Structure equation modeling

I. Overview

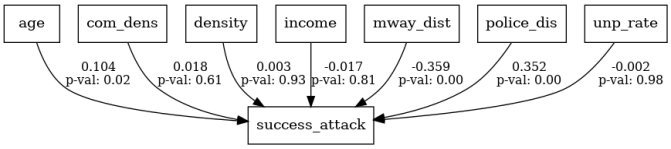

Fig. 1. SEM Model

In Figure 1, directional relationship from the predictor variables to the outcome variables is shown. The tilde symbol ˜, indicates a directional relationship from the predictor variables to the outcome variable. Essentially, it specifies that success_attack is regressed on the other variables listed on the right-hand side of the formula.

1) Name of objective: (ULS) unweighted least square
2) Optimization method: SLSQP
3) Objective value: 0.000
4) Number of iterations: 50

Equation used

$$\begin{aligned}\text{success\_attack} \sim & \, com\_dens + \\ & age + income + \\ & unp\_rate + density + \\ & police\_dis + mway\_dist\end{aligned} \tag{1a}$$

TABLE I
Parameter Estimates

Variable	Estimate	Std. Error	z-value
success_attack ⟶ com_dens	0.000 337	0.000 656	0.513 490
success_attack ⟶ age	0.003 073	0.001 354	2.270 089
success_attack ⟶ income	−0.000 414	0.001 723	−0.240 056
success_attack ⟶ unp_rate	−0.000 102	0.004 123	−0.024 623
success_attack ⟶ density	0.000 084	0.000 998	0.083 945
success_attack ⟶ police_dis	0.000 324	0.000 032	10.049 766
success_attack ⟶ mway_dist	−0.000 111	0.000 014	−8.217 081

1) DoF: 28
2) chi2: 0.0000004704235
3) chi p-value: 1
4) CFI: 1
5) GFI: 1
6) RMSEA: 0

II. Model

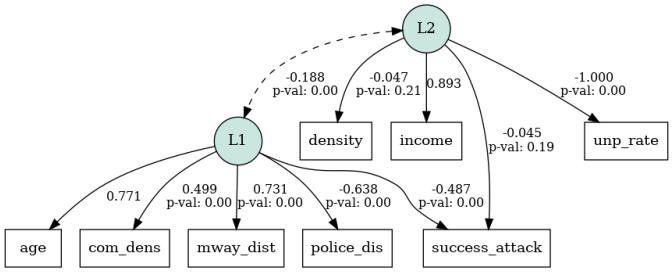

Fig. 2. SEM Model

In figure 2, we can conclude that commercial density, age, police distance, motorway distance are emerging as significant factors for predicting success of attack.

1) objective: (DWLS) Diagonally weighted least square
2) Optimization method: SLSQP
3) Objective value: 0.187
4) Number of iterations: 124

$$\begin{aligned}\text{L1} \sim & \, com\_dens + \\ & age + income + \\ & unp\_rate + density + \\ & police\_dis + mway\_dist\end{aligned} \tag{2a}$$

$$\text{L2} \sim income + unp\_rate + density \tag{2b}$$

$$\text{success\_attack} \sim \text{L1} + \text{L2} \tag{2c}$$

TABLE II
Parameter Estimates

Variables	Estimate	Std. Err	z-value
age ⟶ L1	1.000000	null	null
police_dis ⟶ L1	-22.312517	1.467501	−15.204 427
mway_dist ⟶ L1	86.185086	5.060644	17.030 458
com_dens ⟶ L1	0.950915	0.074655	12.737 455
income ⟶ L2	1.000000	null	null
unp_rate ⟶ L2	-0.473068	0.065219	−7.253 544
density ⟶ L2	-0.029171	0.033489	−0.871 065
success_attack ⟶ L1	-0.015681	0.001504	−10.426 593
success_attack ⟶ L2	-0.001003	0.000951	−1.054 167

1) DoF: 18
2) chi2: 135.306313
3) chi p-value: 0
4) CFI: 0.935434
5) GFI: 0.926657
6) RMSEA: 0.095007

A. Relation explanation

L1 and L2: These are latent variables in the model. Latent variables are not directly observed but are inferred from observed variables (we have divided the observed variables in two sets) . In this context, L1 and L2 represent underlying factors that are influencing the observed variables. The value of -0.188 represents the estimated correlation coefficient between the two latent variables. In this case, a negative correlation coefficient suggests that as one latent variable increases, the other tends to decrease, and vice versa.
The regression path from L2 to ”success attack” is not statistically significant.
The regression path from L1 to ”success attack” is statistically significant, indicating a significant negative relationship between L1 and ”success attack”.

The covariance between L1 and L2 indicates the degree of correlation between the two latent variables beyond their individual relationships with observed variables. A negative covariance suggests an inverse relationship between L1 and L2, indicating that higher values of one variable are associated with lower values of the other. This suggests that factors influencing L1 may have an impact on L2, and vice versa, beyond their direct relationships with observed variables.

Based on the information obtained, it seems plausible to infer that L2 may not have a direct effect on ”success attack” but might influence it indirectly through its influence on L1. This interpretation aligns with the idea of mediation in SEM, where one variable (L1) mediates the relationship between another variable (L2) and an outcome (success attack).

Relation between Factors

Commercial density (com_dens), age, police distance (police_dis), and motorway distance (mway_dist) all show statistically significant relationships with the latent variable L1, which represents a construct related to community well-being. These relationships suggest that certain demographic and geographic characteristics, such as higher commercial density, older populations, greater police presence, and increased distance from major highways, may contribute to lower rates of successful attacks.
Additionally, the observed variables income, unemployment rate (unp_rate), and population density (density) show significant relationships with the latent variable L2

The significant relationships observed in the SEM model underscore the complex interplay between geographic, demographic and economic factors in influencing success of attack.