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Social Mobility, Status Inheritance, and Structural Constraints: Conceptual and Methodological Considerations*

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Abstract

This paper examines the new statistical model of social mobility introduced by Hauser. The main contention of this paper is that the conception of status-specific inheritance, employed by Hauser's model and the related model of quasi-independence, ignores the fact that status inheritance is a structural concept. More specifically, these models assume, inappropriately, that the tendency toward a status-specific inheritance can exist without the converse tendency that individuals of other statuses of origin tend to obtain that status less than expected under a fair allocation of statuses. This paper also demonstrates the need for the clarification of such concepts as inheritance, hierarchy, and rigidity of status system and for a more explicit justification of new statistical models of social mobility with reference to these fundamental conceptions.

When new statistical techniques or models are introduced, it is not always clear what the hidden assumptions of those models are and whether those assumptions are compatible with the main substantive ideas to be pursued in a given research. As the model becomes more complicated and the statistics employed more esoteric, the potential disparity between the substantive ideas and the statistical model becomes less obvious and harder to identify. Recent exchanges among Hope (1981), Macdonald (1981), and Hauser (1981) concerning the new mobility ratios introduced by Hauser (1978, 1981) are clear examples of this problem. Each critic has made some valuable points and, overall, Hauser has defended his model ably by both invoking the principle of parsimony and emphasizing the indispensable role that theory and substantive

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knowledge can and should play in the construction and identification of a model. However, it is not clear whether the exchanges have touched on the central issue—the conceptual and theoretical foundation of the new model and the potential disjunction between the statistical model and underlying substantive pursuits. This paper, therefore, is an attempt to clarify some of the issues not resolved by the exchanges.

More specifically, I will argue that there is an element of contradiction in the implicit conception of status inheritance of Hauser's new model (1978, 1981) and Goodman's model of quasi-independence (1965, 1968, 1969a), of which Hauser's model is a modification. Hope and Macdonald's criticisms as a whole miss the mark by making the problems of Hauser's model appear to be matters of statistical indeterminacy, when its real weakness lies in its conceptual foundation. Hence, another, perhaps more important, objective of this paper is to call for a critical reexamination of simple, but fundamental, ideas of mobility studies and for a more explicit justification of statistical models in light of these ideas.

Status-Specific Inheritance and Its Measurements

One of the perennial concerns of mobility studies is how to measure the extent to which a social stratification system is open or closed. There is literally an endless variety of measures proposed in the literature (for excellent reviews, see Boudon 1973; Pullum 1975). Among these, we will concentrate on three approaches that try to measure the extent of status-specific inheritance, mainly because Hauser's model is best understood in this connection. The three approaches are different from each other mainly in the choice of standards against which the observed frequencies are compared: as the baseline model, (1) the classic approach uses the model of perfect mobility, (2) Goodman's approach uses the model of quasi-independence, and (3) Hauser's approach uses an extension of the quasi-independence model.

The classic approach, the earliest to appear and the most widely used (Blau and Duncan 1967; Glass 1954; Rogoff 1953, to cite a few), considers the occupational structure as given, and uses the expected frequencies under the assumption of statistical independence as the standards with which to measure the degree of inheritance of occupational statuses. More specifically, given a mobility table in which fathers' occupational statuses are cross-classified with those of their sons, the status-specific inheritance (R_{ij}) [where $i=j$] is measured by the ratio of the observed frequency (F_{ij}) over the corresponding expected frequency (F^*_{ij}), for the diagonal cell (i,j), where $i=j$:

$$R_{ij} = F_{ij} / F^*_{ij}. \qquad (1)$$

The expected frequencies are determined solely by the marginal frequencies ($F_{i.}$ and $F_{.j}$) and the total sample size N:

$$F^{*}_{ij} = (F_{i.} \times F_{.j}) / N. \tag{2}$$

Of course, one could examine the ratios pertaining to the off-diagonal cells as easily as the ratios of the cells in the main diagonal, but for the sake of simplicity, we will concentrate our attention on the measurement of status-specific inheritance. It is useful for later comparisons to express the expected frequencies under this model in terms of now-popular multiplicative effect parameters (Bishop et al. 1975):

$$F^{*}_{ij} = (c)(a_i)(b_j), \tag{3}$$

where (c) stands for a constant, and (a_i) and (b_j) stand for effects of respective marginal frequencies. The parameters as written in Equation (3) are underidentified and require reparametrization. (See Logan [1983] for a good exposition of identification and parametrization in loglinear models.) There is therefore room for some indeterminacy, which is resolved by employing conventional parametrization techniques. One more-or-less arbitrary but well-known solution is to set $c = 1/N$, and $a_i = F_{i.}$ and $b_j = F_{.j}$. The equivalence between this form and Equation (2) is obvious by inspection.

The second approach, proposed by Goodman (1965, 1968, 1969a), uses as the baseline model what is known as the quasi-independence model. The basic strategy of this approach is to test and fit an independence model to a mobility table from which certain cells (usually ones on the main diagonal) are removed. If the independence model fits the modified table, then the expected frequencies for the removed cells under the model are used as the basis for comparison. The expected frequencies under the assumption of quasi-independence can be expressed in the same form as Equation (3):

$$F^{**}_{ij} = (c)(a_i)(b_j). \tag{4}$$

The coefficients in this equation are estimated using the observed frequencies after certain cells are blanked out and using an iterative procedure (Bishop et al. 1975; Goodman 1969).

The need for this new approach was demonstrated by Goodman and it is highly instructive to examine the type of hypothetical data Goodman used to demonstrate the need. In Table 1, we present such data. This table is reproduced from Hauser (1978), not from Goodman's original tables, for the convenience of later expositions. Note that if we were to replace the observed frequency of the top-left corner cell (500) with a new frequency (100), the resulting modified table would exhibit perfect social mobility or statistical independence. In other words, if we were to ignore the (1,1) cell, the mobility pattern observed in the remaining cells fits perfectly the model of statistical independence. Thus, it seems reasonable to use the quasi-independence model (independence model with certain cells ignored) as the true reflection of mobility processes operating with respect to those remaining cells, and to use the excess frequencies observed in the first cell as an indication of status-specific inheritance of the first status category. A mobility ratio, R_{ij}, based on such a model will show $R_{11} \doteq 5$, and the ratios for the rest of the cells all equal to 1. The baseline model is shown in Table 1.2.

On the other hand, if we were to apply the classic approach to this hypothetical table, and examine the ratio between the observed and expected frequencies, we would get the results shown in Table 1.3. On the surface, it seems that we get erroneous or misleading answers: the mobility ratios for the two lower statuses not only indicate status inheritance, but of an even greater magnitude than that for the first status category. Goodman (1968, 1969a) and Featherman and Hauser (1978) indicate that the "misleading" results produced by the application of the model of perfect mobility are due to the confounding effect of the excess frequency in the (1,1) cell. The excess frequency in the cell (1,1) not only affects the frequencies in the two corresponding margins but also affects indirectly the relative frequencies of all the marginals.

The third approach, proposed by Hauser (1978, 1979, 1981) and used extensively by Featherman and Hauser (1978), is a modification of the second. When it is applied to Table 1, the two approaches are completely equivalent. Thus, it is informative to see this equivalence. Instead of ignoring or deleting cells that are suspected to have excess frequencies, Hauser's model handles those cells with the introduction of as many additional interaction terms as necessary to represent different levels of interaction. The underlying model is represented by the following equation:

$$F^{***}{}_{ij} = (c)(a_i)(b_j)(d_k), \tag{5}$$

where d_k stands for parameters associated with different levels of interaction and k is an index for the levels identified. For Table 1, the two levels are the (1,1) cell and the rest of the cells, and the level matrix and associated parameter estimates are shown in Table 1.4. One possible parametrization of Equation (5) is as follows:[1]

$c = 1/900; a_1 = a_2 = a_3 = b_1 = b_2 = b_3 = 300;$

and

$d_1 = 5; d_2 = 1.$

In this particular example, by assigning a unique level to the (1,1) cell, the observed frequency of that cell is exactly reproduced by the model. Also by virtue of the fact that the frequencies in the remaining cells fit the model of statistical independence exactly, all the observed frequencies are

Table 1. HYPOTHETICAL MOBILITY TABLES AND ASSOCIATED MODELS

1.1 Observed Frequencies

Father's Status	Son's Status (1)	(2)	(3)	Total
(1) Upper	500	100	100	700
(2) Middle	100	100	100	300
(3) Lower	100	100	100	300
Total	700	300	300	1,300

1.2 Expected Frequencies Under Quasi-Independence (Perfect Mobility With New Marginal Constraints)

Father's Status	Son's Status (1)	(2)	(3)	Total
(1) Upper	100	100	100	300
(2) Middle	100	100	100	300
(3) Lower	100	100	100	300
Total	300	300	300	900

1.3 Expected Frequencies and Mobility Rates Under Perfect Mobility

	Expected Frequencies			Total	Mobility Ratios		
(1)	376.92	161.54	161.54	700	1.33	.62	.62
(2)	161.54	69.23	69.23	300	.62	1.44	1.44
(3)	161.54	69.23	69.23	300	.62	1.44	1.44
Total	700	300	300	1,300			

1.4 Level Matrix and Estimated Parameters

	Level Matrix			Parameter Estimates		
(1)	1	2	2	5	1	1
(2)	2	2	2	1	1	1
(3)	2	2	2	1	1	1

reproduced exactly with the application of Equation (5). This will not in general be the case when the model is applied to more complex and real data.[2]

Hauser then proposes to use as measures of inheritance the ratios between the observed frequencies and the frequencies reproduced by the following truncated equation:

$$\hat{F} = (c)(a_i)(b_j)$$

which is obtained by simply dropping the last term (d_k) from Equation (5) *after* the parameters are estimated on the basis of the full model. The predicted frequencies from the truncated equation are the same as expected frequencies under the assumption of quasi-independence. Note in particular that the predicted frequencies given by Equation (6) are the same as expected frequencies under the assumption that the available occupational positions are determined by the reduced marginal frequencies, *and* that, given these constraints, status assignments follow the random probability rule. The marginals assumed and the predicted frequencies under this model are shown in Table 1.2. The ratios between the observed frequencies and the expected frequencies are represented by the parameters of the level matrix, and this will be the case in general if there is a perfect fit between the full model (5) and the data.

The quasi-independence model, however, rarely fits any real mobility table when the number of occupational categories used is more than three (Goodman 1968, 1969a; Pullum 1975).[3] Hence, Hauser notes the irony: it fits well only when the categorization is so broad that the meaning of inheritance becomes vague (1978, p. 929). Thus there is a need to introduce a new or modified model which can handle mobility patterns observed in a larger table, and Hauser's model can be seen as a response to this need. Given the mobility data shown in Table 2.1, Hauser argues that the level matrix shown in Table 2.2 is appropriate because the observed frequencies can be predicted with the help of such a matrix and Equation (5), and because it is based on substantive theory or at least on the knowledge that he has accumulated from extensive previous analyses.

The new mobility ratios based on the comparison between the observed frequency and the predicted frequencies from the truncated equation are shown in Table 2.3.[4] From this table, Featherman and Hauser concluded, among other things, that there is a severe tendency toward status immobility at the two extremes of status categories and a tendency toward status disinheritance at the middle category. Compare this table with Table 2.4, which contains the traditional mobility ratios based on the classic approach. (These are the ratios that Blau and Duncan used in interpreting their earlier study on the occupational structure of the United States.) The old ratios indicate that there is a tendency for status inheritance for the middle status as well.

Table 2. SOCIAL MOBILITY IN THE UNITED STATES*

2.1 Observed Mobility

Father's Occupation	Son's Occupation (1) UNM	(2) LNM	(3) UM	(4) LM	(5) Farm	Total	Adjusted Total
Upper nonmanual	1414	521	302	643	40	2920	2229.6
Lower nonmanual	724	524	254	703	48	2253	2263.3
Upper manual	798	648	856	1676	108	4086	5928.8
Lower manual	756	914	771	3325	237	6003	6282.7
Farm	409	357	441	1611	1832	4650	3063.3
Total	4101	2964	2624	7958	2265	19912	--
Adjusted total	3630.8	3562.5	3745.2	8169.9	560.2	--	19668.6

2.2 Level Matrix for Featherman and Hauser's Model

2	4	5	5	5
3	4	5	5	5
5	5	5	5	5
5	5	5	4	4
5	5	5	4	1

2.3 Ratios Between Observed and Expected Under Hauser's Model

3.42	1.28	.71	.70	.64
1.73	1.28	.59	.75	.75
.74	.61	.77	.69	.65
.65	.80	.64	1.27	1.32
.73	.64	.76	1.27	20.91

2.4 Ratios Between Observed and Expected Under Independence

2.35	1.20	.78	.55	.12
1.56	1.56	.86	.78	.19
.95	1.06	1.59	1.03	.23
.61	1.02	.98	1.39	.35
.43	.52	.72	.87	3.46

*Mobility from Father's (or Other Family Head's) Occupation to Son's First Full-Time Civilian Occupation: U.S. Men Aged 20-64 in March 1973 (Featherman and Hauser 1978, p. 150).

As was the case with respect to the quasi-independence model, the baseline model for Hauser's mobility ratio is provided by the truncated Equation (6), which is obtained simply by dropping the last term from Equation (5), after all the parameters are estimated. One possible parametrization of the model is to set the constant, c, equal to the reciprocal of the adjusted total sample size, that is, 1/19,668.6, and the parameters for the row and column effects to those adjusted marginals shown in Table 2.1.[5] In other words, the baseline model for the third approach is provided by the perfect mobility model with the new adjusted marginal constraints. On what basis, then, can one claim that the new mobility ratios provide more fundamental information than the old mobility ratios? More substantively, does the middle status (upper manual status) show status inheritance or disinheritance? That is exactly one of the points of contention between Hauser, on the one hand, and Hope and Macdonald, on the other. Hope and Macdonald tend to view the new ratios as more or less arbitrary, while Hauser considers them meaningful, partly on the grounds that they provide a more parsimonious description of the observed pattern than the ratios based on other models, and partly on the grounds that they are theoretically defensible or, at least, that they "tell a story worth hearing." With these background materials, we are now in a position to evaluate these conflicting claims.

Hidden Assumptions about Occupational Structure

Consider once again the simple example shown in Table 1. Macdonald and Hope would argue that there are other models equally compatible with the pattern shown in that table. For instance, alternative models with different level matrices and expected values are shown in Table 3. The first alternative model (Table 3.1) suggested by Macdonald indicates that the following two interpretations are formally equivalent: (1) that sons of the upper status tend to inherit their father's status while sons of other statuses do not (the original interpretation of Hauser and Goodman), and (2) that sons of the upper status tend to avoid the two lower statuses of destination while there is no tendency for any status inheritance. The second alternative model (Table 3.2) indicates that these two preceding interpretations are also formally equivalent to the interpretation (3) that sons of the upper status are underrecruited into the two lower statuses of destination. Finally, the third alternative model (Table 3.3) indicates that all these interpretations are formally equivalent to the interpretation (4) that the two lower statuses as a group tend to inherit their joint group status while the upper status does not show any tendency for inheritance. Therefore the interpretation provided by the original quasi-independence model is not unique and the new ratios do not reveal an "intrinsic" or "true" underlying pattern of social mobility as claimed by Hauser and Goodman.

To these charges, Hauser counters that such formal equivalency is not critical, because the pattern he identified is simpler, requiring only one exception, while the other models require two or more exceptions.[6] (Interaction parameters other than the value of 1 are counted as exceptions.) On the basis of parsimony, he would choose his model over the others. He then offers an ultimate defense:

> I do not believe that a model consists only of a set of expected values, but it also (and mainly) consists of the structure or story that we use to interpret and explain those expected values. It is all well and good when a model has no equiva-

Table 3. EQUIVALENT MODELS FOR DATA REPORTED IN TABLE 1.1

Level Matrix			Estimated Parameters			Baseline Frequencies			Total
3.0 Original Interpretation (Reproduced from 1.4)									
1	2	2	5	1	1	100	100	100	300
2	2	2	1	1	1	100	100	100	300
2	2	2	1	1	1	100	100	100	300
Total						300	300	300	900
3.1 First Alternative									
1	2	2	1	.2	.2	500	500	500	1,500
1	1	1	1	1	1	100	100	100	300
1	1	1	1	1	1	100	100	100	300
Total						700	700	700	2,100
3.2 Second Alternative									
1	1	1	1	1	1	500	100	100	700
2	1	1	.2	1	1	500	100	100	700
2	1	1	.2	1	1	500	100	100	700
Total						1,500	300	300	2,100
3.3 Third Alternative									
1	1	1	1	1	1	500	100	100	700
1	2	2	1	5	5	100	20	20	140
1	2	2	1	5	5	100	20	20	140
Total						700	140	140	980

lents, that is, when it carries unique implications for population data, but that is rare indeed in the social sciences. Most of the time, a model is no more than a vehicle for rendering a complete and internally consistent interpretation of a body of data in light of the ideas we draw from observation, theory, convention, or whatever . . . (1981, p. 576).

This is an overstatement, however. An empirical analysis based on a model should be able to eliminate at least the critical rival hypothesis or interpretation. Otherwise, the so-called empirical findings will not be informative. All these models are equally as parsimonious as the original model proposed by Goodman and Hauser, in the sense that they all require two levels or a single contrast for the interaction effect. Furthermore, they seem to tell equally interesting stories. If the choice among these alternative interpretations is important, then that choice has to be made on some extra-statistical grounds. That much, I think, is agreed on by all the proponents of the exchange. But do these models render complete and internally consistent interpretations?

On closer examination, the stories told by these models are not satisfactory. The implicit ideas on which these models are built cannot be sustained. All four baseline models (that generate the expected frequencies against which observed frequencies are compared) assume that the marginal distributions do not provide any important information about the occupational structure and that, therefore, they can be made quite different from the observed. Notice the changes in the assumed marginal frequencies in Table 3. By assuming that the marginals can be changed, these models ignore the fact that the marginal distributions reflect "conditions of supply and demand" and the fact that "they reflect demographic replacement processes and past and present technologies and economic condition" (Hauser 1978, p. 930). In other words, these models implicitly consider the social structure under which the mobility processes must operate quite irrelevant. It is true that, as noted by Hauser, there is a part–whole relationship between the marginal effects and interaction effects: the frequencies in a mobility table are interrelated because a large frequency in a main diagonal cell implies relatively large frequencies in the corresponding two marginal cells. The alleged virtue of the quasi-independence model (and Hauser's modification of it) is its ability to eliminate the confounding of these two types of effects. But do these new models succeed in this regard? The answer is negative.

Consider the way in which the quasi-independence model "eliminates" or "controls for" the confounding of marginal and interaction effects. On the correct assumption that the excess frequencies in the main diagonal cells would affect the marginal frequencies, the cells that are suspected to have excess frequencies are blanked out. Such an elimination of the diagonal cells, however, leads to estimates that are conceptually inappropriate. More specifically, the quasi-independence model for Table 1.1 assumes that the marginal frequencies for the upper status for both generations would be 300 if there were no "interaction effect" for the (1,1) cell. In other words, it implies that without the status-specific inheritance for the upper status, the occupational status distribution would have been as shown in Table 1.2. One might argue that without the tendency for the inheritance for the upper status, the distribution of frequencies for the first row would change and, therefore, the column totals (the status distribution of sons) would change. But it is inappropriate to assume that the interaction effect in the (1,1) cell would change the marginal distribution of the statuses of fathers. It seems to be a logical contradiction to assume that the occupational structure of the father's generation is dependent on the interaction of the father's status and the son's status.

Let us try to construct a plausible theory about the social processes under which the frequencies of Table 1.1 are generated. First of all, we will have to take the marginal distributions of the father's generation as given. Second, let us suppose, for the sake of argument, that only the upper status can pass status advantages to its children. But this very fact implies that the sons of the upper class obtain more than their fair share of upper-status positions, which in turn means that some other group had to obtain less than its share of upper-status positions. The very notion of status inheritance is a relational one. The supposition that one class and one class alone shows the tendency for inheritance is a self-contradiction, because status-specific inheritance does not have any meaning except in a relational context. So the model represented by the original level matrix is internally inconsistent.[7]

Now consider another scenario. Assume that the number of available status positions are determined by external factors. Given that there are 700 openings at the highest status and 300 each for the lower two statuses, if the society allocated these positions without respect to the status of origin, more sons of upper-status fathers must have moved out of the upper-status positions and more sons of the lower two statuses must have moved up than are actually observed in Table 1.1. These movements would also imply that some other changes in status distribution must also happen, because the number of positions available is assumed fixed. Seen in this context, the mobility ratios shown by Table 1.3 contain useful information. Observed frequencies are compared with the expected frequencies under the assumption of independence and under the assumption that the occupational structure is given. Although there are other problems, the ratios correctly indicate at least the fact that sons of upper-status fathers obtained more than their fair share of upper-status positions and that they obtained fewer than their fair share of lower-status positions. Likewise, these ratios point out the fact that sons of the two lower statuses as a group obtained fewer than their fair share of upper-status positions and more than their fair share of lower-status positions.

Hauser's extension of the quasi-independence model suffers from conceptual problems similar to those of the quasi-independence model. There is no explicit justification for the claim that the model controls for structural constraints; either the analogy to the quasi-independence model or the fact that the model contains parameters for the row and column effects is simply taken as sufficient grounds for assuming that those structural constraints are adequately taken into consideration. The baseline model used by Hauser implicitly assumes that the adjusted marginal frequencies shown in Table 2.1 correctly represent a situation in which the confounding of marginal and interaction effects is eliminated. These adjusted frequencies are obtained by generating the expected frequencies by using the truncated model (Equation (6)) and then summing these frequencies across the rows and columns. Another equivalent interpretation of the baseline model is to note the fact that these internal frequencies (used as the standards for comparison to measure new mobility ratios) can be generated by assuming that these adjusted marginal frequencies are given and that there is no interaction between the two status categories. In other words, the model implicitly assumes that, if there were no interaction effects, the occupational distribution would have exhibited the adjusted frequencies shown in Table 2.1. For instance, it assumes that there would be only 3063.3 farm positions for the fathers and 560.2 such positions for the sons. As argued earlier, it is conceptually awkward to assume that the positions available for the father's generation are affected by statistical association between fathers' and sons' statuses.

Hauser's full model is valuable if it is viewed basically as a tool with which to predict the observed frequencies as parsimoniously as possible. However, it does not follow that the baseline model that Hauser proposed as a standard of comparison is equally useful. It is true that Hauser fits the full model to the data with care and with guidance provided by theory and with extensive knowledge gained through his previous work.[8] But fitting the full model and using a part of it or a truncated equation as the basis for measuring the true or "intrinsic" inheritance are two analytically distinct operations. There are no grounds to suppose that the hypothetical frequencies generated by the truncated prediction equation can serve as a meaningful basis for comparison. The only justification to be found is that the full model fits the data while the perfect mobility model does not (Hauser 1978, p. 936), but it is the truncated equation, not the full model, which provides the standards and which therefore is playing the same role as the perfect mobility model. The truncated model does not fit the data—it does not even fit the marginal distributions, whereas the perfect mobility model at least reproduces the marginal frequencies and therefore satisfies the structural constraints implied by the marginal frequencies.

A simple analogy with ordinary regression may help clarify the conceptual problem. Suppose that two independent variables X_1 and X_2 have an interactive effect on the dependent variable Y. Suppose further that X_1 is a dummy variable coded as 0 or 1. The full prediction equation or regression equation would have the following form:

$$Y^* = a + b_1X_1 + b_2X_2 + b_3X_1X_2.$$

Hauser's baseline model is equivalent to using the same equation with the coefficients estimated on the basis of the full model but the last terms deleted or truncated from it. Such predicted values are highly dependent on the choice of scaling and coding and have meaning only with respect to the special frame of reference used. The estimates of all the coefficients for such a model are very sensitive to any changes in that frame of reference. (See Allison [1977] for an excellent discussion of interaction effect and its relation to coding and scaling.) The situation becomes even more unstable as more variables and more interaction terms are introduced. Suppose now that two researchers are fitting such equations to two different data sets, each looking for an acceptable fit between the final model and a data set and that one researcher ends up with a model with two interaction terms and the other with three. If each researcher then uses the truncated equation containing only those additive terms and compares the predicted values based on the truncated equation to the actual data, will they produce comparable results or interpretations? The answer is negative, because predicted values based on truncated equations will vary, sometimes dramatically, with any addition of new terms to the full model. Theories and substantive ideas that might have been used for the selection of the final equations for the two different data sets cannot be used as justifications for the use of truncated equations as standards of comparison. These truncated models do not have clear meaning apart from the context provided by the full model and specific coding and scaling used.

Hierarchy, Inheritance, and Rigidity of Stratification System: Reflections on Conceptualization

It has been argued that the classic approach, based on the use of perfect mobility as the baseline, has certain desirable features which the new mobility ratios lack. For example, the application of the model of statistical independence to Table 1.1 would have indicated the existence of a two-class system: two lower statuses show internal homogeneity as well as equivalent standing relative to the upper status (Breiger 1981; Goodman 1981a). The old ratios reveal correctly that one class cannot exhibit a tendency toward status inheritance (excess frequency) without the other showing a similar tendency, whether it is due to status advantage of the upper class or to status disadvantage of the lower class. So there is no reason to consider that the pattern indicated by the old mobility ratios is misleading just because it does not agree with the pattern indicated by the new ratios. There still remains one alleged deficiency of the old mobility ratios: they are affected by the relative magnitude of marginal frequencies. Given the argument that, in a two-class society, a tendency for inheritance for one class should imply an equivalent tendency for the other, we expect the two ratios to be equal; but they are not. The ratio for the upper class (1.33) is smaller than the ratio for the lower class (1.44), owing to the differences in the marginal frequencies—700 vs. 600 (Boudon 1973; Featherman and Hauser 1978; Hauser 1978; Tyree 1973). According to these ratios, the two classes reveal different degrees of inheritance. This failing of the old mobility ratio as a measure of status-specific inheritance was an important reason behind the search for a new ratio. I will argue in this section that this alleged deficiency of the old ratio is not so much the failing of the perfect mobility model as of our conceptualization of status-specific inheritance.

The degree of status-specific inheritance or disinheritance is measured by the ratio between the observed frequency in the main diagonal and the corresponding expected frequency under the model of perfect mobility, or by some function of this ratio, such as the logarithm of it. It is informative to examine this conception of status-specific inheritance in relation to a simple mobility pattern for which there is no dispute over the meaning of the pattern of association and its measurement. Such an example is provided by the so-called "uniform association" models (Clogg 1982a, 1982b; Duncan 1979; Goodman 1972, 1979a, 1979b, 1981b, 1981c; Haberman 1974, 1979; Hout 1983). The basic property of a uniform association is that the odds-ratio for every 2×2 subtable, consisting of four adjacent cells, is uniform. Sucn an example is given in Table 4.1.

In this particular case, the uniform odds-ratio is 2. Note, for instance, that the odds that sons of upper-status fathers will obtain the upper status rather than the middle status is 2 (=200/100), while the odds that sons of middle-status fathers will obtain the upper status rather than the middle status is 1 (=100/100). The ratio of these odds, odds-ratio for short, is 2. This odds-ratio is also known as the cross-product ratio: $(200 \times 100)/(100 \times 100) = 2$. In a competition involving two adjacent statuses of destination, this odds-ratio indicates the advantage that the sons of higher-status fathers enjoy over the sons of the next lower-status fathers (Goldthorpe 1980).

Such a uniform odds-ratio also implies an existence of hierarchy and distance. The greater the differences between the two statuses involved, either in origin or destination statuses, the greater the odds-ratio in favor of the higher status of origin obtaining the higher status of destination. For example, in general, the advantages which the upper-status sons enjoy over the lower-status sons are given by $t^{(i-j)(i'-j')}$, where t is the uniform odds-ratio (in this case 2), the i and j stand for statuses of origin and i' and j' those of destination. In Table 4.1, the status advantage that the top status origin enjoys over the bottom status origin in a competition involving the top and bottom statuses of destination is $2^{(3-1)(3-1)} = 2^4 = 16$ $(= 200 \times 200/(50 \times 50)$. The index of power is given by the multiplication of steps or distances involved in each status dimension—two steps in fathers' status hierarchy and two steps in sons' status hierarchy.

If the mobility pattern of every society exhibits a uniform association, there will be no problem in comparing the rigidity of stratification systems across societies; the greater the odds-ratio, the greater the rigidity of the status hierarchy. The odds-ratio for each society would at once capture both the distance between statuses and the existence of barriers between the statuses, because the greater the odds-ratio the greater the obstacles to overcome in order to cross the status barrier *at each step of status*

Table 4. UNIFORM ASSOCIATION AND MEASURES OF STATUS INHERITANCE

4.1 Hypothetical Table With Common Odds-Ratio=2

Father's Status	Son's Status (1)	(2)	(3)	Total
(1) Upper	200	100	50	350
(2) Middle	100	100	100	300
(3) Lower	50	100	200	350
Total	350	300	350	1,000

4.2 Expected Frequencies and Mobility Ratios Under Perfect Mobility

	Expected Frequencies			Total	Mobility Ratios		
(1)	122.5	105.0	122.5	350	1.63	.95	.41
(2)	105.0	90.0	105.0	300	.95	1.11	.95
(3)	122.5	105.0	122.5	350	.41	.95	1.63
Total	350	300	350	1,000			

4.3 Expected Frequencies and Mobility Ratios Under Quasi-Perfect Mobility

	Expected Frequencies			Total	Mobility Ratios		
(1)	50	100	50	200	4	1	1
(2)	100	200	100	400	1	.5	1
(3)	50	100	50	200	1	1	4
Total	200	400	200	800			

4.4 Another Hypothetical Table With Common Odds-Ratio=2, Different Marginals

Father's Status	Son's Status (1)	(2)	(3)	Total	Mobility Ratios		
(1) Upper	300	200	50	550	1.75	.87	.34
(2) Middle	300	400	200	900	1.07	1.07	.95
(3) Lower	150	400	400	950	.51	1.01	1.55
Total	750	1,000	650	2,400			

movement. Because there is a uniform barrier between every two adjacent statuses, this type of society exhibits, in a sense, a tendency for "uniform fluidity." But the mobility ratios will not reveal such a uniformity. Table 4.2 contains the ratios of the observed frequencies over the expected frequencies under the assumption of perfect mobility.

The two extreme statuses show higher status inheritance than the middle status. Such a disparity is not due to the differences in the marginal frequencies. The mobility ratio or immobility ratio (as it is also called) does not reveal the system characteristic as simply as an odds-ratio would. This deficiency of the mobility ratio is not due to the use of the perfect mobility model as the baseline. If one were to apply the quasi-perfect mobility model as the baseline (i.e., blank out the cells in the main diagonal), such a model would fit the data perfectly, and the new ratios would indicate the patterns shown in Table 4.3. They show that there is a severe status immobility at the extreme statuses and moderate status disinheritance at the middle status. (This is the type of pattern that Goodman noted for British and Danish data [1965, 1968, 1969a] and Grusky and Hauser [1984] noted for the United States and Hungary.)[9]

The fact that there is less status-specific inheritance at the middle status (as measured by the old ratio) is simply an inherent property of any stratification system in which strong hierarchical principle applies in status assignment. Given the ladder of hierarchy, those from the middle status have to move only one step to reach either of the extreme statuses but those from the extreme statuses have to move two steps to reach the other extreme and, therefore, the exchanges between the extreme categories are rarer, which in turn contributes to the appearance of smaller outflow from the extreme statuses. At any rate, the important point is that the indicators of status-specific inheritances can mislead one to believe that there is no single overriding principle in status assignment even when such a universal principle operates in a society.

Table 4.4 shows another example in which the uniform odds-ratios are 2, but with different marginal distributions from Table 4.1. It was shown in Table 4.2 that, if we ignore the fact that a strong uniform association is compatible with nonuniform mobility ratios, the comparison of status-specific inheritance across different statuses for a single table can be misleading. The example in Table 4.4 shows that the ratios are confounded further by the differences in the marginals and that comparison of the ratios across different tables requires additional precautions. The indicated inheritance for the upper status is greater in Table 4.4 than in Table 4.1 (as shown in 4.2) simply because the proportion of the upper status group is smaller in Table 4.4 than in Table 4.1.

A natural next question is: Would standardization of marginals help overcome these problems? To answer this question, a series of mobility tables with uniform odds-ratios ($t = 2$) are presented in Table 5. The mar-

Table 5. UNIFORM ASSOCIATION ($T=2$) AND EVEN MARGINAL DISTRIBUTIONS

5.1 Two-Class System

	(1)	(2)	Total
(1)	117.16	82.84	200
(2)	82.84	117.16	200
Total	200	200	400

5.2 Three-Class System

	(1)	(2)	(3)	Total
(1)	164.01	94.99	41.00	300
(2)	94.99	110.03	94.99	300
(3)	41.00	94.99	164.01	300
Total	300	300	300	900

5.3 Four-Class System

	(1)	(2)	(3)	(4)	Total
(1)	223.12	123.39	43.63	8.86	400
(2)	123.39	136.48	96.50	43.63	400
(3)	43.63	96.50	136.48	123.39	400
(4)	9.86	43.63	123.39	223.12	400
Total	400	400	400	400	1,600

5.4 Five-Class System

	(1)	(2)	(3)	(4)	(5)	Total
(1)	280.36	155.93	52.83	9,75	1.10	500
(2)	155.93	173.44	117.53	43.36	9.75	500
(3)	52.83	117.53	159.28	117.53	52.83	500
(4)	9.75	43.36	117.53	173.44	155.93	500
(5)	1.10	9.75	52.83	155.93	280.39	500
Total	500	500	500	500	500	2,500

Note: Marginal totals are rounded to whole numbers.

ginal distributions are even and the frequencies are adjusted such that the expected frequency in each and every cell under the assumption of statistical independence is 100.[10] The inheritance ratios may be readily ascertained.

These tables further illustrate the point that, even without the confounding effects of uneven marginal distributions and structural changes, the mobility ratio for a given status is affected by both its position in a status hierarchy and the number of status gradations used in a study. An important implication to draw from these illustrations is that, if the use of indicators of status-specific inheritance can mislead us in regard to such a simple pattern (a uniform association for a table with even and equal marginal distributions), the danger in relying on them can be even greater when the mobility table is further complicated by a variety of other confounding effects. Once again we repeat the point made earlier: differences in mobility ratios do not necessarily mean a lack of uniform status rigidity; hence, it is inappropriate to conclude on the basis of a smaller ratio for the middle status that there is a greater status fluidity at the middle of status hierarchy than at the extremes.

These discussions lead us to problems arising from a lack of clear conceptualization of key terms used in mobility studies. Such terms as fluidity, rigidity, inheritance, and hierarchy are used without explicit definition. Or rather, although each term is given specific operational definition (for example, status-specific inheritance is measured by the ratio between the observed and expected frequency), the relationships between the related terms are rarely articulated. Let us examine some important benchmark conceptions of mobility studies.

The notion of perfect mobility, as defined by statistical independence between fathers' and sons' statuses, enjoys universal acceptance as the standard of *a complete lack of status hierarchy and inheritance*. This standard also serves as benchmark conception of the greatest possible fluidity of the status system. If there is a corresponding benchmark conception of status rigidity, the observed mobility patterns may be compared with these two standards and the degree of status rigidity may be ascertained in theory by measuring the extent to which the observed pattern deviates from the pattern of statistical independence *toward* the pattern of complete lack of fluidity or maximum rigidity. (Note that the terms fluidity and rigidity are used as antonyms.) Unfortunately, there is no consensus on the definition of maximum possible rigidity of a status system. In particular, the notion of the maximum hierarchical assignment of statuses may not coincide with the notion of the maximum status inheritance except in a special and unlikely circumstance in which there is no structural shift from one generation to the next.

Table 6 contains examples of different conceptions of maximum possible status rigidity under such structural shifts. The first set of tables shows a structural shift in which the number of upper-status positions is increasing, while the second set shows a structural shift in which upper-status positions are decreasing. Such a shift will force a certain amount of mobility. There is a consensus that mobility forced by such changes should be separated from mobility that occurs due to inherent openness of the status system. As noted earlier the perfect mobility model provides the

Table 6. MAXIMUM RIGIDITY OF STATUS SYSTEM UNDER STRUCTURAL SHIFTS: HIERARCHY VS. INHERITANCE

Father's Status	Primacy of Hierarchical Principle: Son's Status				Primacy of Inheritance Principle: Son's Status			
	Upper	Middle	Lower	Total	Upper	Middle	Lower	Total
6.1 Upward Shifts in Status Structure								
Upper	300	0	0	300	300	0	0	300
Middle	200	100	0	300	0	300	0	300
Lower	0	200	200	400	200	0	200	400
Total	500	300	200	1,000	500	300	200	1,000
6.2 Downward Shifts in Status Structure								
Upper	300	200	0	500	300	0	200	500
Middle	0	100	200	300	0	300	0	300
Lower	0	0	200	200	0	0	200	200
Total	300	300	400	1,000	300	300	400	1,000
6.3 Structural Shifts in a Two-Class Society								
Upper	300		0	300	300		0	300
Lower	200		500	700	200		500	700
Total	500		500	1,000	500		500	1,000

standard for the maximum possible fluidity, but there are two different conceptions of maximum rigidity: one provided by the maximum possible status inheritance and the other provided by maximum possible hierarchical assignment.

Tables on the left side show the pattern in which status assignment of sons is based strictly on the hierarchical principle; higher-status positions of destination are first assigned to sons of higher-status origin. Tables on the right show the pattern in which all the available positions of a given status are first assigned to sons of the same origin status. Under a rigid hierarchical assignment, the majority of individuals of the middle status of origin are assigned to the newly created upper (lower) status positions, thereby making the inheritance of the middle status weak. On the other hand, when the principle of inheritance is supreme, one-half the individuals of the lower (upper) status of origin are forced to fill the new positions created at the top (bottom). In either case, there is no free or pure mobility. Note another important point: the notion of forced mobility or structurally induced mobility does not have a clear meaning and its measurement depends on the choice of the conceptions of maximum rigidity of a status system. For example, given the marginal shifts shown in

Table 6.1 and 6.2, if we were to use the maximum hierarchical assignment as the standard of comparison, there would be 400 structurally induced movements. On the other hand, if we were to use the maximum possible inheritance as the standard, there would be 200 such movements.

The conceptual distinction between the two notions of maximum status rigidity is not clearly made in the literature mainly because these two conceptions are indistinguishable in a 2 × 2 mobility table (see Table 6.3) and because most discussions of structural mobility have relied on the examples provided by such a 2 x 2 table (Boudon 1973). Perfect social mobility or maximum fluidity of a stratification system implies a complete lack of both inheritance and hierarchy, but absence of fluidity may not imply "maximum inheritance" *and* "maximum hierarchical rigidity."

Some Concluding Remarks

One of the central themes of this paper has been that there can be a substantial disjunction between the statistical tools we use in mobility studies and the substantive ideas we pursue. As statistical models become more complex and the meanings of parameters of these models become more esoteric, it will be harder to detect this potential disjunction. We have shown that seemingly sophisticated statistical models such as Hauser's structural model of the mobility table and Goodman's quasi-independence model contain elements of self-contradiction when these models are scrutinized with the help of several benchmark conceptions of social mobility.

Another theme is that the analysis of social mobility is plagued by the proliferation of terms that are often implicitly defined by the parameters of fairly complex statistical models. The notions of status-specific inheritance, rigidity of the status system, structurally induced mobility, mobility ratio, immobility, and so on, are often treated merely as terms in a particular statistical model. As a consequence, these terms are used in the context in which the meanings of such fundamental ideas as the maximum rigidity of a status system are left undefined: for instance, there is no clear articulation of the relationship between the concept of status-specific inheritance and the concept of the rigidity of a status system.

Another related theme, implicit in much of the preceding discussion, is the potential dangers of "relying solely or primarily on empirical data (mobility tables) to reconstruct theories."[11] Refining statistical models on the basis of successive application of models to the same data, often done in the use of now-popular log-linear models, can be useful as an expedient means of exploratory analysis. But the resulting model (with implied theories to accompany it) must be subjected to benchmark conceptions that are grounded on substantive theory. In calling for a more determined effort to make the implicit assumptions of new statistical tools as explicit as possible, this paper has called attention to the usefulness of the benchmark conceptions of social mobility, such as status rigidity, status inheritance, and status hierarchy.

Notes

1. This parametrization is slightly different from Hauser's (1978), but these two parametrizations are equivalent in essence. The current parametrization reveals more readily the expected marginal frequencies, which will be used extensively in later discussion.
2. For such data, the complete reproduction of the observed frequencies will require an additional term for residual or error:

$$F_{ij} = (c)(a_i)(b_j)(d_k)(e_{ij}).$$

For the present discussion, this additional complication need not be introduced.
3. It is argued elsewhere (Kim 1985) that the earlier findings by Goodman (1965, 1968, 1969a), by Iutaka et al. (1975), and by Grusky and Hauser (1984), to the effect that many 3×3 mobility tables fit the model of quasi-perfect mobility, cannot be used as empirical validation of the quasi-independence model.
4. In this case the new mobility ratios do not always coincide with the level parameters because of the presence of the error terms mentioned in note 2. If the fit between the full model and the observed data is good, there should not be significant differences between the two.
5. These adjusted frequencies for the marginals and total are obtained by first creating the predicted cell frequencies using the truncated equation as given in Hauser (1978) and summing these cell frequencies across rows and columns. In the new parametrization, these adjusted marginal frequencies can be taken as estimates of parameters of a_i and b_j as defined in Equations (5) and (6).
6. Hauser notes: "Imagine that you are analyzing this hypothetical table 9 times, but at each turn a different one of the 9 cell entries is unknown to you. When the contents of cell (1,1) are unknown, and only then, will you conclude that there is no association in the remainder of the table. That is the sense in which it is obvious by inspection that the model of [Table 3.0] is to be preferred to the model of [Table 3.1]. Note that the latter model is asymmetric and, further, that it requires us to locate the interactions in two cells, rather than in one cell of the classification" (Hauser 1981, p. 574).
7. Pontinen (1982), whose central theme is consistent with the main contentions of this paper, nevertheless provides an interesting interpretation of the model of quasi-perfect social mobility. The justification for deleting the (1,1) cell from Table 1.1 would be that upper-class fathers have reserved so many upper-status positions for their sons that these positions are not available for the sons of other statuses; hence they need not be counted in the marginal frequencies.
8. A pertinent warning that Hauser has made with respect to the "received" knowledge may very well apply to his own use of the received knowledge based on the application of "quasi-independence" models. He writes: "In undertaking to interpret a mobility table we may know little or nothing about either the marginal effects or the interaction effects. Assuredly we will want to be cautious in basing our interpretation of a table on received knowledge, for most received knowledge about the structure of mobility tables is based on departures from the model of statistical independence . . ." (1978, p. 927).
9. It is shown elsewhere (Kim 1985) that applying the quasi-independence model to a 3×3 mobility table is not informative and that, in a 3×3 table, if the quasi-perfect mobility model fits the data then any uniform association model fits the data equally well.
10. The marginal frequencies can be adjusted to any pattern without disturbing the internal

odds-ratios. The iterative procedure introduced by Deming (1943) is easy to use. See also Mosteller (1968) and Bishop et al. (1975).
11. Quoted from comments of an anonymous referee.

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