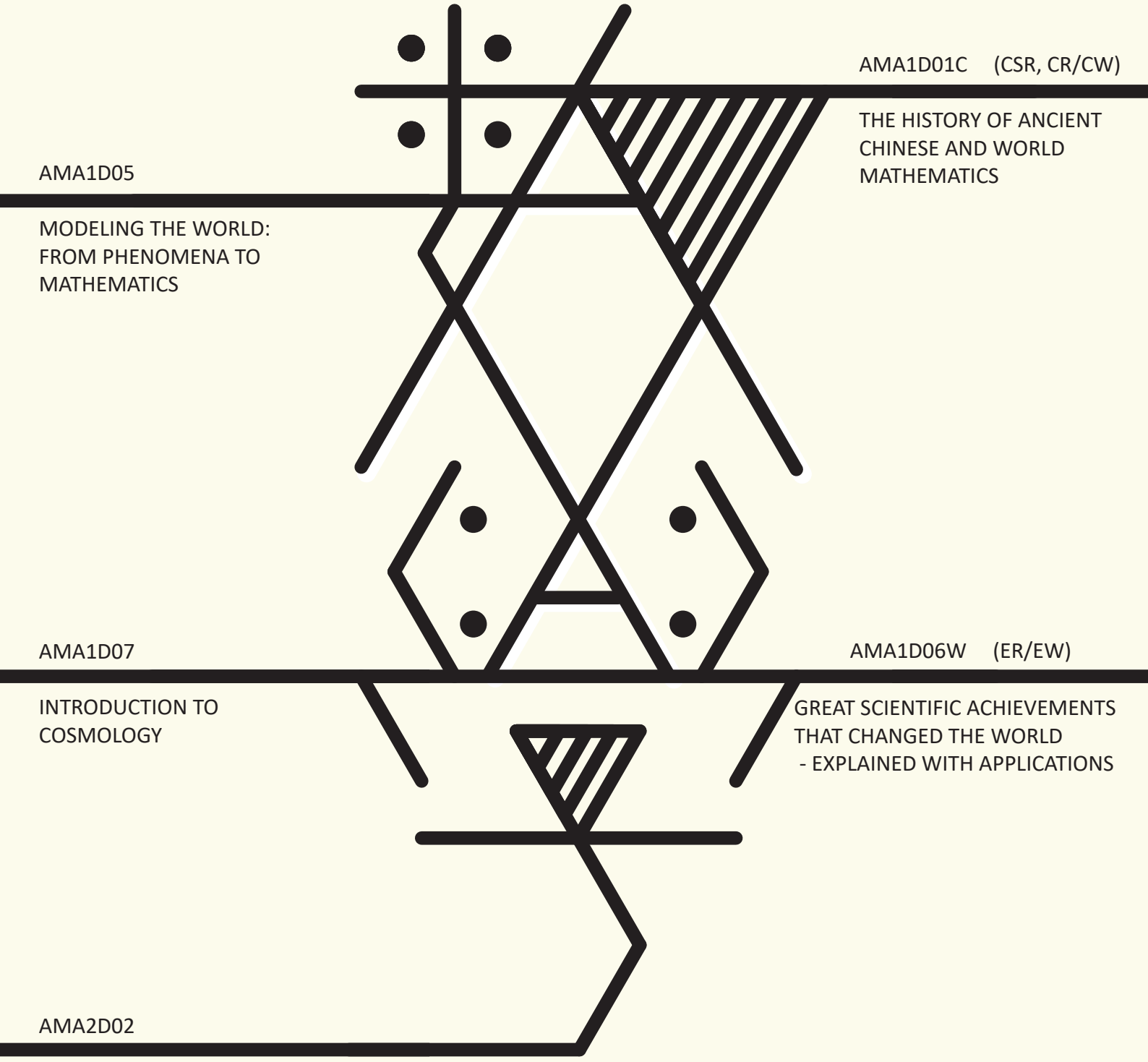

AMA1D01C (CSR, CR/CW)

THE HISTORY OF ANCIENT CHINESE AND WORLD MATHEMATICS

AMA1D05

MODELING THE WORLD: FROM PHENOMENA TO MATHEMATICS

AMA1D07

INTRODUCTION TO COSMOLOGY

AMA1D06W (ER/EW)

GREAT SCIENTIFIC ACHIEVEMENTS THAT CHANGED THE WORLD - EXPLAINED WITH APPLICATIONS

AMA2D02

STATISTICS IN SOCIETY

DEPARTMENT OF APPLIED MATHEMATICS

應 用 數 學 系

Subject Description Form

Subject Code	AMA1D01C
Subject Title	The History of Ancient Chinese and World Mathematics
Credit Value	3
Level	1
Planned Student Intake per Year	Optimal class size: 75 Planned number of sessions to be offered: Semester 1: _____ Semester 2: 1 Summer Term: _____
GUR Requirements Intended to Fulfil	Please indicate which of the following GUR requirements the proposed subject intends to fulfil [Please check ALL boxes that may apply.] ☐ **Languages and Communication Requirement** (LCR) ☐ **Requirement in Healthy Lifestyle** ☐ **Broad Discipline Requirement** (BDR) Please specify Broad Discipline Area: _____ ☒ **Cluster Area Requirement** (CAR) Please check the box(es) below to indicate the cluster area(s) the subject contributes in a major way: ☐ Human Nature, Relations and Development ☐ Community, Organization and Globalization ☐ History, Cultures and World Views ☒ Science, Technology and Environment ☒ **China-Study Requirement** (CSR) More than 60% CSR-related content? Yes ☒ or No ☐ (Please check as appropriate) ☐ **Eligible for "English Writing" (EW) designation** - include an extensive piece of writing (2,500 words)? Yes ☐ or No ☐ (Please check as appropriate) ☒ **Eligible for "Chinese Writing" (CW) designation** - include an extensive piece of writing (3,000 characters) Yes ☒ or No ☐ (Please check as appropriate) ☐ **Eligible for "English Reading" (ER) designation** - include a reading of an extensive text (100,000 words or 200 pages)? Yes ☐ or No ☐ (Please check as appropriate) ☒ **Eligible for "Chinese Reading" (CR) designation** - include a reading of an extensive text (100,000 characters or 200 pages) Yes ☒ or No ☐ (Please check as appropriate)
Medium of Instruction	Please check the appropriate box: ☒ English ☒ Cantonese* ☐ Putonghua* ☐ Others* (Please specify: _____) **Justification(s):** For the part on Ancient Chinese History of mathematics, teaching materials would include those written in Chinese, and thus, the medium of instruction would include Cantonese. However, for the part of western-world History of Mathematics, English would be the major medium of instruction. * *In line with the University policy, English will be the medium of instruction except for the Chinese culture- or Chinese literature-related subjects, which will normally be taught in Putonghua as recommended by the Working Group. For other subjects to be offered in Cantonese, Putonghua or other languages, justifications should be provided for special consideration.*

Student Study Effort Required	Class contact:	
	▪ AMA Lecture	26 Hrs.
	▪ AMA Tutorial	13 Hrs.
	▪ CBS Lecture/Tutorial	TBA Hrs.
	Total class contact	45 Hrs.
	Other student study effort:	
	▪ Self Study	16 Hrs.
	▪ Assignments	8 Hrs.
	▪ Project (including drafting for CW requirement)	34 Hrs.
	▪ Preparation for quizzes (for CR requirement)	20 Hrs.
	Total student study effort	117 Hrs.
Pre-requisite and/or Exclusion(s) *(Note 2)*	Nil	
Objectives *(Note 3)*	(a) To introduce the historical development of mathematics of Ancient China and the world, and to expand students' intellectual capacity beyond their disciplinary domain so as to enable them to tackle professional and global challenges from a multidisciplinary perspective, and in a holistic manner. (b) To let students gain an enhanced understanding of China through ancient Chinese mathematics (CSR). (c) To nurture student's overall cultural appreciation via the learning of ancient worlds' mathematics. (d) To enhance student's Chinese Writing (CW) skills through Project writings and Assignments, and through instructional activities conducted by CBS staff. (e) To cultivate student's Chinese Reading (CR) skills so that they can demonstrate their understandings of the selected articles on Ancient Chinese Mathematics.	
Intended Learning Outcomes *(Note 4)*	Upon completion of the subject, students will be able to: (a) relate popular mathematical theories and results to their historical roots, and to comprehend popular Chinese literature of ancient Chinese mathematics (CR). (Relating mathematical theories to their historical roots would involve higher order thinking, whereas, to comprehend literature on ancient Chinese mathematics would involve literacy). (b) identify the achievements made by ancient Chinese as well as by other cultures in mathematics, and able to write about it (CR+CW). (To write about ancient Chinese mathematics would involve literacy, whereas, to be able to identify the achievement of mathematics of ancient Chinese and of other cultures would enhance students' interests, attitude, skills and intellectual capacity beyond their disciplinary domain to prepare for life-long learning). (c) apply simple ancient mathematical techniques to solve for ancient mathematical problems. (To be able to apply any mathematical techniques involve higher order thinking). (d) determine time line of events for the development of mathematics in ancient	

	China and other ancient cultures. (To be able to determine time line of events would enhance students' interests, attitude, skills and intellectual capacity beyond their disciplinary domain to prepare for life-long learning). (e) identify some famous mathematicians and give a brief account their major contributions in history of mathematics (CW). (To be able to give a brief historical accounts of ancient mathematicians would involve literacy, whereas, to be able to identify famous mathematicians would enhance students' interests, attitude, skills and intellectual capacity beyond their disciplinary domain to prepare for life-long learning).
Subject Synopsis/ Indicative Syllabus *(Note 5)*	中國古代數學 介紹先秦至清代中國數學發展、數學技巧及傑出數學家。比對中國古代與世界各地的數學發展歷程。題目包括： 1 概論 2 開方術 3 海島算經（唐代初年） 4 中國剩餘定理 5 測圓海鏡（金代） **Development of Mathematics outside China** We study and compare mathematics in different civilizations in different historical periods. Ancient Time Brief introduction to mathematics in ancient Egypt, Mesopotamia, Greece, India, and the Islamic world Modern Time Mathematics in Medieval and Renaissance Europe; The introduction of algebra; Pre-calculus and calculus in the 17th Century; Development of analysis, probability and statistics, algebra and number theory, and geometry in the 18th Century.
Teaching/Learning Methodology *(Note 6)*	Teaching of the subject is mainly through a traditional Lecture/Tutorial manner. Projects will be used to assess Writing requirement (CW) and quizzes will be used to asses Reading requirement (CR). Individual assignments and projects will be assigned to students. For the projects, students are required to write at least 3000 characters of Chinese (CW). AMA is responsible for the mathematics materials, whereas, CBS is responsible for the Chinese writing skills (CW). Four sets (of no less than 50 pages each) of additional materials written in Chinese will be assigned to students as reading materials (CR). Quizzes in the form of multiple choice questions will be conducted via the CBS system to test students on their understandings of the materials. Presentations will be given by the students during tutorials followed by in-class and small group discussions, and reports will be submitted afterwards. Students would

have to research for literature review, making use of our library and the internet extensively to source historical materials not presented in lectures and tutorials.

Topics on Projects could be, but not limited to the followings:
1. 談古今中外如何估算圓周率π。
2. 論李善蘭的尖錐求積術。
3. 論中國古代高次方程的數值解法。
4.中國古代如何應用重差術解決有關測量的問題。

Assessment Method

(Note 7)

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed (Please tick as appropriate)				
		a	b	c	d	e
1. Assignments	10%	✓	✓	✓		✓
2. Quizzes (to assess CR requirement)	20%	✓	✓			✓
3. Project/Presentation (to assess CW requirement)						
Marked by CBS	10%	✓	✓			
Marked by AMA	40%			✓	✓	✓
4. Exam	20%	✓	✓		✓	✓
Total	100 %					

Continuous Assessment comprises of assignments, project/presentation and quizzes. A written exam (predominately with multiple choice questions) is held at the end of the semester.

To pass the subject, students are required to obtain Grade D or above in both the Continuous Assessment and the Examination components in order to satisfy all the intended learning outcomes.

Reading List and Reference

Please indicate clearly in this section if the subject should have an "R" designation. If so, subject proposers should also indicate clearly which items on the Reading List constitute the expected reading requirement and include the page numbers.

"R" designation reading list:

(1) 吳文俊、白尚恕、沈康身，《劉徽研究》，九章出版社，1993。
pp. 79-86, 87-103, 104-121, 385-394, 402-413. (total 65 pages)

(2) 郭金彬、孔國平，《中國傳統數學思想史》，科學出版社，2004。
pp. 284-336. (total 53 pages)

(3) 紀志剛，《南北朝隋唐數學》，河北科學技術出版社，1999。
pp. 1-44, 356-386. (total 75 pages)

(4) 孔國平，《李冶朱世傑與金元數學》，河北科學技術出版社，1999。
pp. 36-80, 291-311. (total 66 pages)

Total number of pages for "R" designation reading list : 259 pages.

Textbook

- 錢寶琮，《中國數學史》，科學出版社，1981。

References

- 李儼、杜石然，《中國數學》，1986。
- Li Yan, Du Shiran, John N. Crossley, Anthony W.C. Lun, 《Chinese Mathematics A

	Concise History》, Oxford Science Publications, 1987. • 李迪，《中國數學史簡編》，遼寧人民出版社，1984。 • Victor J. Katz, 《A History of Mathematics》, 2004.

Subject Description Form

Subject Code	AMA1D05
Subject Title	Modeling the World: From Phenomena to Mathematics
Credit Value	3
Level	1
Pre-requisite / Co-requisite/ Exclusion	Nil
Objectives	This subject aims to introduce the basic background knowledge, concepts and techniques of mathematical modeling via different real life examples in natural science, engineering, economics, and social science. The main objective of this subject is to arouse students' interest in mathematical modeling. Emphasis is focused on equipping students with abilities to understand simple models and relate them to our daily life. Advanced knowledge in mathematics is not required in this subject.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. have a basic understanding of the general concepts in mathematical modeling; b. appreciate the beauty of different mathematical models; and c. have the ability to use appropriate approaches to formulate simple models and hence tackle real life problems. <u>Literacy:</u> In addition to learning from teaching materials delivered in lectures and tutorials, students are encouraged to read other relevant reference books and scientific articles related to mathematical modeling. Students are also required to understand, summarize, and analyze these reading materials when they prepare their presentation and final report. (ILO (a), and (b)) <u>Higher order thinking:</u> This is an introductory course to mathematical modeling. Students will learn the basic mathematical concepts and language, which are applicable to simple real life models. They will develop a scientific and logical thinking through the formulation of different models used in

	natural science, engineering, as well as social science. They will also have the opportunity to enhance their analytical and critical thinking when they analyze and solve the real life models and interpret the model solutions. Students' higher order thinking skills (e.g., logical thinking, analytical skills, critical thinking) will be enriched. (ILO (c)) <u>Life-long learning:</u> The course will emphasize on equipping students' abilities to formulate, analyze, and interpret different models raised in our daily life. These abilities are important skills for everyone in his/her personal and career development as a student or as an employee. This course will give students an overview on the importance of mathematical models in real life as well as basic training for solving simple models so that students will have the ability to identify the problem and the ability to search and explore the possible techniques to analyze and solve the models themselves in the future. (ILO (a), (b) and (c))
Subject Synopsis/ Indicative Syllabus	**Overview of mathematical modeling (2 hours)** **Modeling with number (9 hours)** • Diet problem: How do you stay fit? • Ways to mix juice • How can I win without cheating? *Topics and techniques to be covered:* ✓ *Linear programming: Graphical/ Simplex method* ✓ *Game theory: Two person zero sum game, Prisoner's dilemma* **Modeling with graph (12 hours)** • Which way should I go? • How can I travel on time? • Where to place your Wi-Fi router? • Who is your perfect match? *Topics and techniques to be covered:* ✓ *Euler and Hamilton paths* ✓ *Shortest path (Dijkstra's algorithm)* ✓ *Minimal spanning tree (Prim's algorithm)* ✓ *Maximum flow (augmenting path algorithm)* **Modeling with function (9 hours)** • The safety stock level • The spread of infectious diseases • Investment annuity *Topics and techniques to be covered:* ✓ *Inventory management model: Economic ordering*

<table>
<tr><td></td><td>
quantity (EOQ), Economic production quantity (EPQ)
✓ Predator-prey model: Newton method, Euler method

Counting (7 hours)
• What is the best bet?
• I forgot my password. Random try?
• The hidden pattern in nature: Golden ratio
Topics and techniques to be covered:
✓ Permutations and combinations
✓ Recurrence relations, Difference equations
</td></tr>
<tr><td>Teaching/Learning Methodology</td><td>
<u>Lectures:</u>
This is the major teaching method used in this subject. In the lectures, the basic concepts and knowledge will be delivered to the students through practical examples from real life problems. Students may be required to read some scientific articles or watch video clips on related topics before classes.

<u>Tutorials:</u>
The knowledge and concepts delivered in lectures will be further enhanced in tutorials through in-class exercises and other activities. Students are encouraged to figure out the solutions by themselves through discussions and debates.

<u>Project and presentation:</u>
A project with presentation will be required during the semester. Real life problems will be given. Students would have to research for literature review, and make use of the knowledge learned from the lecture materials and the literature to obtain their own findings and report their results during the presentation at the end of the semester.
</td></tr>
<tr><td>Assessment Methods in Alignment with Intended Learning Outcomes</td><td>
<table>
<tr><td rowspan="2">Specific assessment methods/tasks</td><td rowspan="2">% weighting</td><td colspan="5">Intended subject learning outcomes to be assessed (Please tick as appropriate)</td></tr>
<tr><td>a</td><td>b</td><td>c</td><td></td><td></td></tr>
<tr><td>1. Assignments / In-class exercises</td><td>20%</td><td>✓</td><td>✓</td><td>✓</td><td></td><td></td></tr>
<tr><td>2. Project / Presentation</td><td>20%</td><td>✓</td><td>✓</td><td>✓</td><td></td><td></td></tr>
<tr><td>3. Examination</td><td>60%</td><td></td><td></td><td>✓</td><td></td><td></td></tr>
</table>
</td></tr>
</table>

Total	100 %						

Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:

There will be assignments and in-class exercises in which simple questions on concepts and theories of mathematical modeling will be set. This helps to reinforce the understanding of the knowledge and techniques covered in the lectures and tutorials, and to evaluate the progress of students' study regularly during the semester.

Project and presentation can give opportunities for students to integrate the concepts, theories, and techniques of mathematical modeling together to formulate, analyze, and interpret some real life problems. Students also have chances to summarize their findings and communicate effectively during the presentation.

Examination is conducted at the end of the semester to assess the understanding on the subject content for individual student.

Student Study Effort Expected	Class contact:	
	▪ Lecture	26 Hrs.
	▪ Tutorial	13 Hrs.
	Other student study effort:	
	▪ Self Study	39 Hrs.
	▪ Assignments	10 Hrs.
	▪ Prepare project and presentation	20 Hrs.
	Total student study effort	108 Hrs.

Reading List and References

Giordano, F.R., Fox, W.P., and Horton, S.B.	A First Course in Mathematical Modeling	Nelson Education, 2013
Barton, J.T.	Models for Life : An Introduction to Discrete Mathematical Modeling with Microsoft Office Excel	Wiley, 2016
Eastaway, R., Wyndham, J.	Why Do Buses Come in Threes?: The Hidden Maths of Everyday Life	Pavilion Books, 2014
Morris, P.	Introduction to Game Theory	Springer, 1994
Rosen, K.H.	Discrete Mathematics and its Application	McGraw-Hill, 2013

Subject Description Form

Please read the notes at the end of the table carefully before completing the form.

Subject Code	AMA1D06W
Subject Title	Great Scientific Achievements that Changed the World - Explained with Applications
Credit Value	3
Level	1
Pre-requisite / Co-requisite/ Exclusion	nil
Objectives	The subject aims to explore the most important and influential scientific discoveries that changed the world, in layman terms, i.e., in the simplest, brief, clear, intuitive, and suitably leveled terms. The student will gain an understanding and appreciation of the scientific discoveries (and the history behind it) and its multitude of applications for the betterment of the human condition currently, and in the future.
Intended Learning Outcomes *(Note 1)*	Upon completion of the subject, students will be able to: (a) Understand the history and motivation of the theory and the basic postulates of each scientific theory. (b) Recognize and appreciate the importance of the scientific theories to solving real world problems. (c) Explain and value the significance of the intellectual achievements and how they have changed humanity's view of the world. (d) Summarize the overall message of scientific articles published in popular media (magazines, newspapers, websites) and references (journals and books) about recent developments in science
Subject Synopsis/ Indicative Syllabus *(Note 2)*	<u>Geometry and Calculus</u> History of Geometry; Basic postulates of Euclidean Geometry; Pythagoras; non-Euclidean Geometry; applications to real life such as architecture; medicine (MRIs and molecular imaging); animation and movies. History of Calculus; Newton and Leibniz; basic ideas of Calculus as a study of change, described with pictures and real life examples with applicable and relevant calculations; infinitesimal change; description of some applications of Calculus include landing a man on the moon; curing diseases; modeling financial markets; predicting weather and earthquakes. <u>Darwin's theory of evolution</u> History of Darwin's theory of evolution; living organisms and evolution; natural selection and survival; application to how genes, diseases and viruses change overtime and how to fight them using vaccines and drug development; generalized applications includes the study of development of education, literature and religion.

	Relativity Theory History of relativity; basic postulates of Einstein's theory of special relativity will be explained in layman terms with many pictures and examples: inertial frames; constancy of speed of light; general relativity; gravity; fourth dimension; consequences of the theory of relativity in science and philosophy; Einstein's famous $E=mc^2$ equation explained; applications to nuclear fusion and global positioning systems (GPS); black holes. Quantum Mechanics History of Quantum Mechanics; basic postulates of quantum mechanics in layman terms; differences between Newtonian and Quantum Mechanics; consequences of postulates of Quantum Mechanics in science, philosophy and religion: double split experiment and wave-particle duality, integer multiple energies and photons; probabilistic interpretations; Schrodinger's cat paradox; Heisenberg's uncertainty principle; applications of quantum mechanics: ultra-precise clocks; magnetic resonance imaging (MRI); cryptography; powerful computers; lasers and telecommunications. Other possible topics to be explored within a semester, depending on overall student interest (which will be assessed by a student survey taken at the beginning of class) are: Freudian and Pavlovian psychology; Heliocentrism, Combustion, Vaccines, DNA, Plate techtonics, statistical mechanics, Cosmology and Big Bang Theory; dark matter, elementary particles; Information Theory; Quantum computing; artificial intelligence; Game theory, Financial derivatives and the financial market. Review of topics will be done in consultation with various colleagues and departments and faculties at PolyU, e.g. AP, ABCT in FAST, FHSS, FE, FH, FB.
Teaching/Learning Methodology *(Note 3)*	The subject will be delivered with blended learning approach through lectures and tutorials with active learning components to heighten student engagement in both lecture and tutorials. Lectures and tutorials will contain student response systems incorporated with peer instruction to increase students' learning experience. E-material and videos will be made available for each topic covered. Videos will also be used to flip one or two lectures in the course. In class lecture active learning and participation will be promoted to increase interaction between students and instructions, and students with other students. In class participation will include raising questions or comments, and submitting online responses to multiple choice or short answer questions posed by the instructor during lecture. Questions, comments and online responses are recorded by student response systems (e.g.,YoTeach! Kahoot! Badaboom! PaGamO) Tutorials will include interactive and student-centered activities, such as small group discussions, student demonstrations, games, case-based and problem-based learning, think-pair-share and online research on certain scientific theories discussed in lectures. Tutorials will also incorporate problems similar to the reading quiz and will prepare students for this assessment. The last two to three tutorials of the semester will be allocated for student presentations on

their selected written projects.

Tentative Teaching and Learning Schedule:

Weeks 1: Introduction to Geometry.
Week 2: Applications of Geometry to real life.
Week 3: Calculus for the Layman.
Week 4: Applications Calculus to real life.
Weeks 5: Darwin's theory of evolution; natural selection. *(Draft 1: 700 words to ELC due)*
Week 6: Applications of Evolutionary theory I: genes, diseases and viruses.
Week 7: Applications of Evolutionary theory II: education, literature and religion.
Weeks 8: Introduction to Relativity Theory. (Midterm Test)
Week 9: Introduction to General Relativity Theory.
Week 10: Applications of Relativity theory to real life. *Mechanics (Draft 2: 1500 words to ELC due)*
Weeks 11: Introduction to Quantum Mechanics *(30 minute Reading Quiz in tutorials)*
Week 12: Experiments and Interpretations of Quantum. *(Student Presentations in Tutorials)*
Week 13: Applications of Quantum Mechanics to real life. *(Student Presentations in tutorials)*
Week 13 (or later): *2500 word Final Paper due to Subject teacher*.

Assessment Methods in Alignment with Intended Learning Outcomes

(Note 4)

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed (Please tick as appropriate)					
		a	b	c	d		
1. Written project (English Writing Requirement) Draft 1700 words to ELC (Week 4 or 5) Draft 2 1500 words to ELC (Week 9 or 10) Final Paper 2500 words to Subject Teacher (Week 13 or later)	40 (30% + 10% from ELC)	✓	✓	✓	✓		
2. Midterm Test	15	✓	✓	✓	✓		
3. Presentation	15	✓	✓	✓	✓		
4. Reading Assessment/Quiz (English Reading Requirement)	10	✓	✓	✓	✓		

5. Final Exam	20	✓	✓	✓	✓		
Total	100 %						

Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:

Written project: Students may select a scientific theory that has not been covered in class, and write a 2500 word review essay which covers the following topics: (a) what motivated the theory to come into being; (b) the basic postulates of the theory; (c) what are the important applications of this theory; (d) how do these applications solve some real world problems today, and (e) a brief description of a current topic which is unsolved in the theory today, that will help advance the theory and its applications to more problems in the future. A rubrics based on parts (a) to (e) will be employed to assign a grade to this project. Turnitin will be used to assess plagiarism. Possible project topics may include: Freudian and Pavlovian psychology; Heliocentrism, Combustion, Vaccines, DNA, Plate tectonics, statistical mechanics, Big Bang Theory; dark matter, elementary particles; artificial intelligence; Information Theory. Quantum computing; Game theory, financial derivatives and the financial market. The instructor must approve other topics not included in this list above. Topics must be chosen by students or approved by instructors by week 5 of the semester. Topics to be chosen by a student must not be in the student's major field of study.

Midterm Test: A one hour in class midterm-test will contain true/false and multiple choice questions, short answer questions, and possibly one or two long answer questions (one paragraph long) on the Geometry and Calculus and Darwin's theory of evolution, its consequences and its applications.

To complete this essay, students will submit two drafts online to ELC's EWR Learn@PolyU course site as part of the English Writing Requirement and receive detailed feedback from them to revise their drafts. The 1st and 2nd draft will be 700 and 1500 words, and be due in approximately the 5th and 10th week of classes, respectively. Students can also book up to two consultations with ELC teachers to discuss their writing. Final draft will be submitted to the Subject course site before the final examination date.

Excellent papers will be referred to Inscribe (peer-reviewed student journal) for publication.

Presentation: The presentation will be a maximum of four minutes in length on the topic chosen in their written project; and can be either a straight power point talk, or can be a "half" PechaKucha presentation (10 slides are shown 20 seconds each – with total length of 3 minutes and 20 seconds) on their chosen topic. PechaKucha slides must have minimal amount of writing, and have images, which represent the spoken presentation. Presentation grades will be allocated according to a rubric based on the following elements: organization, content, performance and originality. All student presentations will be peer (15%) and instructor (85%) reviewed and we will use the PolyU "Gongyeh" app for comments, feedback and assessment on each student presentation. Student presentations will be held in the last two weeks of tutorials of the semester.

Reading Assessment (English reading Requirement)

	Students are required to read 200,000 word book (or a maximum of 4 manuscripts) out of class and they will be assessed by a reading quiz, worth 10%. ***Reading Quiz (10%):*** Students will be given a reading assignment of two to three chapters in one of the books in the reference below, and be required to write a 30 minute quiz in the 11th week of tutorials. The quiz will consist of multiple-choice, fill in the blank, some short answer and one long answer question. **Final Exam**: The final exam will contain true/false, multiple choice and short answer questions, and possibly one or two long questions will be given to students in order to test their knowledge on the basics of a scientific theory, its consequences and its applications.	
Student Study Effort Expected	Class contact:	
	▪ Lecture	26 Hrs.
	▪ Tutorial	13 Hrs.
	Other student study effort:	
	▪ Homework and self-study	38 Hrs.
	▪ Research and preparation of written project and presentation	35 Hrs.
	Total student study effort	112 Hrs.
Reading List and References	Sections or chapters will be taken from the following books for the following topics: ***Geometry and Calculus*** Kalid Azad, "Calculus, Better Explained: A Guide To Developing Lasting Intuition", eBook + Video Course by Kalid Azad (see link https://betterexplained.com/calculus/) ***Darwin's theory of evolution*** Charles Darwin, "On the Origin of Species", Cambridge University Press, 2009 (electronic version) Richard Dawkins, "The Selfish Gene", Oxford University Press, 4th edition, 2016. Daniel Duzdevich, "Darwin's On the Origin of Species: A Modern Rendition", Indiana Press, 2014 ***Relativity theory:*** Martin Gardner, Relativity theory simply explained, Dover, 1997. Carlos I. Calle, "Einstein for Dummies", Wiley Publishing Inc., 2005 Kip S. Thorne, "Black Holes & Time Warps: Einstein's Outrageous Legacy", W.W. Norton & Company, 1994. ***Quantum Mechanics:*** Steven Holzner, "Quantum Physics For Dummies", Revised Edition, Wiley 2013	

	Leon M. Lederman, Christopher T. Hill, "Quantum Physics for Poets", Prometheus Books, 2011 A plethora of websites and e-materials pdfs, videos, etc…) to be listed in more detail in "Reference list" to be provided to students in the first day of class. ***Other Popular Science books for Reading Requirement*** Carl Sagan, "Cosmos", Random House, 1980. Fritjof Capra, "The Tao of Physics", Shambhala Publications, 1975. Stephen Hawking, "A Brief History of Time: From The Big Bang to Black Holes", Bantam Dell Publishing Group, 1988. Richard Feynman, "Surely You're Joking, Mr. Feynman!", W.W Norton, 1985. John A. Paulos, "Innumeracy: Mathematical Illiteracy and Its Consequences", Hill and Wang, 1988.

Note 1: Intended Learning Outcomes
Intended learning outcomes should state what students should be able to do or attain upon completion of the subject. Subject outcomes are expected to contribute to the attainment of the overall programme outcomes.

Note 2: Subject Synopsis/ Indicative Syllabus
The syllabus should adequately address the intended learning outcomes. At the same time over-crowding of the syllabus should be avoided.

Note 3: Teaching/Learning Methodology
This section should include a brief description of the teaching and learning methods to be employed to facilitate learning, and a justification of how the methods are aligned with the intended learning outcomes of the subject.

Note 4: Assessment Method
This section should include the assessment method(s) to be used and its relative weighting, and indicate which of the subject intended learning outcomes that each method purports to assess. It should also provide a brief explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes.

Subject Description Form

Subject Code	AMA1D07
Subject Title	Introduction to Cosmology
Credit Value	3
Level	1
Pre-requisite / Co-requisite/ Exclusion	Nil
Objectives	The main objectives of this subject are: a) To offer students a general understanding, at an elementary level, of cosmology from the observational and theoretical perspectives. b) To widen student's view on forefront knowledge and enhance their independent learning skills. c) To present the basic observational facts on which our understanding of the structure and evolution of the Universe is based d) To develop students' moral affection through raising their awareness on the roles of human beings in the nature and the universe.
Intended Learning Outcomes	a) Upon completion of the subject, students will be able to:understand the principles and laws that describe the observational/ experimental aspects of cosmology b) understand the dynamic interactive processes that take place in the Universe c) acquire the basic techniques to enhance the understanding on cosmology and science d) analyze data and make appropriate judgments on scientific phenomena e) conduct self-learning and contribute to team work in any disciplines/areas
Subject Synopsis/ Indicative Syllabus	• The visible universe. Galaxies, their structure and classification; determination of the cosmic distances; determination of the ages of the cosmic objects. • The observational basis of cosmology. The cosmological redshift; Hubble's law • Elementary theory of the Big Bang. Newtonian cosmology; the energy conservation equation; the expansion equation; cosmological models; the deceleration parameter; the age of the Universe • Elementary general relativity; the metric of the Universe; geometry of the Universe

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- Physics of the early Universe. Primordial nucleosynthesis; structure formation; the Cosmic Microwave Background; anisotropy of the Cosmic Microwave Background; the WMAP and Planck satellite observations
- The very early Universe. Problems of the standard cosmological models; inflationary models; quantum cosmology; the no-boundary proposal of Stephen Hawking
- The accelerating Universe. Supernovae as standard candles; the discovery of the recent acceleration of the Universe; dark energy and dark matter; the cosmological constant problem.

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<tr><td>Teaching/Learning Methodology</td><td>

<u>Lecture:</u>

This class will consist of 9 weekly 3-hour lectures and 4 sessions of student presentations. Each lecture will be dedicated to a particular topic relevant to the study of Cosmology. Both the mathematical and the physical aspects of the field will be stressed. We will explain the mathematics in layman's terms so as to accommodate students from different backgrounds. During the course of a lecture, pictures and videos will be presented to aid the students in obtaining an intuitive understanding. Weekly readings from classical and forefront popular science books will be assigned so that all students will have the opportunity to learn from the precise yet non-technical writing styles of cosmology scholars.

<u>Observations:</u>

We will offer three observation sessions for a total of 8 hours. The Objects that will be observed include the sun, stars, and other celestial bodies. The observations will be done using optical and radio telescopes. In each session, each student will complete a set of experimental exercises for evaluation. After each observation session, students are required to complete a laboratory report in analyzing real time data.

Visiting Hong Kong Astronomical Observatory (Ho Koon)

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<tr><td>Assessment Methods in Alignment with Intended Learning Outcomes</td><td>

<table>
<tr><td rowspan="2">Specific assessment methods/tasks</td><td rowspan="2">% weighting</td><td colspan="5">Intended subject learning outcomes to be assessed (Please tick as appropriate)</td></tr>
<tr><td>a</td><td>b</td><td>c</td><td>d</td><td>e</td></tr>
<tr><td>1. Assignment</td><td>20%</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td></tr>
<tr><td>2. Observation exercises</td><td>20%</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td></tr>
<tr><td>3. Test</td><td>30%</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td></td></tr>
<tr><td>4. Presentation</td><td>30%</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td></tr>
<tr><td>Total</td><td>100 %</td><td colspan="5"></td></tr>
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	Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes: There will be three observational work sheets, one take-home assignment, one mid-term test, and one final presentation. We guarantee that the observation equipments are enough to accommodate the needs for all the students. For instance, we have solar filters that every student can use for doing observation of the sun. <u>Final presentation;</u> At the end of the semester, students will divide into groups. Each group will deliver a presentation on an assigned topic related to cosmology. Through these presentations, students will have the opportunity to acquire the skills of self-learning, analysis and organization of material, critical thinking, teamwork, and communication, all of which are important skills that our university graduate should possess. Topics of presentation We will suggest some interesting topics to the students for doing project presentation. The topics are suggested as follows: Black Holes, Dark Matter, Dark Energy, 21cm Cosmology, String Cosmology, Gravitational Wave Cosmology, Large Scale Structure, Supernovae Cosmology, Brain-World Cosmology, Parallel Universe, etc.	
Student Study Effort Expected	Lecture and presentation	39 Hrs
	Observations	8 Hrs
	Other student study effort:	60 Hrs
	Total student study effort	107 Hrs
Reading List and References	An Introduction to Galaxies and Cosmology, by Mark H. Jones and Robert J. Lambourne, Cambridge University Press, 2015 Astronomy Today Volume 2 : Stars and Galaxies (8th Edition) by Eric Chaisson and Steve McMillan, Pearson Education, Inc., Addison-Wesley, 2014 Extragalactic Astronomy and Cosmology: An Introduction, by Peter Schneider, Springer, 2014 Cosmology: A First Course, by Marc Lachieze-Rey, Cambridge University Press, 2011 An Introduction to Modern Astrophysics, by B. W. Carroll and D. A. Ostlie, Pearson, 2013	

Subject Description Form

Subject Code	AMA2D02
Subject Title	Statistics in Society
Credit Value	3
Level	2
Pre-requisite/ Co-requisite/ Exclusion	
Objectives	Statistical thinking is very important in all walks of life and in the society. From business and commerce to science and technology, statistics plays an essential role to help us explore issues and to understand problems in the real world. This subject aims to provide an introduction to the concepts of exploratory data analyses. Through studies of popular opinion polls in Hong Kong, students will learn to interpret and draw conclusions from real-world data. Using practical examples and case studies drawn from the society, students will learn about the practical uses and misuses of statistics. Statistical software will be used.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: 1. understand the fundamental concepts of exploratory data analyses, to summarize and to present numerical information both numerically and graphically. 2. be aware of the uses and misuses of statistics, to understand the reasons behind the calculations, the statistical assumptions under which they are valid. 3. properly interpret index numbers, opinion polls and other statistical results, and to draw conclusions from real-world data in the society.
Subject Synopsis/ Indicative Syllabus	*Exploratory Data Analysis* What are central tendency and dispersion and how to compute them? How to present graphical and numerical summaries of data? Students will start with a single variable and progressing into the relation between two variables in the application of these techniques. *Index Numbers* What is an index number? How are index numbers constructed? How to interpret an index number? Why are official statistics usually released in index number format? Simple examples relating to daily life will be illustrated. Important Index Numbers:

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<tr><td></td><td>Consumer price index: What is its purpose? Is it an indicator of inflation? Its applications in daily life.

Share price indexes: Hang Seng Index, Dow Jones Index, Financial Times Index, Nikkei Index, etc. What are their purposes? How to interpret the index with a particular reference to potential investors?

Exchange rate index: What is its purpose? How to interpret the index?

Opinion polls
Do you think the opinion of a small sample can represent the population of a city? How are public opinions collected? What are the uses and misuses of opinion surveys? How to achieve reliable survey results? How to interpret survey results? Examples of popular opinion polls will be given.

Uses and Misuses of Statistics
How to gather data and produce and interpret numerical and graphical results for simple data sets? Errors, biases and misuses of statistics in presenting statistical results. Practical examples will be drawn and illustrated from the business setting and the society.</td></tr>
<tr><td>Teaching/Learning Methodology</td><td>Lectures will be used to introduce the subject materials. Tutorials will include small group discussion. Practical case studies will be used to strengthen students' concepts, statistical interpretation and statistical presentation skills. Some examples of case studies include presenting economic trends, a class opinion poll, and understanding index numbers. During tutorials, statistical software such as R and Excel will be used and more hands-on examples will be illustrated. Students are required to reinforce their knowledge through assignments including additional case studies/mini-project in the course. There will be an end-of-term examination, which will test students on their understanding of statistical concepts, interpretation of graphs and statistical results and results of opinion polls.</td></tr>
<tr><td>Assessment Methods in Alignment with Intended Learning Outcomes</td><td>
<table>
<tr><td rowspan="2">Specific assessment methods/tasks</td><td rowspan="2">% weighting</td><td colspan="3">Intended subject learning outcomes to be assessed (Please tick as appropriate)</td></tr>
<tr><td>1</td><td>2</td><td>3</td></tr>
<tr><td>a. Assignments</td><td>30%</td><td>✓</td><td>✓</td><td>✓</td></tr>
<tr><td>b. Tutorials</td><td>20%</td><td>✓</td><td>✓</td><td>✓</td></tr>
<tr><td>c. Exam</td><td>50%</td><td>✓</td><td>✓</td><td>✓</td></tr>
<tr><td>Total</td><td>100%</td><td>✓</td><td>✓</td><td>✓</td></tr>
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	The assignment consists of case studies and group project that will help students to develop critical thinking ability over computing and interpreting statistical summaries and graphs.	
Student Study Effort Required	Class contact:	
	■ Lecture	26 Hrs.
	■ Tutorial	13 Hrs.
	■ Examination	3 Hrs.
	Other student study effort:	
	■ Assignment	45 Hrs.
	■ Self-study	30 Hrs.
	Total student study effort:	117 Hrs.

Reading List and References	Textbook: Graham, A (2013) Teach Yourself Statistics. Hodder & Stoughton, London. Reference: Babbie, E.R. (2013) The Basics of Social Research. 6th ed. Thomson Frankfort-Nachmias, C. & Leon-Guerrero, A. (2014) Social Statistics for a Diverse Society. 7th ed. Pine Forge Press. Tufte ER (2001) The Visual Display of Quantitative Information. Graphics Press, 2nd ed. Hong Kong Economic Trends. Census & Statistics Department, HKSAR. Hong Kong Social and Economic Trends. Census & Statistics Department, HKSAR. Hong Kong Monthly Digest of Statistics. Census & Statistics Department, HKSAR. Useful websites: Census and Statistics Department, Hong Kong SAR http://www.info.gov.hk/censtatd/ Hong Kong Monetary Authority http://www.info.gov.hk/hkma/ Hong Kong Public Opinion Polls http://hkupop.hku.hk/english/popexpress/ United Nations http://www.un.org/