

多變量分析簡介

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多變量分析方法分類

- 相依方法(Dependence)
 - 討論自變數與應變數之間的關係
 - 例如 $X \rightarrow Y$
- 互依方法(Interdependence)
 - 不區分自變數與應變數，直接討論變數之間的關係。
 - 例如集群分析

多變量分析方法的分類依據

- 以衡量尺度分類
 - 名目尺度(nominal)
 - 序列尺度(ordinal)
 - 區間尺度(interval)
 - 比率尺度(ratio)
- 以變數的角色分類
 - 自變數
 - 應變數

相依方法		應變數			
		一個		多個	
		計量	非計量	計量	非計量
自 變 數	一 個	計量	<ul style="list-style-type: none"> •簡單迴歸 (Simple Regression) •區別分析 (Discriminant Analysis) •羅吉斯迴歸 (Logistic Regression) •機率迴歸 (Probit Regression) 	<ul style="list-style-type: none"> •典型相關 (Canonical Correlation Analysis) 	<ul style="list-style-type: none"> •多元區別分析 (Multiple Discriminant Analysis)
		非計量	<ul style="list-style-type: none"> •T檢定 (T test) •單因子變數數分析 (One-way ANOVA) 	<ul style="list-style-type: none"> •間斷型區別分析 (Discrete Discriminant Analysis) 	<ul style="list-style-type: none"> •多變異量變異數分析 (MANOVA) •間斷型多元區別度分析 (Discrete Multiple Discriminant Analysis)

相依方法			應變數			
			一個		多個	
		計量	非計量	計量	非計量	
自變數 多個	計量	•複迴歸 (Multiple Regression)	•區別分析 (Discriminant Analysis) •羅吉斯迴歸 (Logistic Regression) •機率迴歸 (Probit Regression)	•結構方程模式 (Structural Equation Modeling, SEM)	•多元區別分析 (Multiple Discriminant Analysis)	
	非計量	•多因子變異數分析 (n-way ANOVA)	•間斷型區別分析 (Discrete Discriminant Analysis) •聯合分析 (Conjoint Analysis)	•多變異量變異數分析 (MANOVA)	•間斷型多元區別度分析 (Discrete Multiple Discriminant Analysis)	

相依方法1

- 簡單迴歸(Single Regression)
 - 當自變數與應變數都各只有一個，且二者都是屬計量的變數時，則二者之間所建立的線性函數關係即為簡單迴歸
- 複迴歸(Multiple Regression)
 - 當自變數有多個，應變數有一個，且二者都是屬計量的變數時，則二者之間所建立的線性函數關係即為多元迴歸或複迴歸。
- 變異數分析(Analysis of Variance, ANOVA)
 - 當反應變數只有一個且為屬量的變數，而解釋變數也只有一個但為屬質的變數時，則探討解釋變數對反應變數是否有影響關係的分析架構即為單因子變異數分析(One-way ANOVA)

相依方法2

- **區別分析(Discriminant Analysis)**
 - 當應變數只有一個且為非計量的變數，自變數有一個以上且為計量的變數時，則二者之間所建立的線性函數為一區別分析。
- **Logit & Probit**
 - 當應變數只有一個且為非計量的變數，自變數有一個以上、且為計量或計量與非計量混合（即其中一些變數為計量一些變數為非計量）的變數時，則二者之間所建立的線性函數關係之一即為一 Logit 或 Probit 迴歸。
 - Logit 分析的應變數為二元變數（0或1），Probit 分析的應變數則是介於0至1中的百分比變數。
- **間斷型區別分析(Discrete Discriminant Analysis)**
 - 當應變數只有一個且為非計量的變數，自變數有一個以上且亦為非計量的變數時，則二者之間所建立的線性函數關係即為一間斷型區別分析。

相依方法3

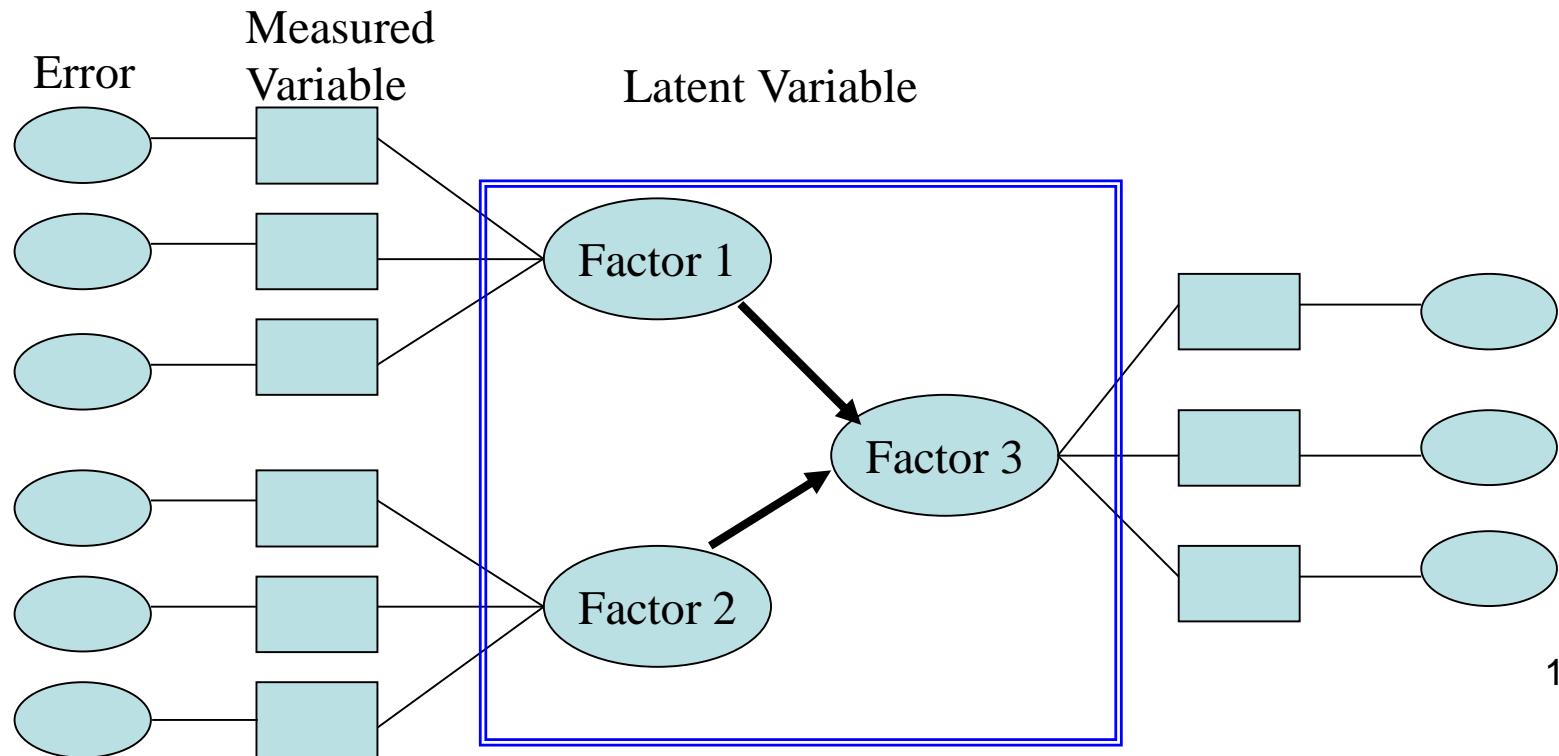
- 聯合分析(Conjoint Analysis)
 - 當應變數只有一個且為序列 (ordinal) 的變數，而自變數有一個以上且為非計量的變數時，則探討自變數對應變數是否有影響關係的分析架構即為一單調變異數分析(Monotonic Analysis of Variance, MONANOVA)，而單調變異數分析為聯合分析的一種情況。
- 典型相關(Canonical Correlation)
 - 當應變數有二個以上且為非計量的變數，而自變數也有二個以上且也為計量的變數時，則探討自變數與應變數間是否有關係時的分析架構即為一典型相關分析

相依方法4

- 多變量變異數分析(Multivariate Analysis of Variance, MANOVA)
 - 當應變數有二個以上且為計量的變數，而自變數也有二個以上但為非計量的變數時，則探討自變數與應變數間是否有關係時的分析架構即為多變量變異數分析
- 多元區別分析(Multiple-group Discriminant Analysis, MDA)
 - 當應變數有一個內涵有三種以上情況的非計量變數，而自變數有二個以上但為計量的變數時，則探討自變數與應變數間是否有關係時的分析架構即為多元區別分析
- 間斷型多元區別分析(Discrete MDA)
 - 當應變數有有一個內涵有三種以上情況的非計量變數，而自變數有二個以上且為非計量的變數時，則探討自變數與應變數間是否有關係時的分析架構即為一間斷型多元區別分析

相依方法5

- 結構方程模式(SEM)
 - 同時處理多個自變數與應變數的關係，實際觀察值與其背後的潛在特質間的相互關係。



互依方法		變數尺度	
變數 個數	兩個	計量	非計量
	多個	<ul style="list-style-type: none"> 相關分析 (Correlation) 	<ul style="list-style-type: none"> 交叉分析表 (Cross Tabulation)
		<ul style="list-style-type: none"> 主成份分析 (Principle Component Analysis) 因素分析 (Factor Analysis) 集群分析 (Cluster Analysis) 計量多元尺度分析 (Multidimensional Scaling, MDS) 	<ul style="list-style-type: none"> 對應分析 (Correspondence Analysis) 非計量多元尺度分析 (Multidimensional Scaling, MDS)

互依方法1

- 簡單相關分析(Simple Correlation Analysis)
 - 當探討一個計量變數與另一個計量變數間的關係時，如果不區分何者為應變數，何者為自變數，則通常用的是簡單相關分析
- 交叉分析表(Cross Tabulation)
 - 當變數有兩個且均為非計量變數時，可以將所有觀察點(observation)依其歸屬兩個變數內涵的情況，以次數的方式呈現在一個雙向對應的表格。
- 主成份分析(Principle Component Analysis)
 - 將原有數目較多的計量變數資料，加以縮減以產生少數新的變數。

互依方法2

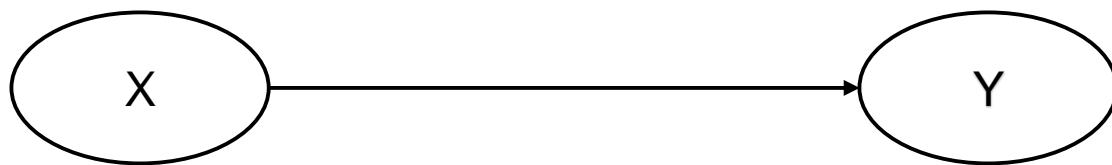
- 因素分析(Factor Analysis)
 - 透過因素分析，可將變數背後隱藏的共同因素找出來，然後再分析每一個變數受到特定共同因素影響的部分有多少，而屬於每一變數自身獨特性質的部分又有多少
- 集群分析(Cluster Analysis)
 - 當要對觀測點(observations)進行分群時，通常採用集群分析
- 對應分析(Correspondence Analysis)
 - 當雙向或多向關係表中的變數，其內涵有很多種的時候，表格會變得很龐大且難以分析，此時可以將各變數的所有內涵縮減成以少數的成份(component)來代表

簡單迴歸與複迴歸

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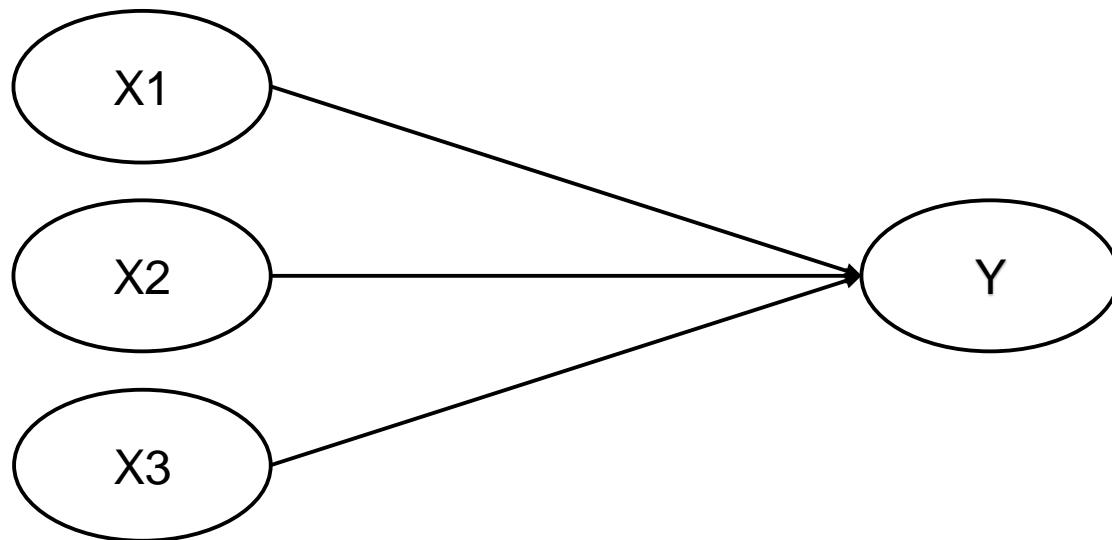
簡單迴歸

- 應用時機
 - 模型只有一個自變數、一個應變數
 - 自變數與應變數皆為連續尺度
 - 分析軟體：**SPSS**



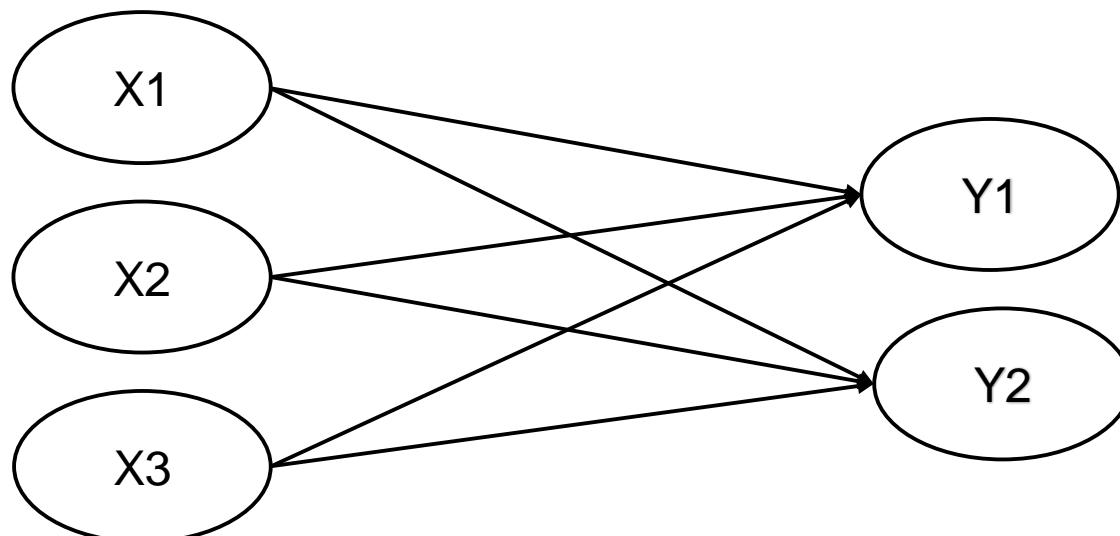
複回歸

- 應用時機
 - 模型有兩個以上自變數、一個應變數
 - 自變數與應變數皆為連續尺度
 - 分析軟體：**SPSS**

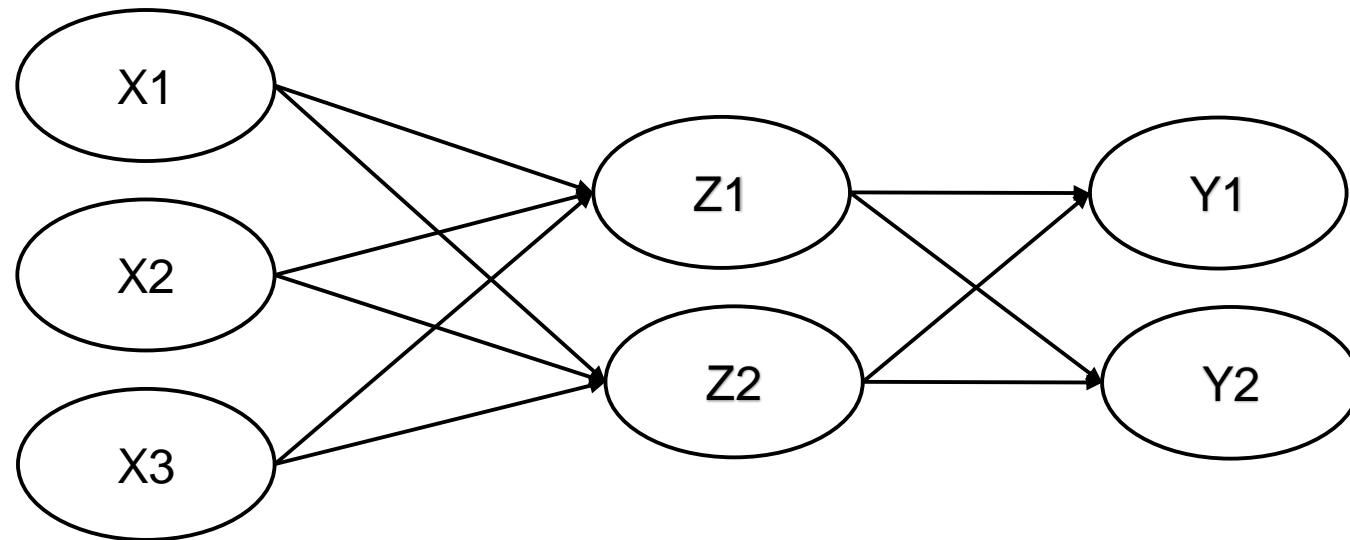


結構方程模型

- 應用時機
 - 模型有兩個以上自變數、兩個以上應變數
 - 所有變數皆為連續尺度



結構方程模型(cont.)



結構方程模型(cont.)

- 分析軟體
 - 共同變異為基礎(Covariance-based, CB-SEM)
 - AMOS、LISREL
 - 偏最小平方法為基礎(Partial Least Square, PLS-SEM)
 - PLS

使用PLS的理由

Table 1. Reasons for Using PLS-SEM

	Number of Studies in MISQ Reporting (N = 65)	Proportion Reporting (%)	Number of studies in JM, JMR, and JAMS Reporting (N = 60)	Proportion Reporting (%)
Total	46	70.77	20	33.33
Specific Reasons:				
Small Sample Size	24	36.92	15	25.00
Non-Normal Data	22	33.85	19	31.67
Formative Measures	20	30.77	19	31.67
Focus on Prediction	10	15.38	14	23.33
Model Complexity	9	13.85	6	10.00
Exploratory Research	7	10.77	1	1.67
Theory Development	6	9.23	0	0.00
Use of Categorical Variables	4	6.15	6	10.00
Convergence ensured	2	3.08	2	3.33
Theory Testing	1	1.54	5	20.33
Interaction Terms	1	1.54	5	8.33

SmartPLS 實作

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PLS資料分析邏輯

- 同時進行因素分析及路徑分析
- 同時處理多條複迴歸式
- 利用Bootstrapping克服小樣本問題
- 屬於驗證型因素分析(Confirmatory Factor Analysis, CFA)
 - SPSS因素分析屬於探索型因素分析(Exploratory Factor Analysis, EFA)

PLS資料分析流程

1. 資料品質檢定

- 1) 利用SPSS
- 2) 信度：Cronbach's α
- 3) 效度：因素分析

2. 模型檢定

- 1) 利用SmartPLS
- 2) 信效度分析
- 3) 模型檢定(路徑係數 β 值、顯著與否T值)

SmartPLS

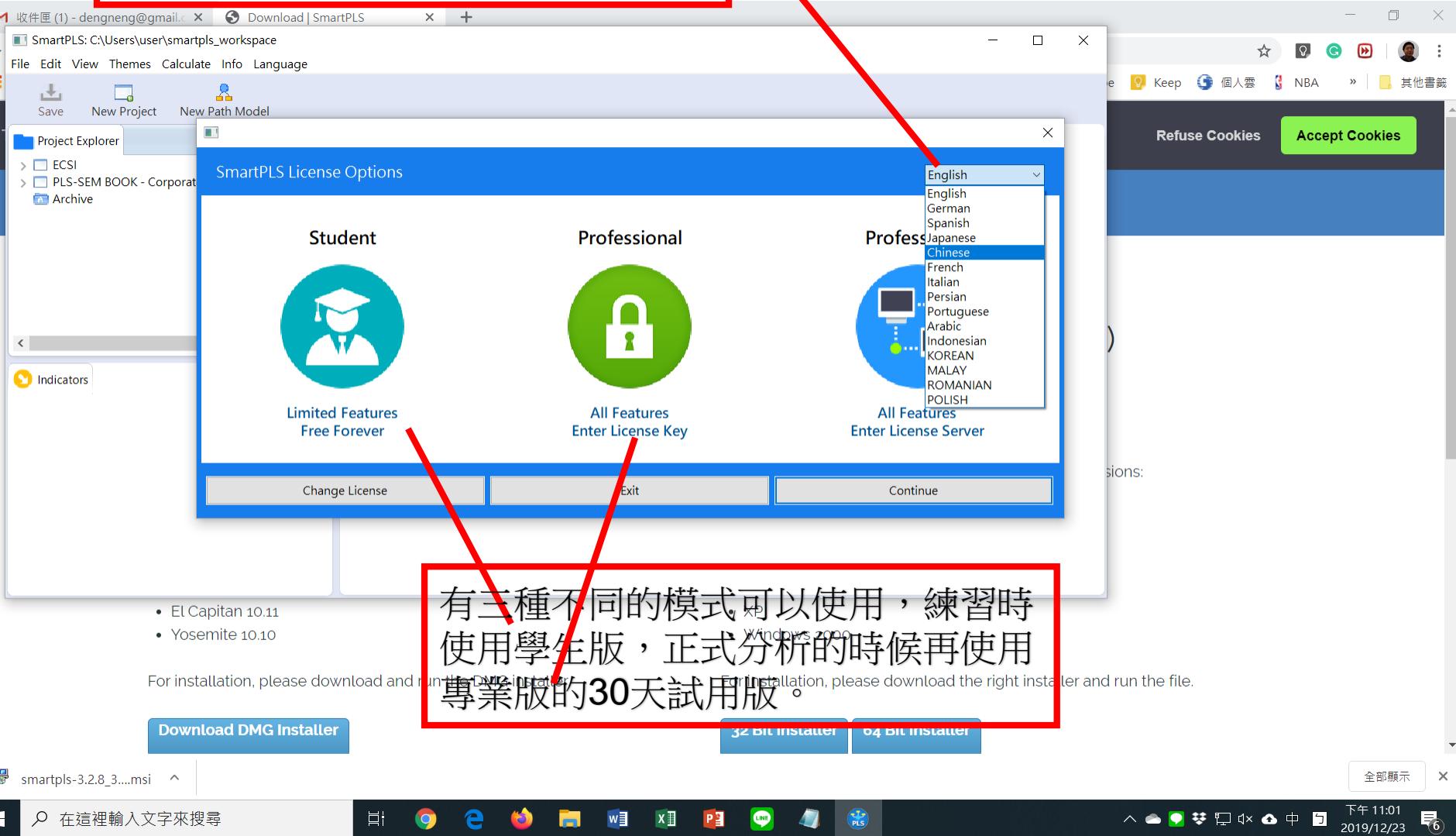
- 官方網站:

<https://www.smartpls.com/>

- 下載網址:

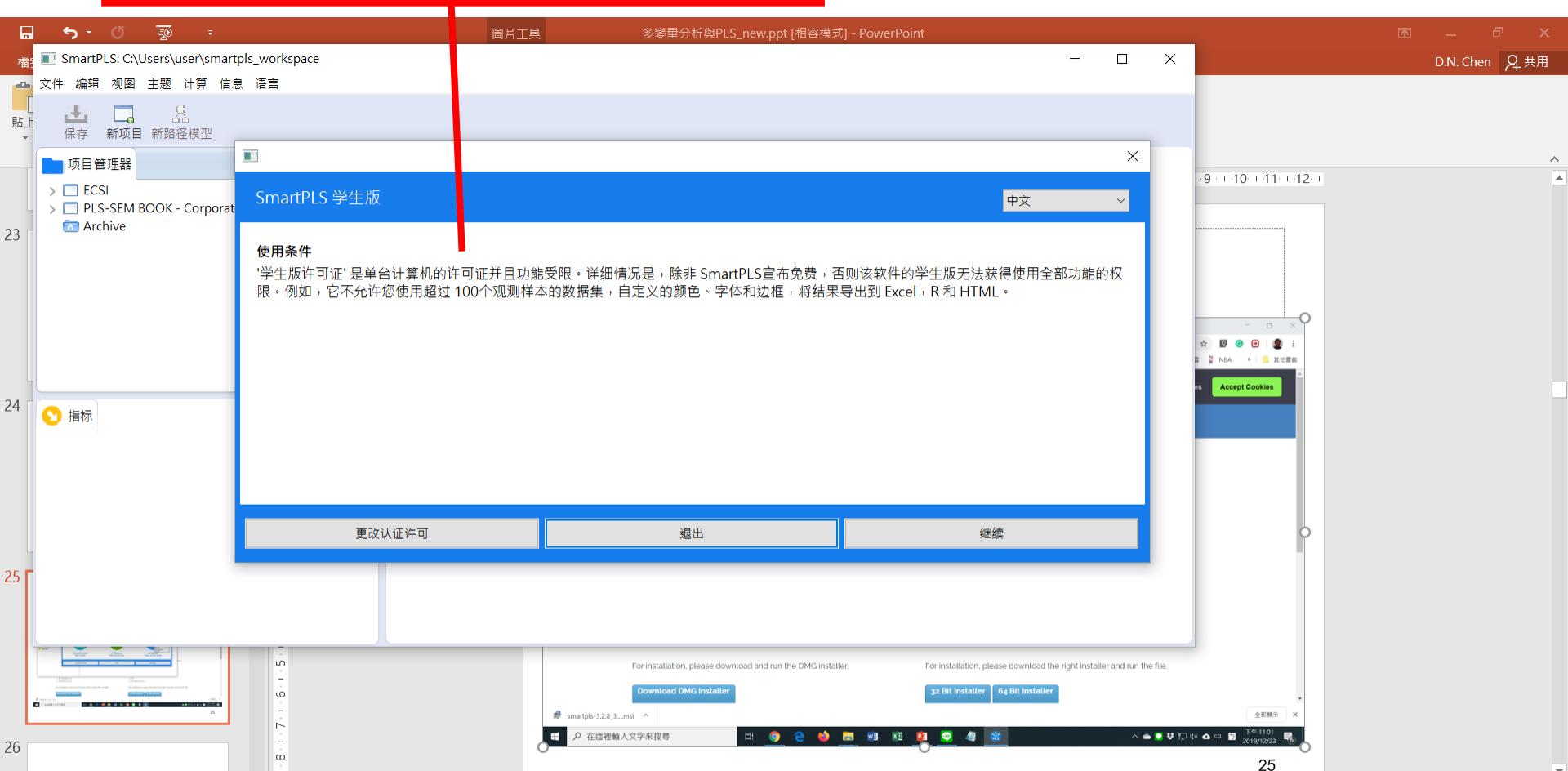
<https://www.smartpls.com/downloads>

下載後安裝執行畫面，可以自行設定不同語言，中文只有簡體字。

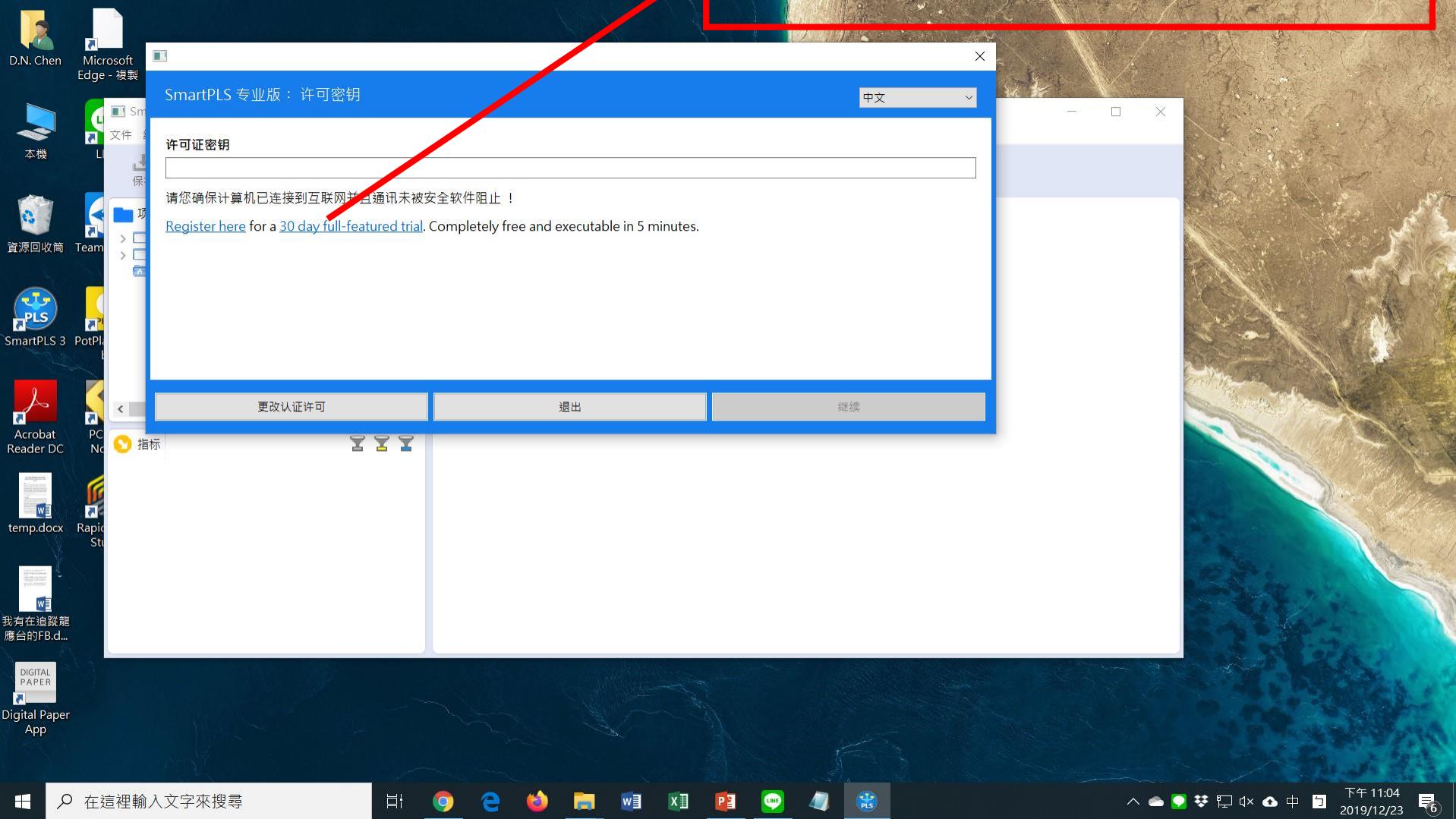


有三種不同的模式可以使用，練習時
使用學生版，正式分析的時候再使用
專業版的30天試用版。

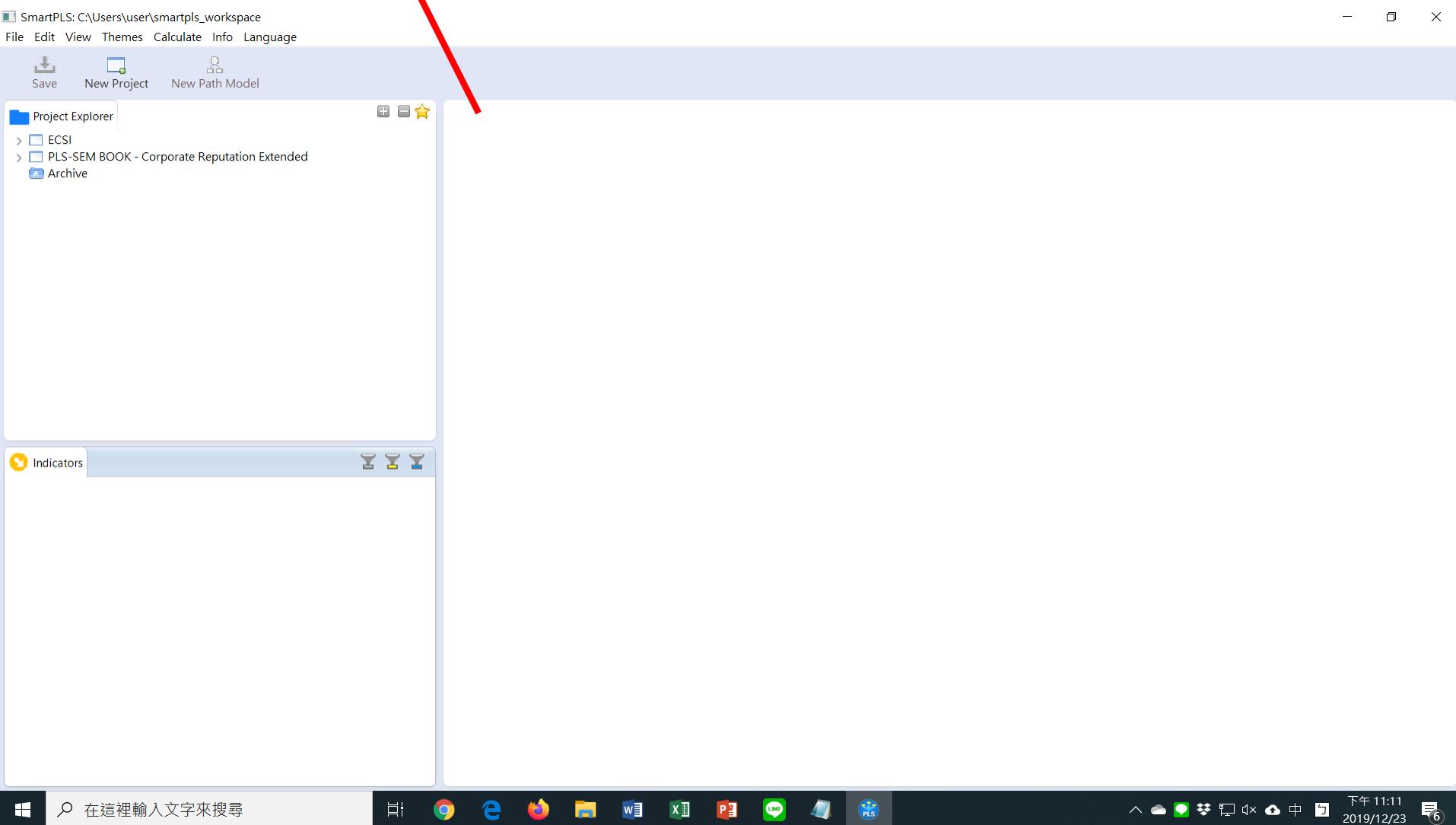
學生版說明，只能分析100樣本，分析
資料輸出格式也有限制。



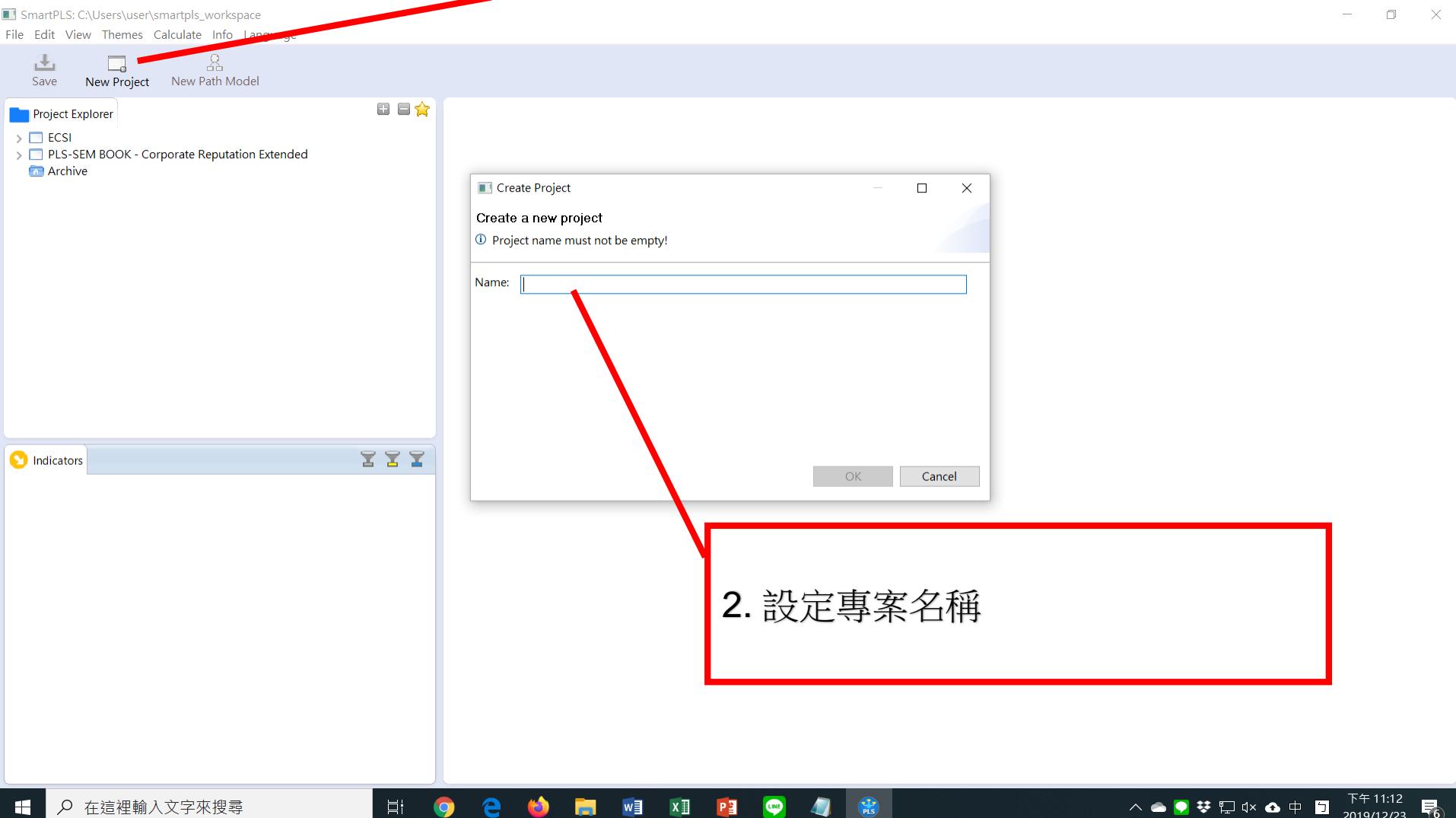
專業版提供**30**天全部功能無限制的試用版完全免費，要把握**30**天內把資料分析完成，以碩士論文來說時間綽綽有餘。



進去系統之後的初始畫面

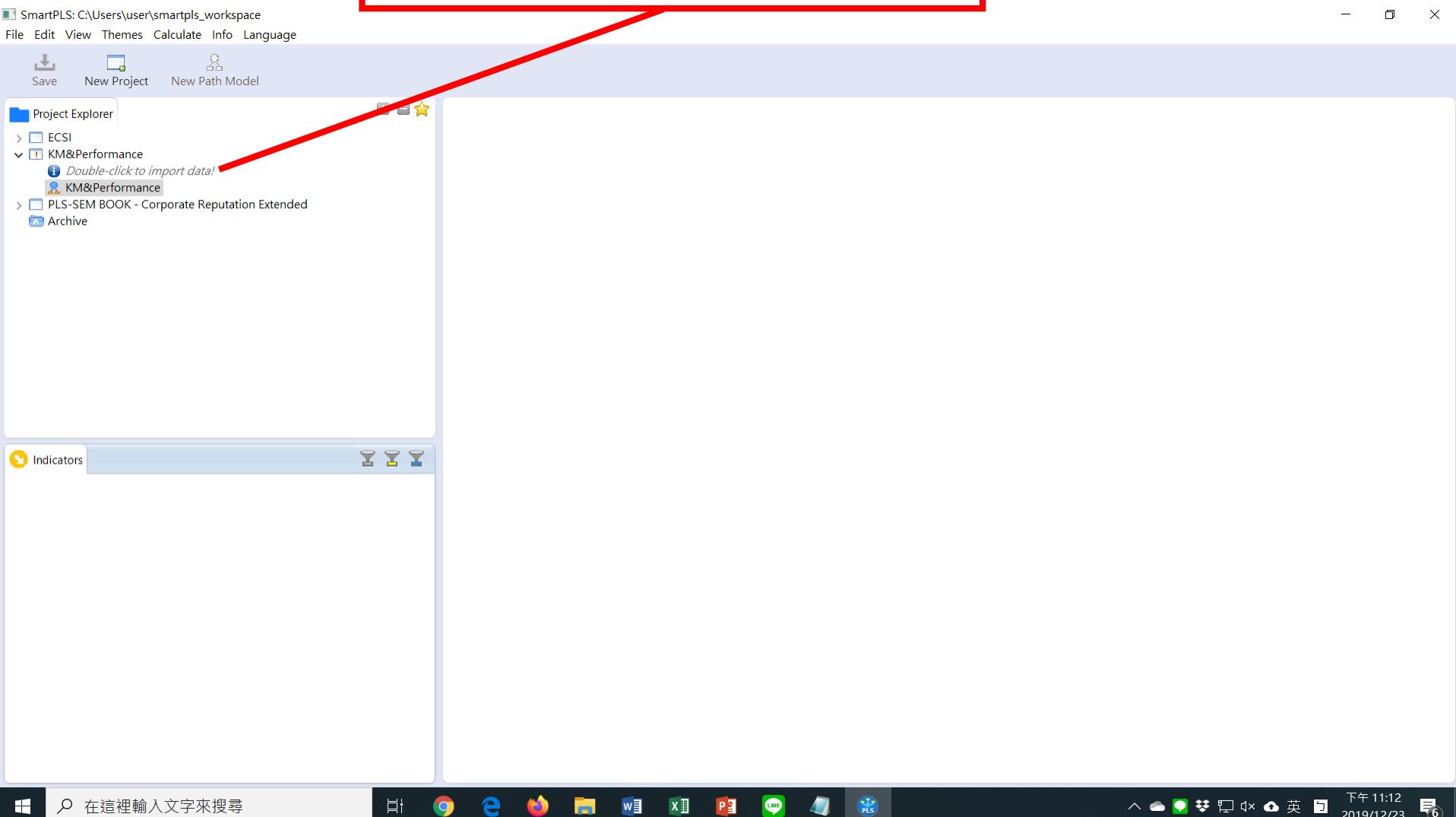


1. 設定新的專案

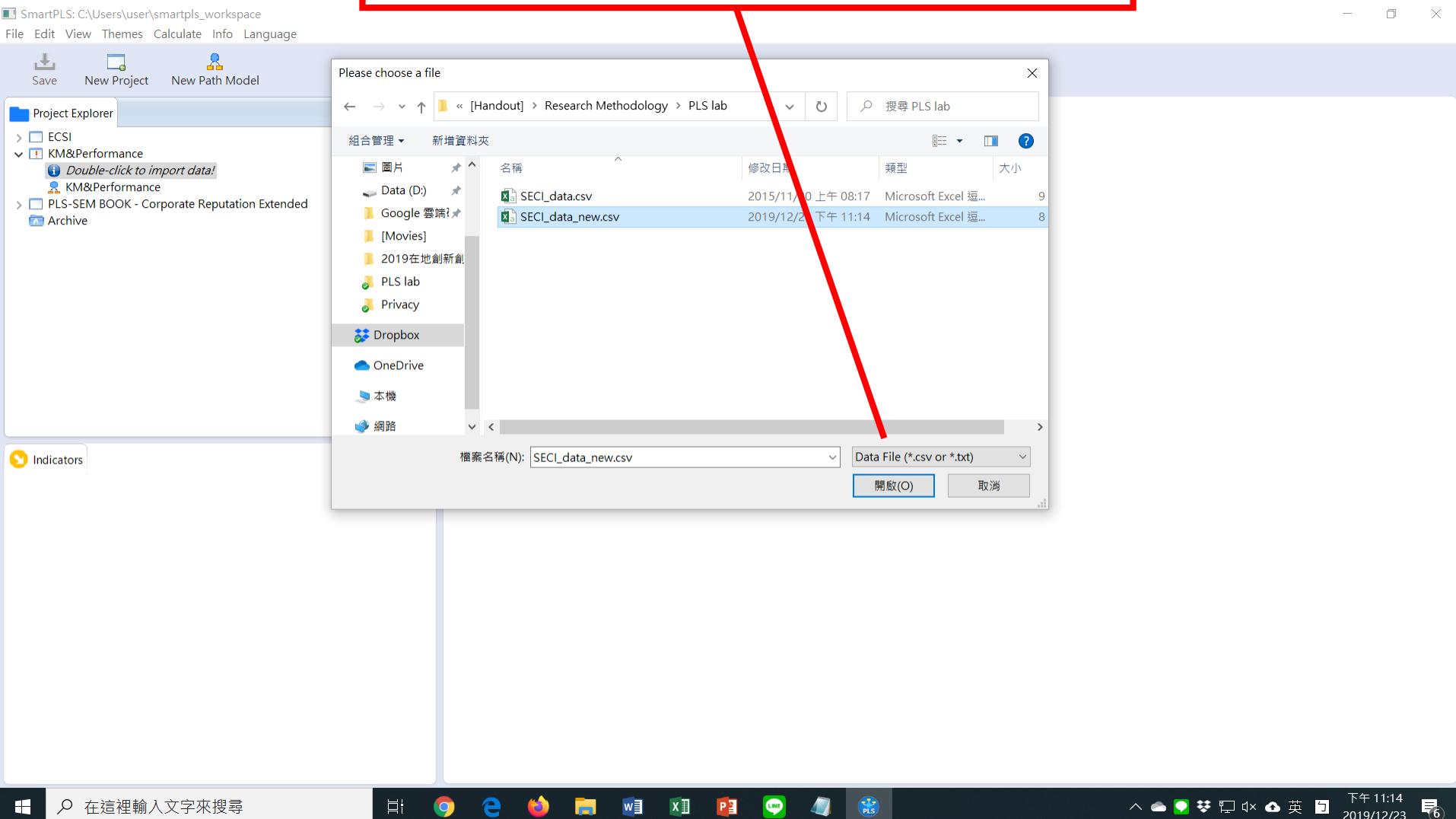


2. 設定專案名稱

成功建立資料分析專案之後，按兩下
載入想要分析的資料檔案。



選擇想要分析的資料檔案，切記只能分析**csv**或**txt**檔案，如果原來的資料是**excel**檔案，必須先轉成**csv**或**txt**才能被讀取。



成功載入資料！資料檔案的名稱前面會出現綠色圖示，代表資料沒有問題。

The screenshot shows the SmartPLS software interface. At the top, a red box highlights the message "成功載入資料！資料檔案的名稱前面會出現綠色圖示，代表資料沒有問題。". A red arrow points from this message to the "Project Explorer" panel on the left, where a green folder icon next to the file "SECI_data_new.txt" indicates that the data has been successfully loaded.

SmartPLS: C:\Users\user\smartpls_workspace

File Edit View Themes Calculate Info Language

Save New Project New Path Model Add Data Group Generate Data Group Clear Data Groups

Project Explorer

- ECSI
- KM&Performance
- KM&Performance
- SECI_data_new [100 records]**
- PLS-SEM BOOK - Corporate Reputation Extended
- Archive

SECI_data_new.txt

Delimiter: Comma Encoding: UTF-8
Value Quote Character: None Sample size: 100
Number Format: US (e.g. 1,000.23) Indicators: 36
Missing Value Marker: None Missing Values: 0

Re-Analyze Open External

Indicators:	Indicator Correlations		Raw File								Copy to Clipboard	
	No.	Missing	Mean	Median	Min	Max	Standard ...	Excess Kurt...	Skewness			
S1	1	0	4.960	5.000	2.000	7.000	0.979	0.098	-0.568			
S2	2	0	5.050	5.000	3.000	7.000	0.953	-0.256	-0.031			
S3	3	0	5.180	5.000	3.000	7.000	0.910	-0.142	-0.044			
S4	4	0	3.940	4.000	1.000	7.000	1.287	-0.053	0.371			
S5	5	0	4.800	5.000	2.000	7.000	1.140	-0.369	-0.008			
S6	6	0	4.520	4.000	1.000	7.000	1.081	0.748	0.044			
E1	7	0	4.190	4.000	1.000	7.000	1.262	-0.305	-0.033			
E2	8	0	4.210	4.000	1.000	7.000	1.202	0.112	-0.240			
E3	9	0	4.370	4.000	2.000	7.000	1.092	-0.602	0.105			
E4	10	0	4.320	4.000	2.000	7.000	1.191	-0.834	0.076			
E5	11	0	4.130	4.000	1.000	7.000	1.146	0.009	-0.219			
E6	12	0	4.650	5.000	2.000	7.000	1.161	-0.598	0.057			
C1	13	0	4.330	4.000	1.000	7.000	1.327	-0.204	-0.082			
C2	14	0	4.190	4.000	1.000	7.000	1.317	-0.458	-0.011			
C3	15	0	4.010	4.000	1.000	7.000	1.229	-0.245	0.211			
C4	16	0	4.260	4.000	1.000	7.000	1.230	0.106	-0.250			
C5	17	0	4.340	5.000	1.000	7.000	1.336	-0.300	-0.340			
C6	18	0	4.380	5.000	1.000	7.000	1.198	0.315	-0.420			
I1	19	0	4.700	5.000	1.000	7.000	1.109	1.023	-0.451			
I2	20	0	5.100	5.000	2.000	7.000	0.922	1.110	-0.124			
I3	21	0	4.500	5.000	2.000	7.000	1.237	-0.225	0.032			
I4	22	0	4.460	5.000	1.000	7.000	1.260	-0.282	-0.045			
I5	23	0	4.500	5.000	1.000	7.000	1.162	0.554	0.007			

1. 利用Latent Variable（潛在變數）來建立研究模型裡面的研究構面

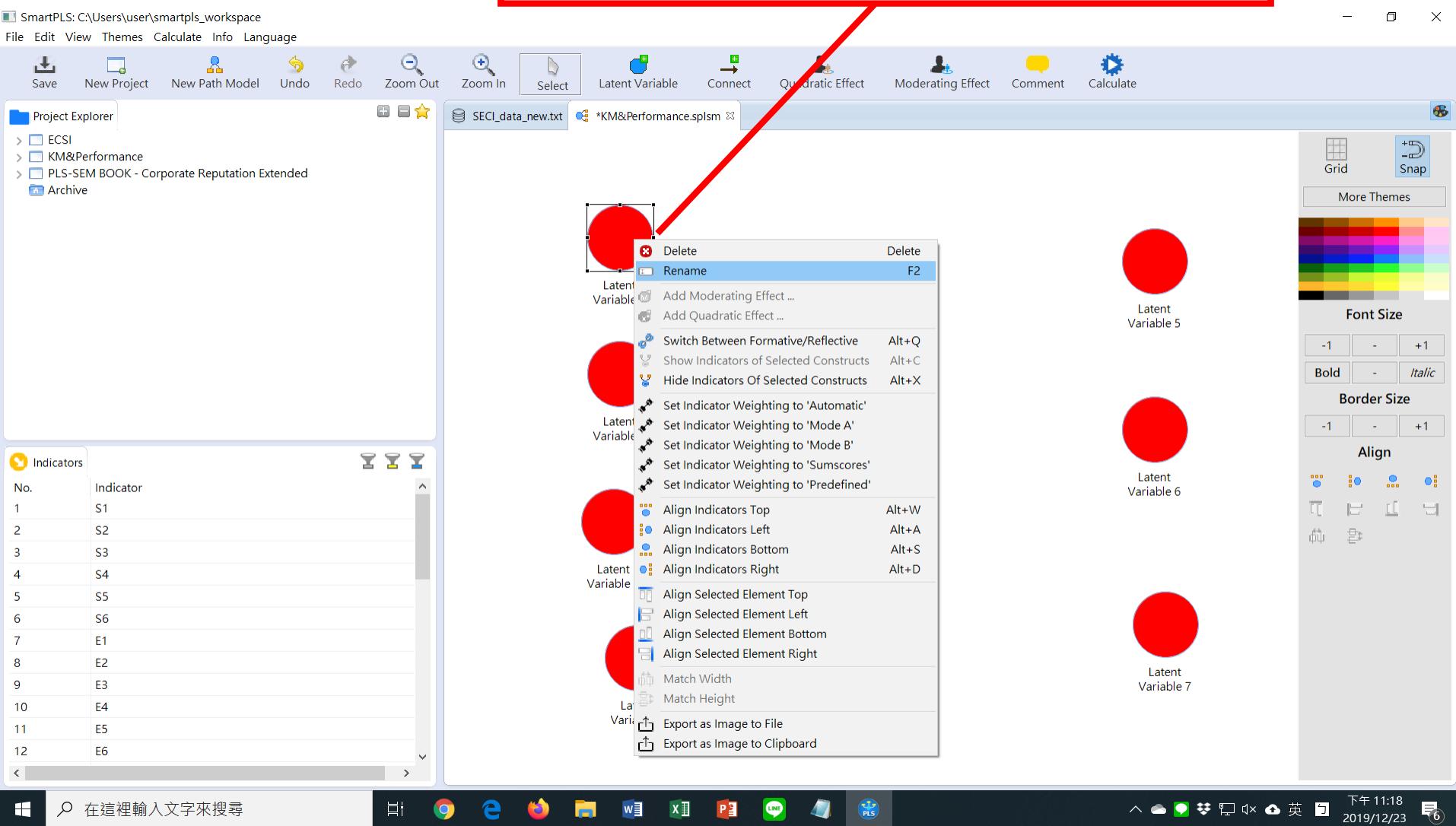
The screenshot shows the SmartPLS software interface. The top menu bar includes File, Edit, View, Themes, Calculate, Info, and Language. The toolbar contains icons for Save, New Project, New Path Model, Undo, Redo, Zoom Out, Zoom In, Select, Latent Variable, Connect, Quadratic Effect, Moderating Effect, Comment, and Calculate. A red arrow points from the 'Latent Variable' icon to the text '1. 利用Latent Variable（潛在變數）來建立研究模型裡面的研究構面'. The project explorer on the left lists files: ECSI, KM&Performance, PLS-SEM BOOK - Corporate Reputation Extended, and Archive. The main workspace shows a file named SECI_data_new.txt. A context menu is open over the file, with the option 'Create latent variables (ALT+2)' highlighted. A red box encloses the text '2. 利用Connect來建立研究模型裡面的構面間關係連結（研究假說）'. On the right, there are themes, font size, border size, and align tools. The bottom taskbar shows various application icons.

2. 利用Connect來建立研究模型裡面的構面間關係連結（研究假說）

根據研究模型，將所需要的潛在變項設定出來。

The screenshot shows the SmartPLS software interface. The top menu bar includes File, Edit, View, Themes, Calculate, Info, and Language. The toolbar contains icons for Save, New Project, New Path Model, Undo, Redo, Zoom Out, Zoom In, Select, Latent Variable (highlighted with a red arrow), Connect, Quadratic Effect, Moderating Effect, Comment, and Calculate. The Project Explorer panel on the left lists projects: ECSI, KM&Performance, PLS-SEM BOOK - Corporate Reputation Extended, and Archive. The main workspace displays seven red circular nodes labeled Latent Variable 1 through Latent Variable 7. A context menu on the right provides options for Grid, Snap, More Themes, Font Size, Border Size, and Align. The Indicators panel on the left lists 12 indicators: S1 through S6 and E1 through E6. The taskbar at the bottom shows various application icons, and the system tray indicates the date and time as 2019/12/23, 11:17 PM.

將滑鼠移至潛在變項上面，滑鼠按右鍵會出現許多設定，先將潛在變項的名稱依照研究模型的設定進行修改。



全部修改完畢！

SmartPLS: C:\Users\user\smartpls_workspace

File Edit View Themes Calculate Info Language

Save New Project New Path Model Undo Redo Zoom Out Zoom In Select Latent Variable Connect Quadratic Effect Moderating Effect Comment Calculate

Project Explorer

- ECSI
- KM&Performance
- PLS-SEM BOOK - Corporate Reputation Extended
- Archive

SECI_data_new.txt *KM&Performance.splsm

Indicators

No.	Indicator
1	S1
2	S2
3	S3
4	S4
5	S5
6	S6
7	E1
8	E2
9	E3
10	E4
11	E5
12	E6

Grid Snap More Themes

Font Size

Border Size

Align

在這裡輸入文字來搜尋

下午 11:20
2019/12/23

```
graph TD; S1((S1)) --> E1((E1)); S2((S2)) --> E2((E2)); S3((S3)) --> E3((E3)); S4((S4)) --> E4((E4)); S5((S5)) --> E5((E5)); S6((S6)) --> E6((E6)); E1 --> C((Combination)); E2 --> C; E3 --> C; E4 --> I((Internalization)); E5 --> N((New Market)); E6 --> FR((Fast Response)); C --> N; C --> FR; I --> FR; I --> FM((Flow Mgmt.));
```

緊接著先點選**Connect**，之後開始將研究構面之間的關係用拖拉的方式設定出來，這些有箭頭的直線即是研究假說。

SmartPLS: C:\Users\user\smartpls_workspace

File Edit View Themes Calculate Info Language

Save New Project New Path Model Undo Zoom Out Zoom In Select Latent Variable Connect Quadratic Effect Moderating Effect Comment Calculate

Project Explorer

- ECSI
- KM&Performance
- PLS-SEM BOOK - Corporate Reputation Extended
- Archive

SECI_data_new.txt *KM&Performance.splsm

Indicators

No.	Indicator
1	S1
2	S2
3	S3
4	S4
5	S5
6	S6
7	E1
8	E2
9	E3
10	E4
11	E5
12	E6

Socialization → New Market

Externalization → New Market

Combination → New Market

Internalization → New Market

Socialization → Fast Response

Externalization → Fast Response

Combination → Fast Response

Internalization → Fast Response

Socialization → Flow Mgmt.

Externalization → Flow Mgmt.

Combination → Flow Mgmt.

Internalization → Flow Mgmt.

Grid Snap More Themes

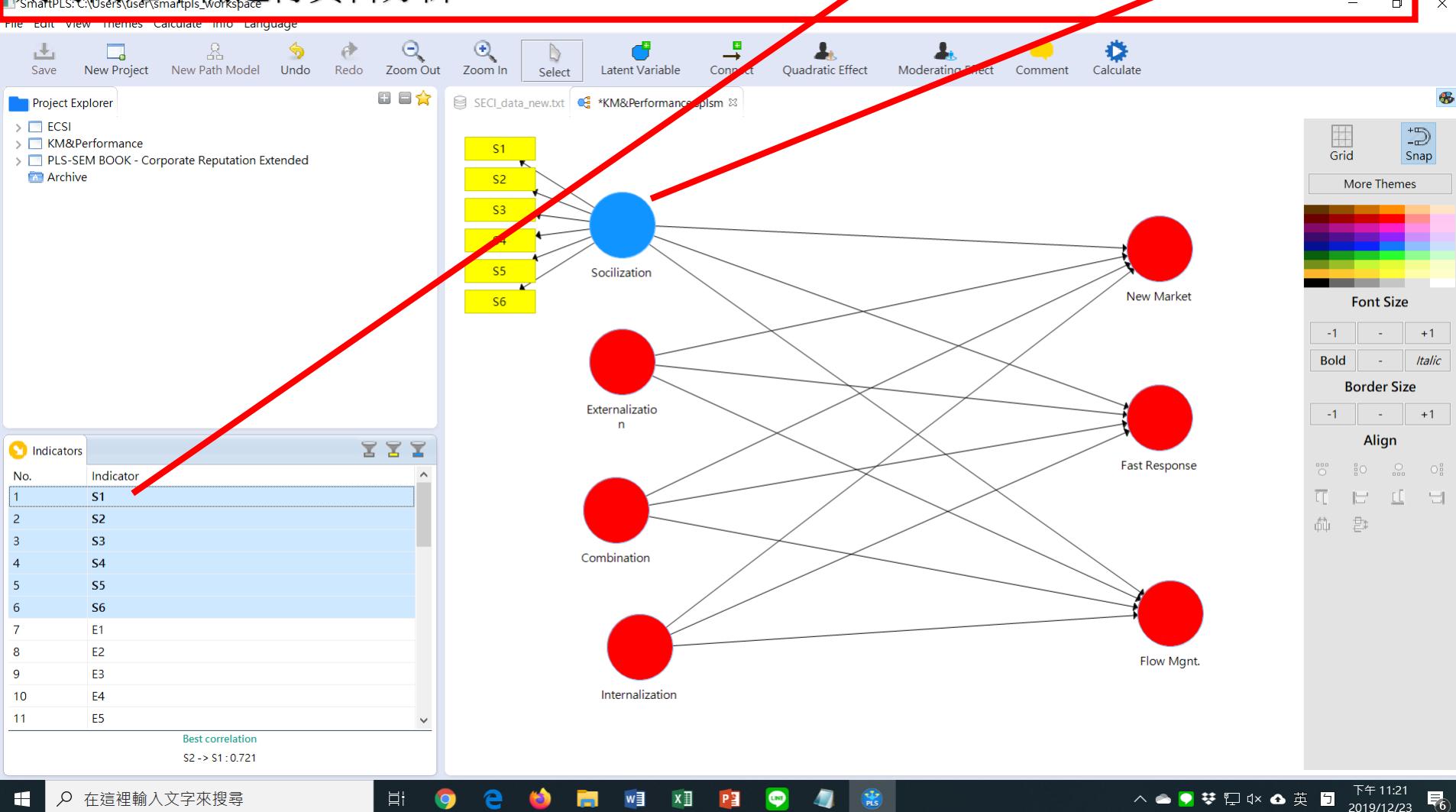
Font Size

Border Size

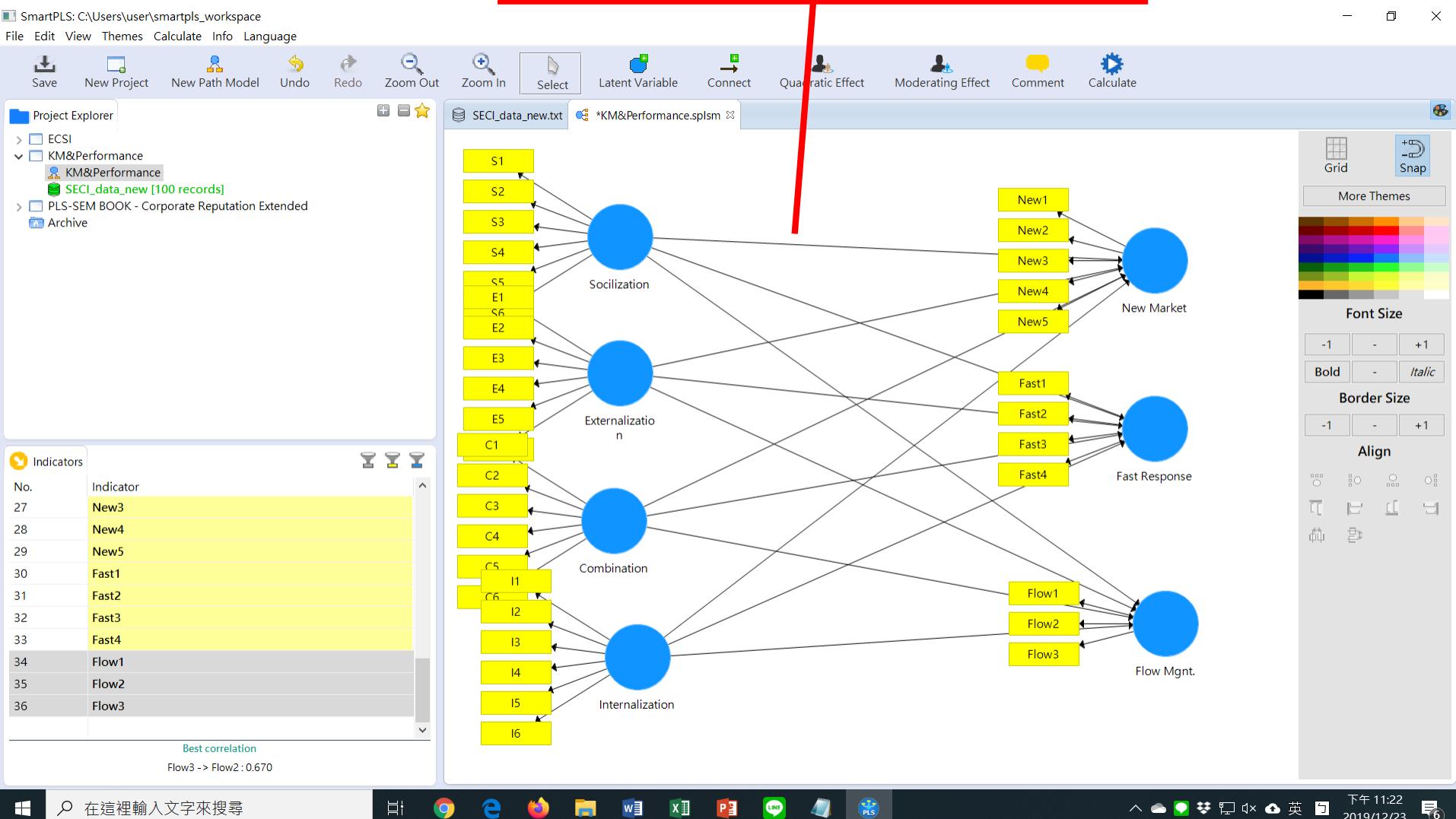
Align

```
graph LR; Socialization --> NM[New Market]; Socialization --> FR[Fast Response]; Socialization --> FM[Flow Mgmt.]; Externalization --> NM; Externalization --> FR; Externalization --> FM; Combination --> NM; Combination --> FR; Combination --> FM; Internalization --> NM; Internalization --> FR; Internalization --> FM;
```

此時全部的研究模型建立完畢，然後每一個潛在變項尚未指定它所對應的量表，程式當然無法執行，因此緊接著將每一個潛在變項所對應的測量指標(量表)用拖拉的方式進行設定。若潛在變項已經被指定問項，則圖形會變成藍色，待全部變項皆變成藍色，則可開始準備進行資料分析。



完成全部的潛在變項與測量指標之間的對應，全部的潛在變項皆變成藍色，此時可以開始準備分析。



開始資料分析之前若覺得版面太亂，
可以將滑鼠移至潛在變項上面，按下
右鍵，進行測量指標的排版。

SmartPLS: C:\Users\user\smartpls_workspace

File Edit View Themes Calculate Info Language

Save New Project New Path Model Undo Redo Zoom Out Zoom In Select Latent Variable Connect Quadratic Effect Moderating Effect Comment Calculate

Project Explorer

SECI_data_new.txt *KM&Performance.splsm

S1 S2 S3 S4 S5 E1 S6 E2 E3 E4 E5 C1 C2 C3 C4 C5 I1 I2 I3 I4 I5 I6

Socialization Externalization Combination Internalization

New Market

Fast1 Fast2 Fast3 Fast4 Flow1 Flow2 Flow3

Best correlation Flow3 -> Flow2 : 0.670

Indicators

No.	Indicator
27	New3
28	New4
29	New5
30	Fast1
31	Fast2
32	Fast3
33	Fast4
34	Flow1
35	Flow2
36	Flow3

Delete F2

Rename

Add Moderating Effect ...

Add Quadratic Effect ...

Switch Between Formative/Reflective

Show Indicators of Selected Constructs

Hide Indicators Of Selected Constructs

Set Indicator Weighting to 'Automatic'

Set Indicator Weighting to 'Mode A'

Set Indicator Weighting to 'Mode B'

Set Indicator Weighting to 'Sumscores'

Set Indicator Weighting to 'Predefined'

Align Indicators Top Alt+W

Align Indicators Left Alt+A

Align Indicators Bottom Alt+S

Align Indicators Right Alt+D

Align Selected Element Top

Align Selected Element Left

Align Selected Element Bottom

Align Selected Element Right

Match Width

Match Height

Export as Image to File

Export as Image to Clipboard

在這裡輸入文字來搜尋

下午 11:23
2019/12/23

```
graph LR; Socialization --> S1; Socialization --> S2; Socialization --> S3; Socialization --> S4; Socialization --> S5; Socialization --> E1; Socialization --> E2; Socialization --> E3; Socialization --> E4; Socialization --> E5; Externalization --> E3; Externalization --> E4; Externalization --> E5; Externalization --> C1; Externalization --> C2; Externalization --> C3; Externalization --> C4; Externalization --> C5; Combination --> I1; Combination --> I2; Combination --> I3; Combination --> I4; Combination --> I5; Combination --> I6; Internalization --> Flow1; Internalization --> Flow2; Internalization --> Flow3; NewMarket --> New1; NewMarket --> New2; NewMarket --> New3; NewMarket --> New4; NewMarket --> Fast1; NewMarket --> Fast2; NewMarket --> Fast3; NewMarket --> Fast4; NewMarket --> Flow1; NewMarket --> Flow2; NewMarket --> Flow3;
```

若檢查所有的潛在變項與測量指標之前的關係沒有錯誤，也可以選擇將測量指標隱藏起來，簡化版面。

SmartPLS: C:\Users\user\smartpls_workspace

File Edit View Themes Calculate Info Language

Save New Project New Path Model Undo Redo Zoom Out Zoom In Select Latent Variable Connect Quadratic Effect Moderating Effect Comment Calculate

Project Explorer

SECI_data_new.txt *KM&Performance.splsm

Socialization → New Market → Fast Response → Flow Mgt.

External Environment → Co-ordination → Internal Environment

Indicators

No.	Indicator
27	New3
28	New4
29	New5
30	Fast1
31	Fast2
32	Fast3
33	Fast4
34	Flow1
35	Flow2
36	Flow3

Best correlation
Flow3 -> Flow2 : 0.670

Diagram Context Menu (Right-clicked on New Market indicator):

- Delete F2
- Rename
- Add Moderating Effect ...
- Add Quadratic Effect ...
- Switch Between Formative/Reflective
- Show Indicators of Selected Constructs Alt+C
- Hide Indicators Of Selected Constructs Alt+X**
- Set Indicator Weighting to 'Automatic'
- Set Indicator Weighting to 'Mode A'
- Set Indicator Weighting to 'Mode B'
- Set Indicator Weighting to 'Sumscores'
- Set Indicator Weighting to 'Predefined'
- Align Indicators Top Alt+W
- Align Indicators Left Alt+A
- Align Indicators Bottom Alt+S
- Align Indicators Right Alt+D
- Align Selected Element Top
- Align Selected Element Left
- Align Selected Element Bottom
- Align Selected Element Right
- Match Width
- Match Height
- Export as Image to File
- Export as Image to Clipboard

```
graph LR; Socialization --> NewMarket[New Market]; Socialization --> FastResponse[Fast Response]; Socialization --> FlowMgt[Flow Mgt.]; ExternalEnv[External Environment] --> Co[Co-ordination]; Co --> InternalEnv[Internal Environment]; NewMarket --> Fast1[Fast1]; NewMarket --> Fast2[Fast2]; NewMarket --> Fast3[Fast3]; NewMarket --> Fast4[Fast4]; FastResponse --> Flow1[Flow1]; FastResponse --> Flow2[Flow2]; FastResponse --> Flow3[Flow3];
```

點選Calculate準備開始進行資料分析，必須要執行兩個模式，可先執行PLS algorithm，再執行Bootraping。

SmartPLS C:\Users\user\smartpls_workspace

File Edit View Themes Calculate Info Language

Save New Project New Path Model Undo Redo Zoom Out Zoom In Select Latent Variable Connect Quadratic Effect Moderating Effect Comment Calculate PLS Algorithm

Project Explorer

- ECSI
- KM&Performance
 - KM&Performance
 - SECI_data_new [100 records]
- PLS-SEM BOOK - Corporate Reputation Extended
- Archive

SECI_data_new.txt *KM&Performance.splsm

Indicators

No.	Indicator
27	New3
28	New4
29	New5
30	Fast1
31	Fast2
32	Fast3
33	Fast4
34	Flow1
35	Flow2
36	Flow3

Best correlation
Flow3 -> Flow2 : 0.670

Socialization → Externalization → Combination → Internalization → Fast Response → Flow Mgmt.

Diagram showing a structural model with four latent variables (Socialization, Externalization, Combination, Internalization) and two observed variables (Fast Response, Flow Mgmt.). Paths are indicated by arrows between nodes. The PLS Algorithm dropdown menu is open, listing various statistical methods: Consistent PLS Algorithm, Bootstrapping, Consistent PLS Bootstrapping, Blindfolding, Confirmatory Tetrad Analyses (CTA), Importance-Performance Map Analysis (IPMA), PLS Predict, Finite Mixture (FIMIX) Segmentation, Prediction-Oriented Segmentation (POS), Multi-Group Analysis (MGA), and Permutation.

點選PLS algorithm按鈕後出現以下畫面，不需要修改任何設定即可開始計算。

SmartPLS C:\Users\user\smartpls_workspace

File Edit View Themes Calculate

Save New Project New

Project Explorer

ECSI
KM&Performance
KM&Performance
SECI_data_new [100 records]
PLS-SEM BOOK - Corporate I
Archive

Partial Least Squares Algorithm

The PLS path modeling method was developed by Wold (1982). In essence, the PLS algorithm is a sequence of regressions in terms of weight vectors. The weight vectors obtained at convergence satisfy fixed point equations (see Dijkstra, 2010, for a general analysis of these equations).

Read more!

Setup Weighting

Basic Settings

Weighting Scheme: Path (radio button selected)
Maximum Iterations: 300
Stop Criterion (10^{-X}): 7

Advanced Settings

Configure individual initial weights

Indicators

No.	Indicator
27	New3
28	New4
29	New5
30	Fast1
31	Fast2
32	Fast3
33	Fast4
34	Flow1
35	Flow2
36	Flow3

Best correlation
Flow3 -> Flow2 : 0.670

Basic Settings

Weighting Scheme

PLS-SEM allows the user to apply three structural model weighting schemes:

- (1) centroid weighting scheme
- (2) factor weighting scheme, and
- (3) path weighting scheme (default).

While the results differ little for the alternative weighting schemes, path weighting is the recommended approach. This weighting scheme provides the highest R^2 value for endogenous latent variables and is generally applicable for all kinds of PLS path model specifications and estimations. Moreover, when the path model includes higher-order constructs (often called second-order models), researchers should usually not use the centroid weighting scheme.

Maximum Iterations

This parameter represents the maximum number of iterations that will be used for calculating the PLS results. This number should be sufficiently large (e.g., 300 iterations). When checking the PLS-SEM result, one must make sure that the algorithm did not stop because the maximum number of iterations was reached but due to the stop criterion. Note: The selection

After Calculation: Open Full Report Close Start Calculation

Internalization

Flow Mgmt.

Diagram illustrating the PLS path model. Two nodes, "Internalization" and "Flow Mgmt.", are shown. "Internalization" has two outgoing paths. "Flow Mgmt." has four outgoing paths. All paths are represented by lines connecting the nodes.

以下為PLS分析的結果，PLS分析之後主要要呈現在論文上面的統計數據都在這裡，要透過不同連結的切換來得到想要的數據。

The screenshot shows the SmartPLS software interface. The top menu bar includes File, Edit, View, Themes, Calculate, Info, and Language. The toolbar features Save, New Project, New Path Model, Hide Zero Values, Increase Decimals, Decrease Decimals, Export to Excel, Export to Web, and Export to R. The Project Explorer on the left lists projects like ECSI, KM&Performance (with files SECI_data_new.txt and *KM&Performance.spl), PLS-SEM BOOK - Corporate Reputation Extended, and Archive. The main workspace displays the 'Path Coefficients' table:

	Combinati...	Externalizat...	Fast Respo...	Flow Mgmt.	Internalizat...	New Market	Socilization
Combination			0.085	0.436		0.301	
Externalizat...			0.219	0.092		0.079	
Fast Respo...							
Flow Mgmt.							
Internalizati...			0.367	0.239		0.349	
New Market							
Socilization			0.059	0.002		0.081	

Below the table are sections for Final Results, Quality Criteria, Interim Results, and Base Data, each with a list of links. The bottom navigation bar includes a search bar, browser icons, and system status indicators.

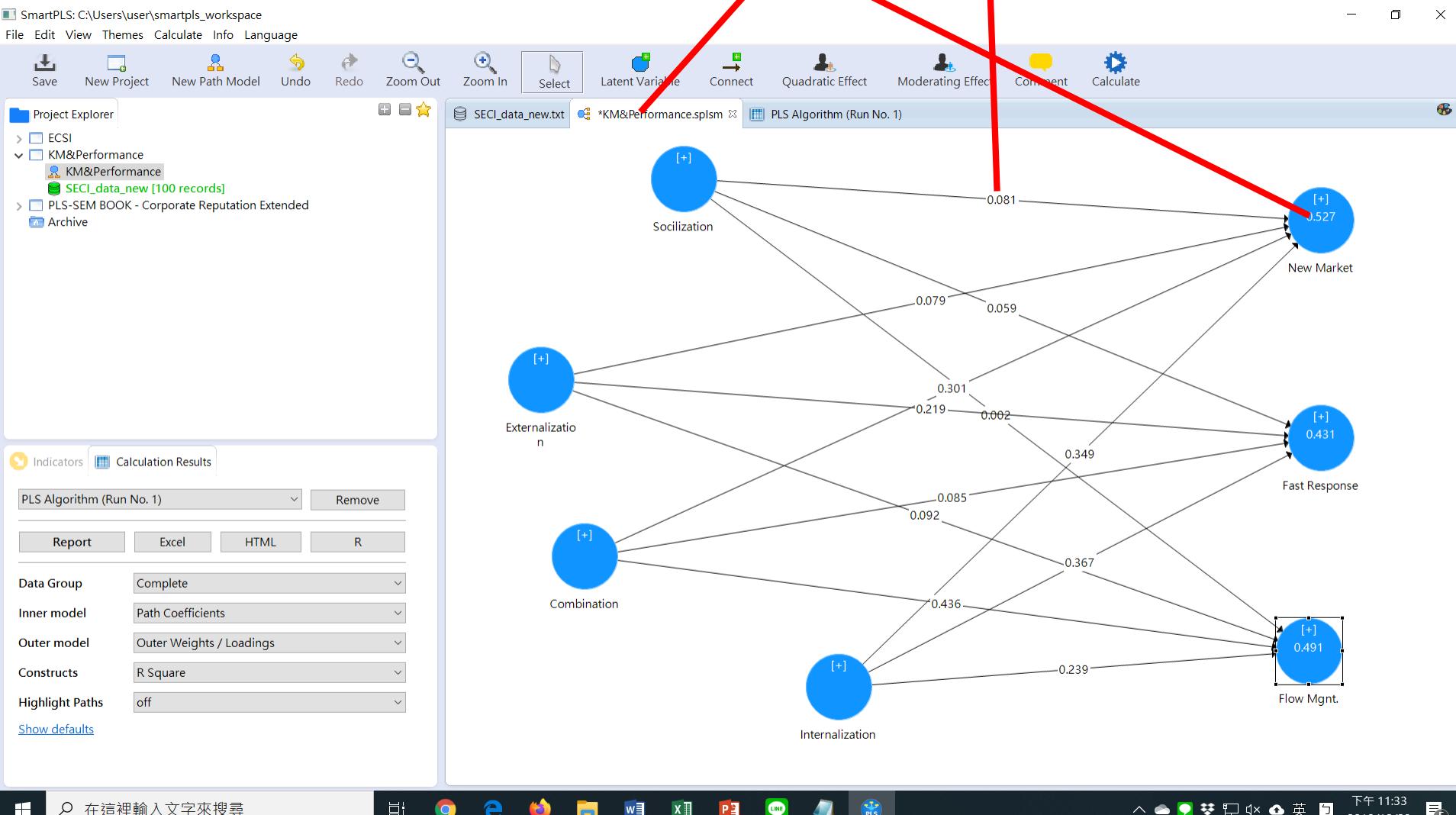
Final Results: Path Coefficients, Indirect Effects, Total Effects, Outer Loadings, Outer Weights, Latent Variable, Residuals.

Quality Criteria: R Square, f Square, Construct Reliability and Validity, Discriminant Validity, Collinearity Statistics (VIF), Model Fit, Model Selection Criteria.

Interim Results: Stop Criterion Changes.

Base Data: Setting, Inner Model, Outer Model, Indicator Data (Original), Indicator Data (Standardized), Indicator Data (Correlations).

為了初步瞭解分析的結果，建議先切換回路徑圖模式，此時可以看到每一條路徑上皆有標記一個介於-1~1之間的數字，這個即為路徑係數，代表兩個潛在構面之間關係的正或負強弱程度。構面上面的數值為R²值，代表這條關係的解釋能力。



再切換回PLS分析結果模式仔細閱讀詳細數字，可以先看一下資料品質（信度、效度）是否有到達所需要的門檻值，一定要放在論文上的包括 Conbach's Alpha(>0.7)、Composite Reliability (>0.7)、AVE(>0.5)。

The screenshot shows the SmartPLS software interface. The top menu bar includes File, Edit, View, Themes, Calculate, Info, and Language. The toolbar has buttons for Save, New Project, New Path Model, Hide Zero Values, Increase Decimals, Decrease Decimals, Export to Excel, Export to Web, and Export to R. The Project Explorer panel on the left lists projects: ECSI, KM&Performance (selected), SECI_data_new [100 records], PLS-SEM BOOK - Corporate Reputation Extended, and Archive. The Indicators panel shows a list of indicators with columns for No. and Indicator, and rows for New3, New4, New5, Fast1, Fast2, Fast3, Fast4, Flow1, Flow2, and Flow3. A note at the bottom says "Best correlation Flow3 -> Flow2 : 0.670". The main workspace displays the "Construct Reliability and Validity" table with data for various constructs. The table includes columns for Matrix, Cronbach's Alpha, rho_A, Composite Reliability, and Average Variance Extracted (AVE). The table data is as follows:

	Cronbach's Alpha	rho_A	Composite Reliability	Average Variance Extracted (AVE)
Combination	0.906	0.908	0.921	0.681
Externalizat...	0.877	0.902	0.908	0.628
Fast Respo...	0.941	0.943	0.958	0.850
Flow Mgmt.	0.844	0.856	0.906	0.762
Internalizati...	0.829	0.835	0.877	0.546
New Market	0.919	0.922	0.939	0.755
Socialization	0.859	0.893	0.895	0.593

Below the table, there are sections for Final Results, Quality Criteria, Interim Results, and Base Data, each with hyperlinks to further details. The status bar at the bottom shows the date and time: 2019/12/23, 11:36 AM.

再檢查一下看一下區別效度，這是PLS分析資料品質檢查最常低於門檻的檢定，表格中的對角線是該構面的AVE平方根，這個數值必須大於該構面跟其他構面之間的相關係數。除此之外，區別效度可以看一下交叉負荷量表，通常放在附錄。

The screenshot shows the SmartPLS software interface. The main window displays the 'Discriminant Validity' table, which includes columns for Fornell-Larcker Criterion, Cross Loadings, Heterotrait-Monotrait Ratio (HTMT), and Heterotrait-Monotrait Ratio (HTMT). The table also includes tabs for Combinations, Externalization, Fast Response, Flow Mgmt., Internalization, New Market, and Socialization. A red circle highlights the value 0.551 in the 'Fast Response' row under the 'Externalization' column. Another red circle highlights the value 0.549 in the 'Socialization' row under the 'Internalization' column. The 'Indicators' table on the left shows various indicator names like New3, New4, New5, Fast1, etc., with rows 27, 28, 29, 30, 31, 32, 33, 34, 35, and 36 highlighted in yellow. The status bar at the bottom indicates 'Best correlation' and 'Flow3 -> Flow2 : 0.670'. The taskbar at the bottom shows various application icons.

Combination	Externalizat...	Fast Respo...	Flow Mgmt.	Internalizat...	New Market	Socializat...
Externalizat...	0.821	0.792				
Fast Respo...	0.551	0.579	0.922			
Flow Mgmt.	0.671	0.613	0.783	0.873		
Internalizati...	0.661	0.675	0.613	0.591	0.739	
New Market	0.658	0.620	0.882	0.759	0.660	0.869
Socialization	0.753	0.726	0.549	0.572	0.730	0.620

No.	Indicator
27	New3
28	New4
29	New5
30	Fast1
31	Fast2
32	Fast3
33	Fast4
34	Flow1
35	Flow2
36	Flow3

VIF共線性檢定，必須小於5。

The screenshot shows the SmartPLS software interface. A red diagonal line has been drawn from the top-left towards the bottom-right, highlighting the 'Collinearity Statistics (VIF)' table.

Collinearity Statistics (VIF)

	VIF
C1	2.047
C2	2.359
C3	2.375
C4	3.511
C5	4.112
C6	3.355
E1	4.313
E2	5.612
E3	1.810
E4	1.795
E5	2.967
E6	1.373
Fast1	4.614
Fast2	3.723
Fast3	5.566
Fast4	3.290

Indicators

No.	Indicator
27	New3
28	New4
29	New5
30	Fast1
31	Fast2
32	Fast3
33	Fast4
34	Flow1
35	Flow2
36	Flow3

Best correlation
Flow3 -> Flow2 : 0.670

File Edit View Themes Calculate Info Language

Save New Project New Path Model Hide Zero Values Increase Decimals Decrease Decimals Export to Excel Export to Web Export to R

Project Explorer SECI_data_new.txt *KM&Performance.splsm PLS Algorithm (Run No. 1)

Copy to Clipboard: Excel Format R Format

Final Results Quality Criteria Interim Results Base Data

Path Coefficients R Square Stop Criterion Changes Setting

Indirect Effects f Square Construct Reliability and Validity Inner Model

Total Effects Discriminant Validity Outer Model

Outer Loadings Collinearity Statistics (VIF) Indicator Data (Original)

Outer Weights Indicator Data (Standardized)

Latent Variable Model Fit Indicator Data (Correlations)

Residuals Model Selection Criteria

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2019/12/23

模型適配度檢定，主要採用**SRMR**，必須小於0.1，比較嚴格的標準採用0.08，數值愈小愈好。

The screenshot shows the SmartPLS software interface. The top menu bar includes File, Edit, View, Themes, Calculate, Info, and Language. The toolbar has buttons for Save, New Project, New Path Model, Hide Zero Values, Increase Decimals, Decrease Decimals, Export to Excel, Export to Web, and Export to R. The Project Explorer panel on the left lists projects: ECSI, KM&Performance (selected), SECI_data_new [100 records], PLS-SEM BOOK - Corporate Reputation Extended, and Archive. The Indicators panel shows a list of indicators with columns for No., Indicator, and values. The main central area displays the 'Model_Fit' dialog box, which contains a table of fit statistics. A red arrow points from the text above to the SRMR value in the table.

SmartPLS: C:\Users\user\smartpls_workspace

File Edit View Themes Calculate Info Language

Save New Project New Path Model Hide Zero Values Increase Decimals Decrease Decimals Export to Excel Export to Web Export to R

Project Explorer

ECSI

KM&Performance

SECI_data_new [100 records]

PLS-SEM BOOK - Corporate Reputation Extended

Archive

Indicators

No.	Indicator
27	New3
28	New4
29	New5
30	Fast1
31	Fast2
32	Fast3
33	Fast4
34	Flow1
35	Flow2
36	Flow3

Best correlation
Flow3 -> Flow2 : 0.670

Model_Fit

	Saturated ...	Estimated ...
SRMR	0.078	0.108
d_ULS	4.000	7.721
d_G	2.614	3.059
Chi-Square	1,233.056	1,363.974
NFI	0.670	0.635

Copy to Clipboard: Excel Format R Format

Final Results Quality Criteria Interim Results Base Data

Path Coefficients R Square Stop Criterion Changes Setting

Indirect Effects f Square Construct Reliability and Validity Inner Model

Total Effects Discriminant Validity Outer Model

Outer Loading Collinearity Statistics (VIF) Indicator Data (Original)

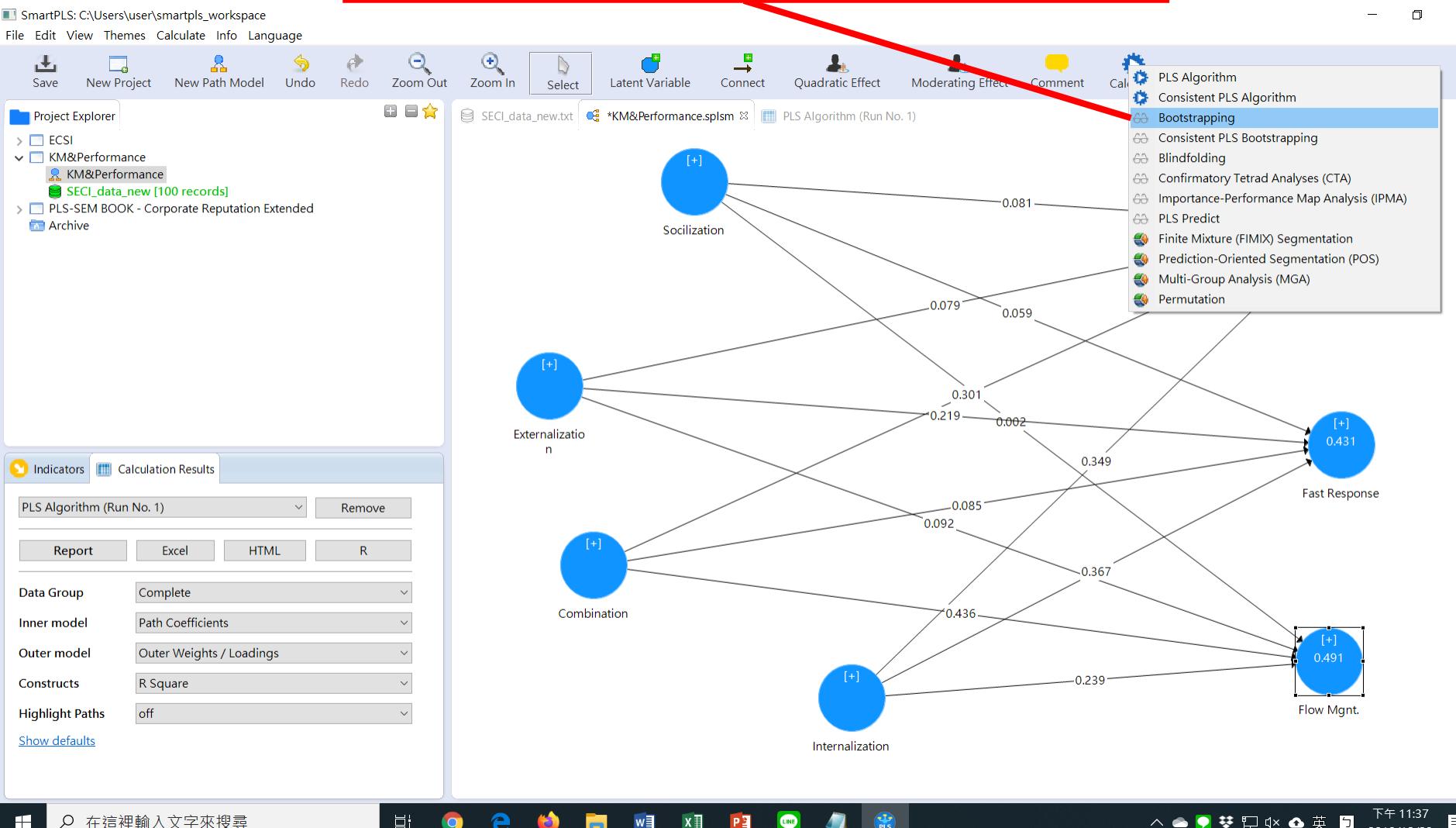
Outer Weights Model Fit Indicator Data (Standardized)

Latent Variable Residuals Model Selection Criteria Indicator Data (Correlations)

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下午 11:35
2019/12/23

PLS algorithm主要提供路徑係數及資料品質，
但是每一條路徑係數是否具有顯著影響關係，必
須透過**Bootstraping**來計算。



Subsamples至少設定為5000，開始執行資料分析。

SmartPLS C:\Users\user\smartpls_workspace

File Edit View Themes Calculate

Save New Project New

Project Explorer

ECSI
KM&Performance
SECI_data_new [100 records]
PLS-SEM BOOK - Corporate I
Archive

Indicators Calculation Results

PLS Algorithm (Run No. 1)

Report Excel

Data Group Complete

Inner model Path Coefficients

Outer model Outer Weights / Loadings

Constructs R Square

Highlight Paths off

Show defaults

Combination

Internalization

New Market

Fast Response

Flow Mgmt.

Subsamples 5000

Do Parallel Processing

Amount of Results Basic Bootstrapping

Advanced Settings

Confidence Interval Method Bias-Corrected and Accelerated (BCa) Bootstrap

Test Type Two Tailed

Significance Level 0.05

Basic Settings

Subsamples

In bootstrapping, subsamples are created with observations randomly drawn (with replacement) from the original set of data. To ensure stability of results, the number of subsamples should be large. For an initial assessment, one may use a smaller number of bootstrap subsamples (e.g., 500). For the final results preparation, however, one should use a large number of bootstrap subsamples (e.g., 5,000).

Note: Larger numbers of bootstrap subsamples increase the computation time.

Do Parallel Processing

This option runs the bootstrapping routine on multiple processors (if your computer device offers more than one core). Using parallel computing will reduce computation time.

Amount of Results

(1) Basic Bootstrapping (default)

Only a basic set of results for bootstrapping is assembled. This includes: Path Coefficients, Indirect Effects, Total Effects, Outer Loadings, and Outer Weights. This option is much faster if a large number of resamples is drawn and useful for preliminary data analysis.

After Calculation: Open Full Report Close Start Calculation

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11:37
2019/12/23

Bootstrapping的分析結果如下畫面，其主要提供每一條路徑係數的數值，及顯著與否T值及P值

SmartPLS: C:\Users\user\smartpls_workspace

File Edit View Themes Calculate Info Language

Save New Project New Path Model Hide Zero Values Increase Decimals Decrease Decimals Export to Excel Export to Web Export to R

Project Explorer

- ECSI
- KM&Performance
 - KM&Performance
 - SECI_data_new [100 records]
- PLS-SEM BOOK - Corporate Reputation Extended
- Archive

Path Coefficients

	Original Sa...	Sample Me...	Standard ...	T Statistics ...	P Values
Combinatio...	0.085	0.090	0.154	0.552	0.581
Combinatio...	0.436	0.441	0.154	2.840	0.005
Combinatio...	0.301	0.307	0.111	2.713	0.007
Externalizat...	0.219	0.216	0.171	1.279	0.201
Externalizat...	0.092	0.094	0.163	0.566	0.571
Externalizat...	0.079	0.068	0.141	0.560	0.575
Internalizati...	0.367	0.381	0.144	2.545	0.011
Internalizati...	0.239	0.241	0.120	1.997	0.046
Internalizati...	0.349	0.364	0.136	2.569	0.010
Socialization...	0.059	0.043	0.135	0.438	0.662
Socialization...	0.002	-0.007	0.146	0.012	0.990
Socialization...	0.081	0.073	0.106	0.766	0.444

Indicators Calculation Results

Bootstrapping (Run No. 1) Remove

Report Excel HTML R

Data Group Complete

Inner model T-Values

Outer model T-Values

Highlight Paths off

Show defaults

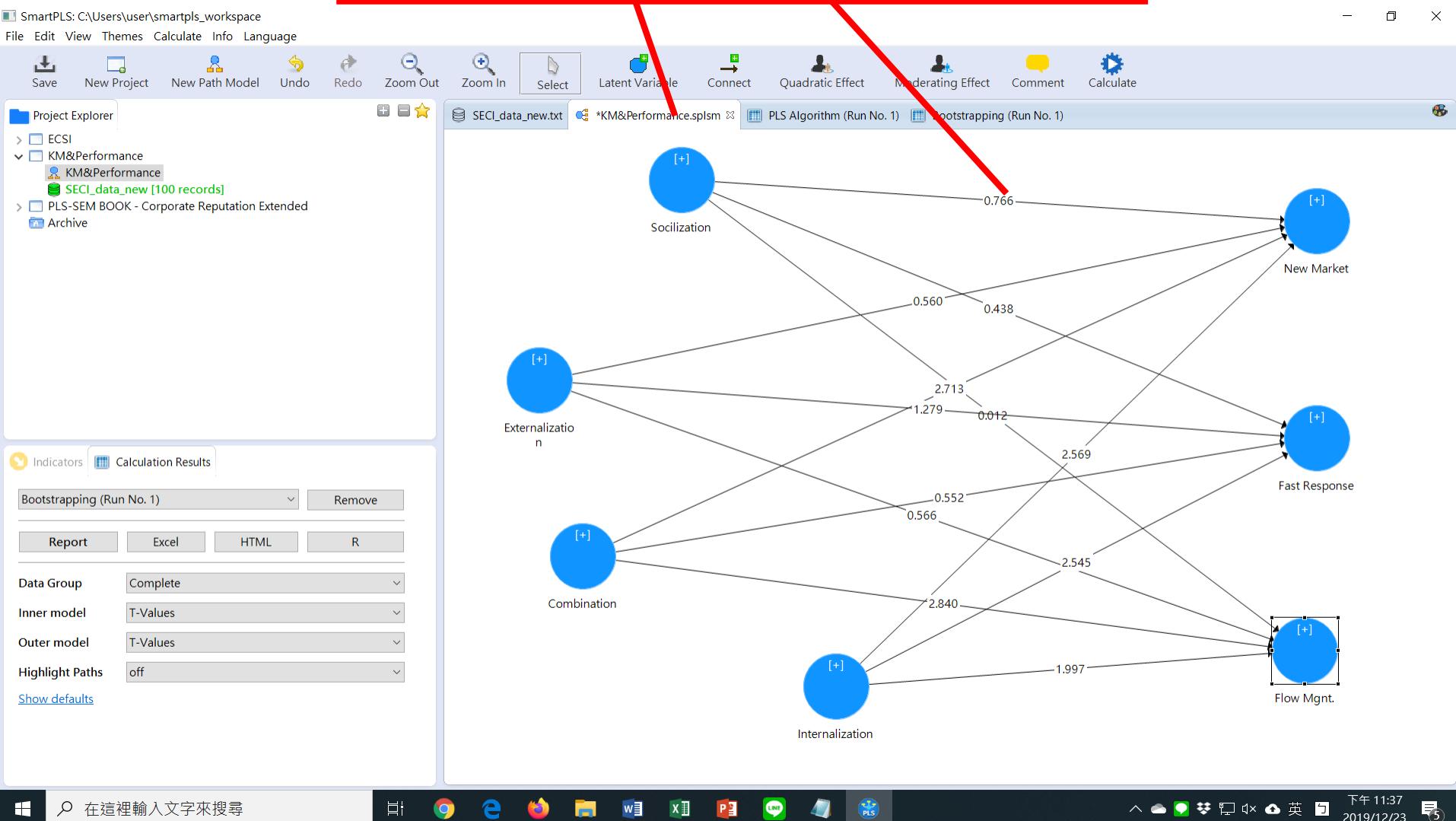
Final Results Histogram Base Data

[Path Coefficients](#) [Path Coefficients Histogram](#) [Setting](#)
[Total Indirect Effects](#) [Indirect Effects Histogram](#) [Inner Model](#)
[Specific Indirect Effects](#) [Total Effects Histogram](#) [Outer Model](#)
[Total Effects](#) [Indicator Data \(Original\)](#)
[Outer Loadings](#) [Indicator Data \(Standardized\)](#)
[Outer Weights](#)

在這裡輸入文字來搜尋

下午 11:37
2019/12/23

可以切回到模型畫面方便閱讀，可以發現圖形上每一條路徑上面多了一個數值，這個數值即是T值，T值愈大愈好，門檻為 >1.96 。



切換回分析結果數據表格，這邊的結果主要就是得到每一條關係(假說)的路徑係數及顯著與否的數值。

The screenshot shows the SmartPLS software interface. At the top, there's a menu bar with File, Edit, View, Themes, Calculate, Info, and Language. Below the menu is a toolbar with Save, New Project, New Path Model, Hide Zero Values, Increase Decimals, Decrease Decimals, Export to Excel (highlighted with a red box), Export to Web, and Export to R. The main workspace is titled "Path Coefficients". It contains a table with columns: Mean, STDEV, T-Values, P-Values, Confidence Intervals, Confidence Intervals Bias Corrected, and Samples. Red arrows point from the text above to the "Export to Excel" button and the table header. The table data includes rows for various path coefficients, such as "Combination -> Fast Response" with a P-value of 0.581. On the left, there's a "Project Explorer" pane showing files like "SECI_data_new.txt", "*KM&Performance.splsm", "PLS Algorithm (Run No. 1)", and "Bootstrapping (Run No. 1)". Below it is an "Indicators" pane listing indicators from 27 to 36, with "New3" highlighted. The bottom status bar shows "Best correlation Flow3 -> Flow2 : 0.670".

Combination	Mean	STDEV	T-Values	P-Values
Combination -> Fast Response	0.085	0.090	0.154	0.552
Combination -> Flow Mgmt.	0.436	0.441	0.154	0.005
Combination -> New Market	0.301	0.307	0.111	0.007
Externalization -> Fast Response	0.219	0.216	0.171	0.201
Externalization -> Flow Mgmt.	0.092	0.094	0.163	0.571
Externalization -> New Market	0.079	0.068	0.141	0.575
Internalization -> Fast Response	0.367	0.381	0.144	0.011
Internalization -> Flow Mgmt.	0.239	0.241	0.120	0.046
Internalization -> New Market	0.349	0.364	0.136	0.010
Socialization -> Fast Response	0.059	0.043	0.135	0.662
Socialization -> Flow Mgmt.	0.002	-0.007	0.146	0.990
Socialization -> New Market	0.081	0.073	0.106	0.444

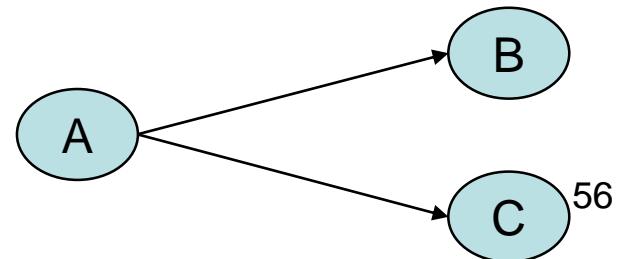
相關指標

- 信度
 - AVE>0.5, Composite Reliability (CR) >0.7, Cronbach's α >0.7
- Convergence Validity
 - Factor loadings>0.7, p<0.05, AVE>0.5, CR>0.7, Cronbach's α >0.7
- 交叉負荷量表
 - Factor loadings > Cross loadings
- Fornell and Larcker區別效度
 - 對角線為潛在變數之AVE開根號，下三角為皮爾森相關係數。開根號值必須大於相關係數。
- 模型解釋力
 - R Square (R^2)愈大解釋力愈高
- Goodness of model fit (模型適配度)
 - SRMR<0.1

信效度指標整理表格

潛在變項	測量變項	因素負荷量	平均數	標準差	AVE	CR	α
A	A1						
	A2						
	A3						
B	B1						
	B2						
	B3						
C	C1						
	C2						
	C3						

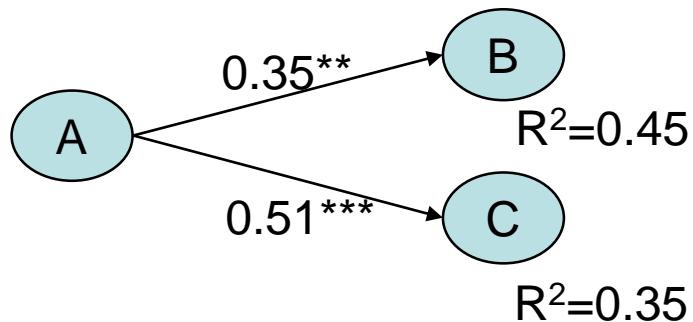
- 交叉負荷量表貼在附錄
- Fornell and Larcker區別效度貼在本文中



路徑分析結果整理表格

路徑(假說)	路徑係數	標準誤	T值	R ²
A→B				
A→C				

- 路徑分析結果模式圖一定要重新整理後放在本文，圖中標上路徑係數、顯著與否、R²。



中介效果檢定

- 利用PLS分析得到的路徑係數及標準誤差進行Sobel test
- Sobel test
 - [http://www.danielsoper.com/statcalc3/calc.asp
x?id=31](http://www.danielsoper.com/statcalc3/calc.asp?x?id=31)

干擾(調節)效果檢定

- 干擾變數為連續型
 - 檢定自變數與干擾變數的相乘結果是否對應變數產生顯著影響。
 - 在應變數上面按滑鼠右鍵→選擇**create moderating effect**→設定自變數、干擾變數→系統產生新一個新變數(自變數*干擾變數)→執行**PLS**分析→檢視新變數是否具有顯著影響($T>1.96$)，若顯著則干擾成立，反之則不成立。
- 干擾變數為類別型
 - 以干擾變數將資料分成多群，進行群組比較(**PLS-MGA**)。

群組比較(PLS-MGA)操作步驟

1. 先於原始資料檔確認分群變數
2. 載入新資料檔
3. 利用分群變數建立分群資料集
4. 進行分群分析(Multi-Group Analysis, MGA)

在原始資料表裡面，先確定有用來做資料分群的欄位，以此例來說，這是企業所處的產業類型，1代表製造業，2代表服務業。用來進行MGA分析的資料分群的欄位，常常都是人口統計變項，例如性別、職業等類別變數。

SECI_data_new.xlsx - Excel

D.N. Chen 共用

檔案 常用 插入 版面配置 公式 資料 校閱 檢視 告訴我您想要執行的動作...

剪下 複製、
貼上 複製格式

新細明體 12 A A 自動排列 通用格式 設定格式化為的條件 格式化為表格

剪貼簿 字型 對齊方式 數值

一般 中等 好 壞 計算方式 連結的儲存格

插入 刪除 格式 儲存格

自動加總 填滿 排序與篩選 尋找與選取

清除

AK1 Industry

	Z	AA	AB	AC	AD	AE	AF	AG	AH	AI	AJ	AK	AL	AM	AN	AO	AP	AQ	AR	AS	AT	AU	AV
1	New2	New3	New4	New5	Fast1	Fast2	Fast3	Fast4	Flow1	Flow2	Flow3	Industry											
2	4	3	3	3	3	3	3	4	4	4	3	1											
3	6	6	5	7	6	6	7	6	5	7	7	1											
4	5	6	5	5	4	5	5	6	5	4	5	1											
5	3	4	4	4	4	5	4	4	5	5	4	1											
6	3	3	3	3	3	5	5	5	3	5	3	2											
7	5	5	6	5	5	5	5	5	5	5	5	2											
8	4	3	3	2	2	3	3	3	3	4	1	1											
9	4	4	5	5	4	4	5	5	4	4	5	2											
10	5	5	5	5	5	5	5	5	5	5	5	2											
11	5	5	5	5	5	5	5	5	5	5	5	1											
12	7	7	6	7	7	7	7	7	6	7	1												
13	6	7	6	6	5	6	6	6	6	6	6	2											
14	4	4	4	4	4	4	4	4	4	4	4	2											
15	3	4	5	4	4	3	4	5	4	3	4	1											
16	5	4	4	4	5	4	4	4	4	4	4	2											
17	7	7	7	7	7	7	7	7	6	5	6	2											
18	3	3	3	3	3	3	3	3	3	4	3	2											
19	5	7	6	6	6	6	6	6	5	4	4	2											
20	4	4	4	5	4	4	4	5	4	3	3	1											
21	5	3	5	4	3	5	3	3	2	3	2	1											
22	6	5	5	5	6	6	6	6	4	5	4	1											
23	5	6	5	3	4	4	6	6	3	5	4	2											
24	3	3	3	3	3	3	3	3	3	3	3	2											
25	5	4	4	4	4	4	4	4	4	4	4	2											
26	5	5	4	4	5	5	5	5	5	5	4	1											

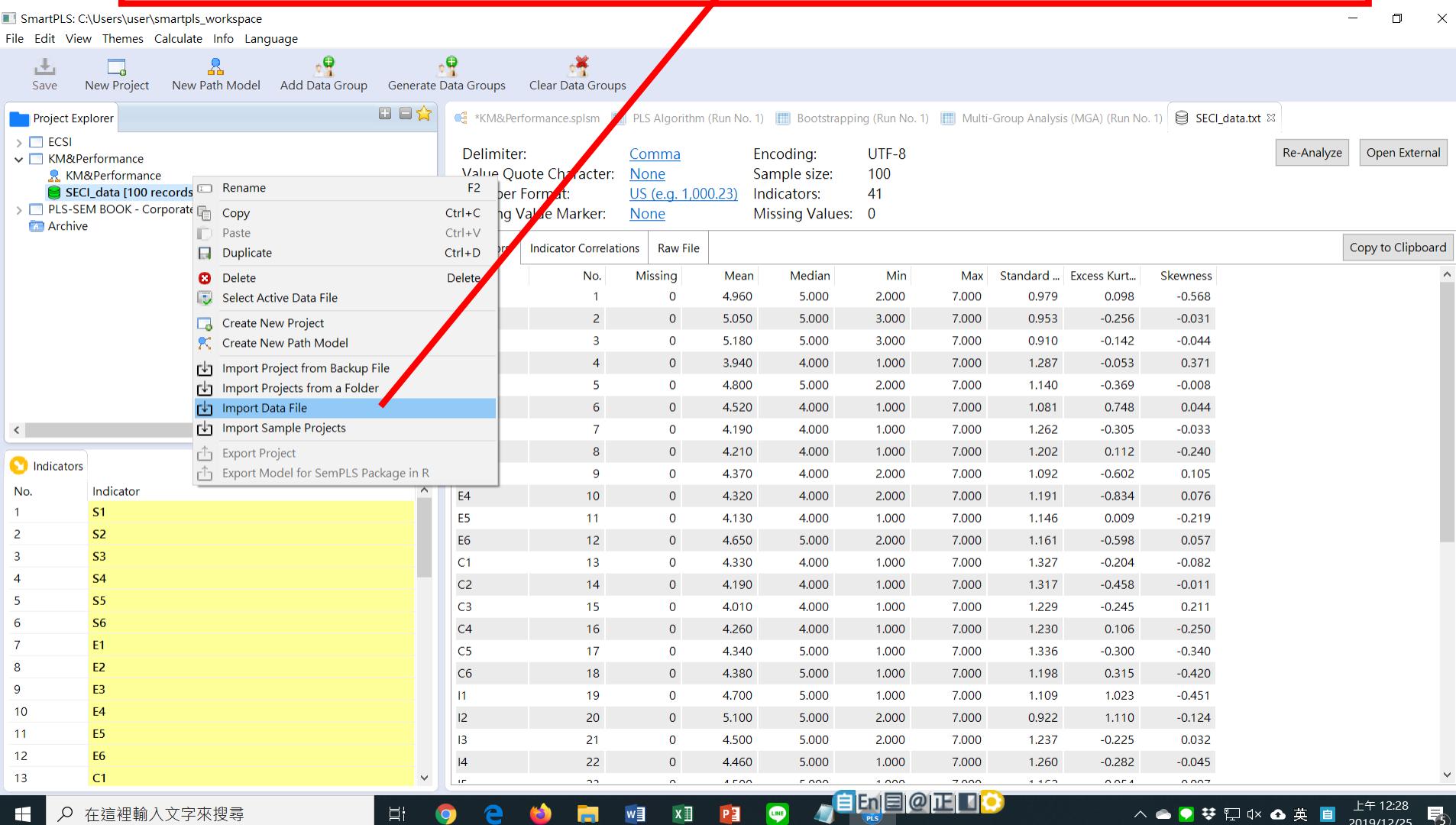
平均值: 1.53 項目個數: 101 加總: 153

就緒 在這裡輸入文字來搜尋

自注目@正口

100% 上午 12:27 2019/12/25

滑鼠移到分析專案，按下右鍵，載入新的資料檔案。再次提醒，資料檔案必須先轉為CSV檔。



滑鼠先點到資料內容的分頁，再利用產生資料群組的功能，進入資料分群設定畫面。

SmartPLS: C:\Users\user\smartpls_workspace

File Edit View Themes Calculate Info Language

Save New Project New Path Model Add Data Group Generate Data Groups Clear Data Groups

Project Explorer

ECSI
KM&Performance
SECI_data_new
SECI_data_new_Industry [100 records]
PLS-SEM BOOK - Corporate Reputation Extended
Archive

Delimiter: Comma Encoding: UTF-8
Value Quote Character: None Sample size: 100
Number Format: US (e.g. 1,000.23) Indicators: 37
Missing Value Marker: None Missing Values: 0

Indicators: Indicator Correlations Raw File

	No.	Missing	Mean	Median	Min	Max	Standard ...	Excess Kurt...	Skewness
S1	1	0	4.960	5.000	2.000	7.000	0.979	0.098	-0.568
S2	2	0	5.050	5.000	3.000	7.000	0.953	-0.256	-0.031
S3	3	0	5.180	5.000	3.000	7.000	0.910	-0.142	-0.044
S4	4	0	3.940	4.000	1.000	7.000	1.287	-0.053	0.371
S5	5	0	4.800	5.000	2.000	7.000	1.140	-0.369	-0.008
S6	6	0	4.520	4.000	1.000	7.000	1.081	0.748	0.044
E1	7	0	4.190	4.000	1.000	7.000	1.262	-0.305	-0.033
E2	8	0	4.210	4.000	1.000	7.000	1.202	0.112	-0.240
E3	9	0	4.370	4.000	2.000	7.000	1.092	-0.602	0.105
E4	10	0	4.320	4.000	2.000	7.000	1.191	-0.834	0.076
E5	11	0	4.130	4.000	1.000	7.000	1.146	0.009	-0.219
E6	12	0	4.650	5.000	2.000	7.000	1.161	-0.598	0.057
C1	13	0	4.330	4.000	1.000	7.000	1.327	-0.204	-0.082
C2	14	0	4.190	4.000	1.000	7.000	1.317	-0.458	-0.011
C3	15	0	4.010	4.000	1.000	7.000	1.229	-0.245	0.211
C4	16	0	4.260	4.000	1.000	7.000	1.230	0.106	-0.250
C5	17	0	4.340	5.000	1.000	7.000	1.336	-0.300	-0.340
C6	18	0	4.380	5.000	1.000	7.000	1.198	0.315	-0.420
I1	19	0	4.700	5.000	1.000	7.000	1.109	1.023	-0.451
I2	20	0	5.100	5.000	2.000	7.000	0.922	1.110	-0.124
I3	21	0	4.500	5.000	2.000	7.000	1.237	-0.225	0.032
I4	22	0	4.460	5.000	1.000	7.000	1.260	-0.282	-0.045
I5	23	0	4.500	5.000	1.000	7.000	1.162	0.654	0.007

Best correlation
Flow3 -> Flow2 : 0.670

在這裡輸入文字來搜尋

SmartPLS

上午 12:20
2019/12/25

可以先設定想要的分群變數名稱，利用預設的也行。再找到我們原先資料集裡面的分群變數進行設定。

SmartPLS C:\Users\user\smartpls_workspace

File Edit View Themes Calculate Info Language

Save New Project New Path Model Add Data Group

Project Explorer

- ECSI
- KM&Performance
 - KM&Performance
 - SECI_data_new
 - SECI_data_new_Industry [100 records]
- PLS-SEM BOOK - Corporate Reputation Extended
- Archive

Indicators

No.	Indicator
28	New4
29	New5
30	Fast1
31	Fast2
32	Fast3
33	Fast4
34	Flow1
35	Flow2
36	Flow3
37	Industry

Best correlation
Flow3 -> Flow2 : 0.670

Generate Data Groups

Name prefix: GROUP_Industry

Group Columns

Group column 0: Industry (2 unique values)

Group column 1: I1 (7 unique values)
I2 (6 unique values)
I3 (6 unique values)
I4 (7 unique values)
I5 (7 unique values)
I6 (7 unique values)

Group column 2:

Prune group

Total:
New1 (7 unique values)
New2 (6 unique values)
New3 (6 unique values)
New4 (6 unique values)
New5 (7 unique values)
S1 (6 unique values)
S2 (5 unique values)
S3 (5 unique values)
S4 (7 unique values)
S5 (6 unique values)
S6 (7 unique values)

Minimum cases:

OK Cancel

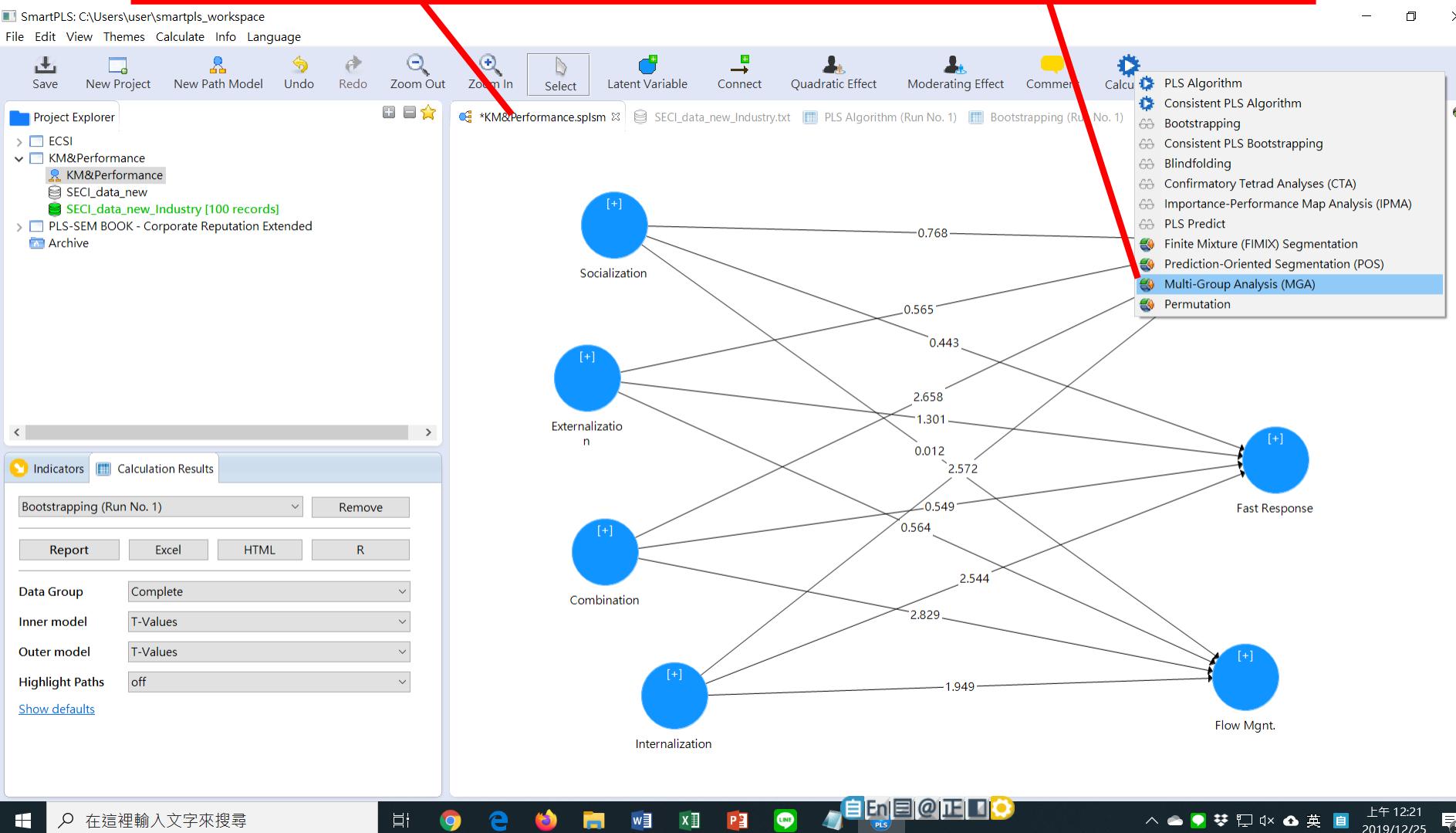
This option allows you to define groups of data for carrying out group-specific analyses. You need to define a variable in your set of data. This grouping variable should have numbers to determine the group membership of each observation (e.g., 1, 2, and 3). The dialog uses the name of the selected variable to name the group. For example, "age_" produces group names of "age_1", "age_2", and "age_3" in the results report. The user can change the prefix for the automatic naming of groups.

C4	16	0	4.260	4.000	1.000	7.000	1.230	0.106	-0.250
C5	17	0	4.340	5.000	1.000	7.000	1.336	-0.300	-0.340
C6	18	0	4.380	5.000	1.000	7.000	1.198	0.315	-0.420
I1	19	0	4.700	5.000	1.000	7.000	1.109	1.023	-0.451
I2	20	0	5.100	5.000	2.000	7.000	0.922	1.110	-0.124
I3	21	0	4.500	5.000	2.000	7.000	1.237	-0.225	0.032
I4	22	0	4.460	5.000	1.000	7.000	1.260	-0.282	-0.045
	23	0	4.500	5.000	1.000	7.000	1.162	0.574	0.007

設定完分群變數之後會進入以下畫面，可以得知資料已經順利被分成兩群，數值為1的有47筆資料，數值為2的有53筆資料。

The screenshot shows the SmartPLS software interface. The top menu bar includes File, Edit, View, Themes, Calculate, Info, and Language. The toolbar has icons for Save, New Project, New Path Model, Add Data Group, Generate Data Groups, Clear Data Groups, and a redacted icon. The Project Explorer on the left lists projects: ECSI, KM&Performance (with sub-items KM&Performance, SECI_data_new, and SECI_data_new_Industry [100 records]), PLS-SEM BOOK - Corporate Reputation Extended, and Archive. The main workspace displays data group statistics for the file *KM&Performance.pism. The statistics show: Delimiter: Comma, Encoding: UTF-8, Value Quote Character: None, Sample size: 100, Number Format: US (e.g. 1,000.23), Indicators: 37, Missing Value Marker: None, and Missing Values: 0. Below this, a table shows two data groups: GROUP_IndustryIndustry(1.0) with 47 records and GROUP_IndustryIndustry(2.0) with 53 records. The Indicators panel on the left lists indicators from No. 26 to 37, with New2 highlighted in yellow. The taskbar at the bottom shows various application icons.

回到路徑模式分析的頁面，再選擇計算功能裡面的MGA分析。



進入MGA分析功能之後是以下畫面，設定群組是前面資料分群後的1或2，以此例而言，群組A設定為數值1的那群，群組B設定為數值2的那群，之後點選開始計算。

SmartPLS: C:\Users\user\smartpls_workspace

File Edit View Themes Calculate

Save New Project New

Project Explorer

ECSI
KM&Performance
SECI_data_new
SECI_data_new_Industry
PLS-SEM BOOK - Corporate I
Archive

Indicators Calculation Results

Bootstrapping (Run No. 1)

Report Excel

Data Group Complete

Inner model T-Values

Outer model T-Values

Highlight Paths off

Show defaults

Multi-Group Analysis (MGA)

The multi-group analysis allows to test if pre-defined data groups have significant differences in their group-specific parameter estimates (e.g., outer weights, outer loadings and path coefficients). SmartPLS provides outcomes of three different approaches that are based on bootstrapping results from every group.

Read more!

Setup Partial Least Squares Bootstrapping Weighting

Basic Settings

Select Groups

The selected groups will be assessed for significant differences in the parameter estimates (e.g., outer weights, outer loadings and path coefficients). All data groups selected under Group A will be compared against all data groups selected under Group B.

[Link to Literature](#)

After Calculation: Open Full Report Close Start Calculation

Combination

[+]

Internalization

[+]

Flow Mgmt.

在這裡輸入文字來搜尋

在任务栏上显示的应用程序图标包括：搜索框、文件资源管理器、谷歌浏览器、边缘浏览器、火狐浏览器、Word、Excel、PowerPoint、聊天应用、电子邮件、正则表达式工具、设置等。右侧任务栏显示了系统状态图标（电池、信号、音量）和日期时间（上午 12:22, 2019/12/25）。

產生MGA分析報表如下

The screenshot shows the SmartPLS software interface. The top menu bar includes File, Edit, View, Themes, Calculate, Info, and Language. The toolbar features Save, New Project, New Path Model, Hide Zero Values, Increase Decimals, Decrease Decimals, Export to Excel, Export to Web, and Export to R. The Project Explorer on the left lists projects like ECSI, KM&Performance, SECI_data_new, and SECI_data_new_Industry [100 records]. The main workspace displays the 'Path Coefficients' table for the 'Multi-Group Analysis (MGA) (Run No. 1)' project. The table includes columns for Path Coefficients, Standard Deviations, t-Values, and p-Values. Below the table are sections for Final Results, Interim Results, and Base Data, each with links to various PLS results. The bottom taskbar shows system icons and the time as 12:23.

SmartPLS: C:\Users\user\smartpls_workspace

File Edit View Themes Calculate Info Language

Save New Project New Path Model Hide Zero Values Increase Decimals Decrease Decimals Export to Excel Export to Web Export to R

Project Explorer

ECSI

KM&Performance

SECI_data_new

SECI_data_new_Industry [100 records]

PLS-SEM BOOK - Corporate Reputation Extended

Archive

Path Coefficients

	Path Coeffici...	Path Coeffici...	Path Coeffici...	Path Coeffici...	STDEV (GR...	STDEV (GR...	t-Values (G...	t-Values (G...	p-Values (...)	p-Values (...)
Combination...	0.040	0.166	0.054	0.129	0.290	0.155	0.138	1.072	0.890	0.284
Combination...	0.615	0.366	0.624	0.330	0.248	0.213	2.477	1.719	0.014	0.086
Combination...	0.200	0.380	0.206	0.358	0.187	0.156	1.072	2.435	0.284	0.015
Externalization...	0.151	0.333	0.166	0.304	0.289	0.244	0.521	1.368	0.602	0.172
Externalization...	-0.084	0.118	-0.071	0.102	0.257	0.249	0.328	0.473	0.743	0.637
Externalization...	-0.015	0.216	-0.017	0.174	0.196	0.227	0.076	0.952	0.939	0.342
Internalization...	0.623	0.109	0.609	0.174	0.169	0.217	3.682	0.504	0.000	0.615
Internalization...	0.315	0.113	0.305	0.170	0.156	0.193	2.014	0.584	0.045	0.560
Internalization...	0.700	0.104	0.697	0.150	0.121	0.182	5.766	0.571	0.000	0.568
Socialization...	-0.014	0.026	-0.026	0.039	0.195	0.178	0.071	0.144	0.943	0.885
Socialization...	-0.005	0.083	-0.017	0.095	0.178	0.234	0.029	0.355	0.977	0.722
Socialization...	0.010	0.047	0.011	0.080	0.120	0.160	0.085	0.292	0.932	0.770

Indicators Calculation Results

Multi-Group Analysis (MGA) (Run No. 1) Remove

Report Excel HTML R

Data Group Complete

Highlight Paths off

Show defaults

Final Results Interim Results Base Data

Path Coefficients Path Coefficients (Samples) Setting

Indirect Effects Indirect Effects (Samples) Inner Model

Total Effects Total Effects (Samples) Outer Model

Outer Loadings Outer Loadings (Samples) Indicator Data (Original)

Outer Weights Outer Weights (Samples) Indicator Data (Groups)

MGA分析的結果主要是要解讀不同的資料群組在原來的路徑(假說)上面有沒有顯著的差異，所以分析結果的討論重點在**PLS-MGA**這裡，可以看到這次分類的結果每一條路徑上的路徑係數在兩群之間的相減值，且此差異是否具有統計上的顯著效果。

The screenshot shows the SmartPLS software interface. The top menu bar includes File, Edit, View, Themes, Calculate, Info, and Language. The toolbar has buttons for Save, New Project, New Path Model, Hide Zero Values, Increase Decimals, Decrease Decimals, Export to Excel (highlighted with a red circle), Export to Web, and Export to R.

The Project Explorer panel on the left lists projects: ECSI, KM&Performance (selected), SECI_data_new, and SECI_data_new_Industry [100 records].

The main workspace displays the 'Path Coefficients' table:

	Path Coefficients-diff (GROUP_IndustryIndustry(1.0) - GROUP_IndustryIndustry(2.0))	p-Value(GR...)
Combination -> Fast Response	0.126	0.666
Combination -> Flow Mgmt.	0.249	0.219
Combination -> New Market	0.180	0.776
Externalization -> Fast Response	0.183	0.685
Externalization -> Flow Mgmt.	0.202	0.713
Externalization -> New Market	0.231	0.783
Internalization -> Fast Response	0.514	0.036
Internalization -> Flow Mgmt.	0.202	0.206
Internalization -> New Market	0.596	0.004
Socialization -> Fast Response	0.040	0.576
Socialization -> Flow Mgmt.	0.088	0.623
Socialization -> New Market	0.037	0.590

The 'Indicators' table on the left shows indicator names from 26 to 37: New2, New3, New4, New5, Fast1, Fast2, Fast3, Fast4, Flow1, Flow2, Flow3, and Industry. The rows for New2, New3, and New4 are highlighted in yellow.

The bottom navigation bar includes links for Final Results, Interim Results, Base Data, Path Coefficients, Path Coefficients (Samples), Indirect Effects, Indirect Effects (Samples), Total Effects, Total Effects (Samples), Outer Loadings, Outer Loadings (Samples), Outer Weights, Outer Weights (Samples), Setting, Inner Model, Outer Model, Indicator Data (Original), and Indicator Data (Groups).

The taskbar at the bottom shows various application icons and the system tray with the date and time (上午 12:24, 2019/12/25).