research
- D) It only works with historical data

SECTION 13: DIGITAL TRANSFORMATION (4 Questions)

Question 49 (6 points)

Define **Digital Transformation** in the context of financial services. Discuss three key dimensions of digital transformation (e.g., customer experience, operational processes, business models) and provide one example for each dimension.

Question 50 (4 points)

Discuss the **challenges traditional financial institutions face** when implementing digital transformation initiatives. Name and explain three specific barriers.

Question 51 (MCQ - 2 points)

Which of the following best describes the concept of "disintermediation" in digital finance?

- A) Increasing the number of intermediaries in financial transactions
- B) Removing traditional intermediaries by enabling direct connections between parties
- C) Regulating all financial intermediaries more strictly
- D) Converting all financial services to digital format

Question 52 (4 points)

Explain how **data analytics and AI** contribute to digital transformation in financial services. Provide two specific use cases where data analytics creates value for either financial institutions or customers.

ANSWER KEY

SECTION 1: DIGITAL FINANCE INTRODUCTION

Answer 1:

Three key technologies foundational to Digital Finance:

1. **Blockchain/DLT (Distributed Ledger Technology):** Enables secure, transparent, and decentralized record-keeping without intermediaries. Transforms financial services by enabling cryptocurrencies, smart contracts, and more efficient settlement systems.
2. **Artificial Intelligence/Machine Learning:** Enables automation of decision-making, pattern recognition, and prediction. Transforms finance through robo-advisors, fraud detection, credit scoring, and algorithmic trading.
3. **Cloud Computing:** Provides scalable, on-demand computing resources and storage. Transforms finance by reducing infrastructure costs, enabling faster innovation, and improving accessibility of financial services.

(Other acceptable answers: Big Data Analytics, Internet of Things, Biometric Technologies, API technologies)

Answer 2: B - To maintain price stability with inflation rates below, but close to, 2% over the medium term

Answer 3:

Sustainable finance systematically incorporates sustainability concerns (ESG) into the evaluation and choice of assets and investment projects.

Three pillars of ESG:

1. **Environmental:** Climate change mitigation, energy efficiency, pollution control, biodiversity protection
    - Example: Carbon emissions, water usage, renewable energy adoption
2. **Social:** Human rights, labor standards, diversity, community relations, data privacy
    - Example: Workplace safety, gender diversity, customer data protection
3. **Governance:** Board structure, shareholder rights, executive compensation, transparency, anti-corruption
    - Example: Independent board members, audit quality, business ethics

Answer 4: C - Germany has a relatively low equity culture with stockholding rates around 18-19%

SECTION 2: INTRODUCTION TO BANKS

Answer 5:

Three main functions of banks:

1. **Maturity Transformation:** Banks accept short-term deposits and provide long-term loans. Important because it enables businesses and individuals to access long-term financing while depositors maintain liquidity.
    - Example: A bank accepts a savings account (withdrawable anytime) and uses it to fund a 30-year mortgage.
2. **Risk Transformation:** Banks pool deposits from many savers and distribute them across diversified loans, reducing individual risk through diversification. Important for spreading and managing financial risks.
    - Example: A bank with 1,000 depositors can withstand a few loan defaults without threatening depositor funds.
3. **Payment Services/Transaction Processing:** Banks facilitate payments between parties through various channels (transfers, cards, etc.). Important for enabling efficient commerce and economic activity.
    - Example: Credit card payments, wire transfers, direct debits.

(Alternative: Information Production - Banks assess creditworthiness and reduce information asymmetry)

Answer 6:

NeoBanks are digital-only banks that operate without physical branches, offering banking services entirely through mobile apps and online platforms.

Differences from traditional banks:

- No physical branches
- Lower operational costs
- Digital-first customer experience
- Often focus on specific customer segments or use cases

One advantage: Lower fees due to reduced overhead costs; modern, user-friendly mobile interfaces; faster account opening

One disadvantage: Limited personal customer service; potential concerns about lack of established reputation; may not offer full range of services (e.g., cash deposits, complex financial advice)

Answer 7: C - Manufacturing physical currency (This is done by central banks and national mints, not commercial banks)

Answer 8:

Two areas where FinTech competition is strongest:

1. **Payments:** FinTech companies like PayPal, Square, Stripe offer faster, cheaper, more convenient payment processing. Traditional banks struggle because of legacy IT systems, complex organizational structures, and slower innovation cycles.
2. **Lending/Credit:** Marketplace lending platforms and online lenders use algorithms for faster credit assessment and approval. Traditional banks struggle due to bureaucratic lending processes, branch-based models, and conservative underwriting approaches.

(Other acceptable areas: Personal Finance Management, Robo-Advisory, Insurance (InsurTech), Money Transfer/Remittance)

SECTION 3: PAYMENT SYSTEMS

Answer 9:

Three key differences:

1. **Speed:** Traditional systems often take days for settlement (especially international), while digital systems process payments instantly or within hours.
2. **Cost:** Digital payments typically have lower transaction costs as they bypass multiple intermediaries. Traditional systems involve multiple banks and clearing houses.
3. **Accessibility:** Digital payments accessible 24/7 from anywhere with internet connection. Traditional systems limited by banking hours and physical branch locations.

Transformation of consumer behavior:

- Increased online shopping and e-commerce
- Reduced cash usage
- Expectation of instant transactions
- Mobile-first payment habits
- Cross-border transactions become routine

Answer 10: B - It standardizes euro payments across Europe, making cross-border payments as easy as domestic payments

Answer 11:

Central Bank Digital Currency (CBDC) is a digital form of central bank money, issued and backed by the central bank.

Two potential benefits:

1. Financial inclusion - Easier access to banking services for unbanked populations
2. More efficient payment systems - Lower transaction costs and faster settlement
   (Other: Monetary policy transmission, reduced cash handling costs, programmable money)

Two potential risks:

1. Bank disintermediation - People might prefer CBDC over bank deposits, weakening banks' funding base
2. Privacy concerns - Central bank could track all transactions, raising surveillance issues
   (Other: Cybersecurity risks, technology implementation challenges, risk of bank runs)

Answer 12:

How contactless payment works:
Contactless payments use Near Field Communication (NFC) technology to transmit payment data wirelessly between a card/device and a payment terminal when brought within a few centimeters of each other. The card/device contains a chip that communicates encrypted payment information.

One security feature:

- Transaction limits (e.g., €50) requiring PIN for larger amounts
- Tokenization - actual card number not transmitted, replaced with a one-time token
- Encryption of payment data

One reason for varying adoption:

- Payment infrastructure readiness (availability of NFC terminals)
- Cultural preferences for cash vs. digital payments
- Trust in technology and security concerns
- Regulatory environment and banking sector support

SECTION 4: BITCOIN/BLOCKCHAIN

Answer 13:

Evaluation against IMF criteria:

1. **Store of Value:**
   - **Assessment:** Poor/Questionable

- Bitcoin experiences extreme price volatility (can lose/gain 50%+ in months)
- Not reliable for preserving wealth over time
- Example: Bitcoin price chart shows massive fluctuations

2. **Unit of Account:**
   - **Assessment:** Poor
   - Extreme volatility makes pricing goods difficult - retailers would need constant price updates
   - High value per Bitcoin (e.g., €50,000+) requires using multiple decimal places for everyday items
   - Price inconsistency across exchanges violates law of one price
3. **Medium of Exchange:**
   - **Assessment:** Limited/Improving
   - Growing but still limited merchant acceptance
   - Used primarily as speculative asset rather than for transactions
   - Transaction costs and speed issues for small purchases
   - However, some major retailers now accept Bitcoin

Conclusion: Bitcoin currently fails to meet the criteria of a traditional currency, particularly as a store of value and unit of account. It functions primarily as a speculative investment asset rather than a currency. However, this could evolve with maturation of the ecosystem and reduced volatility.

Answer 14: B - 21 million (This limit is built into Bitcoin's protocol)

Answer 15:

How blockchain technology works in Bitcoin:

(a) Role of blocks:
Blocks are containers that store a collection of Bitcoin transactions. Each block contains:

- Transaction data (who sent what to whom)
- A timestamp
- A reference (hash) to the previous block, creating a chain
- A cryptographic puzzle solution (proof-of-work)

(b) The concept of mining:
Mining is the process of:

- Collecting pending transactions into a new block
- Solving a computationally difficult cryptographic puzzle (finding a hash that meets specific criteria)

- The miner who solves the puzzle first adds the block to the blockchain and receives a reward (newly created bitcoins + transaction fees)
- Mining secures the network by making it extremely costly to alter past transactions

(c) How transactions are verified:

- When a transaction is broadcast to the network, nodes verify it follows the rules (valid signatures, sufficient funds, etc.)
- Miners include verified transactions in blocks
- Once a block is added to the chain and subsequent blocks are added on top, the transaction becomes increasingly difficult to reverse
- Multiple copies of the blockchain exist across the network, ensuring transparency and preventing fraud

Answer 16: B - The proof-of-work mining process consumes enormous amounts of energy (comparable to small countries' annual electricity consumption)

SECTION 5: OTHER CRYPTOCURRENCIES

Answer 17:

Proof-of-Work (PoW):

- **How it works:** Miners compete to solve complex mathematical puzzles; first to solve adds the block and receives rewards
- **Advantage:** Proven security track record; 51% attack requires controlling majority of computing power (expensive)
- **Disadvantage:** Extremely energy-intensive; limited transaction throughput; high environmental impact

Proof-of-Stake (PoS):

- **How it works:** Validators "stake" (lock up) cryptocurrency as collateral; validators are chosen to create blocks based on their stake size
- **Advantage:** 99%+ more energy efficient; faster transaction processing; lower barriers to participation
- **Disadvantage:** Less proven security model; "rich get richer" dynamics; requires trust in validators

Answer 18:

Smart contracts are self-executing contracts with terms directly written into code on the Ethereum blockchain. They automatically execute when predetermined conditions are met, without intermediaries.

Real-world example:

- **Decentralized Finance (DeFi):** Automated lending protocols where users can lend/borrow funds. Smart contract automatically calculates interest, liquidates collateral if needed, and distributes payments without a bank.
- **Insurance:** Flight delay insurance that automatically pays out if flight tracking data shows a delay.
- **Supply chain:** Automatic payment release when goods are delivered and confirmed via IoT sensors.

Answer 19: B - They are designed to maintain a stable value, typically pegged to fiat currencies (e.g., 1 USDT = 1 USD)

Answer 20:

Pegging mechanisms:

1. **Fiat-Collateralized:**
    - Issuer holds USD (or other fiat) reserves backing each token 1:1
    - Examples: USDT (Tether), USDC
    - Risk: Reserve transparency - are assets really there? Custodian risk, regulatory seizure risk
2. **Crypto-Collateralized:**
    - Backed by volatile crypto assets locked in smart contracts
    - Over-collateralized (e.g., $150 of ETH backs $100 of stablecoin)
    - Example: DAI
    - Risk: Collateral volatility can trigger liquidation cascades; smart contract bugs; oracle failure
3. **Algorithmic:**
    - Uses algorithms to expand/contract supply to maintain peg; little or no reserves
    - Example: TerraUSD (UST) - collapsed in 2022
    - Risk: No hard backing; vulnerable to death spirals if confidence is lost; bank run dynamics

SECTION 6: ICOS AND REGULATIONS

Answer 21:

Initial Coin Offering (ICO): A fundraising mechanism where ventures sell digital tokens to investors in exchange for cryptocurrency (usually) or fiat money.

Three key differences from IPOs:

1. **Regulation:**
    - IPOs: Heavily regulated, require SEC registration (US) or equivalent, extensive disclosure requirements, legal obligations
    - ICOs: Largely unregulated or lightly regulated; minimal disclosure requirements; often just a whitepaper
2. **Investor Protection:**
    - IPOs: Strong investor protections, company audits, prospectus requirements, securities laws apply
    - ICOs: Minimal investor protection; high fraud risk; no standardized disclosure; tokens often don't represent equity or legal claims
3. **Market Structure:**
    - IPOs: Conducted through established underwriters and exchanges; shares represent ownership
    - ICOs: Direct-to-consumer via blockchain; tokens may be utility, security, or currency; global accessibility; lower barriers to entry

(Other acceptable differences: Cost of issuance, speed, ownership rights, secondary markets)

Answer 22: B - When there is an investment of money in a common enterprise with the expectation of profits from the efforts of others

Answer 23:

EU - MiCA (Markets in Crypto-Assets) Regulation:

Main objectives:

- Establish comprehensive regulatory framework for crypto-assets not covered by existing EU financial law
- Protect consumers and investors
- Ensure market integrity and financial stability
- Prevent market manipulation and money laundering

Three specific requirements:

1. **Authorization Requirements:** Crypto-asset service providers must obtain authorization from national regulators to operate

2. **Reserve Requirements for Stablecoins:** Issuers of asset-referenced tokens must maintain adequate reserves and meet strict liquidity requirements
3. **Client Asset Segregation:** Firms must ring-fence client assets from their own balance sheets (lesson from FTX collapse)

(Other provisions: Market abuse rules, transparency requirements, operational resilience standards)

USA - GENIUS Act:

Main objectives:

- Establish first comprehensive federal framework for payment stablecoins
- Ensure consumer protection through reserve backing
- Create clear regulatory standards

Three specific requirements:

1. **1:1 Backing Requirement:** Stablecoins must be fully backed by US dollars or highly liquid assets
2. **Issuer Licensing:** Only approved institutions (insured depositories, federally/state-qualified issuers) can issue stablecoins
3. **Redemption Rights:** Issuers must redeem stablecoins at par on demand; holders have priority claims on reserves in insolvency

Answer 24: B - Establishing comprehensive rules for crypto-assets not yet regulated under EU financial law

SECTION 7: ASSET PRICING WITH CRYPTOCURRENCIES

Answer 25:

"Pushed" Hypothesis (Griffin & Shams 2020):

The pushed hypothesis suggests that Tether is printed/issued regardless of actual demand from cash investors, and this unbacked supply is used to purchase Bitcoin, artificially inflating its price.

Evidence supporting the hypothesis:

1. **Timing of Flows:** Tether flows from Bitfinex to other exchanges (Poloniex, Bittrex) systematically occurred after Bitcoin price drops, followed by Bitcoin price increases
2. **Concentration:** Approximately 50% of Tether-Bitcoin exchange was driven by one large account (1LSg), not diverse investor demand
3. **End-of-Month Effects:** Bitcoin prices declined at month-ends when Tether issuance was high - consistent with liquidating Bitcoin to show reserves for accounting statements

4. **Below-Round-Number Buying:** Heavy Bitcoin buying just below psychological price levels ($500 increments) during Tether authorization periods - consistent with price support strategy
5. **Reserve Insufficiency:** Patterns suggested Tether reserves were insufficient before month-ends, requiring Bitcoin liquidation

Implication: Rather than genuine investor demand, price patterns consistent with strategic market manipulation using unbacked money.

Answer 26:

Sharpe Ratio Calculation:

Formula: Sharpe Ratio = (Average Return - Risk-Free Rate) / Standard Deviation

Calculation:

- Average Return = 15% = 0.15
- Risk-Free Rate = 0.1% = 0.001
- Standard Deviation = 45% = 0.45

Sharpe Ratio = (0.15 - 0.001) / 0.45 = 0.149 / 0.45 = **0.331**

Interpretation:
A Sharpe Ratio of 0.331 indicates that for every unit of risk (standard deviation) taken, the investor receives approximately 0.33 units of excess return above the risk-free rate. This is relatively low compared to traditional investments (where >1.0 is considered good), reflecting Bitcoin's high volatility relative to its return. The low ratio suggests poor risk-adjusted performance during this period.

Answer 27: C - Approximately 25-26% (one-quarter of Bitcoin users)

Answer 28:

Factors contributing to Bitcoin volatility:

1. **Limited liquidity and market depth:**
    - Relatively small market compared to traditional assets
    - Large trades can cause significant price movements
    - Concentrated ownership (whales can move markets)
    - **Implication:** Susceptible to price manipulation; risky for institutional investors
2. **Speculation and sentiment-driven trading:**
    - No underlying cash flows or assets to anchor valuation
    - Price driven by supply/demand dynamics and sentiment
    - High retail participation with emotional trading

- Media coverage and social media can trigger rapid price swings
- **Implication:** Price can deviate far from any fundamental value; bubble-like behavior

(Other acceptable factors: Regulatory uncertainty, exchange failures/hacks, lack of derivatives for hedging, immature market infrastructure)

SECTION 8: ROBO-ADVICE INTRODUCTION

Answer 29:

Robo-Advisors are automated digital platforms that provide algorithm-driven financial planning and investment management services with minimal human intervention.

Three differences from traditional financial advisors:

1. **Service Delivery:**
   - Robo: Fully automated via algorithms; questionnaire-based risk assessment; digital interface only
   - Traditional: Face-to-face meetings; personalized discussions; human judgment and expertise
2. **Cost Structure:**
   - Robo: Low fees (typically 0.25%-0.5% annually); no minimum investments or low minimums
   - Traditional: Higher fees (1%-2%+ annually); often high minimum investment requirements; potentially commission-based
3. **Client Interaction:**
   - Robo: Limited or no human interaction; standardized advice; self-service model
   - Traditional: Ongoing personal relationship; customized advice for complex situations; holistic financial planning

Answer 30: C - Robo-advisors charge 0.25-0.5% annually, traditional advisors charge 1-2% or more

Answer 31:

Smart Beta investing uses rule-based strategies to select and weight securities based on factors other than market capitalization (e.g., value, momentum, quality, low volatility).

Arguments for PASSIVE classification:

- Rules-based approach with transparent methodology
- No active manager making discretionary decisions
- Systematic rebalancing according to predetermined rules

- Lower fees than traditional active management
- Does not try to time markets or pick individual stocks

Arguments for ACTIVE classification:

- Deviates from market-cap weighting (benchmark)
- Requires strategic choices about which factors to target
- Attempts to outperform market-cap weighted indexes
- Factor selection and weighting involve active decisions
- Performance depends on factor timing (which factors work when)

Conclusion: Smart beta sits between passive and active - it's "systematically active" or "passive-plus." It's more active than pure indexing but more passive than traditional active management.

Answer 32: C - Face-to-face meetings with financial planners (Robo-advisors are digital-only with minimal or no human interaction)

SECTION 9: ROBO-ADVICE MARKET & CUSTOMIZATION

Answer 33:

Efficient Market Hypothesis (EMH): Markets are informationally efficient - prices reflect all available information, making it impossible to consistently achieve above-market returns through analysis or trading strategies.

What anomalies mean for EMH validity:

Market anomalies are patterns in returns that violate EMH predictions. Their existence suggests markets are not fully efficient and that systematic strategies can generate excess returns.

Impact on EMH:

- Challenges strong-form efficiency
- Suggests information is not instantaneously incorporated into prices
- Indicates behavioral biases or market frictions exist
- However, some argue anomalies disappear after discovery (McLean & Pontiff 2016)

Two well-known anomalies:

1. **Momentum Effect:**
    - Stocks that performed well in the past continue to outperform in the short-term (3-12 months)
    - Violates EMH: Past returns should not predict future returns

- **Robo-advisor exploitation:** Systematically buy recent winners, sell recent losers; momentum factor in portfolio construction

2. **Value Effect:**
    - Stocks with low price-to-book or price-to-earnings ratios outperform growth stocks over long periods
    - Violates EMH: Market misprices stocks based on fundamentals
    - **Robo-advisor exploitation:** Overweight value stocks; factor-based tilts toward undervalued securities

(Other acceptable anomalies: Size effect, low volatility anomaly, profitability factor, January effect, post-earnings announcement drift)

Answer 34:

Factor investing is an investment approach that targets specific drivers of return across asset classes. Robo-advisors use factor-based strategies to build portfolios that capture systematic risk premiums.

Three common factors:

1. **Value:** Stocks that appear cheap relative to fundamentals (e.g., low P/E, low P/B ratios) tend to outperform. Based on mean reversion and market overreaction.
2. **Momentum:** Securities that have performed well recently tend to continue performing well in the near term (3-12 months). Based on behavioral biases like herding and underreaction.
3. **Size (Small Cap):** Smaller companies tend to outperform larger companies over long periods. May reflect higher risk, lower liquidity, or market inefficiencies.
4. **Quality:** Companies with strong profitability, low debt, and stable earnings tend to outperform. Reflects fundamental business strength.
5. **Low Volatility:** Lower-risk stocks often deliver returns similar to or better than high-risk stocks, violating traditional risk-return relationship.

Answer 35: C - It declines (post-publication returns are lower than in-sample returns, due to combination of statistical bias and publication-informed trading)

Answer 36:

Customization capabilities of modern robo-advisors:

Risk Tolerance Integration:

- Questionnaires assess investor risk appetite, time horizon, and financial goals
- Algorithm adjusts asset allocation (stocks vs. bonds) to match risk profile
- Dynamic adjustment as investor circumstances change

ESG Preferences:

- Screening options to exclude certain industries (e.g., tobacco, weapons, fossil fuels)
- Positive screening to include ESG-focused funds or companies
- Impact investing options aligned with values
- ESG scoring integration in portfolio construction

Other customization:

- Tax optimization (tax-loss harvesting, tax-efficient fund selection)
- Goal-based investing (retirement, home purchase, education)
- Income needs and liquidity preferences
- Socially responsible investing themes
- Religious/ethical restrictions (e.g., Sharia-compliant investing)

Implementation:
Robo-advisors use algorithms that take these preferences as inputs and construct portfolios from a universe of ETFs/funds that match the criteria while maintaining diversification and cost efficiency.

SECTION 10: MARKETPLACE LENDING

Answer 37:

Marketplace Lending (Peer-to-Peer Lending) Business Model:

Structure:

- **Borrowers:** Apply for loans directly on platform; complete application and credit assessment online
- **Lenders/Investors:** Browse loan opportunities; can invest in parts of multiple loans to diversify; earn interest returns
- **Platform:** Acts as intermediary; matches borrowers with lenders; provides technology for credit assessment, loan servicing, and payments; charges origination fees

Differences from traditional banks:

1. **Credit Assessment:**
    - Marketplace: Algorithm-driven using alternative data (e.g., cash flow patterns, online behavior, social data); faster approval
    - Banks: Manual underwriting; traditional credit scores; longer approval process
2. **Risk Management:**
    - Marketplace: Investors bear credit risk directly; can diversify across many loans; transparent risk grades
    - Banks: Bank bears credit risk; diversification through loan portfolio; regulatory capital requirements

3. **Funding Source:**
    - Marketplace: Funded by individual and institutional investors on platform; not deposit-funded
    - Banks: Funded by customer deposits (fractional reserve banking)
4. **Cost Structure:**
    - Marketplace: Lower overhead (no branches); technology-driven; can offer competitive rates
    - Banks: High fixed costs (branches, staff); regulatory compliance costs

Answer 38:

Two reasons for IPO timing in bullish markets:

1. **Higher Valuations:**
    - During bull markets, investor optimism leads to higher price-to-earnings ratios and valuations
    - Companies can raise more capital at better terms
    - Existing shareholders (founders, VCs) can exit at higher prices
    - Market sentiment favors growth stories
2. **Stronger Investor Demand:**
    - Bull markets attract more retail and institutional capital to equity markets
    - Investors more willing to take risks on new issues
    - Higher trading volumes and liquidity
    - Better chances of successful IPO completion (avoiding withdrawn offerings)
    - Positive momentum carries into secondary market trading (less underpricing needed)

(Other acceptable answers: Media attention more positive, comparable companies trading well creates favorable comparisons, underwriters more confident)

Answer 39: B - They can offer faster loan approval through algorithmic assessment (decisions in hours/days vs. weeks)

Answer 40:

Credit scoring algorithms in marketplace lending:

Marketplace lending platforms use machine learning algorithms that go beyond traditional credit scores (FICO) to assess creditworthiness.

Differences from traditional scoring:

- Incorporate many more variables (100s vs. handful)
- Can identify complex, non-linear relationships

- Update models more frequently with new data
- Better at assessing thin-file or no-file borrowers
- Predictive rather than purely backward-looking

Data sources incorporated:

- Traditional: Credit bureau data, income verification, employment history
- Alternative data:
  - Bank account cash flow patterns (spending, savings behavior)
  - Utility and rent payment history
  - Education and employment data (LinkedIn)
  - Online behavior and digital footprint
  - Social media data (connections, activity)
  - Psychometric testing
  - Mobile phone usage patterns

Advantages: Faster decisions, can serve underbanked populations, potentially more accurate

Concerns: Potential bias, privacy issues, explainability challenges

SECTION 11: CROWD INVESTING

Answer 41:

Business Angels vs. Venture Capital Firms:

Dimension	Business Angels	Venture Capital Firms
Investment Size	Smaller (typically €25k-€500k)	Larger (€1M-€50M+)
Stage	Very early (seed, pre-seed)	Later seed, Series A, B, C
Value-Added	Personal mentorship, network access, industry experience	Professional governance, strategic guidance, extensive network, recruitment help
Decision Process	Individual/small group; faster; more flexible	Committee-based; due diligence intensive; slower
Investment Terms	More flexible, less demanding	Formal term sheets, board seats, liquidation preferences, anti-dilution
Time Horizon	Flexible, longer-term	Defined fund life (7-10 years), pressure for exits
Involvement	Hands-on, advisory role	Active board participation, monitoring

As a startup founder, preference depends on stage:

Would choose Business Angel if:

- Very early stage with just an idea or prototype
- Need quick funding decisions
- Value hands-on mentorship and personal relationships
- Want to maintain more control (less dilution)
- Need flexibility in terms

Would choose VC if:

- Ready to scale with proven business model
- Need substantial capital for growth
- Benefit from professional governance and networks
- Seeking validation from established investors (signaling effect)
- Can accept more stringent terms for larger capital

Personal choice explanation should include:

- Assessment of company's stage and capital needs
- Trade-offs between control and resources
- Value placed on specific expertise vs. capital

Answer 42: C - Equity crowdfunding (crowdinvesting)

Answer 43:

Three main risks of equity crowdfunding for investors:

1. **High Failure Rate / Illiquidity:**
    - Most startups fail (70-90% within 5 years)
    - No public market for shares - extremely difficult to exit investment
    - Capital may be locked up for 5-10+ years or permanently lost
    - Valuation uncertainty
2. **Information Asymmetry:**
    - Limited information disclosure compared to public companies
    - No audited financials in many cases
    - Difficulty assessing business viability
    - Potential for fraud or misrepresentation
    - Lack of transparency about business operations
3. **Dilution Risk:**
    - Future financing rounds may heavily dilute early investors
    - No anti-dilution protection for crowd investors

- Professional investors (VCs) may negotiate better terms
- Liquidation preferences may leave crowd investors with nothing

(Other acceptable risks: Lack of investor protections, no voting rights, regulatory uncertainty, platform risk, selection bias)

Answer 44:

Signaling in crowdfunding campaigns:

Signals are observable actions or characteristics that credibly convey information about venture quality, helping investors overcome information asymmetry.

Two credible signals:

1. **Founder Financial Commitment / Equity Retention:**
   - Founders investing their own money or retaining significant equity
   - **Why effective:** Demonstrates "skin in the game"; founders have more to lose if venture fails; aligns incentives; costly to fake
   - Separates committed entrepreneurs from those looking for quick cash
2. **Third-Party Endorsements:**
   - Backing from established VCs, angel investors, or accelerators
   - Patents, awards, or certifications
   - Media coverage from credible sources
   - **Why effective:** Independent validation of quality; these parties have conducted due diligence; reputation at stake; difficult to manipulate
   - Particularly valuable coming from sophisticated investors who have something to lose

(Other acceptable signals: Prior successful exits, educational credentials from top institutions, functioning prototype/product, customer traction, strategic partnerships, professional business plan quality)

SECTION 12: AI IN FINANCE

Answer 45:

Definitions and relationships:

Artificial Intelligence (AI):

- Broadest concept: Technology enabling computers to simulate human intelligence, learning, problem-solving, and decision-making
- Example in finance: Fraud detection systems that identify unusual transaction patterns

Machine Learning (ML):

- Subset of AI: Uses data and algorithms to enable systems to learn and improve from experience without explicit programming
- Example in finance: Credit scoring models that learn from historical loan performance data

Deep Learning (DL):

- Subset of ML: Uses multi-layered neural networks to model complex patterns in data; mimics human brain structure
- Example in finance: Image recognition for processing documents (e.g., ID verification, check deposits)

Neural Networks (NN):

- Specific ML/DL model architecture: Interconnected layers of nodes that process information; foundation of deep learning
- Example in finance: Stock price prediction models using historical market data

Relationship: AI ⊃ ML ⊃ DL; Neural Networks are the building blocks of DL

Answer 46: B - A model that performs well on training data but poorly on unseen data (the model has "memorized" rather than "learned" patterns)

Answer 47:

Look-ahead bias occurs when a model uses information in training that would not have been available at the time a prediction would have been made in practice.

Example in trading strategy:
Suppose you're building a model to predict which stocks will outperform in January based on December data.

Look-ahead bias occurs if:

- You include the stock's actual January returns as a feature in the model
- You use year-end financial statements that weren't published until March
- You use end-of-day closing prices to predict intraday movements
- You include survivorship-biased data (only stocks that didn't go bankrupt)

Example: Stock Return Prediction Model

- **Biased approach:** Use Friday's closing price and Monday's earnings announcement (made after market close Friday) to predict Monday's return
- **Problem:** The earnings announcement wasn't public information when Friday's closing price was set

Why it's problematic:

1. **False performance:** Model appears highly accurate in backtesting but fails in real trading
2. **Misleading insights:** Generates strategies that can't be implemented profitably

3. **Capital loss:** Investors may lose money deploying strategies based on biased models
4. **Academic validity:** Undermines research conclusions about market predictability

Detection: Model shows suspiciously high out-of-sample performance or very low error; feature importance analysis reveals future information being used

Answer 48: B - Low replicability and potential for hallucinations (generating false but plausible-sounding information)

SECTION 13: DIGITAL TRANSFORMATION

Answer 49:

Digital Transformation in financial services refers to the fundamental reshaping of business operations, processes, and customer experiences through the strategic adoption of digital technologies.

Three key dimensions with examples:

1. **Customer Experience:**
   - Transformation: Moving from branch-based to mobile-first digital channels; personalized services through AI
   - Example: Mobile banking apps with features like instant balance checks, peer-to-peer payments, AI chatbots for customer service, personalized product recommendations
   - Impact: 24/7 accessibility, convenience, faster service
2. **Operational Processes:**
   - Transformation: Automating manual processes; using AI for decision-making; cloud-based infrastructure
   - Example: Automated loan underwriting using ML algorithms; robotic process automation (RPA) for back-office operations; blockchain for settlement
   - Impact: Reduced costs, faster processing, fewer errors, scalability
3. **Business Models:**
   - Transformation: Creating new value propositions; platform-based models; ecosystem partnerships
   - Example: Banks offering marketplace lending platforms; insurance companies using telematics for usage-based pricing; embedded finance (financial services integrated into non-financial platforms)
   - Impact: New revenue streams, competitive differentiation, customer lock-in

Answer 50:

Three challenges traditional financial institutions face:

1. **Legacy IT Systems:**
   - Decades-old core banking systems (mainframes, COBOL code)
   - Difficult and expensive to replace or integrate with modern technology
   - Technical debt accumulation
   - Risk of system failures during migration
   - **Impact:** Slow innovation, high maintenance costs, integration challenges
2. **Organizational Culture and Mindset:**
   - Risk-averse culture focused on compliance over innovation
   - Siloed organizational structure resists cross-functional collaboration
   - Lack of digital skills and talent
   - Resistance to change from employees
   - **Impact:** Slow decision-making, difficulty attracting tech talent, innovation bottlenecks
3. **Regulatory Constraints:**
   - Heavy compliance requirements for data protection, capital adequacy, anti-money laundering
   - Regulatory uncertainty around new technologies
   - Geographic licensing requirements limit flexibility
   - **Impact:** Limits experimentation, increases cost of innovation, creates competitive disadvantage vs. less-regulated FinTechs

(Other acceptable challenges: Cost of transformation, cybersecurity risks, customer trust in digital channels, branch network transition, competition from FinTechs, data quality issues)

Answer 51: B - Removing traditional intermediaries by enabling direct connections between parties (e.g., P2P lending bypassing banks)

Answer 52:

How data analytics and AI contribute to digital transformation:

Two use cases:

1. **Credit Risk Assessment:**
   - **How it works:** ML algorithms analyze vast amounts of data (traditional credit bureau data + alternative data like cash flow patterns, social media) to predict default probability
   - **Value for institutions:** More accurate risk assessment, faster loan decisions, ability to serve previously unbanked customers, reduced loan losses

- **Value for customers:** Faster approval times, access to credit for thin-file borrowers, potentially better rates for creditworthy individuals

2. **Fraud Detection:**
   - **How it works:** Real-time AI systems analyze transaction patterns, detect anomalies, and flag suspicious activity using behavioral analytics
   - **Value for institutions:** Reduced fraud losses, lower investigation costs, improved compliance, better customer protection
   - **Value for customers:** Enhanced security, fewer false positives (legitimate transactions blocked), peace of mind, immediate alerts

(Other acceptable use cases: Personalized product recommendations, robo-advisory, chatbot customer service, algorithmic trading, insurance underwriting, anti-money laundering, customer churn prediction, dynamic pricing)

END OF PRACTICE EXAM

Total Points: 52 questions worth varying points (approximately 200-220 total points)

General Study Tips:

1. **Understand Concepts, Don't Memorize:** Focus on understanding WHY things work, not just WHAT they are
2. **Practice Calculations:** Be comfortable with formulas like Sharpe Ratio, returns, etc.
3. **Real-World Examples:** Be able to cite specific companies, regulations, research findings
4. **Compare and Contrast:** Many questions ask you to differentiate between concepts
5. **Current Events:** Stay updated on recent developments in crypto regulations, FinTech news
6. **Critical Thinking:** Be prepared to discuss advantages/disadvantages, risks/benefits
7. **Mock Exam:** Review the official mock exam thoroughly - this practice exam follows its format

Good luck with your preparation!

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1. 2025_26_Digital_Finance_MockExam.pdf
2. Marketplace Lending A New Banking Paradigm.pdf
3. Exercise_8_Digital_Finance.pdf
4. Solutions_Exercise 7 Robo_Customization_Trends.pdf
5. Digital_Finance_Exercise_7.pdf
6. Solutions_Exercise 6 Robo_Market_Trends.pdf
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