LINEAR ALGEBRA

Applied Matrices and Vector Spaces in Mining Engineering

Written by:

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First Edition

Linear Algebra

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In the modern landscape of mining engineering, linear algebra serves as a powerful engine behind data-driven decisions and innovation. From modeling mineral reserves through complex systems of equations, to applying eigenvalue techniques for assessing slope stability, and using matrix factorizations to structure and interpret vast datasets, linear algebra transforms abstract mathematics into practical solutions. By mastering these tools, students and professionals gain the ability to decode complex mining challenges, streamline engineering processes, and construct reliable models that drive efficiency, safety, and technological advancement in the mining industry.

This book offers a practical and application-driven introduction to linear algebra, designed specifically for mining contexts. Key topics include matrices and systems of linear equations, determinants, matrix inverses, matrix factorizations, vector spaces, inner product spaces, orthogonality, linear transformations, and eigenvalues. Each chapter bridges theory with hands-on applications—showing how abstract concepts translate into tools for mineral reserve planning, mine design, and operational optimization.

Beyond the fundamentals, the book highlights real-world case studies where linear algebra directly powers mining innovation: ore grade modeling, slope stability analysis, ventilation network design, and optimization of equipment usage. By blending solid mathematical foundations with cutting-edge engineering challenges, this book equips readers with both the technical depth and the practical mindset to apply linear algebra as a driver of efficiency, safety, and innovation in mining engineering.

Preface

About the Writer

[Bakti Siregar, M.Sc., CDSS](#) works as a Lecturer at the [ITSB Data Science Program](#). He earned his Master's degree from the Department of Applied Mathematics at National Sun Yat Sen University, Taiwan. In addition to teaching, Bakti also works as a Freelance Data Scientist for leading companies such as [JNE](#), [Samora Group](#), [Pertamina](#), and [PT. Green City Traffic](#).

He has a strong enthusiasm for projects (and teaching) in the fields of Big Data Analytics, Machine Learning, Optimization, and Time Series Analysis, particularly in finance and investment. His core expertise lies in statistical programming languages such as R Studio and Python. He is also experienced in implementing database systems like MySQL/NoSQL for data management and is proficient in using Big Data tools such as Spark and Hadoop.

Some of his projects can be viewed here: [Rpubs](#), [Github](#), [Website](#), and [Kaggle](#)

Acknowledgments

Linear Algebra is more than just theory, it's a powerful toolkit for solving real challenges in mining engineering. From handling large systems of equations to applying eigenvalues in stability analysis, the concepts covered here are designed to connect

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mathematics directly with mining practice. This book introduces the essentials: matrices, determinants, inverses, factorizations, vector spaces, inner products, orthogonality, linear transformations, and eigenvalues—always with a focus on how they translate into real mining applications.

We thank all readers and learners who bring curiosity and fresh perspectives. Your questions and insights keep this journey alive. Our hope is that this material not only strengthens your foundation in Linear Algebra but also inspires you to use it as a driver of innovation, safety, and efficiency in mining engineering..

Feedback & Suggestions

Your feedback is invaluable in helping us refine and improve this book. We encourage readers to share their thoughts on the clarity, structure, and practical relevance of the material. Suggestions for expanding discussions—whether on matrices and systems of linear equations, determinants and matrix factorizations, vector spaces and orthogonality, or linear transformations and eigenvalues—are highly appreciated.

With your contributions, we aim to make this book a comprehensive and practice-oriented resource on **Linear Algebra** for Mining Engineering. Thank you for your engagement and support in shaping this learning journey.

For feedback and suggestions, please contact:

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