



NATIONAL UNIVERSITY OF ENGINEERING
COLLEGE OF GEOLOGICAL, MINING AND METALLURGICAL
ENGINEERING

MINING ENGINEERING PROGRAM

GM711 – GEOSTATISTICS

I. GENERAL INFORMATION

CODE	: GM711 Geostatistics
SEMESTER	: 7
CREDITS	: 3
HOURS PER WEEK	: 5 (Theory–Practice)
PREREQUISITES	: MA681 Operations Research
CONDITION	: Compulsory
DEPARTMENT	: Mining Engineering

II. COURSE DESCRIPTION

The course prepares students in the application of spatio-temporal statistical methods for estimating resources and reserves in mineral deposits. Students analyze the models for predicting the probability distribution of ore grades for mining operations. Students understand and apply *kriging* techniques to interpolate the value of a random field of at unobserved location from observations of its value at nearby locations. Specialized software applications are used to solve real problem of Peruvian mining deposits.

III. COURSE OUTCOMES

At the end of the course, students:

1. Understand the theory of regional variables and construct variograms using experimental data of mineral deposits.
2. Construct experimental histograms using different types of probabilistic distribution.
3. Evaluate recognition nets in mining exploration and exploitation.
4. Simulate mineral deposits and estimate their minerals reserves.

IV. LEARNING UNITS

1. INTRODUCTION TO THEORY OF REGIONAL VARIABLES

Regional variables / Stationery hypothesis / Information searching / Structural analysis / Composites of regional variables / Structural analysis using variograms / Construction of experimental variograms for different types of mineral deposits / Filonean deposits / Deposits of gold, copper porphyry, skarn, iron mantles, etc.

2. DATA ANALYSIS AND VARIOGRAPHY

Data analysis through histograms / Construction of experimental histograms / Histogram modeling: normal distribution, lognormal distribution, experimental distribution / Distribution simulation / Central limit theorem / Inverse transform method / Montecarlo method / Variography / Interpretation and applications / Analysis of real cases of Peruvian mining / Variogram modeling / Applications using software applications SURFER, SPSS / Applications using Vissual Basic and C++ programming.

3. EVALUATION AND DESIGN OF SAMPLING NETS

Error measurement through estimation variance / Evaluation of recognition nets used in mining exploration and exploitation / Filed study visit.

4. ESTIMATION OF MINERAL RESERVES AND RESOURCES

Introduction / Analysis and evaluation of polygon method and distance inverse method / Kriging technique / Deduction of Krigeage system / Krigeage variance / Punctual Krigeage / Block Krigeage / Indicators Krigeage / Block valuation Analysis of reports on estimation of reserves and resources in eral Peruvian mining deposits.

5. TONNAGE AND CUTTING LAW

Tonnage curves / Mean law and cut law / Software applications Rockwork, Gemcom, Medsystem, Surpac / Graphical visualization using programming in AutoLISP and AutoCAD.

6. SIMULATION OF MINERAL DEPOSITS

Simulation of mineral deposits / Methods and techniques / Use of software applications.

V. PRACTICAL EXPERIENCES

1. Data analysis and variography
2. Evaluation and design of sampling nets
3. Estimation of mineral reserves and resources
4. Tonnage and cutting law
5. Simulation of mineral deposits

VI. METHODOLOGY

1. Constructivist method in class presentations.
2. In-class workshops.
3. Analysis and solution of mine design problems.
4. Intensive use of specialized software applications.
5. Final report.

VII. GRADING FORMULA

The Final Grade PF is calculated as follow:

$$PF = (EP + EF + PP) / 3$$

EP: Mid-term Exam EF: Final Exam
PP: Average Practical Works

VIII. BIBLIOGRAPHY

1. **DAVID Michel**
Geostatistical Ore Reserve Estimation
Elsevier Scientific Publishing Co. New York, 2007.
2. **MARIN Alfredo**
Simulation of Mineral Deposits
National University of Engineering, 2010.