



Strathmore
UNIVERSITY

**STRATHMORE INSTITUTE OF MATHEMATICAL SCIENCES
MASTER OF SCIENCE IN DATA SCIENCE AND ANALYTICS
END OF SEMESTER EXAMINATION
DSA 8304 Risk Management Analytics**

DATE: 17th July 2022

Time: 2.5 Hours

Instructions

1. This examination consists of **FIVE** questions.
2. Answer **Question ONE (COMPULSORY)** and any other **TWO** questions.

Question 1 (30 Marks)

1. Examine the importance of data quality in risk analytics, discuss the potential impact of incomplete or incorrect data on risk prediction models, and propose strategies for mitigating these issues. (4 marks)
2. Analyze the 2 limitations of different machine learning algorithms (such as decision trees, neural networks, and support vector machines) in predicting credit default risk (4 marks)
3. Besides its involvement in stress testing, analyze three other ways that the risk committee is able to influence risk culture and capabilities in an organization. Provide examples of recent corporate governance scenarios where the risk committee has played a pivotal role in fostering an effective risk culture. (6 Marks)
4. Critically assess the benefits and criticisms of regulatory frameworks for banks and insurance companies. Use contemporary examples to illustrate your points and focus on the effects of recent changes in regulatory expectations, such as the increased focus on individual accountability and documentation. (8 marks)
5. "Risk identification forms the foundation of comprehensive risk management. Given the evolution of risks in the modern global context, including technological, environmental, and geopolitical risks, traditional risk identification methods may need to be supplemented or rethought."

- i) Discuss the concept of emerging risks, and explain how they might be identified. What challenges do emerging risks present for traditional risk identification methods? Consider recent examples such as cyber threats, climate change risks, or global pandemics. (4 marks)
- ii) Risk identification should not be a one-time event, but a continuous process integrated into the organization's operations. Discuss how this can be achieved, considering factors such as organizational culture, information sharing, and reward systems. (4 marks)

Question 2 (15 Marks)

Many Securities and Exchange Commission globally such as the SEC are considering changes to regulations regarding the use of machine learning and artificial intelligence in financial services. This includes the need for organizations to demonstrate how they manage the risks associated with these technologies. AI and ML are increasingly being used for risk identification, assessment, and mitigation in financial institutions. However, this introduces new risks, especially if these technologies are not well understood or properly managed. Auditing of AI/ML models is critical to ensure they are operating as expected and not leading to unintended consequences or risks.

1. Based on this information,
 - i) Discuss any 2 regulatory considerations or potential challenges for the application of machine learning in risk management, especially in the context of recent Securities Exchange Commissions considerations (4 marks).
 - ii) Explain 2 approaches how machine learning can be applied for risk identification, assessment, and mitigation in financial institutions. Discussing the potential risks introduced by the use of these technologies and how they can be managed (6 marks).
2. An analyst after joining a new firm goes through the previous year's files for the Risk Management Department. He makes note of the following that the reported weekly 95% VaR, the h-day 99% VaR and the h-day 70% volatility stressed h-day 99% VaR are summarized as follows:

Estimated	Reported
95% VaR	9%
h-day 99% VaR	12.5%
Stressed h-day 99% VaR	17%
Portfolio Size	USD 115,000

He is interested in determining the first 2 moments - expected return and the volatility of the portfolio and assessing the previous analysis h period estimate. Determine the values these variables that the analyst is interest in. (5 marks)

Question 3 (15 Marks)

A financial institution that has collected a dataset for credit scoring with the following variables:

- Age (continuous)
- Years with current employer (continuous)
- Years at current address (continuous)
- Income (continuous)
- Credit card debt (continuous)
- Auto loan debt (continuous)
- Homeowner (binary: yes or no)
- Default (binary: yes or no)

- i) Utilizing logistic regression, describe the process to develop a credit scoring model based on this data. Discuss the necessary steps for data preprocessing, feature selection, model training, and model evaluation. (4 marks)
- ii) Suppose the trained logistic regression model assigns negative coefficients to 'Age' and 'Years with current employer', and positive coefficients to 'Credit card debt' and 'Auto loan debt'. Interpret these results and explain what they mean in the context of credit scoring. (4 marks)
- iii) Given the limitations of logistic regression, propose strategies for enhancing the model's performance. Consider the potential application of more complex techniques, such as ensemble methods or deep learning. (4 marks)

iv) Differentiate the following terms as used in financial risk management :

- i) risk vanities vs risk culture (1 marks)
- ii) pure vs speculative risks (1 marks)
- iii) static vs dynamic risks (1 marks)

Question 4 (15 Marks)

- 1. Discuss the risk management control cycle, clearly explaining each step (5 marks)
- 2. An investment bank holds a portfolio of Global ETFs and Infrastructure Bonds with allocations of USD 800,000 and USD 700,000 on each instrument. On Monday 6th June 2022, the 7 day quoted prices of the instruments were as follows:

Asset Class	6/06/22	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
Equity	40	43.2	44.5	47.6	40.9	38.34	42.2	39.6
Bond	100	97.86	99.8	102.1	101.9	94.56	93.9	96.67

The Pearson correlation estimate between the ETFs and Infrastructure bonds was determined to be 0.1472.

Required:

- i) Compute the 7-day 95% Value-at-Risk (VaR) of the constructed portfolio (5 marks)
- ii) Compute the 252-day 95% Expected Shortfall of the portfolio, given that the standard

Gaussian density function is $\varphi(z) = \frac{e^{-0.5z^2}}{\sqrt{2\pi}}$ (5 marks)

Question 5 (15 Marks)

- 1. Discuss the key components in internal risk model validation process (4 Marks)
- 2. "Risk committees play a crucial role in the governance and management of risk within an organization. Their failure to perform adequately can have significant consequences, potentially leading to both direct and indirect costs." Discuss measures that can be taken to prevent risk committee failure and mitigate the associated costs. (5 marks)
- 3. "Operational risk, arising from failures of systems, processes, people, or external events, has gained heightened attention in recent years due to several high-profile incidents and increasing regulatory scrutiny. Measurement of operational risk, while challenging, is vital for effective risk management and regulatory compliance." Discuss in-depth three distinct approaches to measuring operational risk, covering both traditional and contemporary methods. (6 Marks)