

**InterGen:  
User's Guide and  
Program Documentation**

**by**

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## **Introduction**

Racial inequality is a fundamental fact of social life in America. Socioeconomic differences between minority and majority populations are large and enduring; they have important consequences for the life chances of individuals and groups.<sup>1</sup>

Sociologists and other social scientists who study social stratification and inequality use quantitative models to describe and analyze the process of socioeconomic attainment and how it leads to group inequalities. They use these models to answer questions such as “What is the nature of the process by which individuals attain status outcomes such as education, occupation, and income?”; “What factors are most important in this process?”; and “How do patterns of status attainment vary by group and what consequences do these differences have for group attainments?”.<sup>2</sup>

Unfortunately, non-specialists generally do not find these models particularly accessible or helpful. This is hardly surprising; most non-specialists do not have the technical background needed to interpret and manipulate systems of multistage, multivariate equations. Consequently, for students and laypersons, complex quantitative models of stratification processes are as likely to obscure and mystify as to inform and enlighten.

This does not mean that non-specialists do not understand the basic social fact that racial stratification is embodied in group differences in status attainment processes that produce and maintain racial inequality. But it does mean that the understandings that students and laypersons have of these processes are intuitive rather than systematic. For example, laypersons have a strong “common sense” grasp of the fact that education and high status social background confer advantages in status attainment while racial discrimination imposes penalties. But they lack the technical expertise to decipher precisely how stratification and group inequality is generated by a complex web of effects that span not only individual lives and but even extend across generations. As a result, important insights about racial stratification and inequality that flow from quantitative models of

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<sup>1</sup> See Oliver and Shapiro (1995) for an overview of racial inequality in America. Alternatively, for a briefer introduction, see Chapter 8 (“Ethnic Inequality”) in Jaret (1995).

<sup>2</sup> Important early statements in this literature include Duncan (1967; 1968), Duncan and Duncan (1968), Featherman and Hauser (1976; 1978), and Jencks (1978). A recent review of the state of this literature can be found in Hamilton (2000).

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status attainment and social stratification are not readily evident to many students and laypersons.

The goal of the InterGen program is to provide a bridge between the social scientist's technical modeling of status attainment and racial inequality and the lay person's more intuitive understanding. In particular, InterGen is geared to showing how racial discrimination in status attainment processes generates group inequality that is transmitted and perpetuated across generations. It is also geared to illustrating two consequences of this intergenerational transmission of group inequality that most non-specialists find non-intuitive. The first is that the level of group inequality that results from discrimination is greater than might be expected on first consideration due to the fact that group inequality is "compounded" over time. The second is that, even under the most optimistic scenarios regarding success in eliminating racial discrimination in status attainment, group inequalities generated by past discrimination are likely to persist for several generations and many decades into the future.

This document serves as a User's Guide for the InterGen program. It provides a discussion of the program's features and capabilities and a general overview of how to use the program.

## Description and Purpose of the Program

The InterGen program is an educational tool focusing on racial stratification and inequality. Specifically, it is geared to helping students explore the social processes that generate racial inequality and perpetuate it over time.

InterGen is inspired by sociological theory and research on status attainment processes and the impact that racial discrimination and the "inheritance" of disadvantage has for long term trends in racial inequality.<sup>3</sup> The goal of the program is to help make the key substantive findings of this technical research literature accessible to non-specialists. It does so by permitting them to explore and manipulate models of intergenerational stratification processes via an intuitive, easy-to-use model interface. More specifically, the InterGen program:

1. Presents a simplified model of status attainment that embodies key features of social stratification processes without being unnecessarily detailed and complicated;
2. Depicts status attainment processes via graphical representations that highlight basic causal connections in an intuitive and

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<sup>3</sup> Among the more immediate inspirations are articles by Duncan (1967), Lieberman and Fuguitt (1967), and Daymont (1980).

easy to understand way;

3. Uses graphical methods to present the quantitative implications of stratification processes for group attainment levels and inter-group inequality on key stratification outcomes (e.g., education and socioeconomic status);
4. Permits users to manipulate the basic parameters of the overall stratification system via easy to use "point-and-click" selection boxes; and
5. Provides immediate graphical feedback on the impact that changes in parameters of the stratification system have on group attainment levels and inter-group inequality.

Another significant feature of the InterGen program is that draws on the new technologies of the World Wide Web and web-based software.<sup>4</sup> Thus, this instructional tool is available to educators, students, and other interested parties who have access to the World Wide Web.

In sum, the program is offered with the hope that it can help provide undergraduate students and interested lay persons a useful introduction to racial stratification and inequality using intuitive, graphical representations of models and outcomes that are faithful to the research literature but convey the logic of analysis and key findings in a manner that is accessible to students with little or no background in quantitative models of stratification and inequality.

## Program Availability and Support

The InterGen program can be found on the web at the Virtual Laboratory in Racial and Ethnic Stratification and Inequality (VLAB-RESI), a site developed and supported with funding from the National Science Foundation and developed by Mark Fossett, Professor in the Department of Sociology and Research Affiliate at the Racial and Ethnic Studies Institutes at Texas A&M University, College Station, Texas. The web address for the site is:

<http://vlab-resi.tamu.edu/vlab.htm>

Funding for the development of the InterGen program and the VLAB-RESI website has been provided by a grant from the **National Science Foundation** (Division of Undergraduate Education, Course Curriculum and Laboratory Improvement Program). Institutional support for the program and the website has been provided by the

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<sup>4</sup> Specifically, InterGen is a Java applet which is loaded from a web page and runs under Java-capable web browsers.

### Overview of the InterGen Model

The InterGen program presents a simple model of the attainment process that generates status outcomes and transmits advantage and disadvantage across generations. A graphical representation of this model is shown in Figure 1.

The model is obviously highly simplified. This suits InterGen's intended function to serve as an educational tool illustrating key principles that govern the generation of inter-group inequality and its persistence over time. InterGen does *not* try to model status attainment and inter-group inequality in its full complexity because it is neither necessary nor desirable to do this to illustrate the theoretical and substantive principles involved. Indeed, presenting a complex model would likely make it more difficult for users to explore the relevant theoretical issues. Thus, the model is kept simple *by design* in order to make it easier for students to use the program and understand its substantive implications.

This graphical representation of the model depicts several key elements of an inter-generational stratification system. The first is *attainment outcomes* – namely, education and socioeconomic status. These are designated separately by generation with “parent’s” attainments distinguished from “respondent’s” attainments.

The second important element is a *structured attainment process* – a system of causal linkages connecting attainment outcomes to “resources” that influence these outcomes. In the visual language of the causal flowgraph in Figure 1, causal influence flows from left to right when lines connect variables. Thus, for example, respondent’s education is determined by parent’s education and parent’s socioeconomic status; and respondent’s socioeconomic status is determined by respondent’s education and parent’s socioeconomic status. These graphical connections between variables translate into a system of linear regression equations whose coefficients represent the quantitative expression of the causal linkages depicted in the figure.

The third element seen in the figure is the inter-generational linking of attainment outcomes. The figure is divided into three panels (moving from left to right) indicating that respondent’s status attainments are linked to the attainments of the previous (parent’s) generation and also indicating that in the future the respondent’s attainments will become resources shaping the next generation’s status attainments.

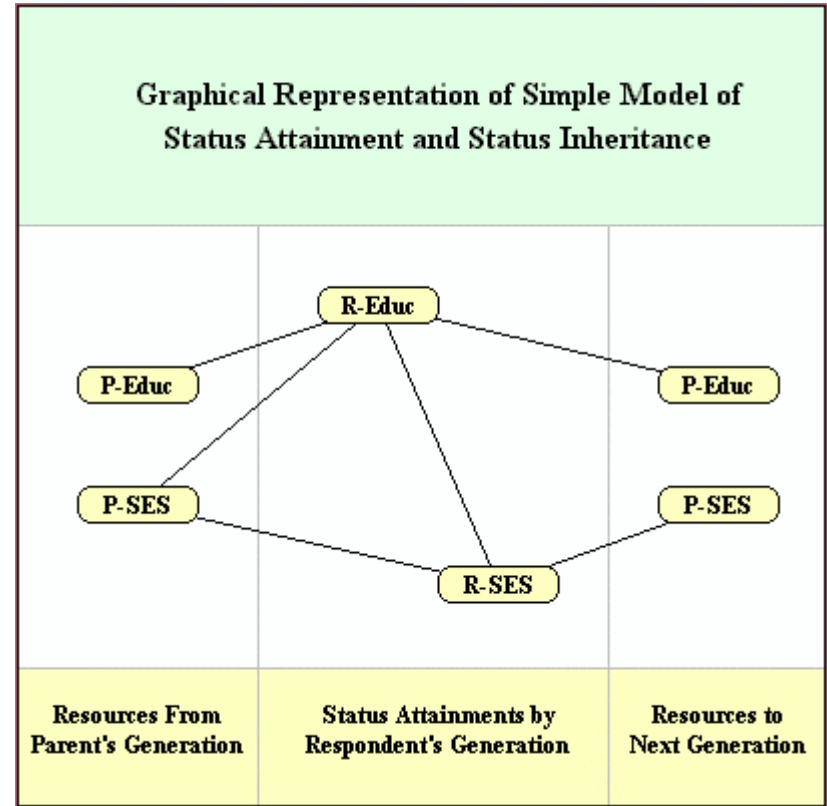


Figure 1

Two important aspects of the InterGen model are not depicted in Figure 1. One is the strength of the connections between the variables. Figure 1 does not visually represent this aspect of the stratification system but the quantitative representation of the model does. Specifically, it allows for the possibility the connections between variables can be weak or strong (i.e., that the coefficients in the regression equations can be smaller or larger). Substantively, this is important because it governs how strongly the past influences the present.

Figure 1 also does not visually represent discrimination, but this is an important feature of the stratification system. The quantitative representation of the model allows for the possibility that racial discrimination will limit minority ability to “convert” resources into attainments at the same rate as whites (i.e., that effect coefficients in

the regression equations will be smaller for blacks than for whites).

Finally, the InterGen model has a highly simplified ethnic system consisting of “whites” and “blacks” with the ethnic mix in the population is fixed at 80% white and 20% black. This particular ethnic mix is a relatively arbitrary choice and has no bearing on the model’s implications for the level of white-black inequality or its trends over time.<sup>5</sup>

The major features of the model have now been introduced. The next sections discuss how to invoke the program and use the model.

## Invoking the Program

To run the InterGen program, take the following steps.

1. Start your browser program (remember that it must be java enabled);
2. Point your browser to the home page of the VLAB-RESI website (address given above);
3. Click on the “InterGen” link on the home page to load the web page dedicated to the InterGen program;
4. Click on the InterGen button on this page to start the InterGen program. It will open in a new browser window that is sized appropriately to display the program and associated help documents.

## On-Screen Program Organization

InterGen divides the browser window into four “frames”: a contact frame, a navigation frame, a notes frame, and a maps frame.

The **Contact** frame is in the upper left. It provides links to return to the home page for the InterGen program and to e-mail comments about InterGen to the Webmaster for the VLAB-RESI web site..

The **Navigation** frame is in the middle left. It provides options for quitting the program, going forward and backward through screens, and invoking the help menu.

The **Notes** frame is in the lower left. It is reserved for presenting information about the InterGen displays. It also is where information about menu options and selections is presented.

The **Model** frame is on the right. It is the largest single frame. The InterGen applet runs in this frame. It occupies most of the area in

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<sup>5</sup> Under the model, the ethnic mix in the population does have implications for *absolute* status levels for minority and majority groups (but only if discrimination is active). The stand-alone version of InterGen provides the option of changing the ethnic mix in the population.

the frame and provides controls which allow the user to manipulate the InterGen model and display various graphical representations of status outcomes and inequality.

## InterGen Program Controls

The InterGen program is operated by using “controls” placed along the bottom of the program’s “frame”. The controls consist of two rows of “selection” boxes and a row of “buttons”. The selection boxes are used to manipulate the parameters of the InterGen model. The buttons are used for invoking the help system or for selecting different graphical presentations of the model and stratification outcomes.

### Program Selection Boxes

**Discrimination in Education.** The “Disc Educ” selection box provides the means for specifying the impact that discrimination has on black educational attainments. The possible settings are percentages ranging from 0-80. A selection of 0% means that there is no racial discrimination in education. Under this setting whites and blacks will “convert” social background characteristics (e.g., parental education and status) into educational attainments at identical rates. A selection of say 40% means that discrimination limits the capacity of blacks to “convert” social background characteristics into educational attainments such that on average the educational attainments of individual blacks will be 40% lower than the educational attainments of whites with identical social background characteristics.

**Discrimination in Socioeconomic Status.** The “Disc SES” selection box provides the means for specifying the impact that discrimination has on black socioeconomic attainments. The possible settings are percentages ranging from 0-80. A selection of 0% means that there is no racial discrimination in socioeconomic status attainment. Under this setting whites and blacks will “convert” education and social background characteristics into socioeconomic status attainments at identical rates. A selection of 40% would mean that discrimination limits the capacity of blacks to “convert” education and social background characteristics into socioeconomic status such that on average the socioeconomic status of individual blacks will be 40% lower than the socioeconomic status of whites with identical education and social background characteristics.

**Structure in Education.** The “R2 Educ” selection box provides the means for specifying the degree to which education attainments are structured (i.e., determined or explained) by social background

characteristics. The possible settings are percentages ranging from 0-80. A selection of 0% means that education outcomes for individuals are completely unrelated to their social background characteristics. This would mean that individual differences in education are random in nature and can be attributed entirely to unknown factors which might be thought of as “luck” or “fortune”. A selection of 50% means that education outcomes for individuals are substantially related to their social background characteristics. This would mean that about half (50%) of individual differences in education can be traced to individual differences in social background characteristics. In addition, it would mean that the remaining of individual differences in education (50% of the total) are random in nature and can be attributed to unknown factors which might be thought of as “luck” or “fortune”.

**Structure in Socioeconomic Status.** The “R2 SES” selection box provides the means for specifying the degree to which socioeconomic status attainments are structured (i.e., determined or explained) by education and social background characteristics. The possible settings are percentages ranging from 0-80. A selection of 0% means that socioeconomic status outcomes for individuals are completely unrelated to their education and social background characteristics. This would mean that individual differences in socioeconomic status are random in nature and can be attributed entirely to unknown factors which might be thought of as “luck” or “fortune”. A selection of 50% means that socioeconomic status outcomes for individuals are substantially related to their education and social background characteristics. This would mean that about half (50%) of individual differences in socioeconomic status can be traced to individual differences in education and social background characteristics. In addition, it would mean that the remaining of individual differences in socioeconomic status (50% of the total) are random in nature and can be attributed to unknown factors which might be thought of as “luck” or “fortune”.

### ***The Time Dimension; Period and Generation***

Each of the selection boxes just described appears twice, once on each of two rows labeled “Period 1” and “Period 2”. The distinction refers to the fact that time in the model is divided into two periods, each one spanning 10 generations.

Depending on the user’s choices the two periods may be characterized by different stratification dynamics. If the selection boxes have the same settings in Period 1 and Period 2, then the model describes a stratification system that is unchanging over a span of 20 generations.

If one or more selection boxes differ in Period 1 and Period 2, then the model describes a situation in which one pattern of stratification dynamics is in place for a period of ten generations (Generations –10 through 0 on the time line) and then is replaced by a new pattern of stratification dynamics (which take effect at Generation 0 on the time line) that remains in effect for the next ten generations (Generations 0 through 10 on the time line).

The possibility of specifying two patterns of stratification dynamics gives the user the option of exploring the consequences of hypothetical changes in racial and socioeconomic stratification dynamics. A typical application would be to specify settings in Period 1 that correspond with racial and socioeconomic stratification dynamics in the “Jim Crow” era and settings in Period 2 that correspond with a new pattern of racial and socioeconomic stratification dynamics that take root in the “Post Civil Rights” era.

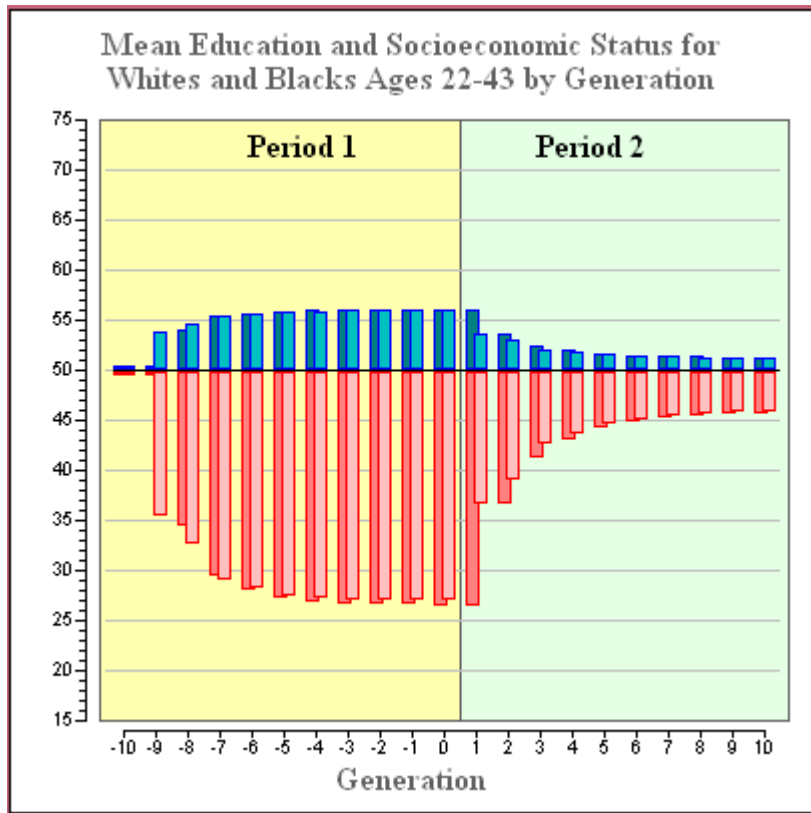
### ***Program Buttons***

**Help.** The “Help” button brings up a help menu in the “notes” frame on the left side of the screen. A second help button is also found in the navigation frame on the left side of the screen. It also can be used to invoke the help system.

**Status Levels.** The “Status Levels” button displays a graph depicting average status levels for whites and blacks on education and socioeconomic status over time. An example is shown in Figure 2. It also presents a quantitative summary of these results (not shown here). In the graphical presentation, a generational time line is on the horizontal or “x” axis of the figure and the vertical or “y” axis gives a scale for status levels. Color shaded bars depict white and black status levels as deviations from 50, the value that each group would have under a system where race did not factor into stratification dynamics.

The shading of the background for the figure reflects the transition from Period 1 to Period 2. Changes in status levels during Period 1 reflect the accumulating consequences of the stratification dynamics in place during that period. Changes in status levels after Period 2 begins reflect the initial and cumulative consequences of the shift to a new system of stratification dynamics.

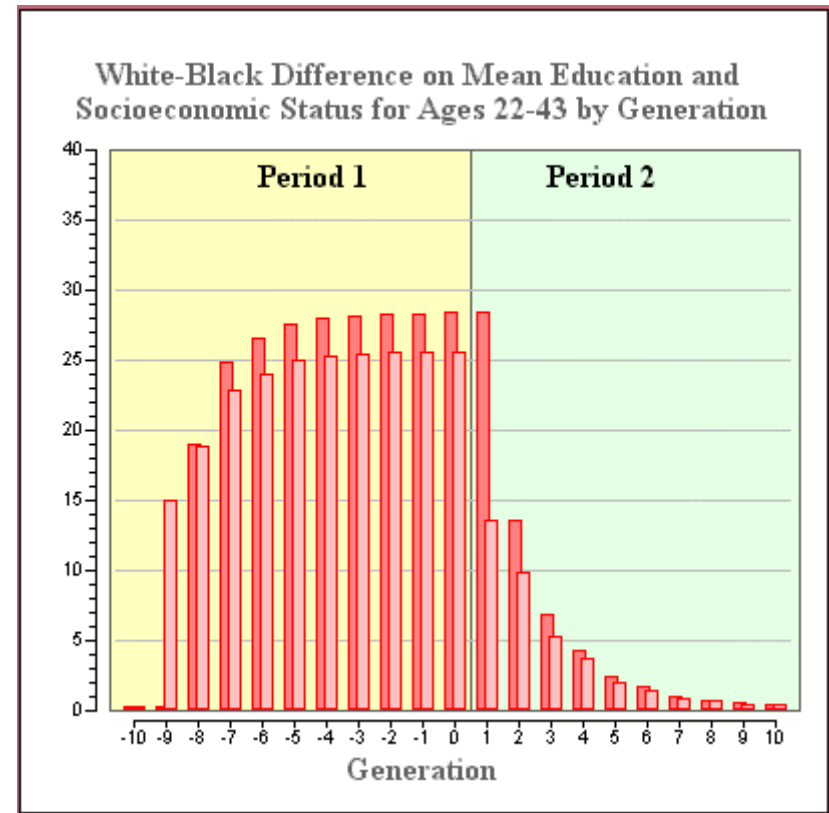
The pattern in Figure 2 is one in which white and black status levels are initially identical (as is always the case for the model), but as the Period 1 stratification system operates white and black status levels begin to diverge sharply. Then, when the Period 2 stratification system begins to operate, the white-black status differences begin to gradually moderate.



**Figure 2**

**Inequality.** The “Inequality” button displays a graph depicting average inequality between status levels for whites and blacks on education and socioeconomic status over time. An example is shown in Figure 3. It also presents a quantitative summary of these results (not shown here). In the graphical presentation, a generational time line is on the horizontal or “x” axis of the figure and the vertical or “y” axis gives a scale for inequality levels. Color shaded bars depict white and black inequality as deviations from 0, the value that would obtain under a system where race did not factor into stratification dynamics.

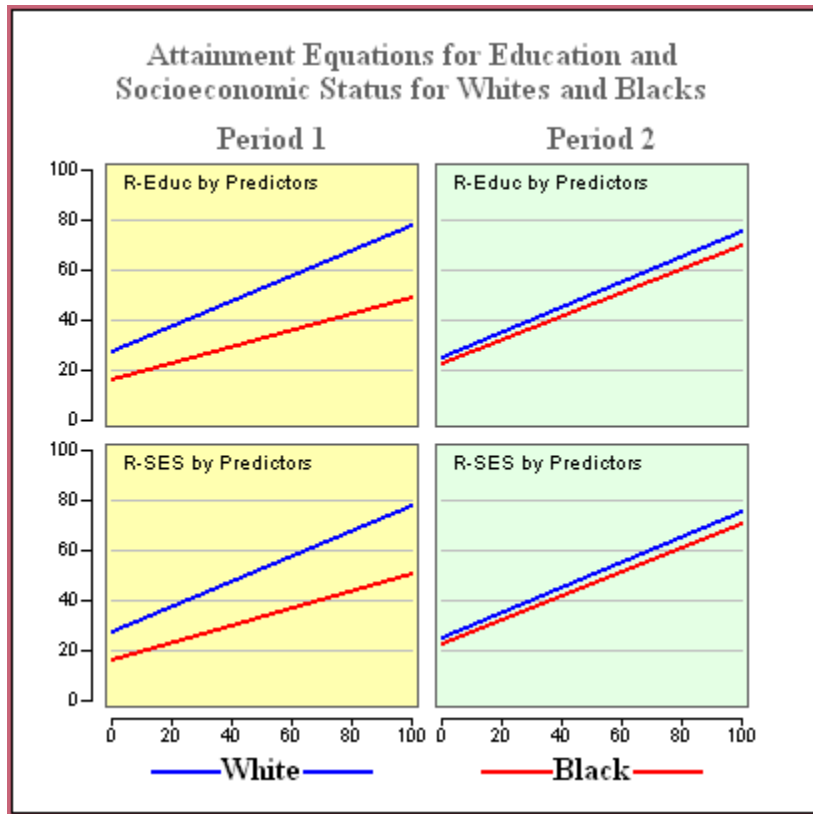
The shading of the background for the figure reflects the transition from Period 1 to Period 2. Changes in inequality levels during Period 1 reflect the accumulating consequences of the stratification dynamics



**Figure 3**

in place during that period. Changes in inequality levels after Period 2 begins reflect the initial and cumulative consequences of the shift to a new system of stratification dynamics.

**Model.** The “Model” button displays a graphical representation of the quantitative model underlying the InterGen analysis (shown earlier in Figure 1). The actual quantitative model is a system of multiple, group-specific, intergenerationally linked attainment equations for education and socioeconomic status. The graphical representation conveys the fact that the outcomes of education and socioeconomic status are connected to multiple factors that shape or determine the outcome. The graphical representation also conveys the fact that the fates of successive generations are potentially linked



**Figure 4**

through the role of social background characteristics (i.e., parent’s education and socioeconomic status) in each new generations’ education and socioeconomic status attainments.

**Equation.** The “Equation” button displays a graphical representation of the group-specific and outcome-specific attainment equations for the model. An example is shown in Figure 4. The display includes four graphs that depict the attainment “rules” governing each outcome (i.e., education and socio-economic attainment) in each period. Each graph displays the linear equation governing attainment for whites (in blue) and blacks (in red).

## Using the Program

InterGen allows users to design “scenarios” that reflect different assumptions about the nature of stratification system. The program translates each scenario into a quantitative model of status outcomes and inter-group inequality and their trajectories over time. Then it displays selected quantitative results in easy-to-interpret charts and tables designed to help the user assess the quantitative and substantive implications of the scenario.

**Specifying the Scenario.** The user implements a scenario by changing the settings of the selection boxes (described above). These choices outline a stratification system with a specific set of features.

Depending on user choices, education outcomes can be strongly or weakly tied to the resources of parental education and socioeconomic status; socioeconomic attainment can be strongly or weakly tied to the resources of education and socioeconomic background; and discrimination can limit the educational and occupational attainments of minorities in varying degrees. The implications of these choices for attainment are reflected in the attainment equations (shown by clicking on the “Equation” button). An example is shown in Figure 2.

**Simulating Interventions and/or Social Change.** Since these settings can be made independently for “Period 1” and “Period 2”, the user can design scenarios that implement a change in the stratification system over time. This gives users the ability to explore the impact of “virtual” policy interventions (e.g., anti-discrimination legislation) and/or “virtual” social changes in social stratification (e.g., increasing importance of education in status attainment) and how the associated changes in the stratification system can affect status outcomes and inter-group inequality.

For example, the user might design a scenario to explore the potential impact of implementing anti-discrimination policies. To do this, the user might design a scenario where the initial values specify that discrimination has a major impact on minority attainments in education and occupation. Then, to represent a “virtual” policy intervention implementing successful efforts to eliminate discrimination, the user can specify a second set of values where discrimination no longer plays a role in these attainment processes. The user can then track status outcomes and inter-group inequality over time to see how they change after the “virtual” policy intervention occurs.

Alternatively, the user might design a scenario to explore the impact of a transition from an “industrial” economy to an “information” economy. Thus, the user might design a scenario where the initial

values specify that occupational attainment is only loosely linked with education while the second values specify that occupational attainment is closely tied to education. The user can then track status outcomes and inter-group inequality over time to see how the increasing importance of education in occupational attainment affects inter-group inequality.

The key is that users can design scenarios to explore different questions they might have about how changes in the nature of the status attainment process affect inter-group inequality and its persistence over time.

**Analysis.** InterGen makes it easy for users to assess the implications of the scenario they have designed by giving the users access to graphs and tables that are easy to understand and interpret. Specifically, the program generates graphs and tables that document: (1) how group status outcomes and inter-group inequality change over time under the initial scenario and (2) how they change over time when the second set of values (reflecting a hypothetical policy intervention or social change) takes effect.

Significantly, InterGen relieves the user from the burden of performing the calculations needed to work out the quantitative implications of the underlying attainment model.

Even more importantly, InterGen allows the user to manipulate the scenario while the graphical results are being displayed. As the user adjusts the scenario, InterGen recalculates the entire model and updates the charts in “real time”. Thus, the user can easily “play” with the scenario and get immediate visual feedback on how outcomes are affected when different aspects of the scenario are manipulated.

Figure 2 provides an example of the graphical display that InterGen provides when the user clicks on the “Inequality” button. The darker bars track white-black education inequality over time. The lighter bars track white-black inequality in socioeconomic status over time. The scenario in place for this analysis is one with high levels of racial discrimination in Period 1 and no discrimination in Period 2. Consequently, inequality first rises to high levels and then later falls to low levels.

### ***Time and the Labeling of Generations***

In the InterGen model, time is measured in generations. The InterGen model keeps track of status outcomes for a total of 21 generations and 20 separate generational transitions. Over this period of time, Period 1 scenario settings are in effect for the first ten generational transitions and Period 2 scenario settings are in effect for the

last ten generational transitions.

Time is measured in relation to the point when the Period 2 scenario settings take effect. Thus, the last generation subject to the attainment rules reflected in the Period 1 scenario settings is designated “**Generation 0**” and the first generation subject to the attainment rules reflected in the Period 2 scenario settings is designated “**Generation 1**”. The generations that follow are designated Generation 2, Generation 3, and so on through Generation 10. The generations that lead up to Generation 0 are designated using negative numbers that “*count down*” (i.e., -10, -9, -8, etc.) to Generation 0.

### **Interpreting Model-Based Results**

A number of basic questions can be considered when examining the substantive implications of any scenario. Some good starting questions are listed below.

1. What status and inter-group inequality outcomes emerge under the Period 1 scenario settings? Over the long run, do whites and blacks differ on status outcomes? If so, by how much?
2. How long does it take for outcomes to emerge and stabilize under the Period 1 settings? How many generations does it take before the inequality patterns emerge and stabilize? Is most of the inequality realized quickly, or does it emerge gradually?
3. When the values of the variables in the model are changed at Period 2, does this lead to changes in status outcomes and inter-group inequality patterns? What happens to inequality patterns after the “intervention”? Does inequality change to a new level? How much of a change is there from the previous pattern of inequality?
4. How long does it take for these new outcomes to emerge and stabilize? Does the new pattern of inequality emerge quickly or gradually? How long does it take before most of the change is realized?

### ***Pinpointing Effects***

Obviously, if the values of more than one variable in the InterGen model are changed at Period 2, it will not be easy to determine which of the changes is responsible for any resulting changes in status outcomes and inter-group inequality. Thus, it is easiest to assess the impact of a change in the model (i.e., a hypothetical policy change) when the only one variable is manipulated.

When the motivation for performing the analysis is to assess the

separate and combined effects of changing two or more variables in the InterGen model, it is still possible to isolate the impact of each change. However, to do so, it may be necessary to explore several scenarios. First, explore the impact of changing the variables in question in isolation (i.e., one at a time). Then explore and the impact of changing them in combination with changes in other variables.

### ***Avoid Naive Generalizations***

By design the InterGen model is relatively simple. This is desirable for instructional purposes but it makes it especially important to remember that the InterGen model is not intended to directly reproduce or predict actual status and inequality patterns in “the real world”.

This does not mean that the basic principles revealed by the InterGen model do not hold in the real world. To the contrary, they undoubtedly do to some extent. For example, under the InterGen model, inter-group inequality resulting from past discrimination tends to persist for many generations when family resources play a strong role in status attainment. There is a strong theoretical and empirical basis for believing that this “finding” applies in a general sense in the “real world”. However, because the InterGen model is highly simplified, the results obtained using this model do not provide a sound basis for describing or forecasting “real” inequality patterns in any precise way.

### **Overview of Program Structure and Algorithms**

This section provides a description of what is involved when the InterGen program implements a simulation scenario. It also includes an overview of some of the key algorithms the program uses.

#### ***Basic Steps in the Model's Quantitative Analysis***

In every analysis, the InterGen program follows certain basic steps to implement the simulation scenario the user has specified. These may be summarized as follows.

1. Establish initial conditions of inter-group *equality*.
2. Implement Period 1 Scenario Settings.
3. Allow Period 1 Settings to Operate for 10 Generations.
4. Implement Period 2 Scenario Settings.
5. Allow Period 2 Settings to Operate for 10 Generations.

*Establish initial conditions of inter-group equality.* InterGen

begins each analysis by implementing the assumption that at Generation -10 (the initial generation in the model) whites and blacks are equal with respect to all status distributions. This means that Whites and Blacks have the same *resource inputs* to the status attainment process. More specifically, the means for Parental Education (P-Educ) and Parental Socioeconomic Status (P-SES) are the same for Whites and Blacks. Under the specific operationalization of these variables, the means for both groups (and for the total population) will necessarily be 50.

*Implement Period 1 Scenario Settings.* InterGen takes the user-specified Period 1 scenario settings and defines status attainment equations implied by these settings.

*Allow the Period 1 Settings to Operate for 10 Generations.* InterGen applies the status attainment equations for the Period 1 scenario and uses them to generate status outcomes for the next generation.

For education attainments, InterGen generates mean education for Whites and Blacks by taking the means for parental education and parental socioeconomic status (resource inputs) and plugging them into each group's attainment equation for education. Similarly, InterGen generates mean socioeconomic status for Whites and Blacks by taking the group means for education (generated in the previous step) and parental socioeconomic status (from the previous generation) and plugging them into each group's attainment equation for socioeconomic status. These operations produce education and socioeconomic status outcomes for Whites and Blacks in the new generation.

InterGen then moves on to repeat this process for the next generation. As it does so, it carries forward each group's means on education and socioeconomic status. These now serve as the resource inputs for the next generation. Thus, education and socioeconomic status outcomes for the most recent generation are carried forward as parental education and parental socioeconomic status for the each successive generation.

This process is repeated for a total of 10 generations. This allows plenty of time for patterns of group status outcomes and inter-group inequality to stabilize at long-term equilibrium values.

*Implement Period 2 Scenario Settings.* InterGen takes the user-specified Period 2 scenario settings and defines status attainment equations implied by these settings.

*Allow the Period 2 Settings to Operate for 10 Generations.* InterGen applies the status attainment equations for the Period 2 scenario and uses them to generate status outcomes for the next generation. This generation is labeled *Generation 1*. It is the first generation whose status outcomes are determined by the Period 2 attainment

process.

As before, InterGen generates mean education for Whites and Blacks by taking the means for parental education and parental socioeconomic status (resource inputs) and plugging them into each group's attainment equation for education. Similarly, InterGen generates mean socioeconomic status for Whites and Blacks by taking the group means for education (generated in the previous step) and parental socioeconomic status (from the previous generation) and plugging them into each group's attainment equation for socioeconomic status. These operations produce education and socioeconomic status outcomes for Whites and Blacks in the new generation.

InterGen then repeats this process for the next generation. As before, education and socioeconomic status outcomes for the most recent generation are carried forward as parental education and parental socioeconomic status for each successive generation.

This process is repeated for a total of 10 generations. This allows plenty of time for patterns of group status outcomes and inter-group inequality to stabilize at long-term equilibrium values.

At this point, InterGen has completed all calculations. The values of status outcomes, inter-group inequality, coefficients of attainment equations, and other key parameters are stored in memory for examination.

### ***Technical Implementation of Attainment Rules***

At a technical level, the InterGen model specifies the "rules" of the status attainment process in terms of linear equations. These equations specify the exact nature of the linkage between status outcomes (e.g., education) and resources (e.g., parental status). The model includes separate equations for each status outcome and each of these outcome-specific equations is specified separately for whites and blacks. In all, the InterGen model includes four linear equations and more than two dozen coefficients.

As attainment models go, the InterGen model is actually very simple. Even so, it is tedious to work directly with the attainment equations. Thus, the InterGen program tries to insulate the user from working directly with the attainment equations. For example, users do not directly set the coefficients of the attainment equations. Instead, they make choices about scenario settings expressed in less technical terms. While these choices ultimately determine the coefficients of the linear equations that govern attainment processes, the user works with the InterGen model at a more general, substantive level.

### ***Individual-Level Attainment and Group Outcomes***

InterGen converts "resources" into status outcomes via simple linear equations that describe the attainment process for individuals. The coefficients in these equations determine exactly how individuals are able to "convert" resources into status outcomes. That is, the coefficients of the equations constitute the prevailing "attainment rules" in society.

For example, the generic specification of any individual's educational outcome is given by the following the individual-level attainment equation for education:

$$\mathbf{y} = a + b\mathbf{x} + c\mathbf{z} + \mathbf{e}$$

where  $\mathbf{y}$  is education,  $\mathbf{x}$  is parental education,  $\mathbf{z}$  is parental socioeconomic status, and  $a$ ,  $b$ , and  $c$  are coefficients or "effect parameters" that embody the "rules" by which resource inputs ( $\mathbf{x}$  and  $\mathbf{z}$ ) are converted into the status outcome ( $\mathbf{y}$ ), and  $\mathbf{e}$  is a random error term.

The role of  $\mathbf{e}$ , the random error term, is important. It reflects the "unpredictable" aspect of educational attainment that results due to "luck" and idiosyncratic factors not associated with the resource inputs that systematically determine education outcomes.

If  $\mathbf{e}$  is dropped from the equation (as in the equation shown below), then  $\mathbf{y}$  can be interpreted as expected value of education based on the systematic, predictable effects of resource inputs on educational attainment

$$\mathbf{y} = a + b\mathbf{x} + c\mathbf{z}$$

The above equation will yield the mean value of  $\mathbf{y}$  when the values of  $\mathbf{x}$  and  $\mathbf{z}$  are set to their respective means. Thus, using capital letters to designate means (instead of scores for specific individuals), the following equation holds.

$$\mathbf{Y} = a + b\mathbf{X} + c\mathbf{Z}.$$

InterGen uses this last equation to calculate the mean educational attainment for each generation. That is, InterGen calculates the mean education for a particular generation by plugging in the group's means on parental education and parental socioeconomic status in the individual-level attainment equation for education for the group.

InterGen uses a similar logic to calculate the mean socioeconomic attainment for each generation. Of course, the calculations are based on different resource inputs and the equations contain different coefficients. This logic is the same, however, and thus each generation's mean socioeconomic status is calculated by plugging in the group's means on education and parental socioeconomic status (the relevant resources) in the individual-level attainment equation for socioeconomic status for the group.

As a reminder, the education and socioeconomic status attainment process may vary for Whites and Blacks (depending on the settings of the discrimination factors). This means that the coefficients used in the above calculations will be different for Whites and Blacks. The same is true for the values of their respective group means on resource inputs (i.e., parental education, parental socioeconomic status, education).

### ***Creating a Time-Stable Status System***

In the “real world” education is measured in “natural” units such as years of schooling completed or degrees attained. Historically, societal change has produced steady increases in educational attainment. Consequently, indicators such as mean years of schooling completed have increased dramatically from one generation to the next.

The role of “across-the-board” societal change on status outcomes is recognized in the research literature with the distinction between “structural” mobility and “circulation” mobility. Circulation mobility refers to increases in status position that occur due to improvement in relative standing on the status outcome (e.g., moving from the bottom ranks to the top ranks of the status distribution). In contrast, structural mobility refers to increases in a status outcome that occur due to a societal-wide increase and that do not involve changes in rank order position.

### ***Adopting the Percentile Score Metric***

Structural mobility is important in the real world, it would not serve the purposes of the InterGen model to include this complication. For this reason, educational and socioeconomic status are defined in terms of **percentile scores** that measure relative standing in education and socioeconomic status distributions. Under this formulation, scores on education and socioeconomic status both range between 0 to 100. In addition, the population means for both education and socioeconomic status in any generation are 50.

The percentile metric is attractive for several reasons. First, percentile scores are familiar and easy to interpret. Second, using them is convenient because it makes it easy to track status levels across time without having to worry about the complicating issue of structural mobility.

Another benefit of using percentile scores to measure education and socioeconomic status is that the meaning of attainment equation coefficients is easy to understand and compare across generations.

For example, if the coefficient for education in the attainment equation for socioeconomic status is 0.40, it means that moving up one percentile in the education distribution leads to a 0.4 percentile score increase in the distribution for socioeconomic status.

### ***Related Modeling Issues***

Unfortunately, while the percentile score metric is attractive, it poses some problems for modeling. Users do not need to concern themselves with these issues (after all, one of the goals of the InterGen program is to make it possible for users to focus on substantive results, not the technical details). Still, the issues warrant brief mention.

To use percentile scores as the metric for education and socioeconomic status, InterGen must accomplish the following trick. It must permit group-specific status attainment equations (which have different coefficients for Whites and Blacks) and group-specific averages for resource inputs. *And*, the group-specific outcomes on education and socioeconomic status generated by these equations must yield an overall or “total” population average (for both groups combined) of exactly 50. To further complicate things, this outcome must be reproduced generation after generation without fail, including the generations involved in the transition from Period 1 scenario settings to Period 2 scenario settings.

The InterGen program accomplishes this trick. It does so in part by drawing on certain principles of regression analysis that permit algebraic methods to be used to find necessary solutions for equations. It also relies on numerical search algorithms that work in combination with algebraic methods to obtain the necessary results.

All of this is hidden from the user. But it is all present in the underlying mathematical model. Every time a setting in either the Period 1 or Period 2 scenario is changed, the InterGen model executes a blizzard of calculations to generate a status system that faithfully reflects the Period 1 and Period 2 scenarios and at the same time produces a status system in which the means, ranges, and variances for education and socioeconomic status are stable from one generation to the next throughout the analysis.

### ***Life Cycle Stages, Attainment Models, and Measurement***

Group outcomes and inter-group comparisons on education and socioeconomic status are calculated for persons in their “prime” years

of labor force participation, ages 22 through 65 (life-cycle stages 2 and 3).

Individuals under age 22 (i.e., in life-cycle stage 1) are not included in calculations of group outcomes and inter-group status comparisons, as they are not yet participating in the labor force. Similarly, individuals age 66 or over (i.e., in life-cycle stage 4) are not included in these calculations, as they are not longer participating in the labor force.

When a generation is in life-cycle stage 1 they are completing their education. The outcomes they attain are determined by (1) the parameters that govern the educational attainment process during the time period, and (2) the resource inputs to the education attainment process (i.e., parental education and parental socioeconomic status). The resource inputs that apply are those for the generation in life-cycle stage 2 (Labor Force Entry and Family Formation).

When a generation is in life-cycle stages 2 and 3 they are in the labor force and competing for socioeconomic status. The outcomes they attain are determined by (1) the parameters that govern the socioeconomic status attainment process during the time period, and (2) the resource inputs to the socioeconomic status attainment process (i.e., education and parental socioeconomic status). The resource inputs that apply for the generation in life-cycle stage 2 are their own educational attainments (acquired in the previous time period) and the socioeconomic status of the generation in life-cycle stage 3 (Late Career). The resource inputs that apply for the generation in life-cycle stage 3 are their own educational attainments (acquired two time periods earlier) and the socioeconomic status of the generation in life-cycle stage 4 (Retirement).

During any given time period, the parameters of the process of socioeconomic status attainment are the same for individuals in life-cycle stages 2 and 3. This is a bit simplistic (since career attainments are greater on average in the second half of the career), but is adopted to make it easy to describe and depict the structure of the status attainment process.

## **Concluding Comments**

The InterGen program provides a useful tool that new students of racial stratification and inequality can use to gain an intuitive appreciation for many of the concepts used in stratification analysis and the major descriptive findings regarding racial inequality and its persistence across generations. However, as noted above, the InterGen model is greatly simplified relative to “real world” stratification

dynamics and should not be interpreted naively. Thus, I strongly encourage the reader to pursue their interest in racial inequality much further. A fuller understanding of the intergenerational transmission of racial inequality can be obtained by overview readings by Jencks (1979) and quantitative research findings regarding patterns and trends in race differences in status attainment (e.g., Hauser and Featherman 1978; Daymont 1980). Given the importance of racial inequality in American life, an educated person should get as broad a perspective on this sociological phenomenon as possible. For the reader who is new to the subject, Jaret (1995) provides a good introduction to many of the topics just noted.

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## Acknowledgements

My inspiration for the InterGen program traces to articles by Lieberman and Fuguitt (1967) and Daymont (1980). These authors investigated the question of how long inter-group inequality in status attainments is likely to persist following the (hypothetical) elimination of discrimination in status attainment processes. They developed answers to this question through model-based analyses of the persistence of inequality. Their goal was to provide a rigorous, theoretically and empirically grounded framework for debating policy options relating to inequality, particularly the potential impact of anti-discrimination and affirmative action programs.

The basic logic of these analyses is straightforward and easily grasped by undergraduate students. Unfortunately, the analytic strategies used in the articles draw on modeling techniques that few sociology undergraduates are familiar with. I developed the InterGen program to overcome this problem and made it easier for students to grasp the implications of status attainment dynamics for inter-group inequality without requiring them to specifically understand the technical details of the underlying modeling framework.

I have received support to develop the InterGen program (and a parallel internet-based program) from several sources that I would like to acknowledge here. The National Science Foundation has provided significant direct funding support for this project. The Department of Sociology at Texas A&M University, headed by Dr. Rogelio Saenz, has provided important matching support for the project. The Race and Ethnic Studies Institute at Texas A&M University, directed by Dr. Mitchell F. Rice, supported the development of the proposal submitted to the National Science Foundation. I am pleased to take this opportunity to acknowledge these important sources of support for the project.

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Finally, I offer special thanks to Stan Hall and Srikrishna Gurugubelli who assisted me in developing the InterGen program and the VLAB-RESI website.

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When InterGen is used in instruction, the preparation of student research papers, or other related activities, the program should be identified and referenced appropriately. The suggested citation for the program is:

Fossett, Mark A. 2001. InterGen: A Computer Model for Exploring the Origins and Persistence of Inter-Group Status Inequality. Department of Sociology and Race and Ethnic Studies Institute, Texas A&M University, College Station, Texas.

Similarly, when the VLAB-RESI web site is used in instruction, the preparation of student research papers, or other related activities, the site should be identified and appropriately referenced. The suggested citation is:

Fossett, Mark A. 2001. VLAB-RESI: A Virtual Laboratory for the Study of Racial and Ethnic Stratification and Inequality. Website maintained by the Department of Sociology and Race and Ethnic Studies Institute. Texas A&M University, College Station, Texas. (<http://vlab-resi.tamu.edu>)

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## Appendix A System Requirements

The InterGen program should run well on computers with the following capabilities and configurations:

*High- or medium-resolution display.* A display set to 1024x768 resolution (or higher). InterGen will run on computers with a screen resolution as small as 800x600, but the result is less satisfactory.

*Web browser software.* One of the following web-browsers: Microsoft Internet Explorer (version 5 or higher) (recommended); or Netscape Navigator (version 4.5 or higher).

*Java capability.* The web browser must be configured to run Java programs.

*Memory.* The computer must have sufficient memory to run the browser program and also the browser's java "engine" that gives it the capability to run the InterGen java applet. It is not possible to say exactly what amount of memory is needed for satisfactory performance (too many factors must be considered). However, symptoms of inadequate memory include slow performance, and badly "behaved" or incomplete graphic displays.

*Processing power.* Most contemporary computers have more than adequate processing speed to provide satisfactory performance for InterGen. Any CPU comparable in performance to a 450MHz Pentium III processor should be adequate.<sup>6</sup>

*High-speed internet access.* The InterGen program loads from the VLAB-RESI web site. While the program and associated documents have been developed with an eye toward keeping programs and documents small so they will load quickly, users with lower-speed internet connections (e.g., conventional dial-up modems) may find loading times unsatisfactory. Users with faster internet connections (e.g., high-speed ethernet connections commonly found on college campuses and cable modem and DSL connections increasingly found in homes) should experience good performance.

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<sup>6</sup> At this time, we have not conducted performance tests using other "flavors" of computers (e.g., Macintosh, Unix workstations, etc.). Thus, we make no recommendations for other "platforms". In principle, web pages and Java applets should work identically across platforms. In practice, this is not the case.

## Appendix B

### Glossary of Concepts and Terms

This appendix provides summary descriptions of the key concepts and terms relating to the InterGen model.

*Education* – The level of education attained by an individual. It is measured in terms of percentile score in the overall status distribution for the total population. Given the properties of percentile scores, the overall mean for education is 50; the range is from 0 to 100; and the standard deviation is 28.9 (Freund 1962: 146). In graphical depictions of the attainment process, education may be designated as “R-Educ”.

*Parental Education* – The education of an individual’s parents. For consistency with the research literature (and for simplicity in the modeling framework) it may be conceived as mother’s educational attainment. It is measured using the same percentile metric used for education. In graphical depictions of the attainment process, parental education may be designated as “P-Educ”.

*Socioeconomic Status* – The socioeconomic status attained by an individual. Following the standard literature, this corresponds to a summary representation of the socioeconomic position associated with an occupation. It reflects a variety of factors including such things as income, fringe benefits, employment stability, occupational setting, and other similar aspects of occupational attainment.<sup>7</sup>

In the InterGen model socioeconomic status may be thought of as economic position deriving from occupational position. It is measured in terms of percentile score in the overall status distribution for the total population. Given the properties of percentile scores, the overall mean for education is 50; the range is from 0 to 100; and the standard deviation is 28.9 (Freund 1962: 146). In graphical depictions of the attainment process socioeconomic status may be designated as either “Status” or “R-SES”.

*Parental Socioeconomic Status* – The socioeconomic status of an individual’s parents. For consistency with the research literature (and for simplicity in the modeling framework) it may be conceived as father’s socioeconomic status. It is measured in terms of the percentile metric used for socioeconomic status. In graphical depictions of the attainment process socioeconomic status may be designated as “P-SES”.

*Explained Variance (R<sup>2</sup>)* – A statistical term that refers to the

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<sup>7</sup> Note that it does not include the subjective, prestige-esteem dimension of occupational attainment.

amount of dispersion in a variable’s overall distribution that can be accounted for in terms of its systematic relationship with a set of predictor variables. It ranges from 0 to 100 where 0 indicates that predictors have no impact on the variable and 100 indicates that the predictors exactly determine the variable. In regression analysis, the multiple r-square statistic registers explained variance. This is sometimes designated as simply “R<sup>2</sup>” or “R<sup>2</sup>”.

*Linear (Regression) Equation* – A mathematical description of the systematic relationship between two variables. It involves both a straight-line relationship specified by the coefficients of the regression equation (intercept and slope) and an assumed structure for the distribution of residuals or “errors of prediction” around the regression line.

*Regression Coefficient* – A quantitative value expressing the amount by which a variable will change following a one-unit increase in the relevant predictor variable. For example, a coefficient of 0.4 indicates that the dependent variable will increase by 4 tenths of a scale unit when the predictor increases by one scale unit.

*Generation (Time)* – Time is measured in generations where sequentially numbered generations reflect a line of descent. For example, for Generations 1, 2, 3, etc., Generation 3 descended from Generation 2 which descended from Generation 1. A new generation enters the InterGen model every 22 years. Each new generation spends one generational time period completing their education. Then they spend two generational time periods participating in the labor force. At the end of the third generational time period, they exit the labor force.

*Life-Cycle Stages* – In the InterGen model individuals progress through a life cycle consisting of four stages each lasting 22 years. The first is spent completing childhood and education. The next two are spent in the labor force. The last is retirement.

*Stage 1: Birth and Education* – During this stage individuals are born and reach age 21. They acquire their education during this stage and it remains fixed throughout the remaining stages of the life cycle. During this stage individuals are not in the labor force and do not compete to attain socioeconomic status.

*Stage 2: Labor Force Entry and Family Formation* – During this stage individuals age from 22 to 43 years old. They enter the labor force and compete to attain socioeconomic status. In addition, they become parents and their children progress through life-cycle stage 1. Their children’s educational attainments are influenced in part by the education and socioeconomic attainments of their parents.

*Stage 3: Late Career* – During this stage individuals age from 44 to 65 years old. They are in the labor force and compete to attain socioeconomic status. Their children are now “grown” and have entered life-cycle stage 2. Their children’s socioeconomic attainments in early career are influenced in part by the socioeconomic attainments of their parents.

*Stage 4: Retirement* – During this stage individuals aged from 66 to 88 years. They are “retired” from the labor force and no longer compete to attain socioeconomic status. However, their socioeconomic position continues to influence the socioeconomic attainments of their children. At the end of the stage they exit the simulation (i.e., they “die”).

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## **Appendix C**

### **Saving and Printing Images**

Notice that InterGen does not have a program control for printing or capturing the images it displays. It is possible to print and/or capture its images, but this is not done directly through the InterGen program. Instead, this is accomplished indirectly by using the capabilities of the browser program, or the operating system used in combination with programs that can manipulate and print graphics images.

This section outlines methods for saving and printing images. Similar instructions can be found in InterGen’ “Help” system.

#### ***Method 1: Direct Printing***

If you use the Microsoft Internet Explorer browser (version 5.0 or higher), you may be able to print displayed images directly from within your browser and get good results.<sup>8</sup> To do so, take the following actions.

- a. Move your pointer to the border region surrounding the applet. (Usually this will be a small yellow border around a maroon applet frame.)
- b. Next, right click on the border region. This will call up an Internet Explorer menu that includes an option to print. Choose that option.
- c. A print dialog box will appear. Under the “Print Frames” heading, check the option to print “Only the selected frame” (since the applet is running in a browser “frame”).
- d. Click on the “Properties” button of the print dialog box to configure your printer for printing graphics. (You can skip this step if the printer’s default settings are set appropriately for graphics printing.)
- e. Click on the “OK” button on the print dialog box to print. If all goes well, the applet image will print successfully.

This direct method of printing is convenient, but may not work predictably under some combinations of browser and printer configurations. Common problems include distorted images, poor image quality for the printed image, and poor matching between screen and printer colors. You may be able to overcome these problems by changing your browser or printer settings. So be prepared to experi-

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<sup>8</sup> Note: The direct method of printing is not available when using the Netscape Navigator browser.

ment until you find a solution that is satisfactory.

### ***Method 2: Capture the Image, Then Print or Save***

The second method takes multiple steps but should work reliably on most systems. It relies on Windows' ability to copy images of either the active window or the entire screen to the Windows "clipboard" (a temporary storage area where the operating system can hold text and images). Once an image is copied to the clipboard, it can then be "pasted" into Windows programs that can accept graphics images.

#### ***Step 1: Capture the Image***

Make sure the browser window is the active window. (It normally will be unless you are switching between programs while using your browser).

Copy the browser window contents to the clipboard by pressing **Alt-Print Screen** (i.e., press the "ALT" and "Print Screen" keys at the same time).

Alternatively, copy the entire screen to the clipboard by pressing **Print Screen**.

Windows does not provide any feedback to show that the window (or screen) has been successfully copied to the clipboard. So you cannot easily tell that you have accomplished your intended task. However, the process is reliable and in most cases the image is now copied to the clipboard and from there can be accessed by other Windows programs.

#### ***Step 2: Paste the Image***

Start a Windows program that will accept graphics images from the clipboard. The Windows "Paint" program is one such program. Word and other popular word processing programs also will accept graphics images. And, of course, specialized graphics editing programs such as PhotoShop will work.

Click on the "Edit" option of the program's main menu.

Click on the "Paste" option on the Edit submenu.

At this point, the image should appear in the program and can be manipulated (e.g., edited, cropped, sized, etc.) as the program's capabilities permit.

#### ***Step 3: Print and/or Save the Image***

Use the program's capabilities to either print the image or save it to disk as a graphics file.

### ***Note on Image Formats***

Graphics images are saved to the clipboard as "bitmap" images. Also, after a program has imported an image from the clipboard, it will typically save the image to disk using the bitmap image format unless the user intervenes and specifically instructs the program to use a different image format.

The significance of this is that bitmap image files can be large (e.g., on the order of 2MB). The size of the graphics file can often be reduced dramatically by using the graphics editing program's ability to save the image to a format that uses "compression" to reduce the size of the file. For example, the "GIF", "JPG", and "PNG" formats are graphics file formats that will greatly reduce the size of the file, perhaps by a factor of 20 or more. For this reason, they are widely used to create images for web documents and other applications where file size is an important consideration.

However, when using GIF, JPG, PNG, and other popular graphics file formats, be careful to note whether the format conversion preserves the image's original colors. If the colors are altered, key information may be lost. (Some programs' conversion routines perform better in this regard than others. For example, the Windows Paint program sometimes alters color schemes when it converts images to compressed formats.)