DEVELOPMENT OF AN ANALYTICAL MODEL FOR STUDYING THE POSSIBILITY OF TRANSITION AMONG DIFFERENT SOCIO-ECONOMIC STATUS STATES

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1. Introduction

The study of the socio-economic characteristics of the individuals is very important. The socio-economic status of individuals is the main feature which affects their attitudes and aspirations in many fields of life. It is of great importance to define the socio-economic status (SES) of individuals and the possibility of transition from a given SES state to another. To achieve this aim an index for the socio-economic status (SES) will be suggested. This index enablesus to determine the SES of each individual. An analytical socio-economic model is developed to illustrate the possibility of transition among different SES states.

II. The Socio-Economic Status Index

To determine the SES of each individual, an index for the SES is introduced. In constructing this index, it is desirable to determine the determinants of each SES state. There are numerous and interrelated factors which determine the SES of any individual. Three basic variables have been chosen in this study to be the determinants of each SES state, these variables are:

1- The educational status of the individual α

2- " occupational " " " " β

3- Individual's income γ

To obtain a scale for the three variables which are chosen to construct the SES index, each variable is categorized-according to its nature and the purpose of the study-in groups, the educational status of the individual is ordered in groups α_L to α_u, the

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occupational status of the individual is ordered is groups β_L to β_u and individual's income is ordered in groups γ_L to γ_u. The SES index is thus ranging from $(\alpha_L + \beta_L + \gamma_L)$ to $(\alpha_u + \beta_u + \gamma_u)$ where: the subscript L denotes the lowest possible value of the variable and the subscript u denotes the highest possible value of the variable.

The scale of the SES index may be divided into a specific number of non-overlapping SES states say ℓ. The highest SES state has the highest average value of the chosen variables. The SES of each individual will be determined according to the above classification. Each individual in the population must be classified in one of the non-overlapping SES states. It is assumed that each SES state consists of homogeneous individuals with respect to the indicators of the SES.

For each one of the variables mentioned above. There is a corresponding intensity function (or force of transition). The following notation is used to denote these intensities:

$\mu(\alpha)$: the force of transition because of the educational status of the individual.

$\mu(\beta)$: the force of transition because of the occupational status of the individual.

$\mu(\gamma)$: the force of transition because of individual's income.

It is assumed that there is an initial SES for each individual in the population. According to the above determination, there are ℓ SES states, each one may be viewed as a sub-population. After an interval of length t units of time measured from the beginning of the observation period, it is desirable to investigate the possibility of transition from a given SES state to another.

III. The Analytical Socio-Economic Model

The suggested model starts with a birth cohort of N adult individuals. Each individual in the cohort is classified according to his initial SES in a well defined SES domain i.e. we have an initial distribution of the cohort according to SES.

After an interval of length t units of time what are the new socio-economic characteristics of the cohort?

Transitions among the ℓ -sub-populations may be caused by one or more of the following forces: the force of transition because of the educational status of the individual $\mu(\alpha)$, the force of transition because of the occupational status of the individual $\mu(\beta)$ and the force of transition because of individual's income $\mu(\gamma)$.

(i) The model assumptions:

In the simplest form of this model it is assumed that;

1- Transition may be caused by having a new SES and a new SES may be caused by one or more of its components.

2- Aperson entering a new SES state cannot return to the previous state.

3- The force (or forces) of transition which causes transition between states is constant with respect to time (i.e they are homogeneous in time).

4- Transitions are possible only from state S_i to state S_{i+1}.

5- The last SES state is absorbing, but the other SES states are transient (i.e. S_i, $i = 1,2,\ldots,\ell-1$ are transient states and S_ℓ is an absorbing state).

Besides the above general assumptions, it is assumed that:

(1) a new SES may be caused by only one of its components

$[\mu(\alpha)$ or $\mu(\beta)$ or $\mu(\gamma)]$ or,

(2) a new SES may be caused by two forces or,

(3) a new SES may be caused by all of its components.

In this case it is assumed that the final effect of the chosen force (or forces) will enable the individual to be in the next SES state.

(ii) The model building:

Passing through the observation period proceeds in steps of length t units of time. During each interval the entire population of size N is exposed to relevant probabilities of having a new SES and moved from one SES state to another within the model. The fraction of individuals who will belong to a certain new SES state during each interval of length t is always an expected proportion calculated by multiplying the number of individuals in a certain category by an appropriate probability (or in certain categories by the appropriate probabilities).

Suppose that the cohort of N individuals is classified according to the initial SES state to ℓ SES states, with N_1 individuals in the first SES state, N_2 individuals in the second SES state,... and N_ℓ individuals in the ℓth SES state, where $N = \sum_{i=1}^{\ell} N_i$.

If $\mu(\delta)$ is the force of transition because of the variable δ and the other causes are held constant, then we have the following relations which hold true between the initial popualtion and the new (or transient) population:

$$\text{New } N_i = [N_i - N_i\,\mu(\delta)] + N_{i-1}\,\mu(\delta)$$

$$\text{with } N_0\mu(\delta) = N_\ell\,\mu(\delta) = 0,\ i = 1,2,\ldots,\ell.$$

where :

$\mu(\delta)$: is the force of transition because of the variable δ,

$\delta = \alpha$ or $\delta = \beta$ or $\delta = \gamma$, and

$N_i\,\mu(\delta)$: is the expected number of individuals in the i th SES state, who will move to the (i+1) th SES state because of the force of transition $\mu(\delta)$ & $i = 1,2,\ldots,\ell-1$.

For $\delta = \alpha$; the transient popualtion reflects the effect of changes in the educational status of individuals on the distribution of the cohort according to different SES states.

In general, all the above measures and relations hold true with the suitable interpretation for $\delta = \beta$ and $\delta = \gamma$.

In this model, New N = Initial N = $\sum_{i=1}^{\ell} N_i$ because mortality is not allowed.

(iii) Some extensions of the model

Many of the above simplifications can be removed:

(1) One of the extensions of this model is to let $\mu(\delta)$ and $\mu(\theta)$ be the two causes of transition while the other cause is held constant. Here we have two different cases, one when it is not allowed to the two forces of transition to affect the population simultaneously and the other when it is allowed to the two forces of transition to affect the population simultaneously.

In the first case, we have the following relations which hold true between the initial population and the transient one:

$$\text{New } N_i = N_i - [N_i - N_{i-1}][\mu(\delta) + \mu(\theta)]$$

$$\text{with } N_0 [\mu(\delta) + \mu(\theta)] = N_\ell [\mu(\delta) + \mu(\theta)] = 0, \; i = 1,2,\ldots,\ell.$$

In the second case, when the model allows transition by the two forces $\mu(\delta)$ and $\mu(\theta)$ simultaneously, we have the following relations which hold true between the initial population and the transient one:

$$\text{New } N_i = N_i - [N_i - N_{i-1}][\mu(\delta) + \mu(\theta) + \mu(\delta)\cdot\mu(\theta)]$$

$$\text{with } N_0[\mu(\delta) + \mu(\theta) + \mu(\delta).\mu(\theta)] = N_\ell[\mu(\delta) + \mu(\theta) + \mu(\delta)\,\mu(\theta)] = 0, \quad i = 1,2,\ldots,\ell.$$

where:

$N_i\,\mu(\delta).\mu(\theta)$: is the expected number of individuals in the <u>ith</u> SES state, who will move to the (i+1)<u>th</u> SES state because of the two forces of transition $\mu(\delta)$ and $\mu(\theta)$, $i = 1,2,\ldots,\ell-1$.

If we choose the case where $\delta = \alpha$ and $\theta = \beta$, the transient population reflects the effect of changes in the educational status and the occupational status of individuals on the distribution of the cohort according to different SES states.

(2) Another extension of the model, is to allow to the three forces of transition to cause transitions.

(3) One of the most important extensions of this model would be to allow reverse transitions in the model, or to allow transitions from state S_i to state S_j where $j \neq i+1$.

(4) In this model it is assumed that any value for the force (or forces) of transition will cause transition, but this assumption is not true and it is desirable to specify the lower value for the force (or forces) of transition to cause transition.

(5) In the previous analysis, it is assumed that the forces of transition are the same for all individuals in any SES state, but it may be more realistic to assume that these forces are functions of some socio-economic variables.

(6) The observation period of length t-which may allow transition is taken as a fixed value, it may be taken as a random variable and it is of great importance to estimate its value. This estimated value of t will be the time required to cause transition.

(iv) The inputs of the model:

The inputs of this model have been restricted to the following types of information:

(1) The distribution of individuals according to their initial SES.

(2) The force (or forces) which may cause transition from a given SES state to another.

(3) The classification of the states (alsorbing or transient).

(v) The outputs of the model:

The outputs of this model have been restricted to the following types of information:

(1) The distribution of the transient population according to their new SES

(2) The most effective force causing transition and the most flexible SES state to transition.

These results may be printed out at any chosen intervals such as a year.

IV. Numerical Example

Suppose that the educational status of the individual is ordered in groups 1 to 6, the occupational status of the individual is ordered in groups 1 to 6 and individual's encome is ordered in groups 1 to 6. The SES index thus ranges between 3 and 18. If the SES scale is divided say to four SES states as follows:

the first SES 3 - 6 which is low
the second SES 7 - 10 which is medium-low
the third SES 11 - 14 which is meduim-high
the fourth SES 15 - 18 which is high.

Given that we have four SES states, then the initial distribution of say 100,000 adult individuals according to their initial SES may be:

SES	1	2	3	4	Total
no.of individuals	30 000	35 000	20 000	15000	100,000

If the only yearly force of transition $\mu(\delta) = 0.05$, then after one year we have the following transient (new) distribution:

SES	1	2	3	4	Total
no.of individuals	28500	34 750	20 750	16000	100,000

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