

Longitudinal Surveys: Why Are These Surveys Different From All Other Surveys?

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ABSTRACT

We review the current status of various aspects of the design and analysis of studies where the same units are investigated at several points in time. These studies include longitudinal surveys, and longitudinal analyses of retrospective studies and of administrative or census data. The major focus is the special problems posed by the longitudinal nature of the study. We discuss four of the major components of longitudinal studies in general; namely, Design, Implementation, Evaluation and Analysis. Each of these components requires special considerations when planning a longitudinal study. Some issues relating to the longitudinal nature of the studies are: concepts and definitions, frames, sampling, data collection, nonresponse treatment, imputation, estimation, data validation, data analysis and dissemination. Assuming familiarity with the basic requirements for conducting a cross-sectional survey, we highlight the issues and problems that become apparent for many longitudinal studies.

KEY WORDS: Frames; Administrative data; Data collection; Nonresponse; Imputation; Estimation; Data analysis.

1. REASONS FOR LONGITUDINAL STUDIES

Each year around the world various statistical agencies conduct thousands of surveys. Usually, these surveys obtain information required for decision or policy making. These surveys are not conducted just for historical purposes, but also to have information on what measures may be taken to assist with making various policy changes. Most surveys are based on cross-sectional data, where a survey is taken of a particular population at a given point in time. Various summaries are taken about the population under consideration at the time of the survey. However, very often the interest is not so much in what actually happened when the survey was taken, but what would be the impact of making various changes. Alternatively, a planned change in policy may be forthcoming and monitoring the effect of this change is desirable. What is most important is the time element. For example, when trying to learn about certain phenomena such as health status or education attainment, one is interested in the various determinants related to these outcomes. Sometimes, the actual temporal relationship is not even clear in terms of what are the causes that precede the effects. These could be measured if, instead of taking a cross-sectional survey, surveys are conducted over time, either as a series of cross-sectional surveys or, alternatively, using the same panel of respondents from one occasion to another. This common sense notion has led to the desire to conduct more longitudinal studies. This also has the benefit that the effects of unobserved variables may be less important when the same respondents are used to compare differences over time.

One of the factors contributing to the increase in the number of longitudinal studies is that administrative data

sources can now be used more effectively, thus making certain longitudinal studies feasible. Administrative data are becoming increasingly available. These data are often routinely collected for the same individuals over a period of time. Even if the data collected from the administrative sources is not ideal for the survey-taker, they may provide a good proxy for the information.

The advantage of designing a study as longitudinal is that a common methodology can be used for each of the various waves of the survey. This may lead to more valid conclusions. Often, when trying to understand various patterns of social and economic change, conducting surveys of the same respondents on a number of occasions is best. Less desirable, but possibly satisfactory, is simply to repeat the survey from one occasion to another without necessarily returning to the same respondents. This may be less costly. The main point is that to understand certain phenomena over time, collecting the information on more than one occasion is necessary.

When making decisions on the nature of a new longitudinal study, a number of cost considerations need to be accounted for. Obviously, one needs to consider the benefits against these various costs. Issues that longitudinal studies could address cover many subject-matter areas. We enumerate just a few of them. In the area of health status, one is interested in changes to health status and the determinants that lead to these changes. In other words, what are the health risks, and what, in fact, is the effect of these health risks on health status in the long term? By collecting the data from the same individuals over a period of time, one can assess these factors, not just on small scale studies typical of clinical trials, but on large-scale nationally-based population health surveys. However, the type of information that can be obtained from a nationally-

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based longitudinal survey would be very different from that which is obtainable in a clinical trial.

Another topic where there is interest in observations over time is in the area of labour and income. For example, it is not enough to have information on the net change to labour force status and labour force participation rate over time. It is also of interest to know which individuals move from say, being unemployed to working or to not being in the labour force. In recent times, employment patterns have changed. More women are working and part-time work is more common. Frequency of job changes is also changing. To understand these phenomena, longitudinal surveys can answer many important questions. The characteristics, for example, of entry level jobs taken by those who were previously unemployed may be of interest, as well as effectiveness of different job search strategies by individuals or the effectiveness of various government training schemes.

Length of spells in poverty is of increasing interest. For example, for persons with low income, how long does one remain in that situation? What are the various factors that will determine whether this is a long-term situation? How important are education and other factors with respect to poverty and the length of poverty spells?

In the field of education, an interesting aspect is the school-to-work transition at the time when people finish full-time school and decide to join the labour force. This behaviour may be measured more easily through a longitudinal study than through other types of surveys. Another education-related example is the effectiveness of various types of education such as vocational training and adult training programs.

In justice and victimization, there are many examples where observing the same individuals over time can be beneficial. Persons who have been victimized could be followed up to assess the long-term implications. As well, persons who have been involved with the judicial system may be observed over time to determine the subsequent patterns of behaviour and the determinants for these patterns.

Studies of consumer behaviour are of great interest to marketers and others. This would include purchasing patterns for consumers. Event histories for consumer purchasing would be very useful to many researchers.

Studies on the effects of government transfer payments to individuals over time can be important to policy makers. A longitudinal study can determine how long individuals may be dependent on such government payments, whether or not habits are created because of the existence of some of these payments, what are the characteristics of the individuals and what are the long-term effects of participation in various assistance programs.

On the economic side, the longitudinal characteristics of various businesses are of great interest. One can measure how efficient these businesses are, what the use of technology is in these businesses, what is the long-term

effect of this use and how productivity is changing over time. Various interesting questions on business demographics could be asked; for example, what are the characteristics of businesses that result in failure, what are the economic conditions under which businesses are created. As well, mergers and amalgamations are of interest with respect to the conditions under which these occur. Through longitudinal studies these phenomena can be more easily measured.

There have been various structural changes to many businesses over the last few years and it is only through longitudinal studies that one can observe some of these structural changes at the micro level. Many measures can be estimated only when the respondents are measured on more than one occasion.

Another area of interest is in agriculture, where the nature of farming is undergoing transition. Of interest is how farms are changing, both in terms of the products that are being produced and the size of the farms. Changes in the characteristics of who is running the operation are also of interest.

As we have discussed, there are many applications and many facets to longitudinal studies. Also, there are many dimensions to their design and analysis. In the following sections we summarize these issues around Four Questions: design issues, implementation issues, evaluation issues and analysis issues. Many of these issues have been discussed in Kasprzyk, Duncan, Kalton and Singh (1989) and in Armstrong, Darcovich and Lavallée (1993). Some design issues and time series methods are reviewed in Binder and Hidioglou (1988). We include a few more recent references.

QUESTION 1: DESIGN ISSUES

When designing a longitudinal study, advance planning is vital to the success of the study. For example, one must ensure that only relevant and accurate information is being collected from the respondents so that the potential benefit of the longitudinal survey is maximized. This implies that the longitudinal analyses to be undertaken from the survey should be planned from the outset to ensure that the relevant data are obtained. Duncan and Kalton (1987) give an excellent summary of many of the issues. Webber (1994) describes the testing strategy used in the planning of the Survey on Labour and Income Dynamics. Huggins and Fischer (1994) discuss the plans for the redesign of the Survey of Income and Program Participation based on their experiences. Longitudinal studies can be more expensive than a series of cross-sectional studies. Therefore, the benefits of collecting these data must be even greater since the costs themselves are higher. As well, ensuring that funding for a longitudinal study can be assured is important since the fruits from the longitudinal nature of the study may not be borne until at least the second or third wave of

the study. There is a difference, of course, between planning for a study to be longitudinal from the beginning as opposed to taking a series of cross-sectional data and trying to merge them into a longitudinal database. Obviously, the former is more desirable but often, because of the history of the survey-taking organization, a series of cross-sectional data already exists so that merging these would be a reasonable alternative; see Hughes and Hinkins (1995).

In general, careful attention needs to be paid to the design of the database for any longitudinal survey where the analysis includes longitudinal measures such as the study of episodes and spells. For some statistical agencies and organizations, the survey program is now in transition from cross-sectional surveys to longitudinal surveys. The change from a series of cross-sectional surveys to longitudinal surveys requires careful planning. When conducting longitudinal surveys, the databases need to be maintained and updated in ways that are very different from cross-sectional surveys. There may be many infrastructure and organizational issues within the agency that become apparent as more longitudinal surveys are being conducted, particularly with respect to the maintenance of the databases and the survey operations. The impact of such changes on the statistical organization may be substantial.

An important issue to consider when planning for a longitudinal survey is whether or not the users will also be requiring cross-sectional estimates. Is there a requirement to have information about the respondents who are in the survey over a period of time, and also being able to produce estimates for a single point in time as if it were a cross-sectional survey? If this is the case, there are major implications on the way the survey is designed and implemented; see Lavallée (1995). This concern would also be present if the variables of interest include comparing cross-sectional estimates over time, as opposed to true longitudinal measures such as studying autocorrelations for common units in a business survey.

Concepts and the definitions used in longitudinal surveys are usually obtained through consultations with the data users. Even the definition of the longitudinal unit to be observed over time may need clarification for dynamic populations. This is the case for both household surveys and for business surveys. Understanding the user requirements and discussing what can be measured over time with appropriate quality is important. During the survey planning, these requirements must be carefully weighed against what is operationally feasible in an actual survey context. Given the eventual costs of these studies, conducting thorough tests is often worthwhile, particularly on the survey questionnaires. A point that deserves more attention is the need for more standard longitudinal measures that are common across countries. This would permit governments and researchers to make better international comparisons.

Another major component for designing longitudinal studies is the creation, use and maintenance of sampling

frames over time in ways that facilitate the implementation of the study. For example, an establishment panel survey may be based on a business register that can be highly dynamic with respect to births, deaths, mergers and amalgamations. It is important that the definitions of which units are to be included in these panels over time are clear under these conditions.

One reason that longitudinal surveys have become more prevalent in recent years is the fact that there are more administrative data files available now that can be used as frames for conducting the longitudinal studies. The administrative files themselves may also contain useful data information besides just being useful as frames per se. Some data manipulation of the administrative data is usually required to make these data useful for the statistical purpose of the longitudinal study, however. In general, the impact of frame changes to the study must be carefully considered at the design stages.

A common practice is to take a number of different administrative files and to match them to create a sampling frame. As well, some longitudinal studies are based solely on the information contained in various administrative files. The difficulty, of course, is that over time these administrative files will change. This may imply a change to the samples that are being taken from these files, and therefore special measures will need to be taken to keep the analyses relevant.

Often a longitudinal study is based on an existing survey or census conducted at a point in time in the past, and this then becomes the basis for the sampling frame for following up respondents over time. One disadvantage of this is that it becomes difficult to obtain cross-sectional estimates when births to the population are excluded from the frame. Record linkage techniques may be necessary for maintaining the frame and such techniques are usually error-prone.

For rare populations, it is often advantageous to use not just a single frame but to use multiple frame methods. This ensures that there is adequate representation from the populations of interest that might be underrepresented in a single frame, but this may also require the use of record linkage and complex weighting techniques.

An important design issue is the method of sampling from the frame once it has been established. In Kalton and Citro (1993), a number of different types of longitudinal surveys were enumerated. These were repeated surveys, that is, a series of cross-sectional surveys; panel surveys, where certain respondents are selected and followed up over time; repeated panel surveys, where new panel surveys are selected at different points in time; rotating panel surveys, where on each occasion a panel is dropped from the study and a new panel is added; overlapping surveys, where there are common respondents from one occasion to the other, but not necessarily through a fixed panel sample design; split panel surveys that can be a combination of panel surveys and repeated or rotating panel surveys. The

sample design must ensure that there is a sufficient sample from the population of interest as well from any of the control groups. Administrative data have proven to be very useful when designing a sample for many of these surveys as they often provide a suitable frame.

As a referee pointed out, a key issue at the design stage is the strategy for dealing with sample loss through attrition, due to nonresponse, leaving the target population, *etc.* Possibilities include topping up the sample in subsequent waves, but such a strategy can distort the representativity of the cohort. Another strategy would be to start with a larger sample and not replace lost units; see, for example Singh, Petroni and Allen (1994).

When deciding on a particular sample design, consideration must be given to the related weighting and estimation issues. As well, the periodicity or frequency of the survey must be established. Obviously, when the variables of interest change more rapidly, having the survey conducted more frequently would be more desirable. On the one hand, more frequent surveys lead to increased cost and respondent burden; on the other hand, less frequent surveys can lead to larger recall biases. These cost-quality tradeoffs are usually difficult to quantify.

Very often, if both cross-sectional and longitudinal estimates are required, ensuring that there will be valid cross-sectional estimates may be necessary to select supplementary samples. This is because there may be members of the population in the cross-sectional estimates who were not in the sampling frame on previous waves and, therefore, would not be represented in the sample. Czajka (1994) studies this for the case of estimating income.

Designing some evaluation samples is also worthwhile at the planning stage. There are a number of sources of bias in longitudinal surveys. Some of these biases can occur simply because the same respondent has been surveyed on a number of occasions. Therefore, consideration should be given to adding additional samples for evaluation purposes only, in order to be able to measure some of these impacts. These samples would include individuals in the target population that were not in the longitudinal survey. They are most useful for evaluating cross-sectional measures.

QUESTION 2: IMPLEMENTATION ISSUES

The second main issue we discuss is related to the implementation of a longitudinal study. First, one has various choices of modes of data collection. Recently, computer-assisted interviewing has gained popularity. With computer-assisted interviewing, more choices of survey instruments are available. For example, using dependent interviewing where the respondent or the interviewer has access to the responses from previous occasions is easier. This may increase or decrease certain biases. Hill (1994) assesses this in the context of Survey of Income and Program Participation.

Of course, since we are going back to the same respondents on a number of occasions, the question of response burden is even more crucial than in a single cross-sectional survey. We do not want to overload the respondent since this could result in higher refusal rates at later waves of the survey. Michaud, Dolson, Adams and Renaud (1995) suggest respondent burden can be reduced by making more use of administrative data. Reducing attrition due to nonresponse is an important goal in longitudinal surveys and consideration may be given to the use of monetary or other incentives to help keep the integrity of the sample over time; see Lengacher, Sullivan, Couper and Groves (1995). Another means of reducing attrition is to collect information to aid in the tracing efforts and to keep in contact with the respondents over time; McGuigan, Ellickson, Hays and Bell (1995) studies alternatives of tracing, reweighting and sample selection modelling, to cope with attrition problems.

In some longitudinal surveys, some data are collected retrospectively; that is, questions are asked which refer to previous points in time as well as the current point in time. This could lead to what is known as seam effects. As a result, the observed changes over the reference periods may depend on which periods contain data obtained retrospectively.

Administrative records may be useful to enrich the database so that not all data need to be collected directly from the respondent; see Michaud *et al.* (1995). Of course, this could depend on the quality of the administrative data, its availability, and what the interplay is between the information from the administrative records and the survey variables; see Stearns, Kovar, Hayes and Koch (1996) for an example that studies this relationship. When dealing with administrative data or merged sample files, there may be data gaps in these various files and how to handle these data gaps becomes an issue.

In general, changes to the frame structure can result in difficulties when performing the longitudinal analyses. Some key characteristics of the respondents could also be changing over time. For example, in a business register, if the industrial classification information changes because of the fact that businesses change the nature of the products that they are producing over time, being able to keep track of this changing classification on the database to ensure that the longitudinal analyses are as useful as possible is important. This can also complicate the analysis.

Many issues arise when the database is obtained by combining the samples from a series of individual surveys. Integrating this information may present a challenge because different surveys may have used different methodologies. This could result in some inconsistencies in the quality of the information from one database to another.

Important issues for many longitudinal surveys are those related to record linkage. Record linkage is used in many processing steps. In some cases, the longitudinal studies may be based solely on these linked files. Record linkage

is common for creating and maintaining the survey frames, including linking administrative files over time, linking administrative files and survey frames and linking separate survey frames. For example, for surveys of establishments, we may wish to create longitudinal composite records for the establishments that are based on several independent repeated surveys, since many of the establishments are surveyed on each occasion. Record linkage is often used to find which units correspond to the same establishments. Record linkage is also used to identify births to a frame. Of course, the errors due to the record linkage can be important in the analysis; see Scheuren and Winkler (1993).

In some cases, in fact, no real respondents are being followed over time. Instead record linkage is used to create artificial populations through statistical matching. These populations are then analysed as if they were real.

Another implementation issue is that of handling non-response. It is known that nonresponse to longitudinal surveys does not occur completely at random. There tends to be differential nonresponse among different subpopulations. Therefore, special attention needs to be placed on how the imputations or reweighting will be performed; see, for example, Tambay, Schiopu-Kratina, Mayda, Stukel and Nadon (1998). When using administrative data as the basis for the longitudinal study, there may be missing administrative data and special procedures will be necessary to handle this situation.

For missing data, there are generally two methods of treatment: imputation and reweighting. Reweighting is common for situations where there is wave nonresponse. Imputation is more frequently used when there is partial nonresponse within a given wave of the survey. There can be advantages to longitudinal imputation as opposed to cross-sectional. For longitudinal imputation, the longitudinal information from the same individual on the database is used as the basis for doing the imputation, as opposed to using other individuals at the same point in time. For attrition and wave nonresponse, one may wish to model the attrition rates and use these models to compensate for the nonresponse through weight adjustments. A variety of weight adjustments were researched for the Survey of Income and Program Participation and the results were presented in Rizzo, Kalton and Brick (1994), Folsom and Witt (1994), and An, Breidt and Fuller (1994). Singh, Wu and Boyer (1995) study this problem for the difficult case of estimating gross flows.

There are many complexities that may be introduced into the derivation of the weights. There are various approaches and techniques available to calculate both cross-sectional weights and longitudinal weights. Cross-sectional weights are used for measures of the population at a single point in time, whereas the longitudinal weights are necessary when data from individuals over more than one occasion are included. The analyst may wish to have person-level weights that are different from the household-level weights; Kalton and Brick (1995). For example, for some variables

such as household income, using household-level weights would be preferable to the individual person-level weights. Weighting becomes more complex with the use of multiple frames. Effective use of administrative data may imply even more complexities in the weighting scheme itself; see, for example Stearns *et al.* (1996).

There are many causes for the samples to become unrepresentative. For example, lack of representativity could be due to problems of coverage due to immigration into the population. Some undercoverage may be due to attrition. Some overcoverage could be due to including some non-sampled co-habitants of a household, thus implying that those individuals could be included in the sample by living with an originally sampled person; see Lavallée (1995) and Kalton and Brick (1995). Other types of systemic overcoverage are also possible. Ensuring that no biases are introduced requires special weighting treatments. For longitudinal surveys in particular, this may become quite complex. Administrative data can be used both to assess whether or not the sample is representative and to provide information for making the appropriate adjustments.

Since much of the estimation for longitudinal study will be associated with measuring change as opposed to measuring the phenomena at a single point in time, there will be questions about how to develop the variances for these estimates of measures of change. Some new procedures may need to be developed for this situation. In general, variance estimates can become quite complicated when the statistics are complex functions of the longitudinal observations. For example, income class boundaries may change over time and studying the transitions of individuals from one class to another is of interest.

Another complexity of estimation may be the desire to include information from ongoing cross-sectional surveys to produce new integrated measures, using all the information that is available from the various available sources.

QUESTION 3: EVALUATION ISSUES

The third set of issues we discuss is related to the evaluation of the information and methods. Even though the evaluations may be conducted separately from the implementation, the results of such evaluations should impact on the survey itself, either by altering the estimation methods or by changing the way the survey is designed and implemented in future waves.

There are many sources of biases that could be studied. Biases may be due to dependent interviewing by giving the respondent and the interviewer information that could refer to a previous occasion of the survey. Seam effects can arise from retrospective studies; see, for example Murray, Michaud, Egan and Lemaître (1991). Other sources of bias could occur when the nonresponse is informative; that is,

when the nonresponse propensity is related to the variable of interest. An example would be when household level nonresponse is correlated with gross flows within the household, where gross flows are the changes in the individual's classification; see Clarke and Chambers (1989). Other biases could be due to measurement or classification errors; see, for example, Bassi, Torelli and Trivellato (1998). Conditioning bias could arise from the fact that since we have been asking the respondents about information, such as labour dynamics, they may have become more sensitized to some of these issues so that their behaviour could change because of the fact that they are included in the survey.

The effect of response errors and interviewer errors on the analysis should be evaluated. Different individual interviewer methods may lead to different error rates. The stability or instability of the turnover of interviewing staff could affect some analyses. Questions such as whether or not the information was collected by proxy can also be relevant.

Other evaluations could be performed to measure the effect of attrition and to evaluate various imputation methodologies and other nonresponse handling strategies; see Tin (1996) for an evaluation of attrition using econometric methods. Schejbal and Lavrakas (1995) study the effect of panel attrition in a dual-frame local telephone survey. Corder, Manton and Woodbury (1994) study ways to improve coverage and reduce attrition in the context of the National Long Term Care Survey. Panel attrition could be the result of non-traceable or refusal cases, the impact of which can be quite different from cross-sectional surveys, and these differences should be studied. Allen and Petroni (1994) discuss the problem of adjusting for movers.

There is a need to develop quality studies that take into account the special features of longitudinal surveys. Many quality control studies are available in the conduct of longitudinal surveys besides the usual ones for cross-sectional surveys, since the repeated nature of the study can lead to a more efficient identification of error-prone cases. Since for longitudinal studies, the stability of the data over time is an issue, methodological changes in the study could have an impact on the longitudinal measures that are of interest and these should be evaluated. Administrative data can provide useful evaluations since some of the data can help validate some of the results.

QUESTION 4: ANALYSIS ISSUES

Analysis concerns are the last set of issues we discuss. It is the potential analysis of the longitudinal study that is its most important facet. The causes or determinants of various outcomes are of major interest to the data users. However, the modelling of these causes can be complex, particularly if the survey itself is of a complex nature. Many of these issues are discussed in Singh and Whitridge (1990) and in Hidirolou and Michaud (1998).

Examples of the kinds of analyses that are common would be measures of gross flows or other measures of gross change. Gross flows refers to the change of an individual from one category to another. In other words, it is the flow from category A to category B between two points in time, as opposed to net flow that is the change in the margins over time. There are difficult questions about the impact of measurement error on the measurement of gross flows. If fairly large measurement errors are present on each occasion, there will be a significant impact on the bias of the estimates of the gross flows, even if the net flows themselves are not as adversely affected. Sometimes, sample rotation will aggravate this problem, since accounting for sample rotation properly when measuring gross flows can be problematic. Special treatment is needed for those panels that are entering the sample on a given occasion and for those panels that have left the sample on the previous occasion to get good estimates of these flows. The changes to the population when gross flows are being measured need to be sorted out from the gross flows themselves. In other words, the change from one occasion to another is a combination of the changes in size of the population and the individual changes within the population. The situation can become even more complex when the gross flows are themselves analysed with respect to other information such as income dynamics.

As a referee pointed out, an important issue is the need for educating users on how longitudinal data can be analysed effectively. The recent increase in the number of longitudinal surveys raises many opportunities for new types of analysis, but many analysts who have been studying only cross-sectional surveys may not be aware of the most appropriate techniques.

For the many surveys that use frames based on administrative data, accounting for the frame changes in the analysis may be necessary, since inclusion on the frame can be subject to changes in administrative procedures, as well as changing conditions for the individuals. For example a file of unemployment insurance beneficiaries would be subject to changing eligibility criteria, as well as changing personal situations.

The measurement of change can often be decomposed into various components. For example, the movement of units in the sample from one domain to another can be sorted out from the changes of the data for units within the same domain. Holt and Skinner (1989) contains an interesting discussion on various components of change.

For more complex analyses, such as modelling of time series, most classical time series models do not account for the fact that the information is derived from a sample survey. Therefore, the sampling errors resulting from the sample survey are not properly taken into account in the time series modelling.

In the analysis, some measures may depend on other cross-sectional surveys. For example, it may be another cross-sectional survey that determines the income class

boundaries to be used in the analysis of the longitudinal survey. This may add to the complexity of the analysis since the boundaries can change over time.

Whether and how to use the sampling weights have created difficulties for many analysts, since many of the classical models for analysis of data over time do not use the sampling weights. Procedures need to be developed that incorporate the survey weights in the analysis properly. For large-scale surveys, using the weights is often preferable as this provides some protection against model misspecification.

Errors resulting from the processing, such as the record linkage operation, may need to be incorporated in the analysis or at least some studies need to be taken to understand the impact of these kinds of errors; see, for example Dorinski and Huang (1994).

Often administrative data are used as part of the analysis since these data may be available more readily than collected information. However, since there may be conceptual or other difficulties with the administrative data, special analytical methods may need to be developed to use the administrative data effectively.

Finally, we mention the difficulties associated with the data dissemination. Longitudinal summary measures need to be developed for many phenomena. Often these are not suitable for the usual tabular displays that are commonly used in cross-sectional studies. Many analyses require access to the microdata. This could create problems with respect to protecting the confidentiality of the respondents. The usual measures that one takes when releasing microdata files on cross-sectional surveys may not be sufficient when releasing surveys which are longitudinal in nature, because the databases are so much richer so that the risk of being able to identify an individual on such databases becomes much greater. Protecting the respondents' confidentiality is of paramount importance, so a conservative approach that may not fulfill all the users' requirements may be necessary.

SUMMARY

We have briefly discussed many of the questions and issues that are now being investigated by researchers concerned with the design and analysis of longitudinal studies. Based on our discussion, we see that many questions need to be further investigated. As we gain more experience with longitudinal surveys, many of these issues will be better understood and many new issues will arise. The opportunities for important research and investigation are numerous.

ACKNOWLEDGEMENTS

The author is grateful for many useful suggestions from the referees and the Associate Editor.

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