

一、課程大綱 Syllabus

<p>課程名稱 Course Title</p>	<p>(中文 Chinese) 微課程- 機器學習與因果推論 (英文 English) Mini-course in Machine Learning and Causal Inference</p>						<p><input type="checkbox"/> 中文授課 <input checked="" type="checkbox"/> 英文授課 Chinese conducted/ English conducted</p>
<p>授課教師 Instructor</p>	<p>主授: 謝志昇 合授: 陳釗而</p>	<p>任職單位 Department</p>	<p>經濟系 Economics</p>	<p>專兼任 Full time/ Adjunct</p>	<p><input checked="" type="checkbox"/> 專任 <input type="checkbox"/> 兼任</p>	<p>職級</p>	<p><input type="checkbox"/> 教授 <input checked="" type="checkbox"/> 副教授 <input type="checkbox"/> 助理教授 <input type="checkbox"/> 講師 Professor/ Associate Professor/ Assistant Professor /Instructor</p>
<p>開課系所 Department</p>	<p>經濟系 Economics</p>	<p>課號 Curriculum Number</p>	<p>323 U1090 ECON5188</p>	<p>學分數 Credits</p>	<p>1 學分</p>	<p>修課人數上限 Student numbers</p>	<p>不限人數。</p>
<p>每週時數 Hours</p>	<p><input checked="" type="checkbox"/> 演講 <u>16</u> 小時 <input type="checkbox"/> 實驗 _____ 小時</p>						
<p>課程性質 Designated for</p>	<p><input type="checkbox"/> 博士班課程 (D 字頭) for PhD <input type="checkbox"/> 碩士班課程 (M 字頭) for MA <input checked="" type="checkbox"/> 高年級課程 (U 字頭) for under,MA,PhD <input type="checkbox"/> 學士班課程 for undergraduate</p>			<p>加選方式 Selection method</p>	<p><input type="checkbox"/> 1. 不限人數。 Add Online no limit for student numbers <input type="checkbox"/> 2. 發給授權碼 Add with Code <input checked="" type="checkbox"/> 3. 人數限制 <u>30</u> 人 Add Online with limit for student numbers of <u>30</u></p>		
<p>課程大綱內容 (含課程概述、教學目標、每週進度及教學內容簡述) Course outlines</p>	<p>一、課程概述 Course Description</p> <p>The course discusses machine learning as well as the use of these methods for causal inference in economics. The challenging part of empirical research in a data-rich environment is to raise good questions and do good data. To this end, we go through examples of the off-the-shelf applications of machine learning to economics. We then present highlights and empirical studies from the emerging econometric literature combining machine learning and causal inference. Mastery of techniques taught in classes demonstrated through the completion of 5 assignment.</p> <p>二、教學目標 Course Objective</p> <p>You will finish the course equipped with a workman's familiarity with the causal machine learning techniques, facility with data handling, and programming.</p> <p>三、每週進度及教學內容簡述 Course outline (Course Schedule of 16 hours)</p> <p>We can arrange the following 16 topics in 16 hours.</p>						

	<p>Topic 1: A helicopter tour of machine learning in economics</p> <p>Topic 2: Regression</p> <p>Topic 3: Research designs and empirical strategies: The Furious Five</p> <p>Topic 4: Logistic regression</p> <p>Topic 5: Modern high-dimensional econometrics</p> <p>Topic 6: Double lasso selection procedure</p> <p>Topic 7: Decision trees</p> <p>Topic 8: Random forests</p> <p>Topic 9: Approximate factor models</p> <p>Topic 10: Factor models in causal inference</p> <p>Topic 11: Double machine learning procedure</p> <p>Topic 12: Causal forests</p> <p>Topic 13: Heterogeneous treatment effects and policy learning</p> <p>Topic 14: Quantile treatment effects</p> <p>Topic 15: Machine learning methods that economists should know about</p> <p>Topic 16: Discussions</p>
<p>指定閱讀及 延伸閱讀 Required readings and extension readings (Textbooks & Reference)</p>	<p>一、指定閱讀(請詳述每週指定閱讀) Required readings</p> <p>Textbook:</p> <ol style="list-style-type: none"> 1. James, Witten, Hastie, and Tibshirani (2021). <i>An Introduction to Statistical Learning with Applications in R</i>. 2nd ed. Springer. [Topics 4, 5, 7, and 8] 2. Taddy (2019). <i>Business Data Science: Combining Machine Learning and Economics to Optimize, Automate, and Accelerate Business Decisions</i>. McGraw-Hill. [Topics 2, 3, 4, 11, and 12] 3. Angrist and Pischke (2009). <i>Mostly Harmless Econometrics</i>. Princeton University Press. [Topics 2, 3 and 14] 4. Instructure’s lecture slides/notes. [Topics 1-14] <p>二、延伸閱讀(請詳述每週延伸閱讀) Extension readings</p> <p>Papers:</p> <ol style="list-style-type: none"> 1. Athey, S. and G.W. Imbens (2019). “Machine learning methods that economists should know about,” <i>Annual Review of Economics</i>, 11, 685-725. [Topic 15] 2. Shah, V., N. Kreif and A.N. Jones (2021). “Machine learning for causal inference: estimating heterogeneous treatment effect,” Chapter 16, <i>Handbook of Research methods and applications in empirical microeconomics</i>. Edward Elgar Publishing. [Topic 13]
<p>成績評量方式 與標準 (請說明各項 評量項目內容 設計、比例及 標準) Grading</p>	<ol style="list-style-type: none"> 1. Students will do 5 assignments (100%). In addition, students will be asked to demonstrate their analytical solutions or computer-based solutions to their fellow students.
<p>本課程對學生</p>	<p>Students should do problem sets and assigned readings. We encourage questions and class</p>

課後學習之要求 Requirements for students after the class:	discussion – we will be asking you questions too!
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2. 授課教師申請開授課程之相關著作或近五年所發表之學術性著作目錄

Working papers, published papers in 1~5 years

1. “Debiased/Double Machine Learning for Instrumental Variable Quantile Regressions,” *Econometrics*, 2021, 9(2), 1-18. (with C.-H. Huang and J.-J. Tien)
2. “Causal Random Forests Model using Instrumental Variable Quantile Regression,” *Econometrics*, 2019, 7(4), 1-22. (with C.-W. Hsiang)
3. “Nonparametric Regression with Multiple Thresholds: Estimation and Inference,” *Journal of Econometrics*, 2018, 206(2), 472-514. (with Y.-Y. Chiou and M.-Y. Chen)