

FOUN046 Mathematics for Science

Section 1: General Information

1.1 Administrative Details

Subject:	Mathematics for Science
Code:	FOUN046
Stream:	Applied Science, Life Science and Health Science
Points:	12
Pre-requisite none but see note below	

1.2 Subject Workload

Number of timetabled hours per week	Number of Personal study hours per week	Total workload hours per week
4	5	9

1.3 Pre-requisites

Students are required to have undertaken a pre-requisite subject.

Yes

A FOUN046 student should have a very good mathematical background in number, basic algebra and graphing. Knowledge of probability and statistics is desirable, but not necessary.

Students who do not have a strong background in senior school Mathematics are advised to do the Bridging Programme BP604 Mathematics for Science paper.

Alternatively, a student may be advised to enroll in the Extra Mathematics Programme.

1.4 Other resource requirements

List specialist facilities and/or equipment required for the delivery of this subject:

Scientific calculator/ access to blackboard/in class technology

Section 2: Academic Details

2.1 Subject Overview

Mathematical problem solving is an important technique for the solution of problems in any area of society. This paper aims to develop the ideas and concepts from Mathematics in such a way that the student develops their problem solving techniques in Mathematics and can apply the processes to Science. This paper will give the student a sound knowledge of mathematical concepts and prepare them for the demands of 100-level Science, Mathematical and Statistical papers at the University of Otago.

2.2 Learning Objectives and Outcomes

Learning Objectives

By the end of the paper, successful students will be able to:

1. explore the use of formulae, relationships, equations, expressions and statistical techniques in a variety of contexts
2. use number, algebra, probability, statistics and trigonometry in different situations and interpret their results
3. develop their mathematical skills in number, algebra, trigonometry, probability, statistics and some curve sketching
4. gain and demonstrate an understanding and appreciation of problem solving techniques in a variety of contexts.

Overview of Learning Outcomes:

Topic 1: CALCULATIONS IN SCIENCE

At the end of this topic a student should be able to:

express numbers to the appropriate degree of accuracy
express numbers in scientific notation
express numbers as ordinary numbers
express quantities in the appropriate SI units
use the rules of exponents to solve problems
use exponent models to solve problems
use rates to compare two quantities of different units
convert quantities from one unit to another
use scale factors
describe and find compass directions
describe and find bearings
use ratios to compare two or more quantities in the same units
express two equal ratios as a proportion
calculate proportions
apply percentages to solve real-life problems
solve problems involving ratios, rates and proportions

Topic 2: ALGEBRA IN SCIENCE

At the end of this topic a student should be able to:

substitute numbers into a formula and calculate the answer
change the subject of a formula
form equations from given information and solve problems
solve equations using algebra
solve word problems using a range of algebraic techniques

Topic 3: LOGARITHMS

At the end of this topic a student should be able to:

convert exponential numbers into logarithmic form
convert logs into exponential form
use the rules of logs to solve problems
use the change of base formula to solve problems
solve a range of problems using logs and/ or exponents.

Topic 4: TRIGONOMETRY IN SCIENCE

At the end of this topic a student should be able to:
describe and use Pythagoras' theorem for right-angled triangles
describe and use the three trig ratios for right-angled triangles
calculate angles of elevation
calculate angles of depression
describe and find compass directions using trigonometry
describe and find bearings using trigonometry
Solve non right-angled triangles using the area rule
Solve non right-angled triangles using the sine rule
Solve non right-angled triangles using the cosine rule
use trigonometrical notation appropriately
solve trigonometrical problems
convert degrees to radians and radians to degrees
find arc length
find the area of a sector
solve problems using radian measure.

Topic 5: GRAPHING IN SCIENCE

At the end of this topic a student should be able to:
plot and describe points on a graph
find the gradient of a line
describe the gradient of a line in terms of its direction and rate of change
sketch lines using the gradient and y-intercept method
sketch lines using the intercepts method
describe the features of a graph in words
sketch simultaneous linear equations
solve graphically word problems involving lines
describe the features of an exponential graph
sketch exponential graphs
use exponents and logarithms in growth model problems
use exponents and logarithms in decay model problems
graph exponential curves and use them to solve problems.

Unit 6: PROBABILITY

At the end of this topic a student should be able to:
define probability
calculate probabilities
use and understand correct probability notations
find the probability of the union, intersection and complement of events
use Venn diagrams to find all the possible outcomes and calculate the probabilities of events
calculate the odds for an event
use decision diagrams to find all the possible outcomes and calculate the probabilities of events with replacements and without replacements
use two way tables to find all the possible outcomes and calculate the probabilities of events
apply probability theory to a range of problems.

Topic 7: STATISTICS

At the end of this topic a student should be able to:

identify and classify quantities into categorical data and numerical data, discrete and continuous data
organize and interpret categorical and discrete data using statistical graphs such as bar graphs, pie charts and line graphs

organize, draw and interpret continuous data using statistical graphs such as histograms, frequency polygons and cumulative frequency curves

for a set of data calculate and interpret measures of central tendency such as mean, mode and median

for a set of data calculate, determine and interpret measures of dispersion, range, interquartile range, percentiles and standard deviation

compare, and comment on, sets of data

define and describe a range of sampling techniques

for a set of data, generate a statistical sample

interpret the spread of data in a normal distribution curve

calculate z-scores in a standard normal distribution

explain the significance of the z-score value

describe a normal distribution

interpret the spread of data in a normal distribution curve

calculate data values described as a normal distribution

calculate probabilities using the standard normal distribution tables

use estimation to compare samples and populations

use confidence intervals to describe samples or populations.

2.3 Subject Content

Topic 1: Calculations for Science

Topic 2: Algebra for Science

Topic 3: Logarithms

Topic 4: Trigonometry

Topic 5: Graphs for Science

Topic 6: Probability

Topic 7: Statistics.

2.4 Teaching Method/Strategies

FOUN046 will consist of 12 lectures and 36 tutorials over 12 weeks. Each week consists of one lecture and three tutorials. Working in groups and independent study will be used in classes.

2.5 Assessment

Assessment Type	When	Weighting	Learning Outcomes Assessed
Internal	Mid-Term Test Week 7	20%	Topic 1 to 4 inclusive
	Statistical assignment Week 8 -11		
Final Examination	Week 13	70%	Topic 5 -7 inclusive

2.5.1 Assessment Strategy

Test 1 (in week 7)

Duration: 45 minutes

Included: all work covered in topic 1, 2, 3 and 4.

The test will consist of two compulsory questions.

Question	Type of	Marks allocation
1	10 parts, short answer, 2 marks each.	20
2	A problem solving question with 3 parts, each worth 10 marks.	30
Total		50

Assignment: Statistical Sampling: Week 8 - 11: Students will be issued with a problem solving exercise covering the topic Sampling. They are expected to complete the assignment and communicate their mathematical ideas using the correct mathematical language and produce their work to a high standard. Students will have about two weeks to complete the assignment.

2.5.2 Hurdle Requirement

In order to pass this paper, students must obtain an overall mark of 50% (C-) or better.

2.5.3 Assessment Details

Assessment	Content/ Format	Time	Details												
Internal Assessment mid term test	all work covered in topic 1 -4	50 minutes	See above												
Internal Assessment Statistics Assignment	Written assignment	Over 3-4 weeks	See above												
Final Examination	all work covered in topic 5-7	2 hours	<p>The examination will consist of four compulsory questions.</p> <table border="1"> <thead> <tr> <th>Question</th> <th>Type</th> <th>Marks allocation</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>10 parts, short answer, 4 marks each</td> <td>40</td> </tr> <tr> <td>2 - 4</td> <td>3 problem solving context questions, worth 20 marks each.</td> <td>60</td> </tr> <tr> <td>Total</td> <td></td> <td>100</td> </tr> </tbody> </table>	Question	Type	Marks allocation	1	10 parts, short answer, 4 marks each	40	2 - 4	3 problem solving context questions, worth 20 marks each.	60	Total		100
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Total		100													

2.6 Prescribed and Recommended Reading

Prescribed Text: none. Use Student Workbooks

Recommended Reading: none prescribed

Websites: none prescribed

3. Subject Details

Week	Lecture (1 hour)	Tutorial (1 hour)	Tutorial (1 hour)	Tutorial (1 hour)
1	Introduction to paper and Topic 1: Calculations for Science: Ratios and Rates	Using the calculator: estimations, significant figures and decimals places	Scientific Notation	Ratios and Rates and Use of Units <u>Set homework:</u> Ratios and Rates
2	Topic 1: Exponents	Working in Groups: Units, Conversion and Scaling using science applications	Exponents 1	Exponents 2
3	Topic 2: Algebra for Science	substitution	transposition	Working in Groups: Percentages Accuracy and Rounding using science applications.
4	Topic 3: Logarithms for Science	Forming equations 1	Forming equations 2	Working with logs 1: properties
5	Topic 4: Trigonometry for Science	Working with logs 2: application	right-angled triangles <u>Set Homework:</u> Angles of Elevation and Depression	Area of triangle, sine rule
6	Topic 5: Graphing for Science	Cosine rule	Circle and radians	Revision Test 1 or catch up
7	Mid Term tests	Mid term tests Maths Test (20%)	St lines:properties and sketch, st line models	Sketch exponential graphs
8	Topic 6: Probability: definition, union, intersection, complement, odds	Growth and Decay models	Union, intersection of events	Complement of events, Odds of events Assignment: Sampling issued and details
9	Topic 7: Statistics: Types of Data Measures of statistics	Successive Events, Decision Diagrams Assignment queries	Two Way Tables Assignment queries	Measures of Central Tendency & Spread 1 Assignment queries
10	Normal Distribution	Measures of Central Tendency & Spread 2 Assignment queries	Measures of Central Tendency & Spread 3 Assignment queries	Normal Distribution Tables Assignment queries
11	Estimation Assignment: Sampling due (10%)	Normal Distribution Applications	Estimation	Working in Groups: Statistical Graphs: drawing and reading of graphs
12	Confidence Intervals	Confidence Intervals	Revision and catch up	Revision and catch up