

Subject Description Form

Subject Code	AMA1D03
Subject Title	Introduction to Pension Mathematics
Credit Value	3
Level	1
Pre-requisite / Co-requisite/ Exclusion	Nil
Objectives	<p>(a) To introduce the concept of pension system, and to appreciate the role and the relationship of pension system to the society.</p> <p>(b) To let students gain an enhanced understanding of interest, discount, life contingency, and financial planning.</p> <p>(c) To nurture student's overall financial planning for retirement via the learning of pension mathematics.</p>
Intended Learning Outcomes	<p>Upon completion of the subject, students will be able to:</p> <p>(a) understand the importance of the pension system to our community.</p> <p>(b) evaluate the elementary measures of interest.</p> <p>(c) command the ideas of basic annuities payments and outstanding balance under amortization.</p> <p>(d) master the concept of measuring death and survival rates through life table.</p> <p>(e) analyze the key factors of the valuation of pension funds.</p> <p>(f) evaluate the normal cost and accrual liability for pension funds under various funding methods.</p>
Subject Synopsis/ Indicative Syllabus	<p><u>Basic Mathematics</u> Experiment, data collection and analysis, elementary concepts of probability and statistical modeling in pension mathematics, model interpretation and validation.</p> <p><u>Introduction to Pension Plans</u> Basic principle of pension schemes, importance of the pension schemes, defined benefit vs. defined contribution pension funds, stakeholders, normal cost, accrual actuarial liability, supplementary cost.</p> <p><u>Measurement of Interest</u> Compound interest, nominal and effective interest and discount rates, present values of annuities, accumulated values of annuities, annuities with monthly payments.</p> <p><u>Amortization Schedules</u> Outstanding balance, prospective method, retrospective method.</p> <p><u>Survival Distributions and Life Tables</u> Age-at-death random variables, survival function, life tables, parametric and non-parametric survival/loss models, introduction to Cox proportional hazard model.</p>

	<p><u>Life Annuities and Benefit Reserves</u> Life annuities with monthly payments, benefit reserves.</p> <p><u>Pension Funding Valuation Methods</u> Unit credit method, projected unit credit, entry age normal method, aggregate method, unfunded liability.</p>																																																						
<p>Teaching/Learning Methodology</p>	<p>Lectures: Lectures will be conducted to present the basic principles and fundamentals of pension funding and the use of mathematics for in-depth understanding.</p> <p>Tutorials: Tutorial questions and Case study/presentation on the selected topics via reading and writing tasks will be employed to raise student's interest and discussion by problem-solving approach.</p>																																																						
<p>Assessment Methods in Alignment with Intended Learning Outcomes</p>	<table border="1" data-bbox="533 801 1481 1384"> <thead> <tr> <th rowspan="2">Specific assessment methods/tasks</th> <th rowspan="2">% weighting</th> <th colspan="6">Intended subject learning outcomes to be assessed (Please tick as appropriate)</th> </tr> <tr> <th>a</th> <th>b</th> <th>c</th> <th>d</th> <th>e</th> <th>f</th> </tr> </thead> <tbody> <tr> <td>1. Assignments</td> <td>30%</td> <td>✓</td> <td>✓</td> <td>✓</td> <td>✓</td> <td>✓</td> <td>✓</td> </tr> <tr> <td>2. Case study / Presentation</td> <td>30%</td> <td>✓</td> <td>✓</td> <td>✓</td> <td>✓</td> <td>✓</td> <td>✓</td> </tr> <tr> <td>3. Test</td> <td>10%</td> <td></td> <td>✓</td> <td>✓</td> <td>✓</td> <td>✓</td> <td>✓</td> </tr> <tr> <td>4. Exam</td> <td>30%</td> <td></td> <td>✓</td> <td>✓</td> <td>✓</td> <td>✓</td> <td>✓</td> </tr> <tr> <td>Total</td> <td>100 %</td> <td colspan="6"></td> </tr> </tbody> </table> <p>Continuous assessment (70%) comprises of assignments, Case study/presentation, and test. Test (10%) will focus on the study of the science and techniques related to the mathematics of pension. Assignments (30%) also include the statistical method to build up survival model and to design Pension scheme with scientific methods and techniques. Besides, Case study/presentations (30%) require students to read and search literature for the relevant topics about pension around the world and its development. A written examination (30%) will be held at the end of the semester.</p> <p>Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:</p> <p>Assignment and test assess the students' understanding of the basic concept and principle of the evaluation. Two assignments and one test will be given.</p> <p>Case study/Presentation assess students' problem solving, critical thinking, analytical and creative thinking skills. It will be based on their individual performance in presentation skills.</p> <p>The subjects focus on the integration of basic concepts and application of the evaluation techniques in pension mathematics. The assessment method based on examination is appropriate.</p>	Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed (Please tick as appropriate)						a	b	c	d	e	f	1. Assignments	30%	✓	✓	✓	✓	✓	✓	2. Case study / Presentation	30%	✓	✓	✓	✓	✓	✓	3. Test	10%		✓	✓	✓	✓	✓	4. Exam	30%		✓	✓	✓	✓	✓	Total	100 %						
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Student Study Effort Expected	Class contact:	
	▪ Lecture	26 Hrs.
	▪ Tutorials	13 Hrs.
	Other student study effort:	
	▪ Self-study	39 Hrs.
	▪ Preparation for project & presentation	30 Hrs.
	Total student study effort	108 Hrs.
Reading List and References	<p><u>References:</u></p> <ol style="list-style-type: none"> 1. Atitken, W. H., A Problem-solving Approach to Pension Fund and Valuation, ACTEX Publication, 1996. 2. Kellison, S.G., The Theory of Interest (3rd ed.), McGraw-Hill/Irwin, 2009. 3. Bowers, N.L., Gerber, H.U., Hickman, J.C., Jones, D.A., and Nesbitt, C.J., Actuarial Mathematics (2nd ed.), Societies of Actuaries, 1997. 4. McGill, D, Brown, K.N., Haley, J.J., Schieber, S., and Warshawsky, M.J., Fundamentals of Private Pensions (9th ed.), New York: Oxford University Press, 2010. 5. Blake, D., Pension Schemes and Pension Funds in the United Kingdom (2nd ed.), New York: Oxford University Press, 2003. 6. Carmichael, I., Pension Power: Unions, Pension funds, and Social Investment in Canada, Buffalo: University of Toronto Press, 2005. <p><u>Reading List:</u></p> <ol style="list-style-type: none"> 1. Polzer K., Financing Future LTSS and Long Life Through more Flexible 401(k) and IRAs, 2014. (https://www.soa.org/Library/Monographs/Retirement-Systems/managing-impact-ltc/2014/mono-2014-managing-ltc.pdf) 2. Bikker, J.A., Steenbeek, O.W., and Torracchi F., The Impact of Scale, Complexity, and Service Quality on the Administrative Costs of Pension Funds: A Cross-country Comparison, Journal of Risk and Insurance, 79(2), 477-514, 2012. 3. Yang, Y., and Chen, K., Comparison of the Pension System Reform in East Asia and South-east Asia, Academics in China, 7, 269-273, 2015. 4. Comprix, J., and Muller, K.A., Pension Plan Accounting Estimates and The Freezing of Defined Benefit Pension Plans, Journal of Accounting and Economics, 51(1-2), 115-133, 2011. 	