https://web.ntnu.edu.tw/~hawjeng/LTA2025.rar

臺灣傳播調查資料庫/資料分析工作坊

中央研究院 2025/09/19

Material

Mplus Demo



調查數據背後的潛在異質結構與動態變化:

從潛在類別分析(LCA)到潛在轉移分析(LTA)

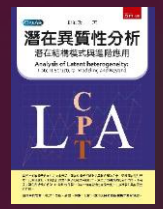
Latent Heterogeneity and Dynamic Changes Behind Survey Data:

From Latent Class Analysis to Latent Transition Analysis

邱皓政 Hawjeng Chiou

國立臺灣師範大學 National Taiwan Normal University

企業管理學系暨教育心理與輔導學系





PART I

INTRODUCTION AND EXAMPLES

數位足跡的故事 INTRODUCTION

國科會臺灣經驗實證調查資料的貼文

TCS2023 網路數位足跡資料檔
資料釋出說明

製表：台灣傳播調查資料庫
更新日期：2024 年 10 月 30 日

開放下載囉

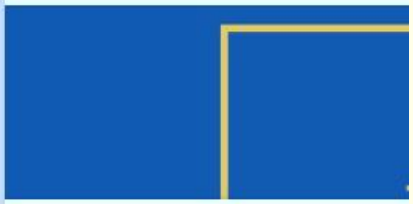
1. **研究簡介：**

為有效因應網路世代快速變動的趨勢所衍伸出的新型態網路使用與傳播行為，本計畫規劃從 2023 年 10 月開始收集網路足跡數據，結合線上問卷調查，探討網路訊息對人們的影響。

各種研究資料都有其侷限性。例如單純以網路大數據資料(例如 Facebook、Youtube 使用者的發文)進行分析的研究，因缺乏相對完
別、年齡或政黨傾向)，常常只能進行整體描
測，較難進行深度的分析或因果推論。而線
的偏誤，也缺乏社會情境與脈絡的資料。結

📌媒體特色題組：民眾從事特
電視新聞和網路的看法
📌新媒體使用行為：民眾對於

TCS提供「調查問卷」、「調查
庫官網，免費下載使用🤩



3. **資料檔案內容**：本次釋出資料共有以下 6 項：
   1) **問卷檔案**：針對有資格參與 TCS 計畫 2023 年網路數位足跡資料蒐集研究的 244 位參與者發放問卷。共計發放 1 波基本資訊問卷、3 波正式問卷讓參與者填答。問卷調查資料內容說明如下：
      A. **問卷調查日期與有效問卷數：**
         A) **基本資訊問卷**：於 2023 年 10 月 25 日至 31 日邀請 244 位參與者填答。期間有 3 位參與者因網路技術問題無法填寫，經排除問題後，延長至 11 月 2 日完成填答，經資料檢誤並刪除不合參與研究資格、未完整填答基本資訊之無效問卷後，最終完成 212 份有效問卷。
         B) **第一波問卷**：於 11 月 1 日至 6 日邀請 212 位合格參與者填答，經資料檢誤並刪除不合參與研究資格、未完整填答之無效問卷後，共完成 202 份有效問卷。
         C) **第二波問卷**：於 12 月 15 日至 19 日邀請 202 位合格參與者填答，經資料檢誤並刪除不合參與研究資格、未完整填答之無效問卷後，共完成 200 份有效問卷。
         D) **第三波問卷**：於 2024 年 1 月 14 日至 16 日邀請 200 位合格參與者填答，經資料檢誤並刪除不合參與研究資格、未完整填答之無效問卷後，共完成 199 份有效問卷。

數位足跡的故事 DATASET

*tcs2023fpq_long.sav [資料集3] - IBM SPSS Statistics 資料編輯器

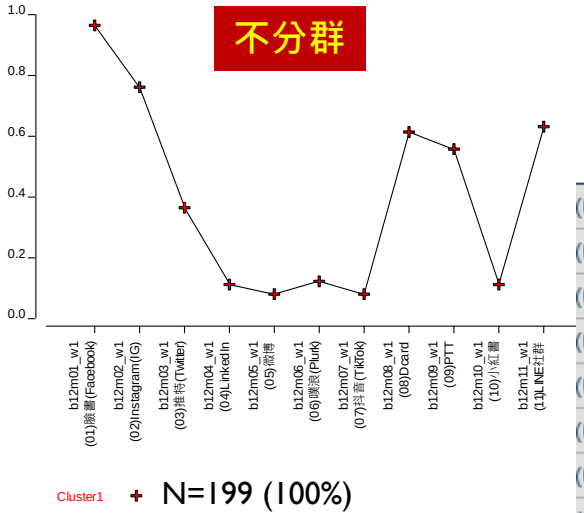
$社群媒體*wave 交叉列表

		wave 問卷波次						
		(01)第1波問卷		(02)第2波問卷		(03)第3波問卷		總計
		計數	%	計數	%	計數	%	計數
$社群媒體[a]	b12m01 使用社群媒體(01)臉書(Facebook)	192	96.5%	186	93%	187	94%	565
	b12m02 使用社群媒體(02)Instagram(IG)	151	75.9%	156	78%	146	73%	453
	b12m03 使用社群媒體(03)推特(Twitter)	72	36.2%	78	39%	72	36%	222
	b12m04 使用社群媒體(04)LinkedIn	22	11.1%	24	12%	24	12%	70
	b12m05 使用社群媒體(05)微博	16	8.0%	13	6.5%	11	5.5%	40
	b12m06 使用社群媒體(06)噗浪(Plurk)	24	12.1%	22	11%	17	8.5%	63
	b12m07 使用社群媒體(07)抖音(TikTok)	16	8.0%	22	11%	20	10%	58
	b12m08 使用社群媒體(08)Dcard	122	61.3%	119	60%	123	62%	364
	b12m09 使用社群媒體(09)PTT	111	55.8%	116	58%	114	57%	341
	b12m10 使用社群媒體(10)小紅書	22	11.1%	21	11%	19	9.5%	62
	b12m11 使用社群媒體(11)LINE社群	125	62.8%	122	61%	120	60%	367
	b12m12 使用社群媒體(12)Threads	0	0.0%	38	19%	43	22%	81
	b12m88 使用社群媒體(88)其他	3	1.5%	2	1.0%	1	0.5%	6
	b12m90 使用社群媒體(90)都沒有	0	0.0%	1	0.5%	0	0.0%	1
總計		199		199		199		597

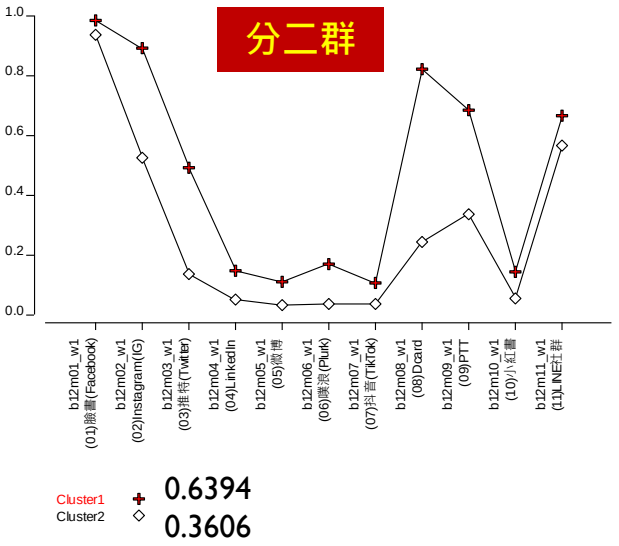
百分比及總計是基於回應者。

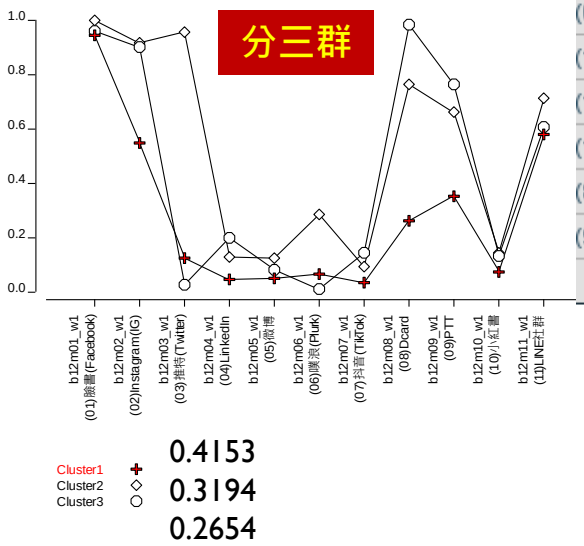
a. 二分法群組於值 1 表格化。

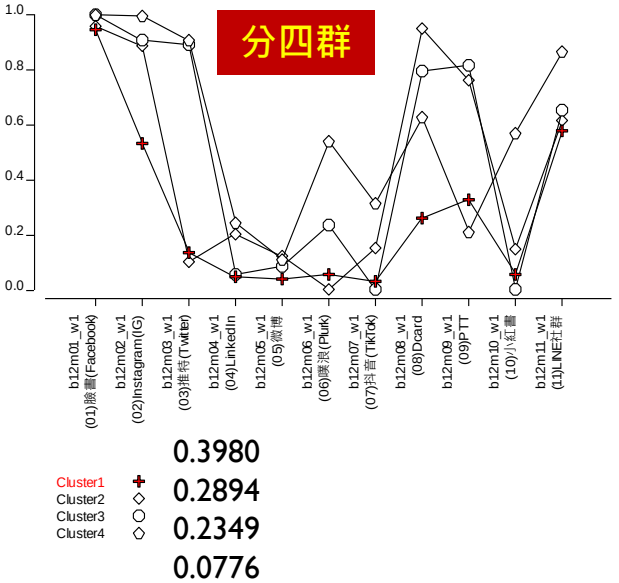
數位足跡的故事 LATENT CLASSES



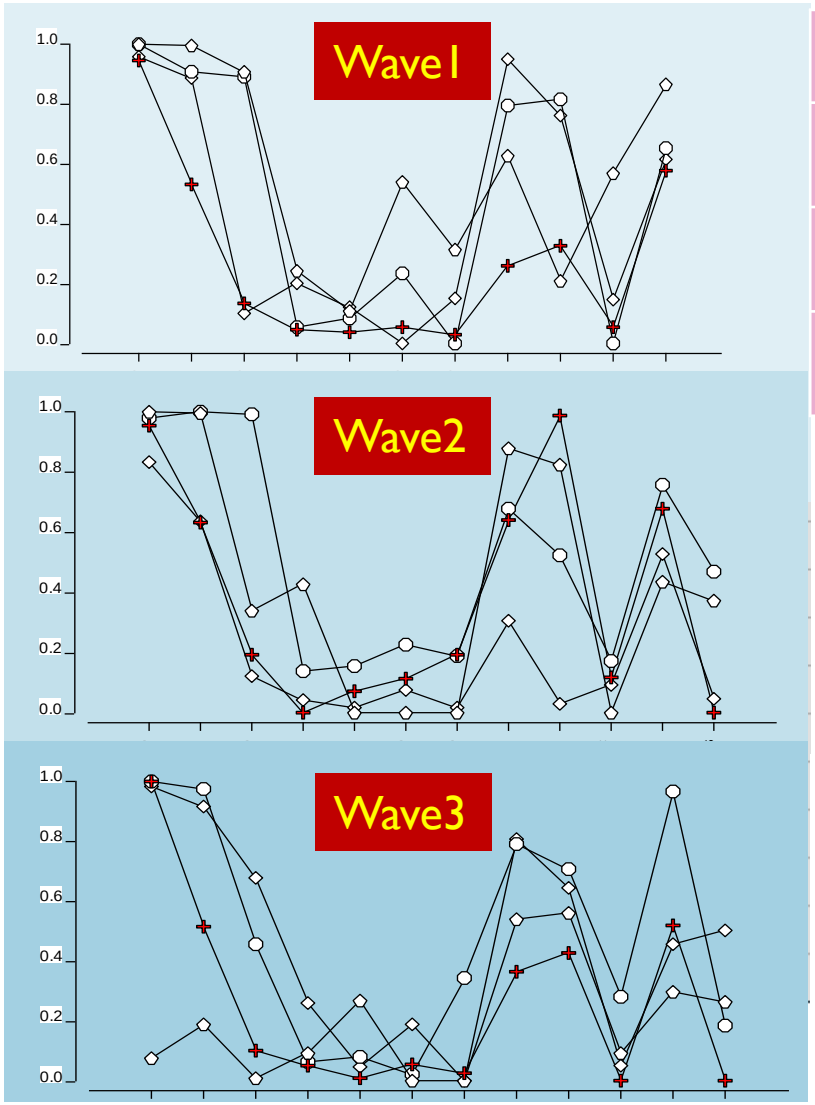
(01)第1波問卷	計數	%
(01)臉書(Facebook)	192	96.5%
(02)Instagram(IG)	151	75.9%
(03)推特(Twitter)	72	36.2%
(04)LinkedIn	22	11.1%
(05)微博	16	8.0%
(06)噗浪(Plurk)	24	12.1%
(07)抖音(TikTok)	16	8.0%
(08)Dcard	122	61.3%
(09)PTT	111	55.8%
(10)小紅書	22	11.1%
(11)LINE社群	125	62.8%
(12)Threads	0	0.0%
(88)其他	3	1.5%
(90)都沒有	0	0.0%
	199	







數位足跡的故事 CHANGING LATENT CLASSES



	Cluster1	Cluster2	Cluster3	Cluster4
Latent Class @Wave1	0.2900	0.3120	0.1737	0.2243
Latent Class @Wave2	0.2670	0.3138	0.1737	0.2456
Latent Class @Wave3	0.2484	0.3299	0.1737	0.2480

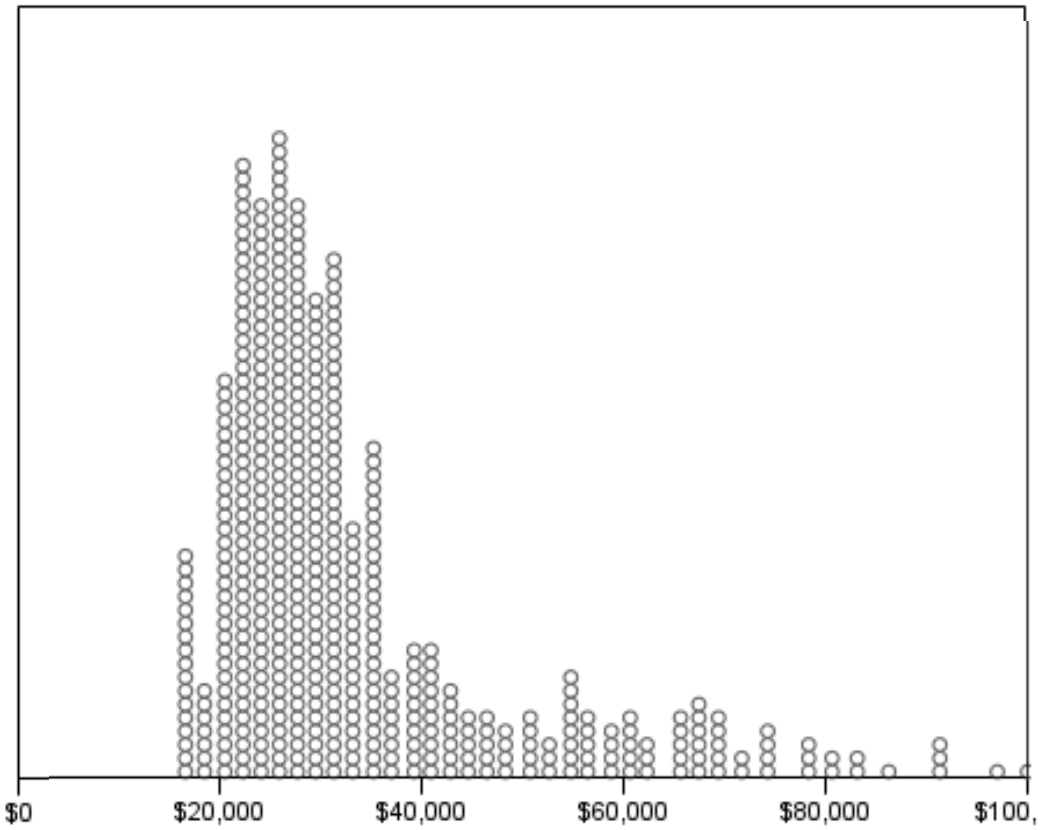
Latent Class@Wave2

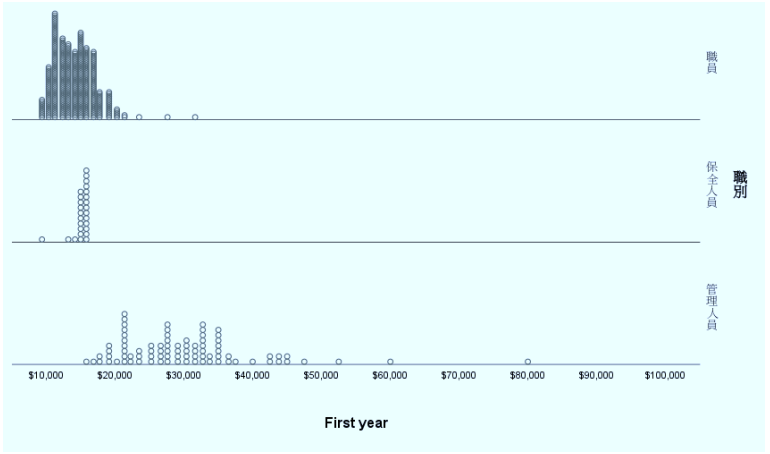
		Cluster1	Cluster2	Cluster3	Cluster4	總計
Latent Class@ Wave1	Cluster1	53			7	60
	Cluster2		60	0	1	61
	Cluster3		0	36	0	36
	Cluster4	2	0	0	40	42
總計		55	60	36	48	199

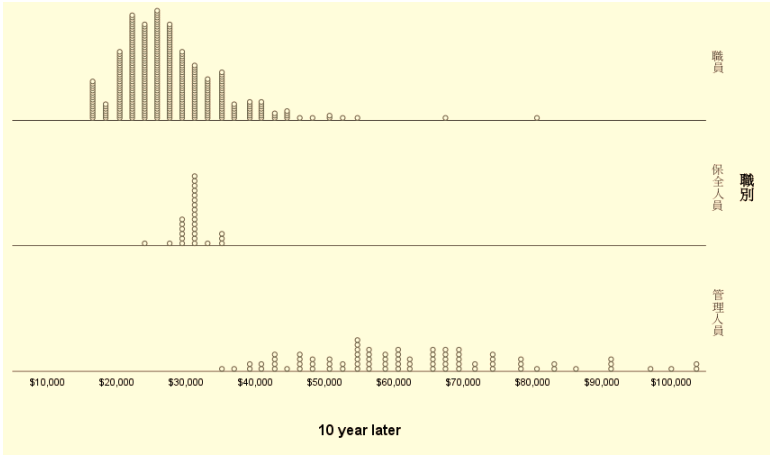
Latent Class@Wave3

		Cluster1	Cluster2	Cluster3	Cluster4	總計
Latent Class@ Wave2	Cluster1	52	1		2	55
	Cluster2	0	60	0	0	60
	Cluster3	0	0	36	0	36
	Cluster4	0	1	0	47	48
總計		52	62	36	49	199

統計如何偵測到他們?







How to identify the heterogeneity in the mixture space, and their move?

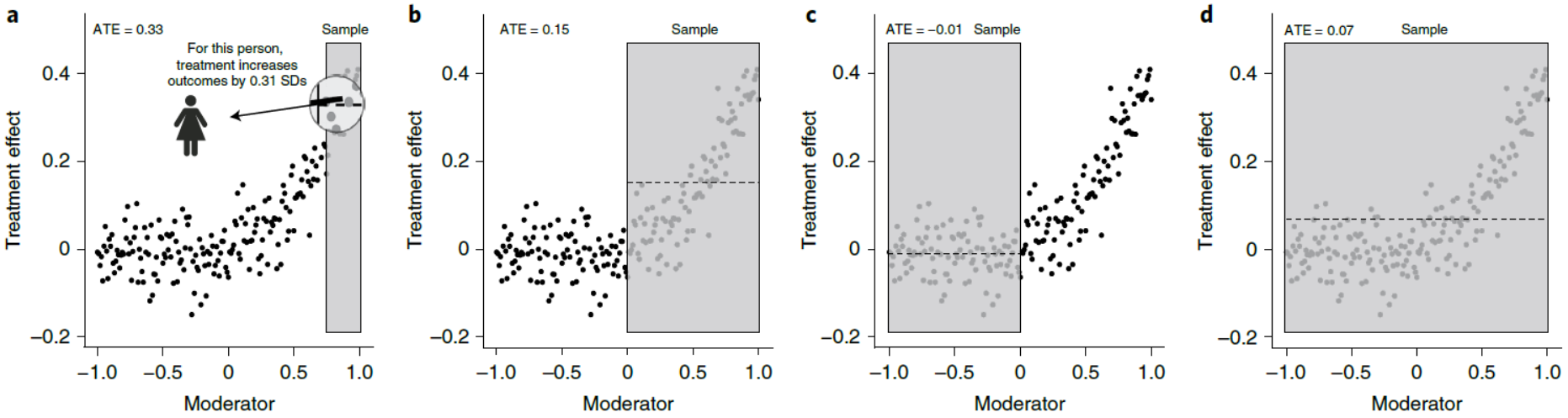
異質性革命

Bryan, C.J., Tipton, E. & Yeager, D.S. (2021). Behavioural science is unlikely to change the world without a heterogeneity revolution. Nature Human Behaviour, 5, 980–989. https://doi.org/10.1038/s41562-021-01143-3

Behavioural science is unlikely to change the world without a heterogeneity revolution

Christopher J. Bryan[1]✉, Elizabeth Tipton[2]✉ and David S. Yeager[1]✉

In the past decade, behavioural science has gained influence in policymaking but suffered a crisis of confidence in the replicability of its findings. Here, we describe a nascent heterogeneity revolution that we believe these twin historical trends have triggered. This revolution will be defined by the recognition that most treatment effects are heterogeneous, so the variation in effect estimates across studies that defines the replication crisis is to be expected as long as heterogeneous effects are studied without a systematic approach to sampling and moderation. When studied systematically, heterogeneity can be leveraged to build more complete theories of causal mechanism that could inform nuanced and dependable guidance to policymakers. We recommend investment in shared research infrastructure to make it feasible to study behavioural interventions in heterogeneous and generalizable samples, and suggest low-cost steps researchers can take immediately to avoid being misled by heterogeneity and begin to learn from it instead.



統計異質性分析方法

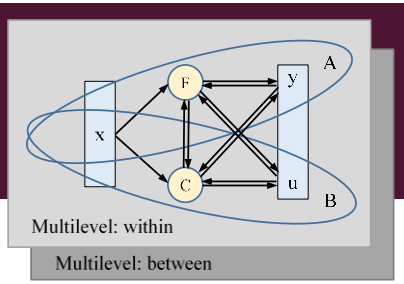
- 外顯 vs 潛在異質性
  - Manifest heterogeneity
    - 異質性可外顯觀察
    - 異質類型以外顯觀察變數反映
  - Latent heterogeneity
    - 異質性無法外顯觀察
    - 異質類型必須估計辨識
- 橫斷vs縱貫面資料
  - Cross-sectional data
    - 單一時點下的觀察數據
  - Longitudinal data
    - 具有時間序列的資料
    - N=1 Time-series data
    - N>1 Panel data

DV	類別IV	連續IV
類別	Contingency χ^2-test Log-Linear Modeling	Discriminant Analysis Logistic Regression
連續	t-test ANOVA Dummy regression	Correlation Linear regression Path analysis

表 1.1 異質母體分析的常見方法

分析方法	分析內容
外顯異質性	
平均差異檢定 analysis of mean difference	平均數的差異分析
列聯表分析 contingency table analysis	次數分配異質性分析
對數線性模式 log-linear modeling	多重次數分配異質性分析
(多變量)變異數分析 (M)ANOVA	平均數結構的變異分析
區別分析 discriminant analysis	異質性的預測分析
羅吉斯迴歸 logistic regression	異質性的預測分析
潛在異質性	
潛在類別分析 latent class analysis	次數分配的潛在異質性
潛在剖面分析 latent profile analysis	平均數結構的潛在異質性
潛在轉移分析 latent transition analysis	潛在類別的隨時變動
混合迴歸分析 mixture regression analysis	迴歸參數的潛在異質性
因素混合模式 factor mixture modeling	因素模式的潛在異質性
成長混合模式 growth mixture modeling	變動軌跡的潛在類別分析

潛在異質性的統計模式



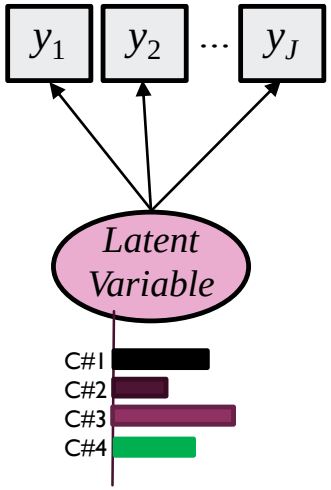
- **潛在類別 (latent class) 反映潛在異質性**
  - 利用一個能將受測者區分成K群潛在類別的潛在變數C，來吸收J個觀察變數之間的結構關係或相依性藉以達成局部獨立 (Hagenaars & McCutcheon, 2002)

- **個人中心的統計模式 Person-centered vs. Variable-centered modeling**
  - **SEM 雙圓體系（Mplus; Muthén & Muthén, 1998-2017)**
    - **A: Continuous latent variables: Factor analysis (F)**
    - **B: Categorical latent variables: Latent class (C)**

Factor Analysis:
Latent factor of **variables**

Latent Structure Analysis:
Latent class of **individuals**

	ID	gender	age1	college	w1	w2	w3	w4	w5	w6	y1	y2	y3	y4	y5
1	1	0	48	0	66	44	44	46	44	44	1.7500	1.7667	1.8750	1.3000	1.8000
2	2	1	46	0	60	60	70	60	60	60	6.1875	8.0000	7.5917	7.0000	7.0000
3	3	1	47	0	44	44	44	44	44	44	3.0000	3.2000	2.5000	2.8000	3.0000
4	4	1	46	0	40	40	40	40	40	40	5.1666	4.3333	3.3750	2.2000	2.8000
5	5	1	33	1	56	84	48	40	70	60	6.0000	7.6250	6.1583	5.5000	5.6000
6	6	0	38	1	53	53	52	45	55	48	6.0000	7.0083	7.3083	7.2000	7.8000
7	7	0	41	0	40	40	40	40	40	40	5.0000	5.8333	6.6667	6.0000	6.0000
8	8	1	46	1	50	68	56	70	70	66	6.0000	7.3333	8.8333	7.0000	7.0000
9	9	0	28	0	57	40	40	40	40	42	2.7083	2.0000	2.0417	2.1000	2.0000
10	10	0	46	0	56	44	44	48	44	44	1.7833	1.7333	2.1500	2.0000	2.0000



EXAMPLE 1

曾明基 (2019). 縱貫性網路使用行為對學業成就的影響：潛藏轉移模型分析取向.教育科學研究期刊, 64:4, p. 31-59. https://doi.org/10.6209/JORIES.201912_64(4).0002

縱貫性網路使用行為對學業成就的影響：潛藏轉移模型分析取向

曾明基
國立東華大學
師資培育中心

摘要

目前探究網路使用行為對學業成就的影響，僅侷限於橫斷性研究，本研究進一步於縱貫性架構下，探究持續動態變化的網路使用行為對學業成就的影響。基於上述，本研究運用屏東教育長期追蹤資料庫國小四年級至六年級學生的固定追蹤樣本，並採用潛藏轉移模型進行網路使用行為對學業成就影響的動態分析。研究發現，網路使用行為可潛在地區分成五個異質群體，且隨著年級的增加，網路使用行為的轉移機率在不同群體的動態變化有所差異。進一步納進學生性別及學業成就分析發現，性別差異影響網路使用行為，且網路使用行為的潛在異質差異在學業成就上的表現不同。針對上述結果，本研究對網路使用行為的形塑及議題發展提出相關的建議。

表 2

國小四至六年級網路使用行為摘要

%	整體（N=8,699）			男生（N=4,415）			女生（N=4,284）		
	四年級	五年級	六年級	四年級	五年級	六年級	四年級	五年級	六年級
玩電玩遊戲	75.1	75.8	71.7	82.7	84.3	85.0	67.4	67.0	58.0
聽音樂、看影片	55.1	64.2	75.2	54.6	63.5	73.3	55.6	64.9	77.2
做作業	31.4	35.0	35.6	26.2	29.8	31.0	36.9	40.3	40.2
傳送電子郵件	15.4	22.5	17.4	15.1	21.9	18.2	15.6	23.1	16.6
上網蒐集資料、閱讀電子報	26.3	30.1	28.8	24.3	27.8	26.4	28.5	32.5	31.2
交友交流（如部落格、MSN、Facebook等）	24.6	51.2	67.2	24.5	49.8	63.4	24.7	52.7	71.1
國語成就（%）	-.034（87.4）	-.017（87.9）	-.027（88.1）	-.159（88.0）	-.151（87.0）	-.169（88.1）	.094（85.0）	.121（86.6）	.119（85.7）
數學成就（%）	-.026（87.0）	-.014（88.8）	-.014（88.7）	-.036（90.4）	-.048（91.8）	-.073（92.4）	-.015（83.2）	.022（85.4）	.047（84.2）

參、研究方法

一、理論架構與研究假設

本研究運用國小四至六年級學生的網路使用行為資料進行分析，在模型的建構上，首先透過模型競爭及實證研究結果，建構網路使用行為的 LCM。其次，根據網路使用行為理論與實證研究發現，提出一個條件化的 LTA，進一步探討性別差異對網路使用行為的動態影響，以及網路使用行為對學業成就的影響，藉由此模型回應本研究的三個研究目的。

二、資料來源

本研究的分析資料取自 PELS，此資料庫是針對屏東縣國民小學學生的學習狀況，進行為期 3 年的長期追蹤調查。第一年計畫主要是對 99 學年度國小四年級 9,868 位學生進行調查，第二年計畫完成追蹤五年級 9,811 位學生，第三年計畫完成追蹤六年級 9,795 位學生。依據研究目的，採用的是三波（國小四至六年級）學生的固定樣本追蹤調查資料進行分析。

本研究除對三個不同時間點的網路使用行為進行 LTA 分析外，並納入性別變項及學業成就進行探究，在三個不同時間點的完整填答有效樣本數共計有 8,699 筆。

表 1

本研究的測量變項

潛在變項	觀察變項	定義與測量方式
	學生性別	使用虛擬編碼，男生為1，女生為0
網路使用行為	三個測量時間點，共六題	你最常使用電腦做什麼事？ 1. 玩電玩遊戲 2. 聽音樂、看影片 3. 做作業 4. 傳送電子郵件 5. 上網蒐集資料、閱讀電子報 6. 交友交流（如部落格、MSN、Facebook 等） 依據填答的有無，填答有為1，填答無為0
國語成就	三個測量時間點	採用PELS四至六年級三波國語的能力測驗分數，並用IRT水平等化過後的分數進行分析
數學成就	三個測量時間點	採用PELS四至六年級三波數學的能力測驗分數，並用IRT水平等化過後的分數進行分析

Model Evaluation and Parameter Estimation

表 3

網路使用行為在三個測量時間點 LCM 的適配度比較（N=8,699）

	class	BIC	ABIC	Entropy
四年級				
	C_4=1	59814.75	59795.68	1
	C_4=2	56861.00	56819.69	.57
	C_4=3	56351.70	56288.15	.54
	C_4=4	56032.69	55946.89	.60
	C_4=5	55988.61	55880.57	.61
	C_4=6	56008.62	55878.33	.58
五年級				
	C_5=1	64269.28	64250.22	1
	C_5=2	60769.70	60728.39	.57
	C_5=3	59980.74	59917.18	.56
	C_5=4	59659.77	59573.97	.59
	C_5=5	59526.51	59418.46	.64
	C_5=6	59569.99	59439.70	.68
六年級				
	C_6=1	60973.25	60954.19	1
	C_6=2	58549.02	58507.71	.58
	C_6=3	57670.42	57606.86	.65
	C_6=4	57464.72	57378.92	.71
	C_6=5	57469.35	57361.31	.64
	C_6=6	57500.21	57369.91	.60

表 4

網路使用行為在四至六年級時分成五個 LCM 的條件機率（N=8,699）

四年級	C_4#1（40.1%）不愛網路組	C_4#2（24.1%）喜歡娛樂組	C_4#3（17.4%）娛樂交友組	C_4#4（9.4%）網路學習組	C_4#5（8.9%）熱愛網路組
玩電玩遊戲	56.9	100.0	91.3	68.4	91.1
聽音樂、看影片	19.5	100.0	76.6	55.8	93.8
做作業	18.9	26.7	15.3	81.8	69.2
傳送電子郵件	1.6	4.6	33.5	16.1	73.5
上網蒐集資料、閱讀電子報	9.8	19.5	16.0	73.9	81.4
交友交流（如部落格、MSN、Facebook等）	5.0	10.9	71.3	14.5	81.0
五年級	C_5#1（26.9%）不愛網路組	C_5#2（17.4%）喜歡娛樂組	C_5#3（35.2%）娛樂交友組	C_5#4（6.5%）網路學習組	C_5#5（14.0%）熱愛網路組
玩電玩遊戲	52.9	97.8	90.7	53.6	89.5
聽音樂、看影片	20.3	100.0	85.4	46.1	93.1
做作業	15.0	32.7	21.3	76.2	75.3
傳送電子郵件	1.2	8.0	27.6	19.2	70.9
上網蒐集資料、閱讀電子報	6.2	27.2	13.5	69.1	86.4
交友交流（如部落格、MSN、Facebook等）	16.6	0.0	87.1	31.4	92.8
六年級	C_6#1（17.6%）不愛網路組	C_6#2（12.0%）喜歡娛樂組	C_6#3（48.6%）娛樂交友組	C_6#4（7.8%）網路學習組	C_6#5（14.0%）熱愛網路組
玩電玩遊戲	43.9	100.0	77.3	45.5	89.4
聽音樂、看影片	25.9	86.7	89.9	53.6	97.8
做作業	16.0	29.0	22.1	78.1	80.4
傳送電子郵件	5.0	5.2	13.3	16.3	59.1
上網蒐集資料、閱讀電子報	2.7	21.3	12.8	75.1	88.2
交友交流（如部落格、MSN、Facebook等）	28.9	0.0	89.5	47.7	95.0

註：1.C_4#1 表示網路使用行為在四年級的第一個潛在類別群組，C_4#2 表示網路使用行為在四年級的第二個潛在類別群組，C_4#3 表示網路使用行為在四年級的第三個潛在類別群組，其餘時間點的潛在類別分群依此類推；2.在第一列 C_4#1（40.1%）括弧裡的 40.1%表示潛在類別的分群機率，所有潛在類別的分群機率加總為 1，代表所有的分析樣本。

Transition Probability and Auxiliary Variables

表 5

網路使用行為在三個測量時間點的 LTA 分析（N=8,699）

轉移機率矩陣 T_{45} 四年級	五年級 不愛網路組（C_5#1）	喜歡娛樂組（C_5#2）	娛樂交友組（C_5#3）	網路學習組（C_5#4）	熱愛網路組（C_5#5）
不愛網路組（C_4#1）	54.9	18.2	11.7	12.0	3.1
喜歡娛樂組（C_4#2）	4.8	45.4	33.7	4.0	12.0
娛樂交友組（C_4#3）	8.0	0.0	78.4	0.0	20.8
網路學習組（C_4#4）	5.1	0.0	3.1	62.9	28.9
熱愛網路組（C_4#5）	1.5	3.6	24.1	0.0	70.8

T_{56} 五年級	六年級 不愛網路組（C_6#1）	喜歡娛樂組（C_6#2）	娛樂交友組（C_6#3）	網路學習組（C_6#4）	熱愛網路組（C_6#5）
不愛網路組（C_5#1）	46.1	9.0	25.4	15.7	3.8
喜歡娛樂組（C_5#2）	4.2	42.3	43.8	1.7	8.1
娛樂交友組（C_5#3）	1.9	4.8	82.8	0.0	10.5
網路學習組（C_5#4）	4.4	0.0	14.3	63.3	18.0
熱愛網路組（C_5#5）	1.8	1.0	37.6	1.9	57.7

LTA裡的LCM	不愛網路組	喜歡娛樂組	娛樂交友組	網路學習組	熱愛網路組
玩電玩遊戲	18.3	94.3	80.0	58.1	90.4
聽音樂、看影片	13.9	58.6	81.2	57.9	93.9
做作業	17.2	18.4	16.1	76.8	69.3
傳送電子郵件	8.0	4.9	15.4	15.9	61.9
上網蒐集資料、閱讀電子報	7.1	14.1	9.7	60.5	75.4
交友交流（如部落格、MSN、Facebook等）	6.1	6.2	89.6	30.5	90.3

註：T_{45} 表示網路使用行為在四年級及五年級之間的機率轉移情形；T_{56} 表示網路使用行為在五年級及六年級之間的機率轉移情形；分析語法詳列於 https://www.dropbox.com/sh/2uydtfmj99fozal/AACQULlF7XQjCt2ktV-kNnF8a?dl=0。

表 6

納入學生性別的三步驟網路使用行為 LTA 模型（N=8,699）

自變項	四年級	勝敗比	相對機率
學生性別	喜歡娛樂組（C_4#2）	1.02***	2.76
	娛樂交友組（C_4#3）	0.49	1.64
	網路學習組（C_4#4）	-0.48***	0.62
	熱愛網路組（C_4#5）	0.38***	1.46

註：表中第二欄未列出的熱愛網路組（C_4#1）為參照組。性別變項影響網路使用行為潛在類別的迴歸係數為勝敗比（odds ratio），原理和傳統的外顯變項邏輯迴歸相似，在此是以潛在類別變項（C_4#1）作為參照組，而非外顯的類別變項。

***p < .001.

表 7

納入學業成就的三步驟網路使用行為 LTA 模型（N=8,699）

	不愛網路組	喜歡娛樂組	娛樂交友組	網路學習組	熱愛網路組
國語成就					
四年級	-.18	-.14	.01	.27	.19
五年級	-.12	-.16	-.08	.29	.13
六年級	-.17	-.26	-.06	.26	.13
數學成就					
四年級	-.23	-.09	.00	.27	.15
五年級	-.20	-.12	-.08	.31	.13
六年級	-.20	-.18	-.07	.31	.14

註：1.表中的國語和數學測驗分數是經過 IRT 水平等化連結而得的標準化分數；2.所有參數估計的 p 值均 < .001。

EXAMPLE 2

Jih-Hsuan Tammy Lin, & Yeu-Sheng Hsieh (2021).,Longitudinal Social Grooming Transition Patterns on Facebook, Social Capital, and Well-Being, *Journal of Computer-Mediated Communication, 26*:6, 320–342., https://doi.org/10.1093/jcmc/zmab011

Longitudinal Social Grooming Transition Patterns on Facebook, Social Capital, and Well-Being

Jih-Hsuan Tammy Lin[1] & Yeu-Sheng Hsieh[2]

[1]College of Communication, Taiwan Institute for Governance and Communication Research, National ChengChi University, Taipei 116, Taiwan

[2]Department of Bio-Industry Communication and Development, National Taiwan University, Taipei 106, Taiwan

The longitudinal associations between Facebook use and well-being have received limited exploration with mixed results. We argue that the transition pattern of an individual's social grooming style based on five social grooming behaviors at different times—referred to as the social grooming transition pattern—is the key to exploring this issue. Based on the social grooming style framework, we employed latent transition analysis through a nationally representative, three-year panel survey (N = 710) in Taiwan. We found that active users remained active in social grooming behavior and had options to shift, and inactive users largely remained inactive in terms of Facebook social grooming style. The results indicated that persistent social image managers gained the most social capital and well-being, greater than persistent social butterflies and those who transitioned from image managers to social butterflies, indicating that adopting strategic social grooming styles in the long-term delivered the best social outcomes.

Table 2 Social Media Use Time (in minutes) and Frequency of Specific Platforms across 2017 and 2019

Wave	SNS time	FB	Twitter	LinkedIn	IG	Weibo	Plurk
Panel data (use FB in both waves) (the analyzed sample in this study, $N = 710$)							
1 (2017)	$M = 796.2$	710	23	25	124	42	4
2 (2019)	$M = 762.7$	710	52	52	222	48	7
Panel data from both waves ($N = 1{,}272$)							
1 (2017)	$M = 624$	768	25	29	129	48	5
2 (2019)	$M = 547.4$	826	60	58	238	53	8

Table 3 Description of Five Social Grooming Behaviors in Latent Transition Models ($N = 710$)

Indicators of latent status		T1		T2	
		Frequency	(%)	Frequency	(%)
Emotional self-disclosure ("How often do you share your emotions on your Facebook wall?")					
Low	情感性自我揭露	555	78.17	549	77.32
high		155	21.83	161	22.68
Informational self-disclosure ("How often do you share daily general events on your Facebook wall (such as where you are, what you are doing, eating, watching, or listening to)?")					
Low	資訊性自我揭露	426	60.00	454	63.94
High		284	40.00	256	36.06
Controversial topics ("How often do you discuss controversial issues on your Facebook wall [such as same-sex marriage, nuclear power]?")					
Low	爭議性話題討論	633	89.15	639	90.00
High		77	10.85	71	10.00
Trending topics ("How often do you discuss current noncontroversial and trending topics [such as online quizzes, popular games, or interesting news]?)"					
Low	流行性話題討論	563	79.30	579	81.55
High		147	20.70	131	18.45
Relationship-maintenance ("How often do you respond to other people's posts on Facebook [including like clicks, emojis, or comments)?)"					
Low	關係性維繫行為	200	28.17	186	26.20
High		510	71.83	524	73.80

Analysis

To study longitudinal user behavior, transition pattern research using latent transition analysis (LTA) is preferred in the social, behavioral and health literature (Daw et al., 2017). LTA is a longitudinal extension of LCA. In LTA, individuals may change membership in latent statuses over time. Thus, when modeling social grooming style over time as a categorical latent variable, multiple aspects of Facebook use behavior are assessed across two occasions and can be used to jointly indicate an individual's behavior status over time. Therefore, LTA can be applied to identify and describe classes of individuals with distinct characteristics of social grooming style over time. At each time point, an individual's behavior status can be identified and transition probabilities from T1 to T2 reflect a parsimonious summary of change in social grooming style over time. That is, LTA provides information about which social grooming style at T1 corresponds to the highest likelihood of transitioning to latent status at T2. Finally, whether individuals with different transition patterns of social grooming style between two time points experience or enjoy different social lifestyles, including social capital and well-being, can be further demonstrated. The details are summarized in the Methodological Appendix.

We first employed LTA to identify the distinct transition patterns of social grooming styles over time. We conducted several latent transition models with different numbers of statuses to determine which model would be more appropriate for the transition patterns of social grooming styles over time based on the G^2, AIC, and BIC criteria for assessing model fit (Collins & Lanza, 2010). We then predicted the latent transition pattern for each individual according to the identified LTA with all observed variables of social grooming behaviors in a two-wave survey. Finally, we used fixed-effects models (Allison, 2009) with predicted transition patterns as the independent variables to investigate how an individual's social capital and well-being are associated with these distinct transition patterns.

Table 4 Latent Transition Model with Five Statuses of Social Grooming Behaviors for Facebook Users

Status	1 社交活躍者 Social butterfly	2 形象管理者 Image manager	3 流行追隨者 Trend follower	4 關係維繫者 Relationship maintainer	5 潛水客 Lurker
T1	0.0896	0.1281	0.1110	0.3082	0.3631
T2	0.0623	0.1476	0.1340	0.2732	0.3829

Table 5 Probability of Response to Indicators of Social Grooming Behavior

Observed variable of social grooming style	Latent status (T1 and T2)				
	1 Social butterfly	2 Image manage	3 Relationship maintainer	4 Trend follower	5 Lurker
Emotional self-disclosure	0.9764	0.7353	0.0066	0.3473	0.0067
Informational self-disclosure	1.0000	0.8599	0.3880	0.4802	0.0379
Controversial topics	0.6492	0.0000	0.0000	0.4008	0.0156
Trending topics	0.9168	0.1293	0.1489	0.5307	0.0000
Relationship maintenance	0.9785	0.8094	0.9014	0.9230	0.4482

Table 6 Diagnostic Statistics for LTA of Social Grooming Behavior

Number of latent statuses	OG-LIKELIHOOD	df	G^2	AIC	BIC
Two latent statuses	−3245.86	1,010	648.14	674.14	733.49
Three latent statuses	−3181.52	1,000	519.45	565.45	670.45
Four latent statuses	−3149.58	988	455.58	525.58	685.36
Five latent statuses	**−3125.62**	**974**	**407.65**	**505.65**	**729.35**

Table 7 Transition Probabilities between Latent Statuses at T1 and Latent Statuses at T2

T2 (columns) T1 (row)	1 (Social butterfly)	2 (Image manager)	3 (Trend follower)	4 (Relationship maintainer)	5 (Lurker)
1 (Social butterfly)	0.4156	0.2132	0.0000	0.2299	0.1412
2 (Image manager)	0.1558	0.4406	0.2123	0.1392	0.0521
3 (Trend follower)	0.0000	0.2042	0.4809	0.0816	0.4375
4 (Relationship maintainer)	0.0167	0.0000	0.0248	0.7061	0.0481
5 (Lurkers)	0.0000	0.0250	0.1261	0.0222	0.8267

Note. The level of darkness of the colors indicates the degree of the proportion: the higher the proportion, the darker the color.

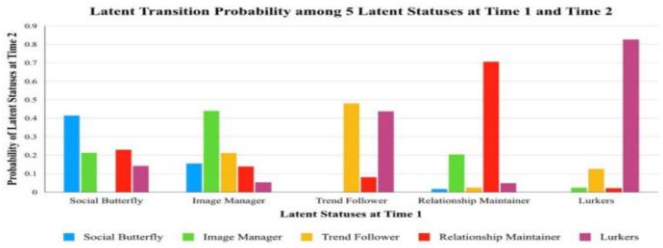


Figure 1 Latent transition probability among five latent statuses at T1 and T2.

LTA with Auxiliary Variables

Table 8 Means and Standard Deviations of Demographic Data for Each Transition Group

	Group 11 ($N = 27$)	Group 22 ($N = 34$)	Group 33 ($N = 25$)	Group 44 ($N = 145$)	Group 55 ($N = 263$)
Sex (male = 1)	.19 (.40)	.35 (.49)	.56 (.51)	.24 (.50)	.49 (.50)
Age	40.56 (8.59)	43.29 (10.89)	42.04 (10.49)	43.68 (11.82)	45.44 (12.67)
Education	14.48 (2.14)	13.47 (2.5)	15.12 (2.32)	14.36 (2.42)	14.09 (2.55)
Married	.59 (.50)	.74 (.45)	.6 (.5)	.61 (.49)	.62 (.49)
Other	0	.03 (.17)	.04 (.2)	.05 (.22)	.07 (.25)
	Group 12 ($N = 11$)	Group 14 ($N = 24$)	Group 21 ($N = 16$)	Group 24 ($N = 10$)	Group 23 ($N = 16$)
Sex (male = 1)	.09 (.30)	.63 (.49)	.38 (.5)	.3 (.48)	.44 (.51)
Age	39.73 (9.22)	37.71 (6.64)	41 (11.55)	43.9 (13.78)	45.69 (13.55)
Education	13.82 (1.89)	14.13 (2.21)	15.25 (2.05)	14.1 (2.23)	13.5 (1.86)
Married	.82 (.40)	.67 (.48)	.56 (.51)	.6 (.52)	.69 (.48)
Other	0	.13 (.34)	.06 (.25)	.1 (.32)	.06 (.25)
	Group 42 ($N = 50$)	Group 45 ($N = 8$)	Group 35 ($N = 30$)	Group 53 ($N = 25$)	Group 54 ($N = 9$)
Sex (male = 1)	.34 (.48)	.75 (.46)	.6 (.50)	.48 (.51)	.22 (.44)
Age	47.04 (11.48)	42 (6.19)	46.43 (14.49)	41.4 (8.84)	42 (15.29)
Education	13.67 (2.27)	14 (2.39)	14.37 (2.85)	14.8 (1.83)	13.75 (1.98)
Married	.66 (.48)	.63 (.52)	.6 (.50)	.52 (.51).	0.67 (.5)
Other	.04 (.20)	.13 (.35)	.03 (.18)	.04 (.02	0

Table 9 Concurrent Analysis: T2 Adjusted Means and Adjusted Standard Deviations of Social Capital and Well-Being by T2 Social Grooming Styles controlling for effects of covariates

	Social butterfly	Image manager	Trend follower	Maintainer	Lurker
N	45	100	66	188	311
Bonding capital	3.99 (.67)^{ab}	4.09 (.60)^{ac}	4.01 (.68)^{ab}	4.00 (.59)^{ab}	3.85 (.74)^{bd}
Bridging capital	3.96 (.66)	3.87 (.67)	3.89 (.61)	3.80 (.67)	3.67 (.71)
Social connectedness	3.71 (.76)^{ae}	3.76 (.73)^{be}	3.68 (.77)^{ae}	3.48 (.80)^{ac}	3.19 (.81)^{d}
Life satisfaction	3.71 (.82)	3.72 (.67)	3.71 (.80)	3.69 (.75)	3.63 (.74)
Social life satisfaction	3.73 (.69)^{ab}	3.84 (.61)^{ab}	3.76 (.77)^{ab}	3.81 (.66)^{ac}	3.63 (.72)^{bd}
Happiness	3.80 (.79)	3.81 (.68)	3.74 (.69)	3.79 (.73)	3.70 (.71)
Loneliness	2.38 (.81)	2.24 (.68)	2.24 (.68)	2.18 (.76)	2.29 (.75)

Note. Means that have no superscript in common are significantly different from each other

A summary: Step-by-Step of LTA

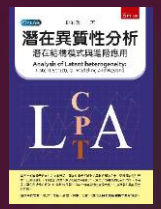
- **Step 1：確認研究設計與資料準備**
  - **檢查縱貫資料 (longitudinal data)**
    - 至少有兩個時間點（T1,T2, …）
    - 同一批受試者在各時間點重複測量
  - **整理觀察變數 (observed variables)**
    - 各時間點的觀察變數(指標)必須相同一致
    - 報告觀察變數計量特徵（categorical or continuous）
- **Step 2：執行潛在類別分析 (LCA/LPA)**
  - **橫斷性 LCA/LPA**
    - 評估合理的潛在類別數目（K）
    - 依據 AIC, BIC, G^2, entropy 等模型適配指標判斷
  - **潛在類別命名**
    - 根據測量參數命名
    - LCA: conditional probability
    - LPA: conditional distribution
- **Step 3：執行潛在轉移分析(LTA)**
  - **無條件LTA (unconditional LTA)**
    - 僅包含估計潛在類別的觀察變數
    - 測量恆等設定: 不同時點的測量參數等值
  - **定態性分析 (analysis of stationarity)**
    - 定態模型: 跨時點間的轉移機率設定為等值
    - 非定態模型: 跨時點間的轉移機率自由估計
- **Step 4：模型適配評估與參數報告**
  - **模式檢查: Preliminary check**
    - 檢查模型收斂性
    - 檢查參數合理性
  - **報告模式適配: AIC, BIC, G^2, entropy**
  - **報告測量參數**
    - LCA: conditional probability
    - LPA: conditional distribution
- **Step 5：解釋潛在轉換模式**
  - **報告潛在類別盛行率 (latent class probability)**
  - **報告轉換機率 (transition probabilities)**
    - 保留機率(群體穩定性)
    - 移動機率(轉出/轉入機率)
- **Step 6：後續分析**
  - **輔助變數 (auxiliary variables)**
    - 解釋變數 (covariates): 如年齡、性別
    - 結果變數 (outcomes): 如well-being
  - **隨機截距 (random intercept)**
    - Categorical RI
    - Continuous RI
  - **誤差校正 (correction for categorization error)**
    - 3 step approach





PART 2

FROM LCA, LPA, TO LTA

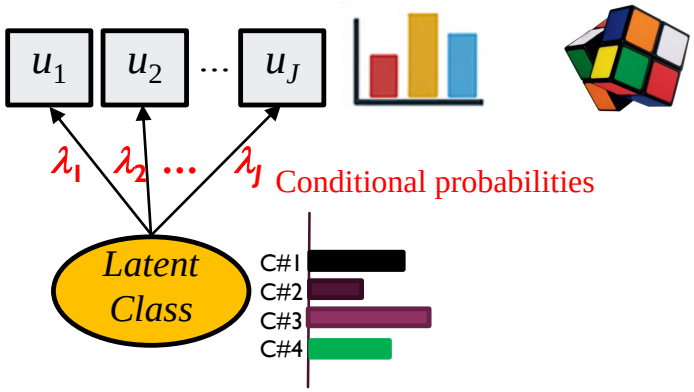


起源: Latent Structure Modeling



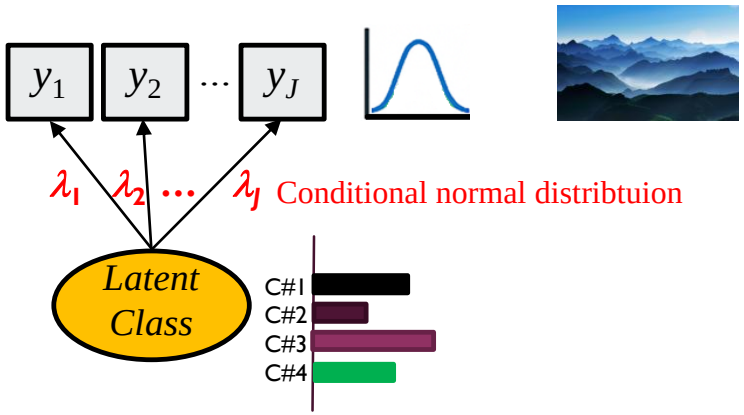
- **Paul F. Lazarsfeld (president of ASA, 1961) and Neil W. Henry (1968)**
- **Latent class analysis (LCA)**
  - **Categorical measures (*u*) as indicators**

$$P(u|C_k = k) = \sum_{k=1}^{K} \pi_k \left[\lambda_k^u (1-\lambda_k)^{1-u} \right]$$

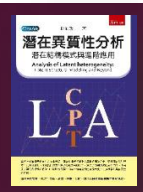


- **Latent profile analysis (LPA)**
  - **Continuous measures (*y*) as indicators**

$$f(y|C_k = k) = \frac{1}{\sqrt{2\pi\sigma_k^2}} \exp\left[-\frac{(y-\mu_k)^2}{2\sigma_k^2} \right]$$



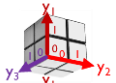
潛在類別分析的基本原理



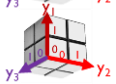
- 多重類別資料的**聯合機率**
  - **同質（單一）母體**

$$P(y_1, y_2, ..., y_J) = P(y_1)P(y_2)...P(y_J) = \prod_{j=1}^{J} P(y_j) = P(\mathrm{Y})$$

  - **異質（多重）母體**

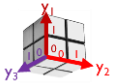


$$P(y_1, y_2, \ldots, y_J|C=1) = P(y_1|C=1)P(y_2|C=1)...P(y_J|C=1) = \prod_{j=1}^{J} P(y_j|C=1)$$



$$P(y_1, y_2, \ldots, y_J|C=2) = P(y_1|C=2)P(y_2|C=2)...P(y_J|C=2) = \prod_{j=1}^{J} P(y_j|C=2)$$

…



$$P(y_1, y_2, \ldots, y_J|C=K) = P(y_1|C=K)P(y_2|C=K)...P(y_J|C=K) = \prod^{J} P(y_j|C=K)$$

  - **有限混合（finite mixture）：LCA**



$$P(y_1, y_2, ..., y_J) = \sum_{k=1}^{K} P(C=k) \prod_{j=1}^{J} P(y_j|C=k)$$

各組互斥　局部獨立

latent class model

$$P(\mathrm{Y}) = \sum_{k=1}^{K} \pi_k P(\mathrm{Y}|C=k)$$

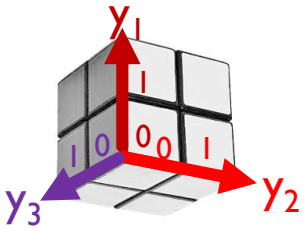
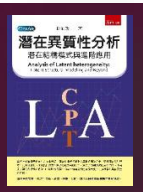


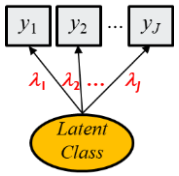
表 3.1　1000 位受測者在三個問診項目的作答情形

作答反應	y_1 發燒	y_2 咳嗽	y_3 流鼻水	*f*	*P*	%
{000}	0	0	0	93	.093	9.3
{001}	0	0	1	68	.068	6.8
{010}	0	1	0	95	.095	9.5
{011}	0	1	1	101	.101	10.1
{100}	1	0	0	81	.081	8.1
{101}	1	0	1	95	.095	9.5
{110}	1	1	0	110	.110	11.0
{111}	1	1	1	357	.357	35.7
小計						
y={0}	.357	.337	.379			
y={1}	.643	.663	.621			
總和				643	1.00	100

潛在類別分析的參數



- **測量參數（measurement parameter）**



  - **題項反應機率（item response probability）**
    - 反映J個帶有Q個水準的觀察變數**Y**與K個潛在類別的潛在變數C的關係

$$P(\mathrm{Y}|C=k)=\prod_{j=1}^{J}P(y_j|C=k)=\prod_{j=1}^{J}\prod_{q=1}^{Q}P(y_j=q|C=k)=\prod_{j=1}^{J}\lambda_{jkq}$$

    - λ_{jkq}：各潛在類別**Y**取值為q時的題項反應條件機率
    - 數值越高表示該觀察變數在該潛在類別中的回答q選項的機率越高

- **結構參數（structure parameter）**
  - **潛在類別機率（latent class probability）**
    - 分群機率π_k越大表示該潛在類別在觀察資料當中的占比越高，在潛在變數各水準具有較重要的地位

$$\pi_k = P(C_i=k) \qquad \sum_{k=1}^{K}\pi_k=\sum_{k=1}^{K}P(C=k)=1$$

P(Y)為8細格之聯合機率

$$P(\mathrm{Y})=P(y_1,y_2,y_3)=\sum_{k=1}^{K}\pi_k P(\mathrm{Y}|C=k)$$

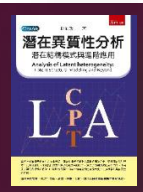
$$=\sum_{k=1}^{K}\pi_k\prod_{j=1}^{J}\lambda_{jk}^{y_j}(1-\lambda_{jk})^{1-y_j}$$

$$\ln P(\mathrm{Y}|C=k)=\alpha_k+\sum_{j=1}^{J}\beta_{jk}$$

表 3.1　1000 位受測者在三個問診項目的作答情形

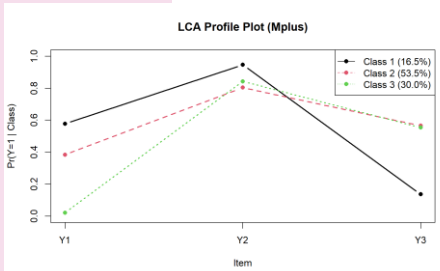
作答反應	y_1 發燒	y_2 咳嗽	y_3 流鼻水	f	P	%
{000}	0	0	0	93	.093	9.3
{001}	0	0	1	68	.068	6.8
{010}	0	1	0	95	.095	9.5
{011}	0	1	1	101	.101	10.1
{100}	1	0	0	81	.081	8.1
{101}	1	0	1	95	.095	9.5
{110}	1	1	0	110	.110	11.0
{111}	1	1	1	357	.357	35.7
小計						
y={0}	.357	.337	.379	邊際分配		
y={1}	.643	.663	.621	(機率和為1.0)		
總和				643	1.00	100

範例說明 (Mplus1.inp)



- **以Mplus進行K=3的LCA估計:**

```
TITLE: LCA on 1000 patients Class3
DATA:      FILE    = Ch3a.csv;
VARIABLE:  NAMES   = ID Y1-Y3;
           USEV    = Y1-Y3;
           CLASSES= C(3);
           CATEGORICAL=Y1-Y3;
ANALYSIS:  TYPE=MIXTURE;
OUTPUT:    TECH1 TECH7 TECH10;
SAVEDATA:  FILE IS Syn3.C3.dat;
           SAVE = CPROB;
```



$$\hat{\pi}_1 = P(C=1) = \frac{\exp(-.597)}{\exp(-.597)+\exp(.579)+\exp(0)} = .165$$

$$\ln P(\mathrm{Y}|C=k) = \alpha_k + \sum_{j=1}^{J} \beta_{jk}$$

MODEL RESULTS

	Estimate	S.E.	Est./S.E.	Two-Tailed P-Value
Latent Class 1				
Thresholds				
Y1$1	-0.314	0.490	-0.640	0.522
Y2$1	0.473	0.316	1.497	0.134
Y3$1	3.782	4.269	0.886	0.376
Latent Class 2				
Thresholds				
Y1$1	-2.881	1.413	-2.039	0.041
Y2$1	-1.410	0.170	-8.272	0.000
Y3$1	-1.682	0.000	999.000	999.000
Latent Class 3				
Thresholds				
Y1$1	1.841	1.562	1.179	0.238
Y2$1	-0.264	0.221	-1.195	0.232
Y3$1	-0.218	0.000	999.000	999.000
Categorical Latent Variables				
Means				
C#1	-0.597	0.000	999.000	999.000
C#2	0.579	0.000	999.000	999.000

表 3.2　1000 名病患的潛在類別模型機率估計結果

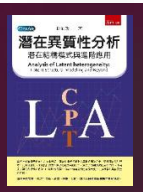
		潛在變數 C			
		C=1	C=2	C=3	Total
觀察變數	α_k=	-.597	.579	0	
	π_k=	**.165**	**.535**	**.300**	**1.000**
y_1 發燒	y=1	.095 (.578)	.507 (.947)	.578*.165	.643
	y=0	.070 (.422)	.029 (.053)	.258 (.863)	.357
y_2 咳嗽	y=1	.004 (.022)	.451 (.843)	.166 (.554)	.663
	y=0	.161 (.978)	.085 (.127)	.133 (.446)	.337
y_3 流鼻水	y=1	.064 (.384)	.430 (.804)	.169 (.566)	.621
	y=0	.101 (.616)	.106 (.196)	.130 (.434)	.379

註：括弧內的機率為各潛在類別內的觀察變數條件機率 λ

$$P(y_1=1|C=1) = \frac{1}{1+\exp(\tau)} = \frac{1}{1+\exp(-.314)} = \frac{1}{1+0.7305} = .578$$

$$P(y_1=0) = \frac{\exp(\tau)}{1+\exp(\tau)} = \frac{\exp(-.314)}{1+\exp(-.314)} = \frac{0.7305}{1+0.7305} = .422$$

機率的閾值運算



- **閾值（threshold）**
  - 將機率轉換成±∞連續型態的logit數列
  - τ: 發生與不發生某事件A的分割點
    - (2-12)

$$\tau = \ln\left(\frac{P(A)}{P(A')}\right) = \ln P(A) - \ln P(A')$$

$$P(A) = P(Y=1) = \frac{\exp(\tau)}{1+\exp(\tau)}$$

$$P(A') = P(Y=0) = \frac{1}{1+\exp(\tau)}$$

    - τ 數值範圍介於±∞，對稱於0
    - τ =0所對應的機率值為.5
  - **logit值**
    - *P*(*Y*=1)對比*P*(*Y*=0)的勝算（*Odds*）機率比對數轉換
    - (2-15)

$$\ln(Odds) = \ln\left(\frac{P(Y=1)}{P(Y=0)}\right)$$

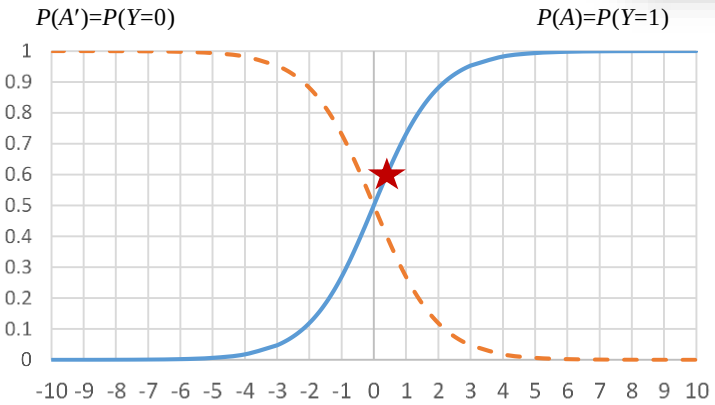


圖2.2 閾值（X軸）與機率值（Y軸）對應圖示

```
Input data file(s)
  T2.1.csv
Input data format  FREE

UNIVARIATE PROPORTIONS AND COUNTS FOR CATEGORICAL VARIABLES

    A
      Category 1    0.500          50.000
      Category 2    0.500          50.000
    B
      Category 1    0.600          60.000
      Category 2    0.400          40.000

MODEL RESULTS

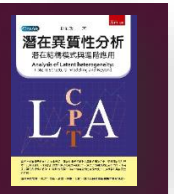
                                                    Two-Tailed
                Estimate       S.E.  Est./S.E.    P-Value
Latent Class 1

 Thresholds
    A$1            0.000      0.200      0.000      1.000
    B$1            0.405      0.204      1.986      0.047

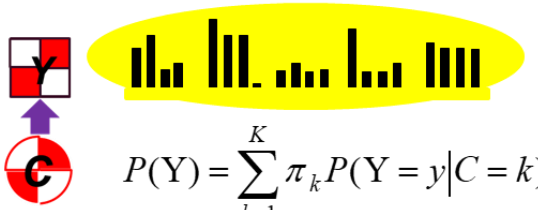
RESULTS IN PROBABILITY SCALE

                                                    Two-Tailed
                Estimate       S.E.  Est./S.E.    P-Value
Latent Class 1
 A
    Category 1     0.500      0.050     10.000      0.000
    Category 2     0.500      0.050     10.000      0.000
 B
    Category 1     0.600      0.049     12.247      0.000
    Category 2     0.400      0.049      8.165      0.000
```

潛在剖面分析

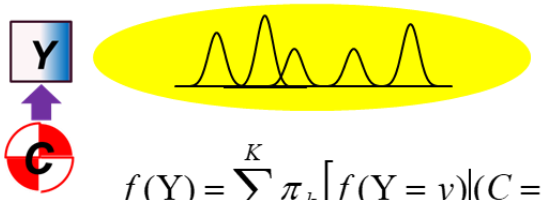


- **基本原理**
  - **Latent profile analysis (LPA)：**利用一組連續性觀察指標來估計資料背後所存在的潛在類別，藉以推估母體異質性
  - **潛在剖面（latent profile）：**不同異質群體在各測量指標上的狀態是起伏不定的平均值折線剖面圖
  - **LCA: 觀察變數是類別變數**



$$P(\mathrm{Y}) = \sum_{k=1}^{K} \pi_k P(\mathrm{Y} = y | C = k)$$

  - **LPA: 觀察變數是連續變數**



$$f(\mathrm{Y}) = \sum_{k=1}^{K} \pi_k \left[f(\mathrm{Y} = y) | (C = k) \right]$$

$$y_{ij} = \mu_{jk} + \varepsilon_{ijk} \qquad \varepsilon_{ijk} \sim N(0, \sigma_{jk}^2)$$

局部平均（local mean）　　局部變異（local variance）

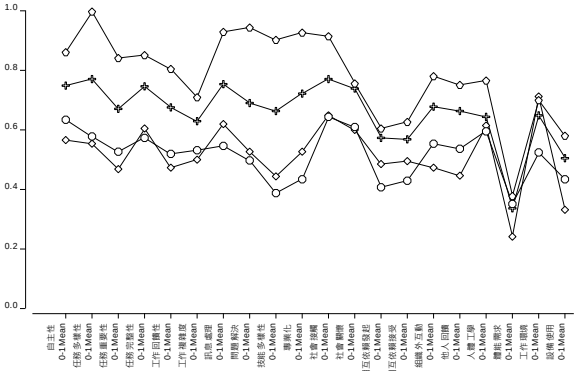


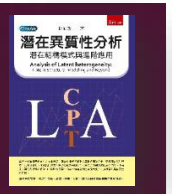
圖 1.3 工作特徵量表的潛在剖面分析圖示
（取自邱皓政、周怡君、林碧芳，2010，p.166）

LPA概似函數

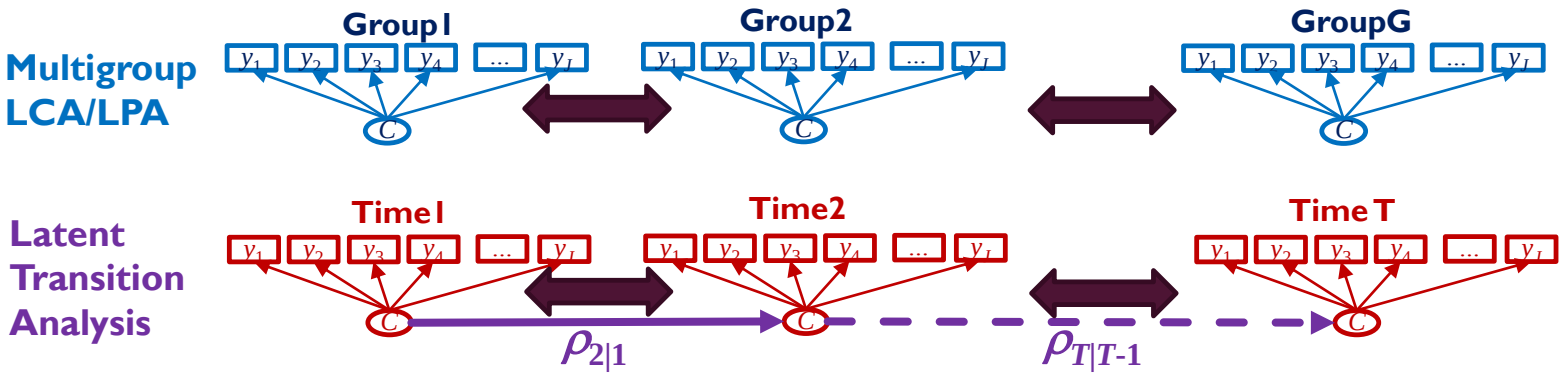
$$L(\Theta | \mathrm{Y}) = \sum_{k=1}^{K} \pi_k \prod_{j=1}^{J} f(y_j | \theta_k)$$

$$f(y_i | \theta_k) = \frac{1}{\sqrt{2\pi\sigma_k^2}} \exp\left[-\frac{(y_i - \mu_k)^2}{2\sigma_k^2} \right]$$

潛在轉移分析

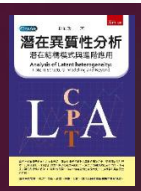


- **基本原理**
  - 潛在轉移分析（latent transition analysis; LTA）：longitudinal extension of the LCA/LPA：估計潛在類別在各時點下的變動情形
  - 以自我迴歸模式（auto-regression model; ARM）來估計*K*個潛在類別在時序上的自我相關（autocorrelation），藉以瞭解異質母體隨時間進展的變化情形
  - 同一個潛在類別變數*C*跨時點的機率變化，類似具有測量恆等性**之多群組分析**

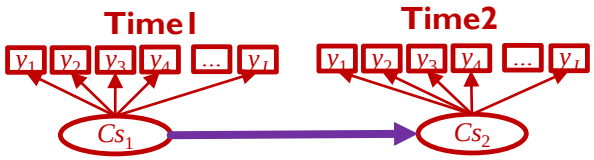


- **馬可夫模型（Markov model）：描述機率狀態隨時間變化的機率模型**
  - 馬可夫鏈（Markov chain）：在一個連續的時間序列上，隨機變數在時點（*t*）的機率狀態僅受到*t*–1的影響，以轉移機率矩陣（transition probability matrix）來描述觀察資料的轉變
  - 多重指標潛在馬可夫模型（multiple indicator latent Markov model）：一組觀察變數的重複測量在*T*個時點下的變動狀態

LTA的模式設定



- **潛在類別變數⇒潛在類別狀態 (state)**
  - 縱貫性的潛在類別變數（Cs）反映不同時點下的分類狀態



- **測量模型：**
  - LCA/LPA

$$f(Y_{tj}=y)=\sum_{k=1}^{K}\pi_{tk}\,f(Y_{tj}=y\,|\,Cs_t=k)$$

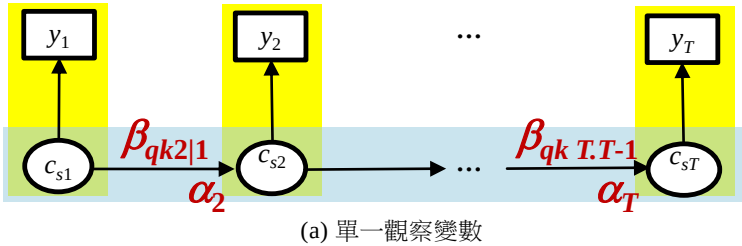
LCA $$P(Y_{tj}=1|Cs_t=k)=1/(1+\exp(\tau_{tkj}))$$

LPA $$f(Y_{tj}=y|Cs_t=k)=\frac{1}{\sqrt{2\pi\sigma_{tkj}^2}}\exp\left[-\frac{(y-\mu_{tkj})^2}{2\sigma_{tkj}^2}\right]$$

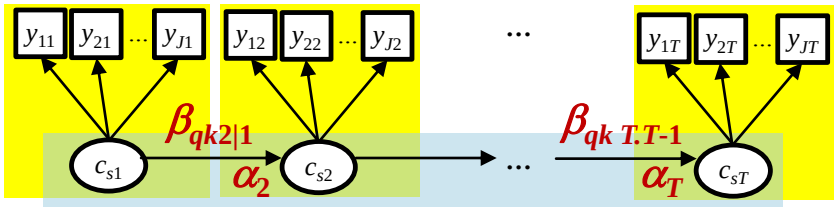
- **結構模型：**
  - 羅吉斯自我迴歸模式

$$P(Cs_t=q\,|\,Cs_{t-1}=k)=\frac{e^{(\alpha_q+\beta_{qk})}}{\sum_{q=1}^{K}e^{(\alpha_q+\beta_{qk})}}$$

$$\ln\left(\frac{P(Cs_t=q\,|\,Cs_{t\text{-}1}=k)}{P(Cs_t=K\,|\,Cs_{t\text{-}1}=k)}\right)=\ln\left(\frac{e^{\alpha_q+\beta_{qk}}}{e^{\alpha_K+\beta_{Kk}}}\right)=\alpha_q+\beta_{qk}$$



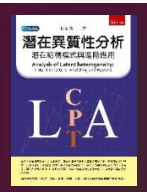
(a) 單一觀察變數



(b) 多重觀察變數

圖7.1 潛在轉移分析的模式圖示

LTA的結構參數



- **羅吉斯迴歸參數**
  - 多元邏輯參數（multinomial logit parameterization）

$$\ln\left(\frac{P(Cs_{t+1}=q\mid Cs_t=k)}{P(Cs_{t+1}=K\mid Cs_t=k)}\right)=\ln\left(\frac{e^{\alpha_q+\beta_{qk}}}{e^{\alpha_K+\beta_{Kk}}}\right)=\alpha_q+\beta_{qk}$$

參照組

限制式 $\alpha_K=0$、$\beta_{Kk}=0$、$\beta_{kK}=0$

表 7.1 組數 *K*=2 與組數 *K*=3 的 LTA 結構參數(勝算對數)

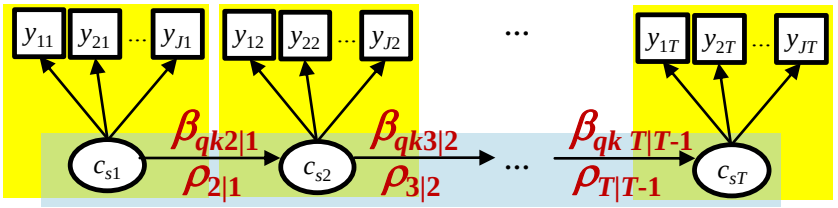
IV		$DV=Cs_t$ *q*=1	*q*=2	*q*=3
		分組數 ***K*=2**		
Cs_{t-1}	*k*=1	$\alpha_1+\beta_{11}$	$\alpha_2+\beta_{21}=0$	
	k=2	$\alpha_1+\beta_{12}$	$\alpha_2+\beta_{22}=0$	

K=2

$$\ln\left(\frac{P(Cs_2=1\mid Cs_1=1)}{P(Cs_2=2\mid Cs_1=1)}\right)=\ln\left(\frac{e^{\alpha_1+\beta_{11}}}{e^{\alpha_2+\beta_{21}}}\right)=\alpha_1+\beta_{11}$$

$$\ln\left(\frac{P(Cs_2=1\mid Cs_1=2)}{P(Cs_2=2\mid Cs_1=2)}\right)=\ln\left(\frac{e^{\alpha_1+\beta_{12}}}{e^{\alpha_2+\beta_{22}}}\right)=\alpha_1$$

- **轉移機率（transition probability）**
  - 描述潛在狀態隨時間遞延的機率分配



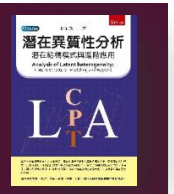
$$\Phi_\rho=\begin{array}{c} \\ C_{k=1|t-1} \\ C_{k=2|t-1} \\ \vdots \\ C_{k=K|t-1} \end{array}\begin{array}{c} \begin{array}{cccc} C_{g=1|t} & C_{g=2|t} & \cdots & C_{g=K|t} \end{array} \\ \begin{bmatrix} \rho_{11} & \rho_{12} & \cdots & \rho_{1K} \\ \rho_{21} & \rho_{22} & \cdots & \rho_{2K} \\ \vdots & \vdots & \ddots & \vdots \\ \rho_{K1} & \rho_{K2} & \cdots & \rho_{KK} \end{bmatrix} \end{array}\begin{array}{l} \\ \Rightarrow \Sigma\rho_{1\bullet}=1 \\ \Rightarrow \Sigma\rho_{2\bullet}=1 \\ \vdots \\ \Rightarrow \Sigma\rho_{K\bullet}=1 \end{array}$$

保留機率：$\rho_{11}\,\rho_{22}\,\ldots\,\rho_{KK}$

移出機率：$\rho_{12}\,\rho_{13}\,\ldots\,\rho_{1K}$

移入機率：$\rho_{12}\,\rho_{22}\,\ldots\,\rho_{K2}$

LTA的分群機率



- **潛在狀態盛行率（latent status prevalence）**
  - 各時點下的潛在類別分群機率（π_{kt}）

$$\pi_{kt} = P(Cs_{t+1} = q \mid Cs_t = k) = \frac{e^{\alpha_{qk}+\beta_{qk}}}{\sum_{q=1}^{K} e^{\alpha_{qk}+\beta_{qk}}} = \frac{\exp(\alpha_{qk}+\beta_{qk})}{\sum_{q=1}^{K}\exp(\alpha_{qk}+\beta_{qk})} \qquad \sum_{k_t=1}^{K}\pi_{kt} = \sum_{k_t=1}^{K} P(Cs = k \mid T = t) = 1$$

  - **t=I期:** α_q為各潛在狀態的平均數，以最後一組為參照組（α_K=0）

$$\pi_{11}^{t=1} = \frac{\exp(\alpha_1)}{\sum_{k=1}^{K}\exp(\alpha_k)} = \frac{\exp(-.031)}{\exp(-.031)+\exp(0)} = \frac{.9695}{.9695+1} = .492 \qquad \pi_{21}^{t=1} = \frac{\exp(\alpha_2)}{\sum_{k=1}^{K}\exp(\alpha_k)} = \frac{\exp(0)}{\exp(-.031)+\exp(0)} = \frac{1}{.9695+1} = .508$$

  - **t>I各期**分群歸屬以自我迴歸參數估計，或以轉移矩陣的保留機率與轉入機率求出下一期各潛在類別的分群機率

$$P(Cs_{1|t}) = P(Cs_{1|t\text{-}1}) \times \rho_{1_t|1_{t\text{-}1}} + \ldots + P(Cs_{K|t\text{-}1}) \times \rho_{1_t|K_{t\text{-}1}}$$

$$\pi_{12} = \left(\frac{\exp(\alpha_1+\beta_{11})}{\sum_{k=1}^{K}\exp(\alpha_k+\beta_{k1})}\right)\times\pi_{11} + \left(\frac{\exp(\alpha_1)}{\sum_{k=1}^{K}\exp(\alpha_k)}\right)\times\pi_{21}$$

$$= \left(\frac{\exp(-1.407+2.517)}{\exp(-1.407+2.517)+\exp(0)}\right)\times.492 + \left(\frac{\exp(-1.407)}{\exp(-1.407)+\exp(0)}\right)\times.508$$

$$= \left(\frac{3.0344}{3.0344+1}\right)\times.492 + \left(\frac{0.2449}{0.2449+1}\right)\times.508$$

$$= .752\times.492 + .197\times.508 = .470$$

$$\pi_{t-1} \times \Phi_\rho = \pi_t$$

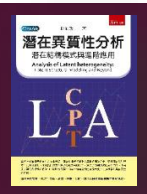
t1→t2 $\begin{bmatrix}.492\\.508\end{bmatrix}\times\begin{bmatrix}.752 & .248\\.197 & .803\end{bmatrix} = \begin{bmatrix}.470\\.530\end{bmatrix}$

t2→t3 $\begin{bmatrix}.470\\.530\end{bmatrix}\times\begin{bmatrix}.752 & .248\\.197 & .803\end{bmatrix} = \begin{bmatrix}.458\\.542\end{bmatrix}$

t3→t4 $\begin{bmatrix}.458\\.542\end{bmatrix}\times\begin{bmatrix}.752 & .248\\.197 & .803\end{bmatrix} = \begin{bmatrix}.451\\.549\end{bmatrix}$

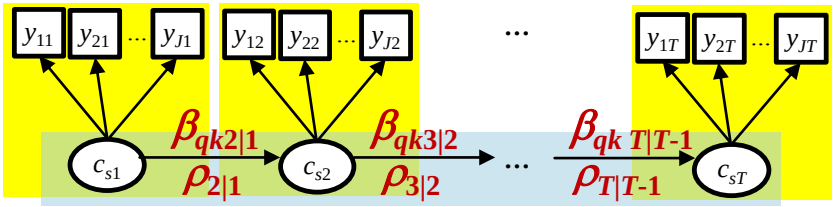
定態模型（轉移機率固定）

定態與非定態



- **定態模型（stationary model）**
  - $T-1$組轉移機率假設為相等
  - $P(Cs_2=g|Cs_1=k)=P(Cs_3=g|Cs_2=k)=\ldots=P(Cs_T=g|Cs_{T-1}=k)$
  - 各期間的轉換機率（包括保留、移出、移入機率）皆相同，亦即自我迴歸模型僅需估計一次截距與斜率參數，然後設定各波之間的不變

```
MODEL:
  %OVERALL%
  [Cs2#1-Cs4#1] (pi1);  !令 Cs=1 在 t=234 的截距恆等標記為 pi1
  [Cs2#2-Cs4#2] (pi2);  !令 Cs=2 在 t=234 的截距恆等標記為 pi2
  Cs2 on Cs1 (ps1-ps4); !令 t=2 對 t=1 做迴歸且恆等標記為 ps1-ps4
  Cs3 on Cs2 (ps1-ps4); !令 t=3 對 t=2 做迴歸且恆等標記為 ps1-ps4
  Cs4 on Cs3 (ps1-ps4); !令 t=4 對 t=3 做迴歸且恆等標記為 ps1-ps4
```

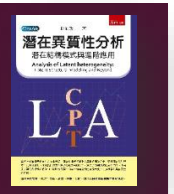


- **非定態模型（non-stationary model）**
  - $T-1$組轉移機率自由估計，轉移機率參數數目增為T倍
  - 轉移機率是否跨期相等，可利用多群組分析檢定統計意義

```
MODEL:
  %OVERALL%
    [Cs2#1-Cs4#1] (pi1-pi3);    !令 Cs=1 在 t=2,3,4 的截距標記為 pi1-pi3
    [Cs2#2-Cs4#2] (pi4-pi6);    !令 Cs=2 在 t=2,3,4 的截距標記為 pi4-pi6
     Cs4 on Cs3 (ps1-ps4);      !令 t=4 對 t=3 做迴歸且標記為 ps1-ps4
     Cs3 on Cs2 (ps5-ps8);      !令 t=3 對 t=2 做迴歸且標記為 ps5-ps8
     Cs2 on Cs1 (ps9-ps12);     !令 t=2 對 t=1 做迴歸且標記為 ps9-ps12
```

```
MODEL:
  %OVERALL%
    Cs2 on Cs1;   !各潛在狀態以 t=2 對 t=1 做迴歸
    Cs3 on Cs2;   !各潛在狀態以 t=3 對 t=2 做迴歸
    Cs4 on Cs3;   !各潛在狀態以 t=4 對 t=3 做迴歸
```

LTA的輔助變數分析



- **納入共變數X:** 多元羅吉斯迴歸參數

t=1 no Cs as IV

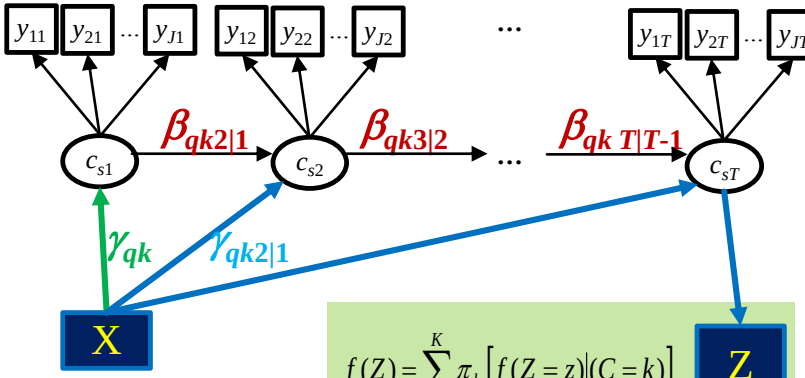
$$P(Cs_1 = q \mid X = x) = \frac{e^{(\alpha_q + \gamma_q x)}}{\sum_{q=1}^{K} e^{(\alpha_q + \gamma_g x)}}$$

t>1 Cs and X as IV

$$P(Cs_t = q \mid Cs_{t-1} = k, X = x) = \frac{e^{(\alpha_q + \beta_{qk} + \gamma_{gk} x)}}{\sum_{q=1}^{K} e^{(\alpha_q + \beta_{qk} + \gamma_{gk} x)}}$$

$$\ln\left(\frac{P(Cs_t = q \mid Cs_{t-1} = k, X = x)}{P(Cs_t = K \mid Cs_{t-1} = k, X = x)}\right) = \ln\left(\frac{e^{\alpha_q + \beta_{qk} + \gamma_{qk} x}}{e^{\alpha_K + \beta_{Kk} + \gamma_{Kk} x}}\right) = \alpha_q + \beta_{qk} + \gamma_{qk} x$$

限制式 α_K=0、β_{Kk}=0、γ_{kK}=0



$$f(Z) = \sum_{k=1}^{K} \pi_k \left[f(Z = z) \mid (C = k) \right]$$

$$z_{ij} = \mu_{jk} + \varepsilon_{ijk}$$

$$\varepsilon_{ijk} \sim N(0, \sigma^2_{jk})$$

- **納入遠端Z:** latent class ANOVA

表 7.x 組數 K=2 與組數 K=3 的 covariate LTA 結構參數(勝算對數)

IV		$DV=Cs_t$ q=1	q=2	q=3
		分組數 K=2		
Cs_{t-1}	k=1	$\alpha_1+\beta_{11}+\gamma_{11}x$	$\alpha_2+\beta_{21}+\gamma_{21}x=0$	
	k=2	$\alpha_1+\beta_{12}+\gamma_{12}x$	$\alpha_2+\beta_{22}+\gamma_{22}x=0$	

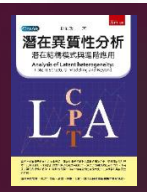
Interaction model: estimate γ_{qk}

X在t-1期各組(k)對t期特定組(q)的影響力不同

Main effect model: estimate $\gamma_{q\bullet}$

X在t-1期各組(k)對t期特定組(q)的影響力相同

邱皓政(2023) 潛在異質性分析



1 異質性分析概說

1.1 前言：異質的世界 / 1-2
1.2 異質性的意義 / 1-3
1.3 異質性的分析策略 / 1-5
1.4 潛在變數的混合與群尺光譜 / 1-12
1.5 分析軟體 / 1-14

2 類別資料的機率運算

2.1 機率原理 / 2-2
2.2 機率與概似運算 / 2-7
2.3 機率的閾值運算 / 2-9
2.4 對數線性模式 / 2-11

3 潛在類別分析原理

3.1 LCA 的模型設定 / 3-2
3.2 LCA 的參數 / 3-4
3.3 LCA 分類 / 3-10
3.4 LCA 的 Mplus 分析範例 / 3-15

4 參數估計與模型評估

4.1 LCA 的參數估計 / 4-2
4.2 模式適配評鑑 / 4-14
4.3 訊息準則 / 4-22
4.4 解釋力評估策略 / 4-27
4.5 分類診斷策略 / 4-29

5 參數設限與多群組分析

5.1 LCA 的限定模式 / 5-2
5.2 設限模型範例 / 5-5
5.3 多群組分析 / 5-15

6 潛在剖面分析

6.1 前言 / 6-2
6.2 LPA 的統計原理 / 6-3
6.3 LPA 的範例分析 / 6-7

7 潛在轉移分析

7.1 前言 / 7-2
7.2 LTA 的統計原理 / 7-4
7.3 LTA 的範例說明 / 7-15
7.4 動靜者模式 / 7-26
7.5 隨機截距模式 / 7-32

8 潛在類別輔助模式

8.1 前言 / 8-2
8.2 輔助模式的分析策略 / 8-3
8.3 輔助模式的統計原理 / 8-8
8.4 潛在類別迴歸 / 8-13
8.5 潛在類別變異數分析 / 8-32
8.6 潛在類別列聯表分析 / 8-42
8.7 迴歸輔助模式 / 8-49
8.8 羅吉斯迴歸輔助模式 / 8-57

Mplus: Random Intercept Latent Transition Analysis (statmodel.com)

Mplus

TUESDAY
OCTOBER 29, 2024

HOME ORDER CONTACT US LOGIN MPLUS DISCUSSION

MPLUS
Mplus at a Glance
General Description
Mplus Programs
Pricing
Version History
System Requirements
Platforms

MPLUS DEMO VERSION

TRAINING
Mplus Web Talks
Short Courses
Short Course Videos and Handouts
Web Training
Mplus YouTube Channel

DOCUMENTATION
Mplus User's Guide
Mplus Diagrammer
Technical Appendices
Mplus Web Notes
FAQ
User's Guide Examples
Mplus Book
Mplus Book Examples
Mplus Book Errata

ANALYSES/RESEARCH
Mplus Examples
Papers
References

SPECIAL MPLUS TOPICS
Bayesian SEM (BSEM)
Complex Survey Data
DSEM – MultiLevel Time Series Analysis
Exploratory SEM (ESEM)
Genetics
IRT
Measurement Invariance and Alignment
Mediation Analysis
Missing Data

Random Intercept Latent Transition Analysis (RI-LTA)

RI-LTA Web Talks

- What Multi-Level Modeling Can Teach Us About Single-Level Modeling & Vice Versa: The Case of Latent Transition Analysis, Bengt Muthén.

Mplus papers for Random Intercept Latent Transition Analysis (RI-LTA)

- Muthén, B. & Asparouhov, T. (2022). Latent transition analysis with random intercepts (RI-LTA). Psychological Methods, 27(1), 1–16. DOI: 10.1037/met0000370. The 2019 Version 1 of the paper is posted below because it contains different material in some parts, including 2 more examples.

- Muthén, B. & Asparouhov, T. (2019). What multilevel modeling can teach us about single-level modeling: Latent transition analysis with random intercepts (RI-LTA). Version 1.

Data sets for the RI-LTA paper

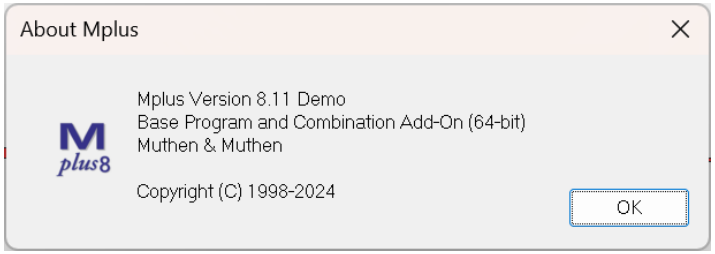
- Life satisfaction example
- Mood example
- Reading proficiency example
- Dating and sexual risk behavior example

Mplus scripts for Version 4 of the RI-LTA paper

- Table 3 runs (Monte Carlo simulations)
  - Regular LTA analysis on data generated by regular LTA, T=2, N=500
  - Regular LTA analysis on data generated by regular LTA, T=3, N=500
  - Regular LTA analysis on data generated by RI- LTA, T=2, N=500
  - Regular LTA analysis on data generated by RI- LTA, T=2, N=500, Step 2
  - Regular LTA analysis on data generated by RI- LTA, T=3, N=500
  - Regular LTA analysis on data generated by RI- LTA, T=3, N=500, Step 2

Mplus

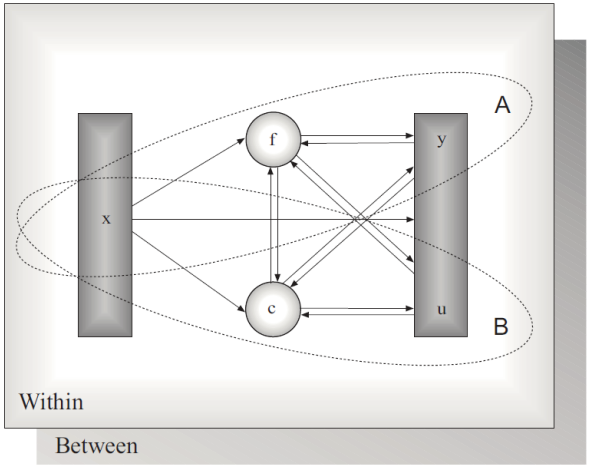
http://www.statmodel.com/



History

https://www.statmodel.com/verhistory.shtml

Version 8.11, May 3, 2024
Version 8 April 2017
Version 7 September 2012
Version 6 April 2010
Version 5 November 2007
Version 4 February 2006
Version 3 March 2004
Version 2 February 2001
Version 1 November 1998



Mplus Version 8.11 Demo

https://www.statmodel.com/demo.shtml

Mplus Version 8.11 Demo is now available for download at no cost for Windows operating systems, Mac OS X, and Linux operating systems. The demo version contains all of the capabilities of the regular version of Mplus. They include:

- Linear regression with multivariate outcomes
- Probit regression for binary and ordered categorical variables with multivariate outcomes
- Logistic regression for binary, ordered, and unordered categorical variables
- Path analysis
- Exploratory and confirmatory factor analysis
- Confirmatory factor analysis with covariates
- General structural equation modeling
- Growth modeling
- Survival analysis
- Time series analysis
- Multilevel modeling
- General latent variable mixture modeling

The Mplus Demo Version is limited only by the number of variables that can be used in an analysis. Following are the limitations:

- **Maximum number of dependent variables: 6**
- **Maximum number of independent variables: 2**
- **Maximum number of between variables in two-level analysis: 2**
- **Maximum number of continuous latent variables in time series analysis: 2**

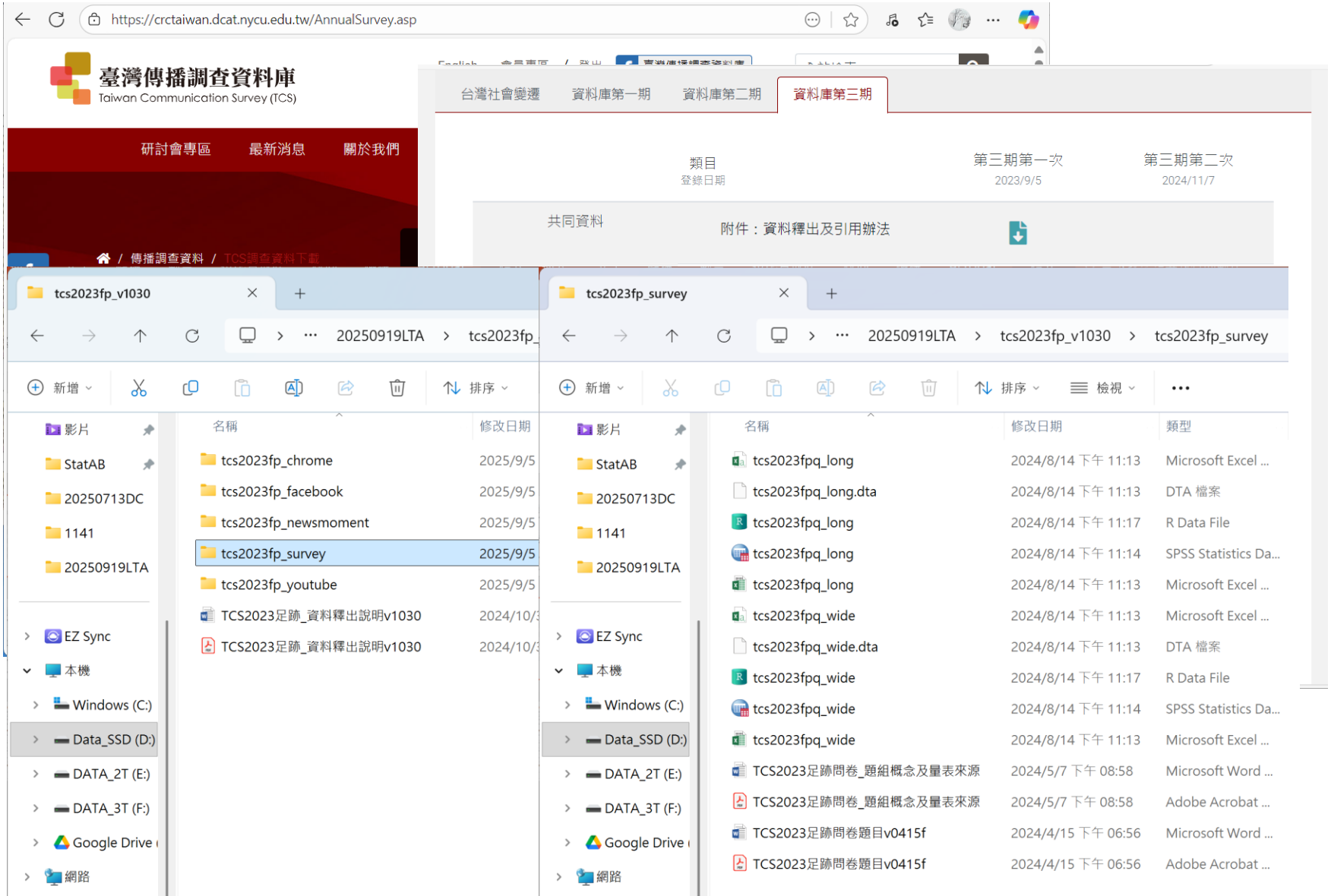


PART 3

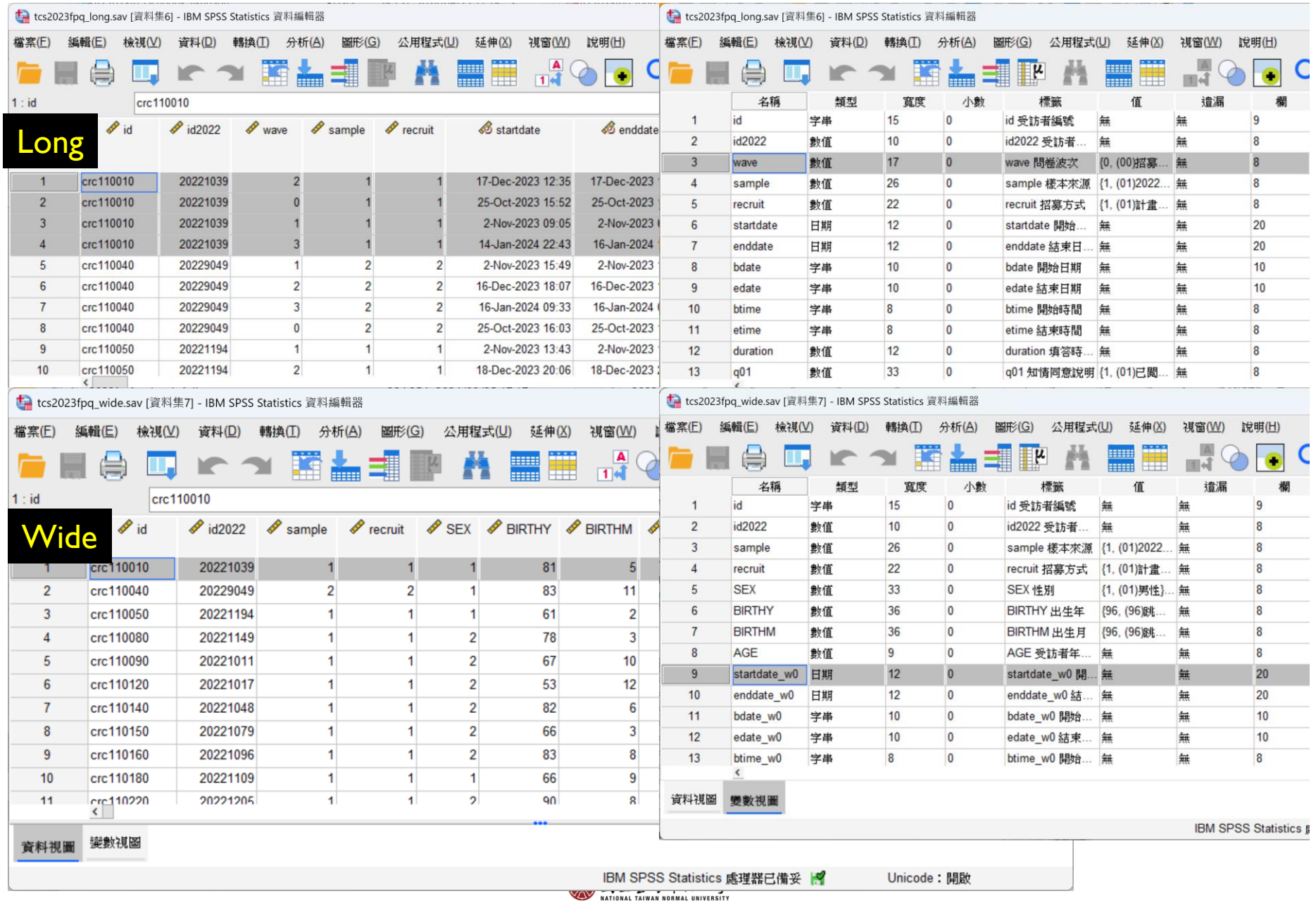
EXERCISE OF LTA

TCS EXAMPLE

TCS 臺灣傳播調查資料庫
https://crctaiwan.dcat.nycu.edu.tw/AnnualSurvey.asp



Data format: Long vs. Wide



三期二次網路足跡問卷題組概念及量表來源

【基本資料：招募問卷】

題號	題目
A01	請問您的姓名？
A02	請問您的性別？
A03	請問您是民國幾年
A11	請問您是在哪一個呢？
A12	那請問您的現住地市區呢？
A13	那請問您戶籍地的與您現住地的縣市
A14	那請問您戶籍地的呢？

【基本資料：三波】

題號	題目
I01	首先，我們想確認您的個人是〔受訪者出生年〕年出生名〔性別：先生/女士〕嗎

【共同題：三波】

題號	題目
B01	請問您每週平均有幾天用 LINE、查詢公車動態

題號	題目
B41	首先，請問您多常與人(包括家人、朋友與不認識或不熟的人，例如計程車機、市場賣菜的)用面對面的方式討論

題號	題目	測量概念	量表來源
	你的喜好、自動推薦給你的政治或社會議題相關資訊呢？		

【共同題：三波】

題號	題目	測量概念	量表來源
B01	請問您每週平均有幾天會上網(包含：使用 LINE、查詢公車動態 APP、上網看影片等）？	有無上網	一期一次自行發展；改自傳播調查資料庫一期一次、一期三次、一期五次至三期一次
B02	請問在您有上網的那一天，您一整天因為「工作(有支薪)或課業所需」而上網的時間大概有多久？	上網工作學習時間	一期二次自行發展；改自傳播調查資料庫一期二次至三期一次
B03	請問在您有上網的那一天，您一整天因為「工作或課業所需以外（例如：休閒娛樂）」而上網的時間大概有多久？	上網娛樂休閒時間	
B10	請問您最近一個月有使用以下哪些媒體呢？不論是透過手機、平板或電腦都算。	媒體使用類型	
B11	請問您最近一個月有沒有使用下列即時通訊軟體？不論是透過手機、平板或電腦都算，要使用 APP 或網頁版才算。	即時通訊軟體使用類型	二期二次自行發展；改自傳播調查資料庫二期二次
B12	請問您最近一個月有沒有使用下列社群媒體？不論是透過手機、平板或電腦都算。	社群媒體使用類型	二期二次自行發展；改自傳播調查資料庫二期二次

題號	題
	己感受的數字。
E02	如果用 0 到 10 表示的距離。0 代表您感非常遙遠，10 代表距離非常貼近，請問距離是多少？請您從 0 到 10 之間己感受的數字。
E03	如果用 0 到 10 表示的距離。0 代表您感非常遙遠，10 代表距離非常貼近，請問間的距離是多少？請您從 0 到 10 之間己感受的數字。
E11	在目前國內的政黨中較支持哪一個政黨？
E12	請問您支持〔貼上的程度是很強、普通
E13	那相對來說，請問您一個政黨？
E20	我們社會上的人常常獨立的問題，有人主布獨立；也有人認為一；還有人的看法是問。如果主張台灣應該在一邊，用 0 表示；認為兩統一的看法在另一邊，用 10 問您比較接近哪裡？
E21	那您覺得國民黨比較接近哪

E50	些政治人物的感覺。0 表示您非常不喜歡這個人，10 表示您非常喜歡這個人。請問您會給蔡英文多少？	溫度計	2004 年『選舉與民主化調查』三年期研究規劃(III)
E51	那請問您會給侯友宜多少？		

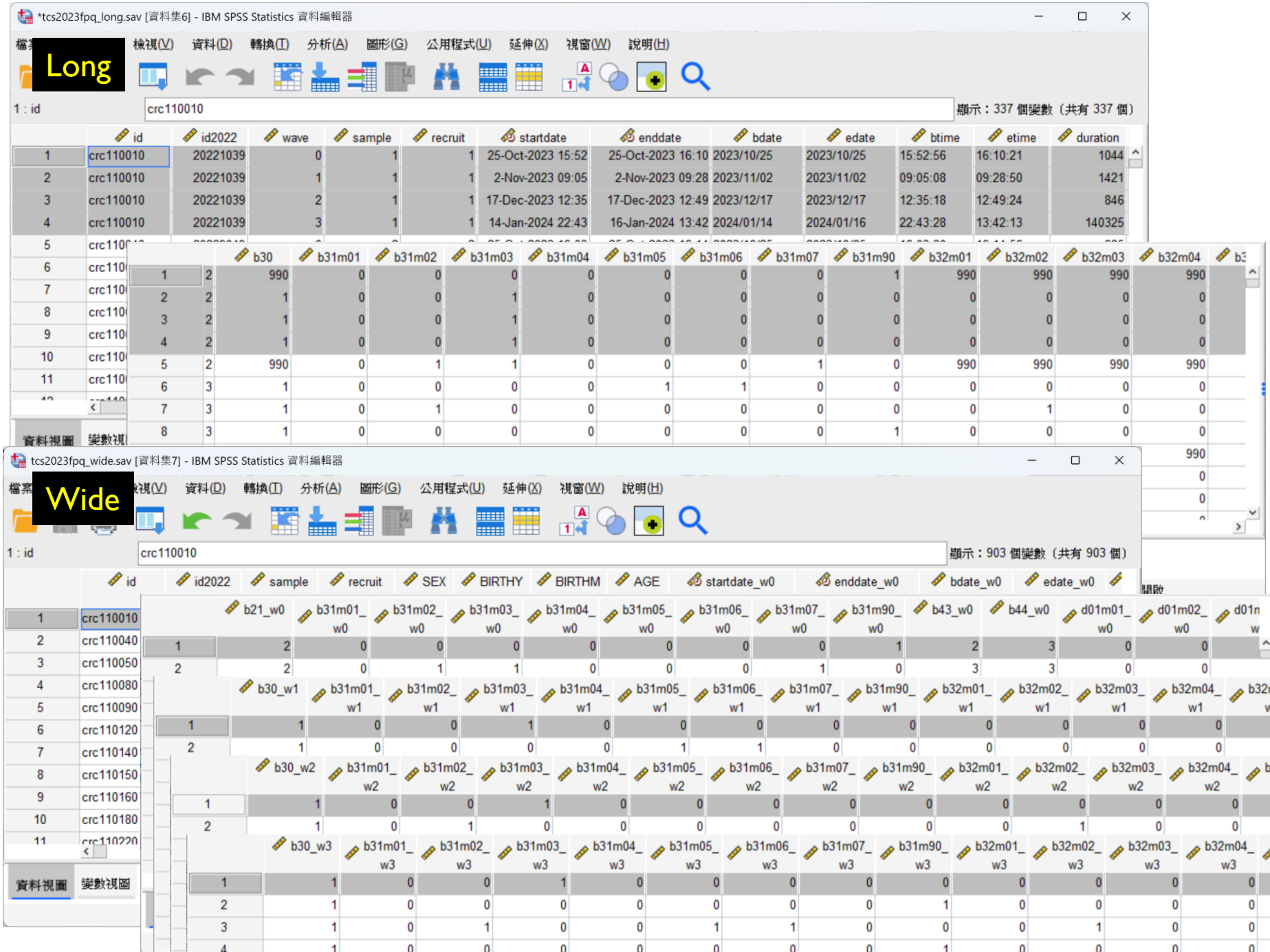
I34	那請問您最常使用的電子郵件信箱是什麼呢？	電子郵件	

概念	量表來
聞注意	改自 Zhao, Leiserowitz Maibach, E &Roser-Re (2011).
遠端威	改自 Brede Berenbaum &Spielberg (2012).
知	改自游清鑫
懼(Fear)	改自 Feldm Stenner (19 播調查資
為	改自 Zhao, Leiserowitz Maibach, E &Roser-Re (2011).

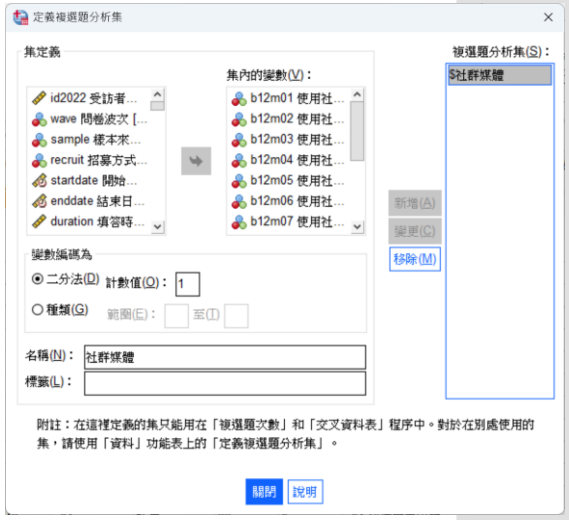
概念	量表來
	沿用傳播調二期三次至

概念	量表來
重	本期問卷小組自
略	本期問卷小組自

概念	量表來
is of dia	改自 Soontjens, Erkel, P. F. (202 傳播調查資料庫 次


*tcs2023fpq_long.sav [資料集6] - IBM SPSS Statistics 資料編輯器
Long
檔案(F) 檢視(V) 資料(D) 轉換(T) 分析(A) 圖形(G) 公用程式(U) 延伸(X) 視窗(W) 說明(H)
1 : id
crc110010
顯示：337 個變數（共有 337 個）
id id2022 wave sample recruit startdate enddate bdate edate btime etime duration
1 crc110010 20221039 0 1 1 25-Oct-2023 15:52 25-Oct-2023 16:10 2023/10/25 2023/10/25 15:52:56 16:10:21 1044
2 crc110010 20221039 1 1 1 2-Nov-2023 09:05 2-Nov-2023 09:28 2023/11/02 2023/11/02 09:05:08 09:28:50 1421
3 crc110010 20221039 2 1 1 17-Dec-2023 12:35 17-Dec-2023 12:49 2023/12/17 2023/12/17 12:35:18 12:49:24 846
4 crc110010 20221039 3 1 1 14-Jan-2024 22:43 16-Jan-2024 13:42 2024/01/14 2024/01/16 22:43:28 13:42:13 140325
b30 b31m01 b31m02 b31m03 b31m04 b31m05 b31m06 b31m07 b31m90 b32m01 b32m02 b32m03 b32m04
1 2 990 0 0 0 0 0 0 0 1 990 990 990 990
2 2 1 0 0 1 0 0 0 0 0 0 0 0
3 2 1 0 0 1 0 0 0 0 0 0 0 0
4 2 1 0 0 1 0 0 0 0 0 0 0 0
5 2 990 0 1 1 0 0 0 1 0 990 990 990 990
6 3 1 0 0 0 0 1 1 0 0 0 0 0 0
7 3 1 0 1 0 0 0 0 0 0 0 1 0 0
8 3 1 0 0 0 0 0 0 0 1 0 0 0 0
資料視圖 變數視圖
tcs2023fpq_wide.sav [資料集7] - IBM SPSS Statistics 資料編輯器
Wide
檔案(F) 檢視(V) 資料(D) 轉換(T) 分析(A) 圖形(G) 公用程式(U) 延伸(X) 視窗(W) 說明(H)
1 : id
crc110010
顯示：903 個變數（共有 903 個）
id id2022 sample recruit SEX BIRTHY BIRTHM AGE startdate_w0 enddate_w0 bdate_w0 edate_w0
1 crc110010
2 crc110040
3 crc110050
4 crc110080
5 crc110090
6 crc110120
7 crc110140
8 crc110150
9 crc110160
10 crc110180
11 crc110220
b21_w0 b31m01_w0 b31m02_w0 b31m03_w0 b31m04_w0 b31m05_w0 b31m06_w0 b31m07_w0 b31m90_w0 b43_w0 b44_w0 d01m01_w0 d01m02_w0
1 2 0 0 0 0 0 0 0 1 2 3 0 0
2 2 0 1 1 0 0 0 1 0 3 3 0 0
b30_w1 b31m01_w1 b31m02_w1 b31m03_w1 b31m04_w1 b31m05_w1 b31m06_w1 b31m07_w1 b31m90_w1 b32m01_w1 b32m02_w1 b32m03_w1 b32m04_w1
1 1 0 0 1 0 0 0 0 0 0 0 0 0
2 1 0 0 0 0 1 1 0 0 0 0 0 0
b30_w2 b31m01_w2 b31m02_w2 b31m03_w2 b31m04_w2 b31m05_w2 b31m06_w2 b31m07_w2 b31m90_w2 b32m01_w2 b32m02_w2 b32m03_w2 b32m04_w2
1 1 0 0 1 0 0 0 0 0 0 0 0 0
2 1 0 1 0 0 0 0 0 0 0 1 0 0
b30_w3 b31m01_w3 b31m02_w3 b31m03_w3 b31m04_w3 b31m05_w3 b31m06_w3 b31m07_w3 b31m90_w3 b32m01_w3 b32m02_w3 b32m03_w3 b32m04_w3
1 1 0 0 1 0 0 0 0 0 0 0 0 0
2 1 0 0 0 0 0 0 0 1 0 0 0 0
3 1 0 1 0 0 1 1 0 0 0 1 0 0
4 1 0 0 0 0 0 0 0 1 0 0 0 0
資料視圖 變數視圖

SPSS
複選題
交叉分析





$社群媒體*wave 交叉列表

			wave wave 問卷波次			
			1 (01)第1波問卷	2 (02)第2波問卷	3 (03)第3波問卷	總計
$社群媒體[a]	b12m01 b12m01 使用社群媒體(01)臉書(Facebook)	計數	192	186	187	565
		在 wave 內的百分比	21.9%	20.2%	20.8%	
	b12m02 b12m02 使用社群媒體(02)Instagram(IG)	計數	151	156	146	453
		在 wave 內的百分比	17.2%	17.0%	16.3%	
	b12m03 b12m03 使用社群媒體(03)推特(Twitter)	計數	72	78	72	222
		在 wave 內的百分比	8.2%	8.5%	8.0%	
	b12m04 b12m04 使用社群媒體(04)LinkedIn	計數	22	24	24	70
		在 wave 內的百分比	2.5%	2.6%	2.7%	
	b12m05 b12m05 使用社群媒體(05)微博	計數	16	13	11	40
		在 wave 內的百分比	1.8%	1.4%	1.2%	
	b12m06 b12m06 使用社群媒體(06)噗浪(Plurk)	計數	24	22	17	63
		在 wave 內的百分比	2.7%	2.4%	1.9%	
	b12m07 b12m07 使用社群媒體(07)抖音(TikTok)	計數	16	22	20	58
		在 wave 內的百分比	1.8%	2.4%	2.2%	
	b12m08 b12m08 使用社群媒體(08)Dcard	計數	122	119	123	364
		在 wave 內的百分比	13.9%	12.9%	13.7%	
	b12m09 b12m09 使用社群媒體(09)PTT	計數	111	116	114	341
		在 wave 內的百分比	12.7%	12.6%	12.7%	
	b12m10 b12m10 使用社群媒體(10)小紅書	計數	22	21	19	62
		在 wave 內的百分比	2.5%	2.3%	2.1%	
	b12m11 b12m11 使用社群媒體(11)LINE社群	計數	125	122	120	367
		在 wave 內的百分比	14.3%	13.3%	13.4%	
	b12m12 b12m12 使用社群媒體(12)Threads	計數	0	38	43	81
		在 wave 內的百分比	0.0%	4.1%	4.8%	
	b12m88 b12m88 使用社群媒體(88)其他	計數	3	2	1	6
		在 wave 內的百分比	0.3%	0.2%	0.1%	
	b12m90 b12m90 使用社群媒體(90)都沒有	計數	0	1	0	1
		在 wave 內的百分比	0.0%	0.1%	0.0%	
		計數	876	920	897	2693

百分比及總計是基於回應。

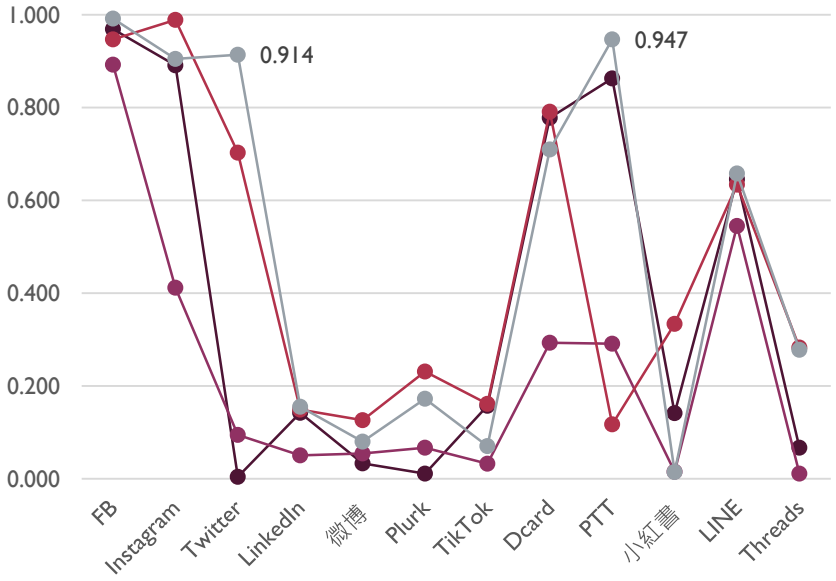
a. 二分法群組於值 1 表格化。

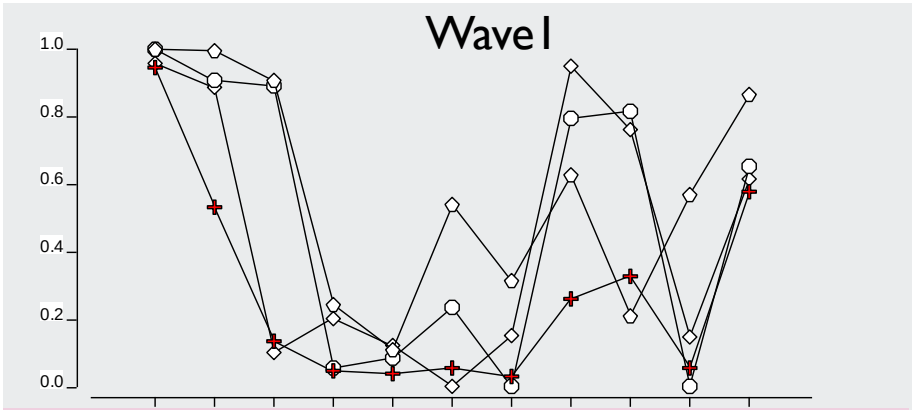
LCA

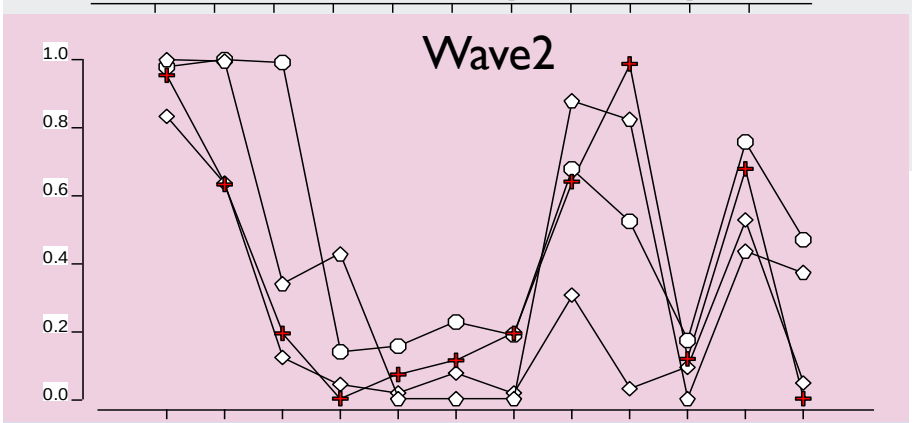
	Cluster1	Cluster2	Cluster3	Cluster4
Wave1	0.3980	0.2894	0.2349	0.0776
Wave2	0.3092	0.2750	0.2401	0.1758
Wave3	0.3799	0.3011	0.2603	0.0587

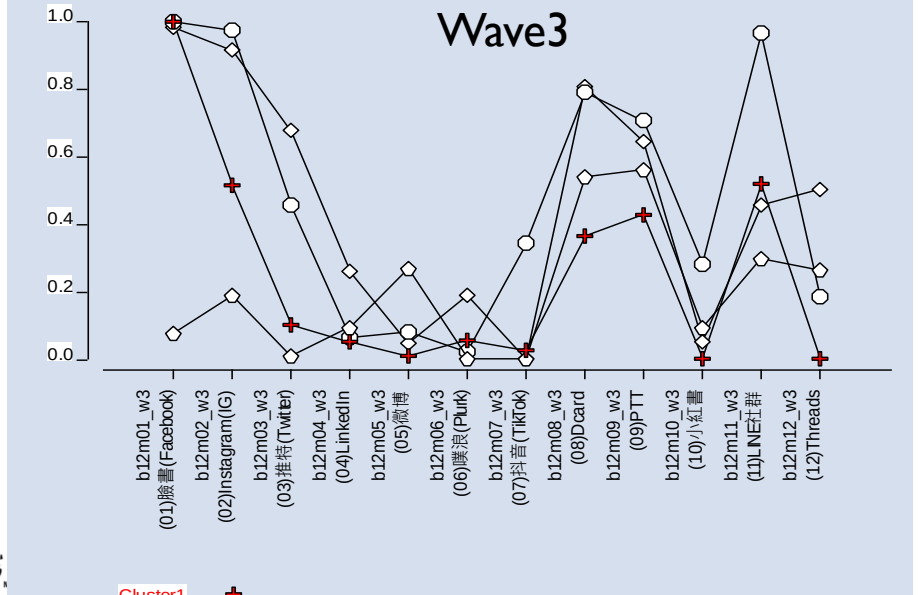
LTA

	Cluster1	Cluster2	Cluster3	Cluster4
Wave1	0.2900	0.3120	0.1737	0.2243
Wave2	0.2670	0.3138	0.1737	0.2456
Wave3	0.2484	0.3299	0.1737	0.2480

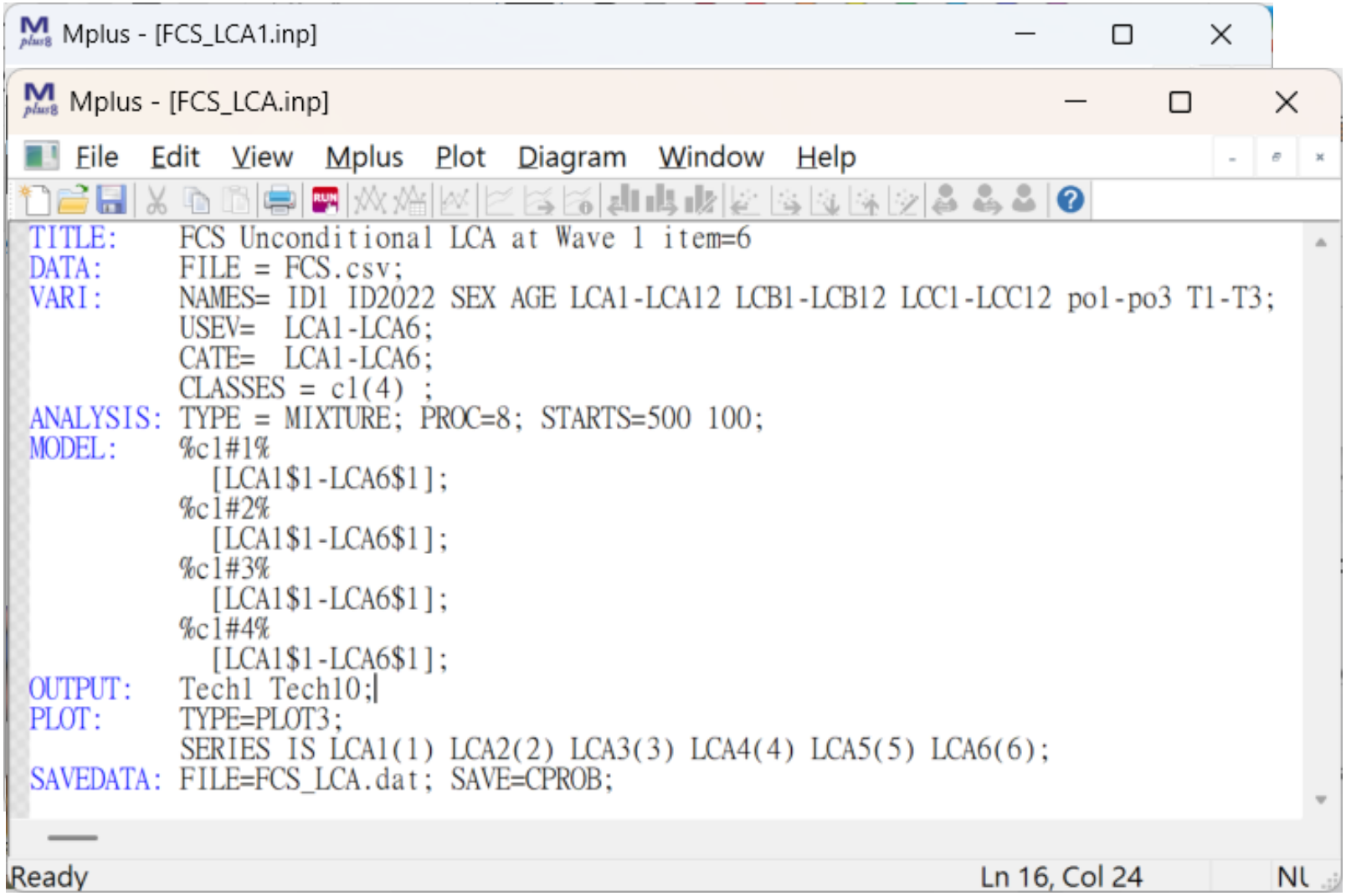








LCA Mplus Syntax data



LCA Mplus Output

Mplus - [fcs_lca]

File Edit View Mplus Plot Diagram Window Help

```
UNIVARIATE PROPORTIONS AND COUNTS FOR CATEGORICAL VARIABLES

    LCA1
      Category 1    0.035          7.000
      Category 2    0.965        192.000
    LCA2
      Category 1    0.241         48.000
      Category 2    0.759        151.000
    LCA3
      Category 1    0.638        127.000
      Category 2    0.362         72.000
    LCA4
      Category 1    0.889        177.000
      Category 2    0.111         22.000
    LCA5
      Category 1    0.920        183.000
      Category 2    0.080         16.000
    LCA6
      Category 1    0.879        175.000
      Category 2    0.121         24.000

MODEL FIT INFORMATION

Number of Free Parameters                       27

Loglikelihood

          H0 Value                       -443.639
          H0 Scaling Correction Factor      0.9974
            for MLR

Information Criteria

          Akaike (AIC)                    941.279
          Bayesian (BIC)                 1030.198
          Sample-Size Adjusted BIC        944.661
            (n* = (n + 2) / 24)

Chi-Square Test of Model Fit for the Binary and Ordered Categorical
(Ordinal) Outcomes

          Pearson Chi-Square
          Value                             7.619
          Degrees of Freedom                   36
          P-Value                          1.0000

          Likelihood Ratio Chi-Square
          Value                             8.088
          Degrees of Freedom                   36
          P-Value                          1.0000
```

Ready Ln 146, Col 1 NUM

Mplus - [fcs_lca]

File Edit View Mplus Plot Diagram Window Help

```
FINAL CLASS COUNTS AND PROPORTIONS FOR THE LATENT CLASSES
BASED ON THE ESTIMATED MODEL

    Latent Classes
       1          71.99998          0.36181
       2          43.75625          0.21988
       3          70.42709          0.35390
       4          12.81667          0.06441

FINAL CLASS COUNTS AND PROPORTIONS FOR THE LATENT CLASSES
BASED ON ESTIMATED POSTERIOR PROBABILITIES

    Latent Classes
       1          71.99998          0.36181
       2          43.75625          0.21988
       3          70.42709          0.35390
       4          12.81667          0.06441

FINAL CLASS COUNTS AND PROPORTIONS FOR THE LATENT CLASSES
BASED ON THEIR MOST LIKELY LATENT CLASS MEMBERSHIP

Class Counts and Proportions

    Latent Classes
       1                72          0.36181
       2                39          0.19598
       3                78          0.39196
       4                10          0.05025

CLASSIFICATION QUALITY

     Entropy                         0.770

Average Latent Class Probabilities for Most Likely Latent Class Membership (Row)
by Latent Class (Column)

           1      2      3      4
    1   1.000  0.000  0.000  0.000
    2   0.000  0.794  0.206  0.000
    3   0.000  0.154  0.800  0.047
    4   0.000  0.081  0.000  0.919


Classification Probabilities for the Most Likely Latent Class Membership (Column)
by Latent Class (Row)

           1      2      3      4
    1   1.000  0.000  0.000  0.000
    2   0.000  0.708  0.274  0.019
    3   0.000  0.114  0.886  0.000
    4   0.000  0.000  0.283  0.717
```

Ready Ln 193, Col 2 NUM

LCA Mplus Output

Mplus - [fcs_lca]

File Edit View Mplus Plot Diagram Window Help

MODEL RESULTS

	Estimate	S.E.	Est./S.E.	Two-Tailed P-Value
Latent Class 1				
Thresholds				
LCA1$1	-4.263	1.007	-4.233	0.000
LCA2$1	-1.946	0.356	-5.461	0.000
LCA3$1	-15.000	0.000	999.000	999.000
LCA4$1	1.946	0.356	5.461	0.000
LCA5$1	2.079	0.375	5.545	0.000
LCA6$1	1.099	0.272	4.037	0.000
Latent Class 2				
Thresholds				
LCA1$1	-2.678	0.756	-3.543	0.000
LCA2$1	0.672	0.880	0.763	0.445
LCA3$1	15.000	0.000	999.000	999.000
LCA4$1	15.000	0.000	999.000	999.000
LCA5$1	15.000	0.000	999.000	999.000
LCA6$1	1.839	0.626	2.937	0.003
Latent Class 3				
Thresholds				
LCA1$1	-15.000	0.000	999.000	999.000
LCA2$1	-1.795	0.707	-2.538	0.011
LCA3$1	15.000	0.000	999.000	
LCA4$1	1.486	0.416	3.568	
LCA5$1	15.000	0.000	999.000	
LCA6$1	15.000	0.000	999.000	
Latent Class 4				
Thresholds				
LCA1$1	-1.106	0.825	-1.340	
LCA2$1	-15.000	0.000	999.000	
LCA3$1	15.000	0.000	999.000	
LCA4$1	15.000	0.000	999.000	
LCA5$1	-0.507	1.605	-0.316	
LCA6$1	15.000	0.000	999.000	
Categorical Latent Variables				
Means				
C1#1	1.726	0.639	2.701	
C1#2	1.228	0.848	1.448	
C1#3	1.704	0.699	2.439	

Ready

Mplus - [fcs_lca]

File Edit View Mplus Plot Diagram Window Help

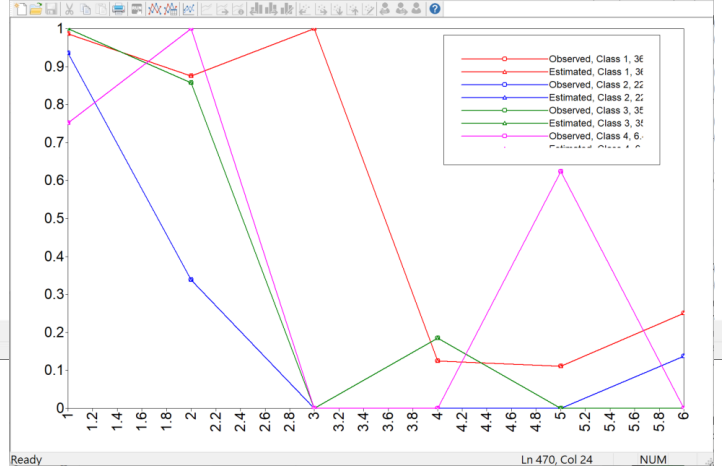
RESULTS IN PROBABILITY SCALE

	Estimate	S.E.	Est./S.E.	Two-Tailed P-Value
Latent Class 1				
LCA1				
Category 1	0.014	0.014	1.007	0.314
Category 2	0.986	0.014	71.498	0.000
LCA2				
Category 1	0.125	0.039	3.207	0.001
Category 2	0.875	0.039	22.450	0.000
LCA3				
Category 1	0.000	0.000	0.000	1.000
Category 2	1.000	0.000	0.000	1.000
LCA4				
Category 1	0.875	0.039	22.450	0.000
Category 2	0.125	0.039	3.207	0.001
LCA5				
Category 1	0.889	0.037	24.000	0.000
Category 2	0.111	0.037	3.000	0.003
LCA6				
Category 1	0.750	0.051	14.697	0.000
Category 2	0.250	0.051	4.899	0.000
Latent Class 2				
LCA1				
Category 1	0.064	0.045	1.414	0.157
Category 2	0.936	0.045	20.578	0.000

Ln 272, Col 62 NUM

Mplus - [Sample proportions and estimated probabilities for Process1 (category 2)]

File Edit View Mplus Plot Diagram Window Help



Ready Ln 470, Col 24 NUM

LCA Mplus Output

Mplus - [fcs_lca]

File Edit View Mplus Plot Diagram Window Help

```
TECHNICAL 1 OUTPUT

     PARAMETER SPECIFICATION FOR LATENT CLASS 1
     PARAMETER SPECIFICATION FOR LATENT CLASS 2
     PARAMETER SPECIFICATION FOR LATENT CLASS 3
     PARAMETER SPECIFICATION FOR LATENT CLASS 4

     PARAMETER SPECIFICATION FOR LATENT CLASS INDICATOR MODEL PART

           LAMBDA(U)
              C1#1          C1#2          C1#3          C1#4
              ____          ____          ____          ____
LCA1             1             2             3             4
LCA2             5             6             7             8
LCA3             9            10            11            12
LCA4            13            14            15            16
LCA5            17            18            19            20
LCA6            21            22            23            24


     PARAMETER SPECIFICATION FOR LATENT CLASS REGRESSION MODEL PART


           ALPHA(C)
              C1#1          C1#2          C1#3          C1#4
              ____          ____          ____          ____
                25            26            27             0

SAVEDATA INFORMATION

  Save file
    FCS_LCA.dat

  Order and format of variables

    LCA1           F10.3
    LCA2           F10.3
    LCA3           F10.3
    LCA4           F10.3
    LCA5           F10.3
    LCA6           F10.3
    CPROB1         F10.3
    CPROB2         F10.3
    CPROB3         F10.3
    CPROB4         F10.3
    C1             F10.3

  Save file format
    11F10.3

  Save file record length    10000

  Save missing symbol        *
```

Ready Ln 470, Col 24 NUM

FCS_LCA.dat

檔案 編輯 檢視

```
 1.000  1.000  0.000  0.000  0.000  0.000  0.000  0.184  0.760  0.056  3.000
 1.000  1.000  1.000  0.000  1.000  1.000  1.000  0.000  0.000  0.000  1.000
 1.000  0.000  0.000  0.000  0.000  0.000  0.000  0.741  0.259  0.000  2.000
 1.000  1.000  0.000  0.000  0.000  0.000  0.000  0.184  0.760  0.056  3.000
 1.000  1.000  0.000  0.000  0.000  0.000  0.000  0.184  0.760  0.056  3.000
 1.000  1.000  0.000  0.000  0.000  0.000  0.000  0.184  0.760  0.056  3.000
 1.000  0.000  0.000  0.000  0.000  1.000  0.000  1.000  0.000  0.000  2.000
 1.000  0.000  0.000  0.000  0.000  0.000  0.000  0.741  0.259  0.000  2.000
 1.000  1.000  0.000  0.000  0.000  0.000  0.000  0.184  0.760  0.056  3.000
 1.000  1.000  0.000  1.000  0.000  0.000  0.000  0.000  1.000  0.000  3.000
 1.000  1.000  1.000  0.000  1.000  0.000  1.000  0.000  0.000  0.000  1.000
 1.000  0.000  1.000  0.000  0.000  1.000  1.000  0.000  0.000  0.000  1.000
 1.000  1.000  0.000  0.000  0.000  0.000  0.000  0.184  0.760  0.056  3.000
 1.000  1.000  1.000  0.000  0.000  0.000  1.000  0.000  0.000  0.000  1.000
 1.000  1.000  1.000  0.000  0.000  0.000  1.000  0.000  0.000  0.000  1.000
 1.000  0.000  0.000  0.000  0.000  0.000  0.000  0.741  0.259  0.000  2.000
 1.000  1.000  1.000  0.000  0.000  0.000  1.000  0.000  0.000  0.000  1.000
 1.000  1.000  0.000  0.000  0.000  0.000  0.000  0.184  0.760  0.056  3.000
 1.000  1.000  1.000  0.000  0.000  0.000  1.000  0.000  0.000  0.000  1.000
 1.000  1.000  0.000  0.000  0.000  0.000  0.000  0.184  0.760  0.056  3.000
 1.000  1.000  0.000  0.000  0.000  0.000  0.000  0.184  0.760  0.056  3.000
 1.000  1.000  0.000  0.000  0.000  0.000  0.000  0.184  0.760  0.056  3.000
 1.000  1.000  0.000  0.000  0.000  0.000  0.000  0.184  0.760  0.056  3.000
```

第 8 行，第 103 欄 22,089 個字元 純文字 100% Windows (CRLF) UTF-8

LCA using R

RStudio

File Edit Code View Plots Session Build Debug Profile Tools Help

Go to file/function | Addins

FCS1.R

Source on Save | Run | Source

```
# ==========  FCS K=4 LCA ==========
# 載入套件
if (!requireNamespace("poLCA", quietly = TRUE)) {
  install.packages("poLCA", repos = "https://cloud.r-project.org")
}
if (!requireNamespace("readxl", quietly = TRUE)) {
  install.packages("readxl", repos = "https://cloud.r-project.org")
}

library(poLCA)
library(readxl)

# 讀取資料
dat <- read_excel("FCS.xlsx")
var <- function(prefix, n) {paste0(prefix, seq_len(n))}
items <- var("A", 12)
#items <- var("B", 12)
#items <- var("C", 12)

# 把 0/1 轉成 1/2 (poLCA 要求)
dat[, items] <- lapply(dat[, items], function(x) ifelse(x == 0, 1, 2))

# 建立模型公式
f1 <- as.formula(paste("cbind(", paste(items, collapse = ","), ") ~ 1"))

# K=4 LCA
set.seed(123)
fit  <- poLCA(f1, dat, nclass=4, nrep=100, maxiter=5000, verbose=TRUE)
print(fit$P)      #類別比例
print(fit$probs) #各題在不同類別的反應機率
posterior <- as.data.frame(fit$posterior) #個人後驗機率 + 最可能類別
colnames(posterior) <- paste0("CPROB", 1:4)
result <- data.frame(ID = dat$ID, class_ml = fit$predclass)
out    <- cbind(result, posterior)
write.csv(out, "FCS4_results.csv", row.names = FALSE)
```

60:1 | FCS K=4 LCA | R Script

Console | Background Jobs

R 4.5.0 · D:/2.1MyConference2025/20250919LTA/ANA/

```
> par(xpd=TRUE) # 允許繪圖區外畫東西
> legend("topright", inset=c(-0.25,0), legend=legend_labels,
+        col=1:4, lty=1:4, pch=16, bty="n")
>
```

RStudio

File Edit Code View Plots Session Build Debug Profile Tools Help

Go to file/function | Addins

Source

Console | Background Jobs

R 4.5.0 · D:/2.1MyConference2025/20250919LTA/ANA/

```
============================================================
Fit for 4 latent classes:
============================================================
number of observations: 199
number of estimated parameters: 51
residual degrees of freedom: 148
maximum log-likelihood: -950.5305

AIC(4): 2003.061
BIC(4): 2171.019
G^2(4): 256.6996 (Likelihood ratio/deviance statistic)
X^2(4): 1403.939 (Chi-square goodness of fit)

> print(fit$P)      #類別比例
[1] 0.25346360 0.46732423 0.04747747 0.23173469
> print(fit$probs) #各題在不同類別的反應機率
$A1
                Pr(1)     Pr(2)
class 1:  1.141282e-187 1.0000000
class 2:   5.490195e-02 0.9450981
class 3:   0.000000e+00 1.0000000
class 4:   4.107658e-02 0.9589234

$A2
                Pr(1)     Pr(2)
class 1:   5.895241e-02 0.9410476
class 2:   4.426119e-01 0.5573881
class 3:  2.887882e-166 1.0000000
class 4:   8.380478e-02 0.9161952

$A3
                Pr(1)        Pr(2)
class 1:  2.936043e-17 1.000000e+00
class 2:  8.526607e-01 1.473393e-01
class 3:  1.682324e-01 8.317676e-01
class 4:  1.000000e+00 8.449089e-11

$A4
               Pr(1)      Pr(2)
class 1:  0.8659555 0.13404447
class 2:  0.9547740 0.04522604
class 3:  0.8934168 0.10658321
class 4:  0.7825883 0.21741174
```

Unconditional LTA

Non-stationary model

Stationary model

Mplus - [FCS_LTA1.inp]

File Edit View Mplus Plot Diagram Window Help

```
TITLE:   FCS LTA Uncoditional Non Stationary model
DATA:    FILE = LTA.csv;
VARI:    NAMES= ID1 ID2022 SEX AGE LCA1-LCA12 LCB1-LCB12 LCC1-LCC12 po1-po3 T1-T3;
         USEV=  LCA1-LCA12 LCB1-LCB12 LCC1-LCC12;
         CATE=  LCA1-LCA12 LCB1-LCB12 LCC1-LCC12;
         CLASSES = c1(4) c2(4) c3(4);
ANALYSIS: TYPE = MIXTURE; PROC=8; STARTS=500 100; ALGORITHM=INTEGRATION;
MODEL:%OVERALL%
         [c2#1 c3#1];  [c2#2 c3#2];    [c2#3 c3#3];
          c2 on c1;    c3 on c2;
       MODEL c1:
         %c1#1%
             [LCA1$1-LCA12$1](AG1-AG12) ;
         %c1#2%
             [LCA1$1-LCA12$1](AG13-AG24);
         %c1#3%
             [LCA1$1-LCA12$1](AG25-AG36);
         %c1#4%
             [LCA1$1-LCA12$1](AG37-AG48);
        MODEL c2:
         %c2#1%
             [LCB1$1-LCB12$1](AG1-AG12) ;
         %c2#2%
             [LCB1$1-LCB12$1](AG13-AG24);
         %c2#3%
             [LCB1$1-LCB12$1](AG25-AG36);
         %c2#4%
             [LCB1$1-LCB12$1](AG37-AG48);
       MODEL c3:
         %c3#1%
             [LCC1$1-LCC12$1](AG1-AG12) ;
         %c3#2%
             [LCC1$1-LCC12$1](AG13-AG24);
         %c3#3%
             [LCC1$1-LCC12$1](AG25-AG36);
         %c3#4%
             [LCC1$1-LCC12$1](AG37-AG48);
PLOT:      TYPE=PLOT3;
           SERIES IS LCA1(1) LCA2(2) LCA3(3) LCA4(4) LCA5(5) LCA6(6)
           LCA7(7) LCA8(8) LCA9(9) LCA10(10) LCA11(11) LCA12(12);
OUTPUT:   Tech1 Tech10 Tech15;
SAVEDATA:FILE=FCS_LTA1.dat; SAVE=CPROB;
```

Ready Ln 42, Col 40

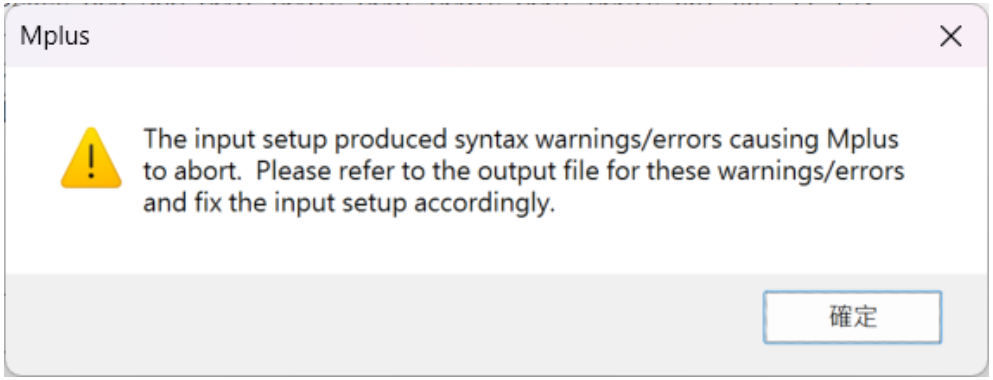
Mplus - [FCS_LTA2.inp]

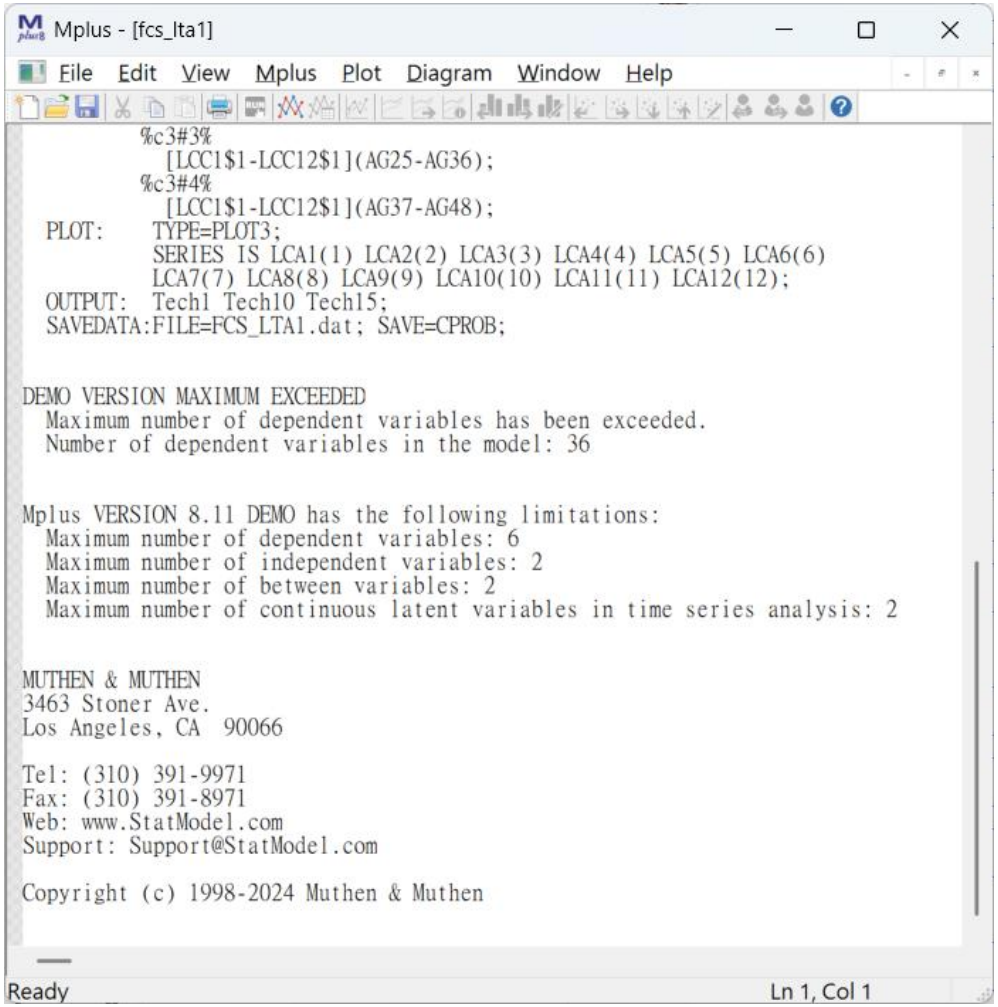
File Edit View Mplus Plot Diagram Window Help

```
TITLE:   FCS LTA Uncoditional Stationary model
DATA:    FILE = LTA.csv;
VARI:    NAMES= ID1 ID2022 SEX AGE LCA1-LCA12 LCB1-LCB12 LCC1-LCC12 po1-po3 T1-T3;
         USEV=  LCA1-LCA12 LCB1-LCB12 LCC1-LCC12;
         CATE=  LCA1-LCA12 LCB1-LCB12 LCC1-LCC12;
         CLASSES = c1(4) c2(4) c3(4);
ANALYSIS: TYPE = MIXTURE; PROC=8; STARTS=500 100; ALGORITHM=INTEGRATION;
MODEL:%OVERALL%
         [c2#1 c3#1](pi1);   [c2#2 c3#2](pi2);    [c2#3 c3#3](pi3);
          c2 on c1 (ps1-ps9); c3 on c2 (ps1-ps9);
       MODEL c1:
         %c1#1%
             [LCA1$1-LCA12$1](AG1-AG12) ;
         %c1#2%
             [LCA1$1-LCA12$1](AG13-AG24);
         %c1#3%
             [LCA1$1-LCA12$1](AG25-AG36);
         %c1#4%
             [LCA1$1-LCA12$1](AG37-AG48);
        MODEL c2:
         %c2#1%
             [LCB1$1-LCB12$1](AG1-AG12) ;
         %c2#2%
             [LCB1$1-LCB12$1](AG13-AG24);
         %c2#3%
             [LCB1$1-LCB12$1](AG25-AG36);
         %c2#4%
             [LCB1$1-LCB12$1](AG37-AG48);
       MODEL c3:
         %c3#1%
             [LCC1$1-LCC12$1](AG1-AG12) ;
         %c3#2%
             [LCC1$1-LCC12$1](AG13-AG24);
         %c3#3%
             [LCC1$1-LCC12$1](AG25-AG36);
         %c3#4%
             [LCC1$1-LCC12$1](AG37-AG48);
PLOT:      TYPE=PLOT3;
           SERIES IS LCA1(1) LCA2(2) LCA3(3) LCA4(4) LCA5(5) LCA6(6)
           LCA7(7) LCA8(8) LCA9(9) LCA10(10) LCA11(11) LCA12(12);
OUTPUT:   Tech1 Tech10 Tech15;
SAVEDATA:FILE=FCS_LTA2.dat; SAVE=CPROB;
```

Ln 42, Col 40

Demo version
retired





Unconditional LTA

Non-stationary model

Mplus - [fcs_lta1]

File Edit View Mplus Plot Diagram Window Help

```
MODEL FIT INFORMATION

Number of Free Parameters                       75

Loglikelihood

          H0 Value                       -2829.451
          H0 Scaling Correction Factor       1.3887
            for MLR

Information Criteria

          Akaike (AIC)                    5808.903
          Bayesian (BIC)                  6055.901
          Sample-Size Adjusted BIC        5818.296
            (n* = (n + 2) / 24)


FINAL CLASS COUNTS AND PROPORTIONS FOR EACH LATENT CLASS VARIABLE
BASED ON THE ESTIMATED MODEL

  Latent Class
    Variable    Class

    C1              1        64.57041          0.32447
                    2        61.57629          0.30943
                    3        15.96564          0.08023
                    4        56.88766          0.28587
    C2              1        57.77557          0.29033
                    2        68.39055          0.34367
                    3        15.96564          0.08023
                    4        56.86824          0.28577
    C3              1        57.07334          0.28680
                    2        65.47636          0.32903
                    3        15.96564          0.08023
                    4        60.48466          0.30394


CLASSIFICATION QUALITY

     Entropy                         0.960
```

Ready Ln 415, Col 43

Stationary model

Mplus - [fcs_lta2]

File Edit View Mplus Plot Diagram Window Help

```
MODEL FIT INFORMATION

Number of Free Parameters                       63

Loglikelihood

          H0 Value                       -2832.113
          H0 Scaling Correction Factor       1.6436
            for MLR

Information Criteria

          Akaike (AIC)                    5790.226
          Bayesian (BIC)                  5997.704
          Sample-Size Adjusted BIC        5798.117
            (n* = (n + 2) / 24)


FINAL CLASS COUNTS AND PROPORTIONS FOR EACH LATENT CLASS VARIABLE
BASED ON THE ESTIMATED MODEL

  Latent Class
    Variable    Class

    C1              1        64.42821          0.32376
                    2        15.93839          0.08009
                    3        56.97213          0.28629
                    4        61.66127          0.30986
    C2              1        66.86147          0.33599
                    2        15.93793          0.08009
                    3        57.91523          0.29103
                    4        58.28539          0.29289
    C3              1        69.08399          0.34716
                    2        15.93746          0.08009
                    3        58.88421          0.29590
                    4        55.09434          0.27686


CLASSIFICATION QUALITY

     Entropy                         0.957
```

Ready Ln 1, Col 1

Unconditional LTA

Non-stationary model

Mplus - [fcs_lta1]

File Edit View Mplus Plot Diagram Window Help

```
LATENT TRANSITION PROBABILITIES BASED ON THE ESTIMATED MODEL

  C1 Classes (Rows) by C2 Classes (Columns)

             1        2        3        4

  1      0.894    0.105    0.000    0.000
  2      0.000    1.000    0.000    0.000
  3      0.000    0.000    1.000    0.000
  4      0.000    0.000    0.000    1.000

  C2 Classes (Rows) by C3 Classes (Columns)

             1        2        3        4

  1      0.988    0.000    0.000    0.012
  2      0.000    0.957    0.000    0.043
  3      0.000    0.000    1.000    0.000
  4      0.000    0.000    0.000    1.000


TRANSITION PROBABILITY ODDS

     TRANSITION TABLE ODDS AND 95% CONFIDENCE INTERVALS FOR C1 TO C2
        1.000(1.000,1.000)   0.118(0.039,0.356)   0.000(0.000,0.000)   0.000(0.000
        0.000(0.000,0.000)   1.000(1.000,1.000)   0.000(0.000,0.000)   0.000(0.000
        0.000(0.000,0.000)   0.000(0.000,0.000)   1.000(1.000,1.000)   0.000(0.000
        0.000(0.000,0.018)   0.000(0.000,0.162)   0.000(0.000,0.000)   1.000(1.000

     TRANSITION TABLE ODDS AND 95% CONFIDENCE INTERVALS FOR C2 TO C3
    1.00(    1.00,    1.00)    0.00(    0.00,    0.00)    0.00(    0.00,    0.00)    0.0
    0.00(    0.00,    0.00)    1.00(    1.00,    1.00)    0.00(    0.00,    0.00)    0.0
    0.00(    0.00,    0.00)    0.00(    0.00,    0.00)    1.00(    1.00,    1.00)    0.0
    0.00(    0.00,    0.00)    0.00(    0.00,    0.00)    0.00(    0.00,    0.00)    1.0


C-SPECIFIC CLASSIFICATION RESULTS

Classification Quality for C1

     Entropy                         0.913

Average Latent Class Probabilities for Most Likely Latent Class Membership (Row)
by Latent Class (Column)

             1        2        3        4

    1    0.894    0.046    0.000    0.059
    2    0.010    0.987    0.002    0.001
    3    0.008    0.001    0.990    0.000
    4    0.024    0.001    0.000    0.975
```

Ready Ln 587, Col 1

Stationary model

Mplus - [fcs_lta2]

File Edit View Mplus Plot Diagram Window Help

```
LATENT TRANSITION PROBABILITIES BASED ON THE ESTIMATED MODEL

  C1 Classes (Rows) by C2 Classes (Columns)

             1        2        3        4

  1      0.987    0.000    0.013    0.000
  2      0.000    1.000    0.000    0.000
  3      0.000    0.000    1.000    0.000
  4      0.053    0.000    0.002    0.945

  C2 Classes (Rows) by C3 Classes (Columns)

             1        2        3        4

  1      0.987    0.000    0.013    0.000
  2      0.000    1.000    0.000    0.000
  3      0.000    0.000    1.000    0.000
  4      0.053    0.000    0.002    0.945


TRANSITION PROBABILITY ODDS

     TRANSITION TABLE ODDS AND 95% CONFIDENCE INTERVALS FOR C1 TO C2
        1.000( 1.000, 1.000)    0.000( 0.000, 0.000)    0.013( 0.000, 0.382)    0
        0.000( 0.000, 0.000)    1.000( 1.000, 1.000)    0.000( 0.000, 0.000)    0
        0.000( 0.000, 0.000)    0.000( 0.000, 0.000)    1.000( 1.000, 1.000)    0
        0.056( 0.012, 0.255)    0.000( 0.000, 0.000)    0.002( 0.000,13.252)    1

     TRANSITION TABLE ODDS AND 95% CONFIDENCE INTERVALS FOR C2 TO C3
        1.000( 1.000, 1.000)    0.000( 0.000, 0.000)    0.013( 0.000, 0.382)    0
        0.000( 0.000, 0.000)    1.000( 1.000, 1.000)    0.000( 0.000, 0.000)    0
        0.000( 0.000, 0.000)    0.000( 0.000, 0.000)    1.000( 1.000, 1.000)    0
        0.056( 0.012, 0.255)    0.000( 0.000, 0.000)    0.002( 0.000,13.252)    1


C-SPECIFIC CLASSIFICATION RESULTS

Classification Quality for C1

     Entropy                         0.910

Average Latent Class Probabilities for Most Likely Latent Class Membership (Row)
by Latent Class (Column)

             1        2        3        4

    1    0.957    0.001    0.003    0.039
    2    0.002    0.989    0.000    0.009
    3    0.004    0.000    0.976    0.019
    4    0.031    0.000    0.064    0.905
```

Ready Ln 414, Col 15

Unconditional LTA

Mplus - [fcs_lta1]

File Edit View Mplus Plot Diagram Window Help

LATENT CLASS INDICATOR MEANS AND PROBABILITIES FOR EACH LATENT CLASS

MEAN/PROBABILITY PROFILES FOR C1

	Latent class 1	2	3	4
LCA1				
Category 1	0.010	0.085	0.120	0.029
Category 2	0.990	0.915	0.880	0.971
LCA2				
Category 1	0.105	0.021	0.589	0.111
Category 2	0.895	0.979	0.411	0.889
LCA3				
Category 1	0.043	0.556	0.983	0.940
Category 2	0.957	0.444	0.017	0.060
LCA4				
Category 1	0.845	0.917	0.965	0.834
Category 2	0.155	0.083	0.035	0.166
LCA5				
Category 1	0.908	0.832	0.937	0.983
Category 2	0.092	0.168	0.063	0.017
LCA6				
Category 1	0.815	0.751	0.925	0.989
Category 2	0.185	0.249	0.075	0.011
LCA7				
Category 1	0.928	0.728	0.958	0.869
Category 2	0.072	0.272	0.042	0.131
LCA8				
Category 1	0.337	0.252	0.709	0.176
Category 2	0.663	0.748	0.291	0.824
LCA9				
Category 1	0.340	0.691	0.694	0.198
Category 2	0.660	0.309	0.306	0.802
LCA10				
Category 1	0.975	0.067	0.982	0.949
Category 2	0.025	0.933	0.018	0.051
LCA11				
Category 1	0.362	0.207	0.434	0.412
Category 2	0.638	0.793	0.566	0.588
LCA12				
Category 1	0.749	0.811	0.988	0.878
Category 2	0.251	0.189	0.012	0.122

MEAN/PROBABILITY PROFILES FOR C2

	Latent class 1	2	3	4
LCB1				
Category 1	0.010	0.085	0.120	0.029
Category 2	0.990	0.915	0.880	0.971
LCB2				
Category 1	0.105	0.021	0.589	0.111
Category 2	0.895	0.979	0.411	0.889
LCB3				
Category 1	0.043	0.556	0.983	0.940

Mplus - [fcs_lta1]

File Edit View Mplus Plot Diagram Window Help

Classification Probabilities for the Most Likely Latent Class Membership (Column)
by Latent Class (Row)

	1	2	3	4
1	0.946	0.000	0.001	0.053
2	0.006	0.993	0.000	0.001
3	0.001	0.000	0.927	0.072
4	0.009	0.002	0.020	0.969

Logits for the Classification Probabilities for the Most Likely Latent Class Membership
by Latent Class (Row)

	1	2	3	4
1	2.889	-4.948	-4.058	0.000
2	1.839	6.937	-0.924	0.000
3	-3.944	-9.877	2.554	0.000
4	-4.699	-6.184	-3.878	0.000

Classification Quality for C2

Entropy	0.927

Average Latent Class Probabilities for Most Likely Latent Class Membership (Row)
by Latent Class (Column)

	1	2	3	4
1	0.983	0.001	0.002	0.014
2	0.001	0.990	0.000	0.008
3	0.003	0.000	0.975	0.022
4	0.022	0.000	0.067	0.911

Classification Probabilities for the Most Likely Latent Class Membership (Column)
by Latent Class (Row)

	1	2	3	4
1	0.978	0.000	0.002	0.020
2	0.006	0.993	0.000	0.001
3	0.002	0.000	0.927	0.072
4	0.016	0.002	0.020	0.961

Logits for the Classification Probabilities for the Most Likely Latent Class Membership
by Latent Class (Row)

Mplus - [fcs_lta1]

File Edit View Mplus Plot Diagram Window

MODEL RESULTS

	Estimate	S.E.	Est./S.E.
Parameters for Class-specific Model Parts of C1			
Latent Class C1#1			
Thresholds			
LCA1$1	-4.606	0.797	-5.782
LCA2$1	-2.138	0.417	-5.124
LCA3$1	-3.113	0.725	-4.295
LCA4$1	1.699	0.302	5.631
LCA5$1	2.288	0.395	5.791
LCA6$1	1.486	0.323	4.598
LCA7$1	2.552	0.418	6.109
LCA8$1	-0.677	0.252	-2.684
LCA9$1	-0.661	0.249	-2.654
LCA10$1	3.659	0.553	6.619
LCA11$1	-0.568	0.243	-2.344
LCA12$1	1.094	0.222	4.933
Latent Class C1#2			
Thresholds			
LCA1$1	-2.382	0.628	-3.791
LCA2$1	-3.824	1.005	-3.807
LCA3$1	0.227	0.493	0.460
LCA4$1	2.396	0.828	2.894
LCA5$1	1.602	0.645	2.486
LCA6$1	1.103	0.440	2.507
LCA7$1	0.986	0.518	1.904
LCA8$1	-1.089	0.513	-2.122
LCA9$1	0.805	0.443	1.817
LCA10$1	-2.638	0.880	-2.996
LCA11$1	-1.340	0.527	-2.543
LCA12$1	1.459	0.477	3.061
...			
Parameters for Class-specific Model Parts of C2			
Latent Class C2#1			
Thresholds			
LCB1$1	-4.606	0.797	-5.782
LCB2$1	-2.138	0.417	-5.124
LCB3$1	-3.113	0.725	-4.295
LCB4$1	1.699	0.302	5.631
LCB5$1	2.288	0.395	5.791
LCB6$1	1.486	0.323	4.598
LCB7$1	2.552	0.418	6.109
LCB8$1	-0.677	0.252	-2.684
LCB9$1	-0.661	0.249	-2.654

Ready

Mplus - [fcs_lta1]

File Edit View Mplus Plot Diagram Window Help

RESULTS IN PROBABILITY SCALE

	Estimate	S.E.	Est./S.E.	Two-Tailed P-Value
Results for Class-specific Model Parts of C1				
Latent Class C1#1				
LCA1				
Category 1	0.010	0.008	1.268	0.205
Category 2	0.990	0.008	126.912	0.000
LCA2				
Category 1	0.105	0.039	2.679	0.007
Category 2	0.895	0.039	22.722	0.000
LCA3				
Category 1	0.043	0.030	1.441	0.150
Category 2	0.957	0.030	32.416	0.000
LCA4				
Category 1	0.845	0.039	21.438	0.000
Category 2	0.155	0.039	3.921	0.000
LCA5				
Category 1	0.908	0.033	27.478	0.000
Category 2	0.092	0.033	2.788	0.005
LCA6				
Category 1	0.815	0.049	16.767	0.000
Category 2	0.185	0.049	3.795	0.000
LCA7				
Category 1	0.928	0.028	33.114	0.000
Category 2	0.072	0.028	2.581	0.010
LCA8				
Category 1	0.337	0.056	5.985	0.000
Category 2	0.663	0.056	11.773	0.000
LCA9				
Category 1	0.340	0.056	6.085	0.000
Category 2	0.660	0.056	11.789	0.000
LCA10				
Category 1	0.975	0.014	72.025	0.000
Category 2	0.025	0.014	1.856	0.064
LCA11				
Category 1	0.362	0.056	6.459	0.000
Category 2	0.638	0.056	11.403	0.000
LCA12				
Category 1	0.749	0.042	17.973	0.000
Category 2	0.251	0.042	6.017	0.000
Latent Class C1#2				
LCA1				
Category 1	0.085	0.049	1.739	0.082
Category 2	0.915	0.049	18.822	0.000
LCA2				
Category 1	0.021	0.021	1.017	0.309

Ready

Unconditional vs. Auxiliary LTA

Unconditional model

Auxiliary model

Mplus - [FCS_LTA1.inp]

File Edit View Mplus Plot Diagram Window Help

```
TITLE:   FCS LTA Uncoditional Non Stationary model
DATA:    FILE = LTA.csv;
VARI:    NAMES= ID1 ID2022 SEX AGE LCA1-LCA12 LCB1-LCB12 LCC1-LCC12 po1-po3 T
         USEV=  LCA1-LCA12 LCB1-LCB12 LCC1-LCC12;
         CATE=  LCA1-LCA12 LCB1-LCB12 LCC1-LCC12;
         CLASSES = c1(4) c2(4) c3(4);
ANALYSIS: TYPE = MIXTURE; PROC=8; STARTS=500 100; ALGORITHM=INTEGRATION;
MODEL:%OVERALL%
        [c2#1 c3#1];  [c2#2 c3#2];    [c2#3 c3#3];
         c2 on c1;    c3 on c2;
      MODEL c1:
        %c1#1%
            [LCA1$1-LCA12$1](AG1-AG12) ;
        %c1#2%
            [LCA1$1-LCA12$1](AG13-AG24);
        %c1#3%
            [LCA1$1-LCA12$1](AG25-AG36);
        %c1#4%
            [LCA1$1-LCA12$1](AG37-AG48);
       MODEL c2:
        %c2#1%
            [LCB1$1-LCB12$1](AG1-AG12) ;
        %c2#2%
            [LCB1$1-LCB12$1](AG13-AG24);
        %c2#3%
            [LCB1$1-LCB12$1](AG25-AG36);
        %c2#4%
            [LCB1$1-LCB12$1](AG37-AG48);
      MODEL c3:
        %c3#1%
            [LCC1$1-LCC12$1](AG1-AG12) ;
        %c3#2%
            [LCC1$1-LCC12$1](AG13-AG24);
        %c3#3%
            [LCC1$1-LCC12$1](AG25-AG36);
        %c3#4%
            [LCC1$1-LCC12$1](AG37-AG48);
PLOT:     TYPE=PLOT3;
          SERIES IS LCA1(1) LCA2(2) LCA3(3) LCA4(4) LCA5(5) LCA6(6)
          LCA7(7) LCA8(8) LCA9(9) LCA10(10) LCA11(11) LCA12(12);
OUTPUT:  Tech1 Tech10 Tech15;
SAVEDATA:FILE=FCS_LTA1.dat; SAVE=CPROB;
```

Ready Ln 42, Col 40

Mplus - [FCS_LTA3.inp]

File Edit View Mplus Plot Diagram Window Help

```
TITLE:   FCS LTA Non Stationary model With Covariate
DATA:    FILE = LTA.csv;
VARI:    NAMES= ID1 ID2022 SEX AGE LCA1-LCA12 LCB1-LCB12 LCC1-LCC12 po1-po3 T1-T3;
         USEV=  LCA1-LCA12 LCB1-LCB12 LCC1-LCC12 SEX AGE ;
         CATE=  LCA1-LCA12 LCB1-LCB12 LCC1-LCC12;
         CLASSES = c1(4) c2(4) c3(4);
ANALYSIS: TYPE = MIXTURE; PROC=8; STARTS=500 100; ALGORITHM=INTEGRATION;
MODEL:%OVERALL%
        [c2#1 c3#1];  [c2#2 c3#2];    [c2#3 c3#3];
         c2 on c1 SEX AGE ;   c3 on c2 SEX AGE ;
      MODEL c1:
        %c1#1%
            [LCA1$1-LCA12$1](AG1-AG12) ;
        %c1#2%
            [LCA1$1-LCA12$1](AG13-AG24);
        %c1#3%
            [LCA1$1-LCA12$1](AG25-AG36);
        %c1#4%
            [LCA1$1-LCA12$1](AG37-AG48);
       MODEL c2:
        %c2#1%
            [LCB1$1-LCB12$1](AG1-AG12) ;
        %c2#2%
            [LCB1$1-LCB12$1](AG13-AG24);
        %c2#3%
            [LCB1$1-LCB12$1](AG25-AG36);
        %c2#4%
            [LCB1$1-LCB12$1](AG37-AG48);
      MODEL c3:
        %c3#1%
            [LCC1$1-LCC12$1](AG1-AG12) ;
        %c3#2%
            [LCC1$1-LCC12$1](AG13-AG24);
        %c3#3%
            [LCC1$1-LCC12$1](AG25-AG36);
        %c3#4%
            [LCC1$1-LCC12$1](AG37-AG48);
PLOT:     TYPE=PLOT3;
          SERIES IS LCA1(1) LCA2(2) LCA3(3) LCA4(4) LCA5(5) LCA6(6)
          LCA7(7) LCA8(8) LCA9(9) LCA10(10) LCA11(11) LCA12(12);
OUTPUT:  Tech1 Tech10 Tech15;
SAVEDATA:FILE=FCS_LTA3.dat; SAVE=CPROB;
```

Ready Ln 32, Col 15

Unconditional vs. Auxiliary LTA

Unconditional model

Auxiliary model

Mplus - [fcs_lta1]

File Edit View Mplus Plot Diagram Window Help

```
MODEL FIT INFORMATION

Number of Free Parameters                       75

Loglikelihood

          H0 Value                          -2829.451
          H0 Scaling Correction Factor          1.3887
            for MLR

Information Criteria

          Akaike (AIC)                       5808.903
          Bayesian (BIC)                     6055.901
          Sample-Size Adjusted BIC           5818.296
            (n* = (n + 2) / 24)


FINAL CLASS COUNTS AND PROPORTIONS FOR EACH LATENT CLASS VARIABLE
BASED ON THE ESTIMATED MODEL

  Latent Class
    Variable     Class

    C1                1        64.57041          0.32447
                      2        61.57629          0.30943
                      3        15.96564          0.08023
                      4        56.88766          0.28587
    C2                1        57.77557          0.29033
                      2        68.39055          0.34367
                      3        15.96564          0.08023
                      4        56.86824          0.28577
    C3                1        57.07334          0.28680
                      2        65.47636          0.32903
                      3        15.96564          0.08023
                      4        60.48466          0.30394


CLASSIFICATION QUALITY

     Entropy                         0.960
```

Ready Ln 415, Col 43

Mplus - [fcs_lta3]

File Edit View Mplus Plot Diagram Window Help

```
MODEL FIT INFORMATION

Number of Free Parameters                       87

Loglikelihood

          H0 Value                          -2806.247
          H0 Scaling Correction Factor          1.2182
            for MLR

Information Criteria

          Akaike (AIC)                       5786.494
          Bayesian (BIC)                     6073.012
          Sample-Size Adjusted BIC           5797.391
            (n* = (n + 2) / 24)


FINAL CLASS COUNTS AND PROPORTIONS FOR EACH LATENT CLASS VARIABLE
BASED ON THE ESTIMATED MODEL

  Latent Class
    Variable     Class

    C1                1        63.27015          0.31794
                      2        25.15456          0.12640
                      3        50.00065          0.25126
                      4        60.57463          0.30440
    C2                1        56.66333          0.28474
                      2        26.47534          0.13304
                      3        55.04752          0.27662
                      4        60.81382          0.30560
    C3                1        53.52768          0.26898
                      2        25.88547          0.13008
                      3        57.87694          0.29084
                      4        61.70992          0.31010


CLASSIFICATION QUALITY

     Entropy                         0.961
```

Ready Ln 117, C

Unconditional vs. Auxiliary LTA

Unconditional model

Mplus - [fcs_lta1]

File Edit View Mplus Plot Diagram Window Help

```
Categorical Latent Variables

C2#1       ON
    C1#1                16.826      3.037      5.541      0.000
    C1#2                 5.410      0.000    999.000    999.000
    C1#3                -8.757      0.000    999.000    999.000

C2#2       ON
    C1#1                15.874      4.656      3.410      0.001
    C1#2                44.129      0.000    999.000    999.000
    C1#3                 6.764      0.000    999.000    999.000

C2#3       ON
    C1#1                 4.310      0.000    999.000    999.000
    C1#2                36.607      0.000    999.000    999.000
    C1#3                53.980      0.000    999.000    999.000

C3#1       ON
    C2#1                33.243      0.000    999.000    999.000
    C2#2                -9.489      0.000    999.000    999.000
    C2#3                14.392      0.000    999.000    999.000

C3#2       ON
    C2#1                11.103      0.000    999.000    999.000
    C2#2                33.935      0.000    999.000    999.000
    C2#3                30.423      0.000    999.000    999.000

C3#3       ON
    C2#1                 5.157      0.000    999.000    999.000
    C2#2                 3.542      0.000    999.000    999.000
    C2#3                54.554      0.000    999.000    999.000

Means
    C1#1                 0.127      0.322      0.394      0.694
    C1#2                 0.079      0.217      0.365      0.715
    C1#3                -1.271      0.312     -4.078      0.000
    C2#1                -7.912      1.982     -3.993      0.000
    C2#2                -9.098      3.715     -2.449      0.014
    C2#3               -28.259      0.000    999.000    999.000
    C3#1               -28.845      5.949     -4.848      0.000
    C3#2               -30.823      0.866    -35.604      0.000
    C3#3               -28.399      0.000    999.000    999.000


QUALITY OF NUMERICAL RESULTS

     Condition Number for the Information Matrix              0.696E-05
       (ratio of smallest to largest eigenvalue)
```

Ready Ln 901, C

Auxiliary model

Mplus - [fcs_lta3]

File Edit View Mplus Plot Diagram Window Help

```
Categorical Latent Variables

C2#1       ON
    C1#1                19.394      6.501      2.983      0.003
    C1#2                30.364      2.474     12.271      0.000
    C1#3                32.794      0.000    999.000    999.000

C2#2       ON
    C1#1               656.680      0.000    999.000    999.000
    C1#2              1216.974      0.000    999.000    999.000
    C1#3               648.461      0.000    999.000    999.000

C2#3       ON
    C1#1                23.214      6.843      3.392      0.001
    C1#2                36.182      0.000    999.000    999.000
    C1#3                61.547      0.000    999.000    999.000

...


C2#1       ON
    SEX                  5.356      2.428      2.205      0.027
    AGE                 -0.657      0.340     -1.934      0.053

C2#2       ON
    SEX                368.494      0.000    999.000    999.000
    AGE                 15.816      0.416     38.050      0.000

C2#3       ON
    SEX                  7.990      2.976      2.684      0.007
    AGE                 -1.668      0.347     -4.812      0.000

C3#1       ON
    SEX                  5.698      2.273      2.506      0.012
    AGE                 -0.025      0.082     -0.300      0.764

C3#2       ON
    SEX                285.620      0.000    999.000    999.000
    AGE                 30.610      0.045    687.194      0.000

C3#3       ON
    SEX                -14.075      2.124     -6.628      0.000
    AGE                  0.134      0.089      1.509      0.131

Means
    C1#1                 0.044      0.261      0.167      0.867
    C1#2                -0.879      0.268     -3.276      0.001
    C1#3                -0.192      0.221     -0.868      0.386
    C2#1                 8.929      8.350      1.069      0.285
```

Ready Ln 1004,

Analysis of Auxiliary Variables via SPSS

		N	平均值	標準差
AGE AGE 受訪者年齡(計算至2024/01/31)	1	52	30.40	7.193
	2	62	36.40	12.587
	3	36	26.83	8.949
	4	49	29.37	7.132
	總計	199	31.37	10.077
c11_w3 c11_w3 對於大眾媒體的新聞報導品質信不信賴(第3波)	1	52	2.63	.627
	2	62	2.74	.651
	3	36	2.75	.732
	4	49	2.59	.537
	總計	199	2.68	.633
c12_w3 c12_w3 假新聞在生活當中普不普遍(第3波)	1	52	1.77	.645
	2	62	1.79	.604
	3	36	1.78	.722
	4	49	1.94	.556
	總計	199	1.82	.626
b21_w3 b21_w3 您對政治的事情感不感興趣(第3波)	1	52	2.17	.678
	2	62	2.31	.781
	3	36	2.22	.832
	4	49	2.12	.754
	總計	199	2.21	.756
b01_w3 b01_w3 每週平均有幾天會上網(第3波)	1	52	14.42	1.684
	2	62	14.31	2.386
	3	36	14.42	1.888
	4	49	14.86	.645
	總計	199	14.49	1.806

變異數分析

		平方和	df	均方	F	顯著性
AGE AGE 受訪者年齡(計算至2024/01/31)	群組之間	2556.656	3	852.219	9.470	<.001
	組內	17547.826	195	89.989		
	總計	20104.482	198			
c11_w3 c11_w3 對於大眾媒體的新聞報導品質信不信賴(第3波)	群組之間	.902	3	.301	.746	.526
	組內	78.515	195	.403		
	總計	79.417	198			
c12_w3 c12_w3 假新聞在生活當中普不普遍(第3波)	群組之間	.944	3	.315	.802	.494
	組內	76.544	195	.393		
	總計	77.487	198			
b21_w3 b21_w3 您對政治的事情感不感興趣(第3波)	群組之間	1.028	3	.343	.596	.618
	組內	112.107	195	.575		
	總計	113.136	198			
b01_w3 b01_w3 每週平均有幾天會上網(第3波)	群組之間	9.119	3	3.040	.931	.427
	組內	636.620	195	3.265		
	總計	645.739	198			

Analysis of Auxiliary Variables via SPSS

C3*SEX SEX 性別 交叉列表

			C3				
			1	2	3	4	總計
SEX SEX 性別	1 (01)男性	計數	18	23	14	27	82
		標準化殘差	-.7	-.5	-.2	1.5	
		調整後殘差	-1.1	-.8	-.3	2.3	
	2 (02)女性	計數	34	39	22	22	117
		標準化殘差	.6	.4	.2	-1.3	
		調整後殘差	1.1	.8	.3	-2.3	
總計		計數	52	62	36	49	199

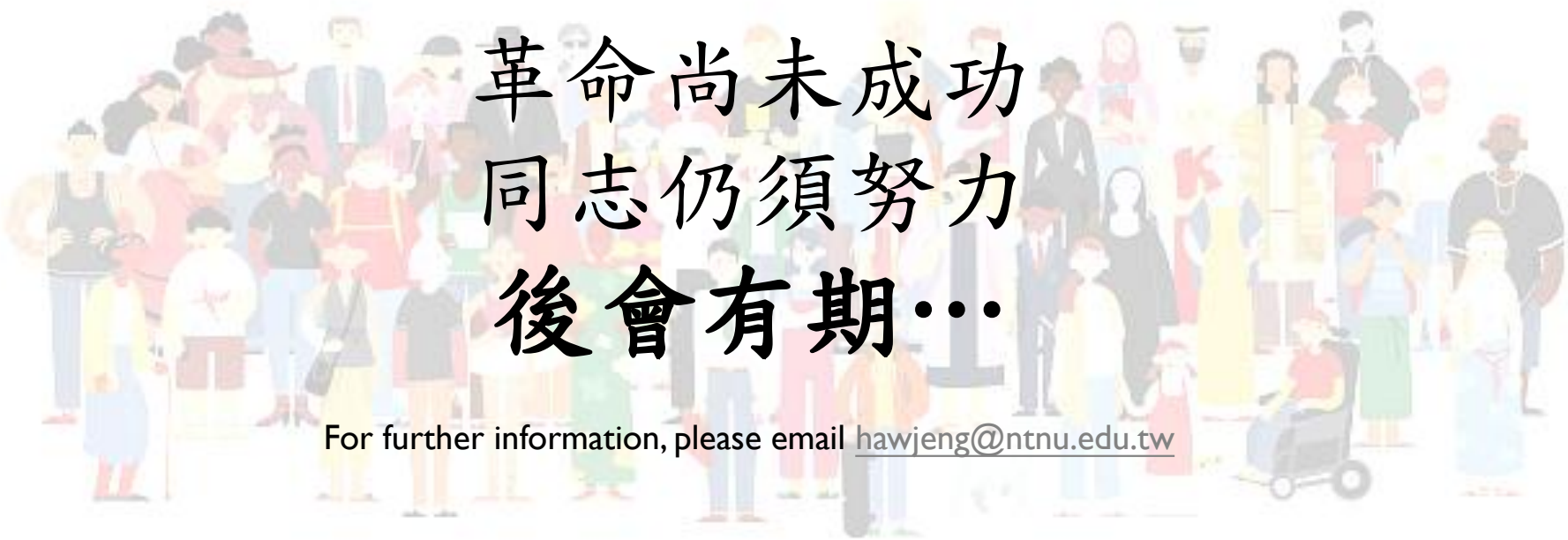
卡方檢定

	值	df	漸近顯著性（兩端）
Pearson 卡方檢定	5.350[a]	3	.148
概似比	5.296	3	.151
線性對線性關聯	4.314	1	.038
有效觀察值的數目	199		

a. 0 單元 (0.0%) 預期計數小於 5。預期的計數下限為 14.83。

Further references

- Asparouhov, T., & Muthén, B. O. (2014). Auxiliary variables in mixture modeling: Three-step approaches using Mplus. *Structural Equation Modeling*, *21*, 329–341. https://doi.org/10.1080/10705511.2014.915181
- Chiou, H., & Wang, S.-T. (In press). State and change of the latent heterogeneity: Monte-Carlo simulation and empirical study of bias-correction of classification with auxiliary variables in random intercept latent transition analysis (RI-LTA). Survey research - Method and application [潛在異質性的變與不變：隨機截距潛在轉移模型(RI-LTA)的分類校正與輔助變數分析之蒙地卡羅模擬與實徵研究; 調查研究-方法與應用]
- Collins, L. M., & Lanza, S. T. (2010). *Latent class and latent transition analysis: With applications in the social, behavioral, and health sciences*. John Wiley & Sons, Inc.
- Hamaker, E. L., Kuiper, R. M., & Grasman, R. P. P. P. (2015). A critique of the cross-lagged panel model. *Psychological Methods*, *20*, 102–116. https://doi.org/10.1037/a0038889
- Muthén, B. O., & Asparouhov, T. (2022). Latent transition analysis with random intercepts (RI-LTA). *Psychological Methods*, *27*, 1–16. https://doi.org/10.1037/met0000370
- Nylund-Gibson, K., Garber, A. C., Carter, D. B., Chan, M., Arch, D. A. N., Simon, O., Whaling, K., Tartt, E., & Lawrie, S. I. (2023). Ten frequently asked questions about latent transition analysis. *Psychological Methods, 28*(2), 284–300. https://doi.org/10.1037/met0000486
- Tseng, M. C. (2023). Latent Profile Transition Analysis with Random Intercepts (RI-LPTA). *Structural Equation Modeling: A Multidisciplinary Journal*, *31*(4), 626–634. https://doi.org/10.1080/10705511.2023.2284671
- Vermunt, J. K. (2010). Latent class modeling with covariates: Two improved three-step approaches. *Political Analysis*, *18*(4), 450–469. http://www.jstor.org/stable/25792024



革命尚未成功
同志仍須努力
後會有期…

For further information, please email hawjeng@ntnu.edu.tw