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FORECASTING USING FINANCIAL MODELS

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Financial forecasting has been an important management tool in industry for many years. In the health care field, it is now nearly impossible to cope with reimbursement formulas, Economic Stabilization Program controls, rate setting, cost controls, and other daily informational demands without some reliable and efficient means of forecasting future operations. The Social Security Amendments of 1972 (Public Law 92-603) require, as a condition of participation under Medicare, that providers have written operating and capital expenditures budgets covering one and three subsequent accounting years. Several states are using prospective rates for Medicaid coverage. The advent of prepayment and capitation payments for health care receives ever increasing attention. Each new development makes the need for financial forecasting more pressing.

A practical tool available to assist financial managers with the mechanics of preparing and modifying financial forecasts is the financial model stored in a time-sharing computer. The purpose of this article is to describe financial modeling using time-sharing.

TIME SHARING

For those readers not yet initiated, the sharing of a computer by several users simultaneously is called "time-sharing." Access to the computer is provided by a "terminal," usually with a typewriter-like keyboard, on which messages are fed into the computer and on which the computer makes its responses. Time-sharing is used by telephoning the computer time-sharing utility and placing the receiver in the connector to the terminal. The coded word necessary for user identification (and for billing) is typed on the computer terminal, and, when that is cleared, the computer is instructed as to the program to be used. The data required to run the program is then entered.

Among the advantages of a time-sharing computer are the facility with which a stored program can be made available to licensed users and, of

course, cost savings. The cost of time-sharing varies with usage and there is usually a monthly minimum charge. In addition, rental of a terminal will average about one hundred dollars per month. The computer executes several users' programs simultaneously at such speeds that one user normally is not aware of the other users.

FINANCIAL MODELS

Financial models are special types of computer programs used to show the fiscal results of various economic assumptions. The best known models are probably those used to forecast the national economy, such as the one devised by the University of Pennsylvania's Wharton School of Business. Such models are tremendously complex in their manipulation of interrelated data. Most financial models are considerably less complex.

For our purposes, their output may be visualized as a computerized columnar pad with the base period financial data of an organization listed down the left column and several blank columns provided for entering monthly, quarterly or annual information for several periods into the future. The model generates the information for the blank columns using the base period data and various assumptions provided by the financial manager.

In financial modeling, the computer does not provide the indispensable thought and judgment needed to prepare useful forecasts. It does, however, free the financial manager of the endless but necessary calculations and paper work so that he has time to provide the thought and judgment.

While the main advantage, then, of financial modeling by computer is time saving, one should note that, without it, much effective forecasting simply would not be done at all because the time required would be excessive.

A most useful feature of a computerized model is the ability to make almost unlimited changes in the numerous assumptions employed, and to obtain revised information in a matter of minutes. The financial manager may often spend long days preparing a forecast in great detail only to have his administrator ask, after his first review of it, "What if this assumption were changed to that?" or, "I forgot to tell you that we are going to make these changes in operations; would you please incorporate them in the budget?" That can be frustrating. Using the computerized financial model, these "what if" questions can be handled with ease in a relatively short time.

Besides facilitating the preparation of operating forecasts, a time-sharing financial model can be used to estimate results of any number of business decisions under various assumptions. For example, can the hospital afford to build a new building if:

Medical-Surgical admissions per thousand population decrease by 5 percent each year through 1977 instead of 2 percent as planned

The average length of stay decreases from 7.6 to 5.9 days and

The projected population increases fail to materialize by 2 percent annually?

■ **A Specific Model** Where do financial models come from? Models sometimes are designed by the users themselves, and sometimes they are designed for use on in-house computers. However, general models are also designed by consulting firms that can be adapted to specific use of their clients, or by computer time-sharing utilities for inclusion in their libraries of programs. A useful model was developed by the Haskins & Sells Management Advisory Services group in San Francisco for a California hospital client that was contemplating a building program. The model can be modified as needed to situations in other institutions. It utilizes the services of International Time-Sharing Corporation, which has developed a specialized computer language called Business Planning Language. This language is particularly well-suited for use in designing financial models.

The model will project balance sheets, income statements, and cash flow statements, or any component of any of these statements. It can be designed to provide as much or as little detail as is needed.

The following is a list of the general types of information that can be generated from this model, for specific areas or all areas of a hospital, for a specific year or a series of years:

Types of Model Output

Balance sheets

Income statements

Cash flow projections

Underlying calculations

Population

Daily hospital service (for each service, medical-surgical, obstetrics, etc.)

Projected annual patient days

Projected revenue charge rates

Projected labor costs per hour

Projected labor hours required by each department for each patient day

Total employee full-time equivalents required

Total monthly and annual revenue and expense

Ancillary services (for each service, laboratory, radiology, etc.)
- Projected services per inpatient day
- Projected outpatient services
- Total services
- Projected inpatient revenue charge rate
- Projected outpatient revenue charge rate
- Projected labor hours for each ancillary service
- Total employee full-time equivalents required
- Total monthly and annual revenue and expense
- Professional fees

Support department costs (by department)

In using a financial model, it is best, in most cases, to make a first try with input data that – while carefully prepared – does not go into great detail. This would be particularly so in constructing projections for a series of years rather than months. Further refinement of the input data can be made in a second try, after the first results have been analyzed; the decision is based on the probability that further refinement will give significantly more accurate results, which might in turn suggest modification of some of the assumptions or of the operating plans.

For this reason, the outputs listed above are not usually all obtained from the model when it is first used, because the input data must be reasonably refined to separate such factors as fixed and variable costs and full-time employee equivalents. Similarly, in using the model to explore the effects of building a new hospital, great amounts of time refining input data would probably not be spent, initially. If the preliminary exploration indicated areas where additional judgments should be applied to the evaluation of the project, further refinements of the input data could be made.

In using any model, the output is only as good as the assumptions made and the data provided to guide the computer. Most time-sharing computer services now offer a number of programs for trend analysis that permit as much sophistication in determining assumptions as is desired. Care must be exercised in this area, because too much sophistication can make it difficult for the financial manager to know whether his data is being manipulated as he intends it to be. He should review the relationships determined by the computer to assure that there is logic and causality in the formulas.

BASIS OF PROJECTION

- **Volume of Services** In forecasting operations, the basis of the projection is an estimate of the volume of services to be rendered. For a series of annual periods, patient days for each hospital service can be calculated by multiplying projected population (in thousands) in the hospital's service area by expected admissions per 1,000 population and the result by the average length of patient stay.

  The hospital's service area can be defined by analyzing admissions by geographic area for the past three to five years. Population projections are often available from studies prepared by such organizations as planning agencies, chambers of commerce, and public utilities. Admissions per 1,000 population may be calculated from admission and population records for the past several years. Average length of stay data is usually readily available in most institutions. It is important to recognize trends in these statistics over the historical period analyzed. Increases or decreases in any of the three factors included in this projection of patient days can be reflected in the model in terms of a percentage increase or an absolute amount of increase in each projection period or simply by stating the expected amount of each for each period. Projections made for a series of years might be broken down to monthly projections based on an analysis of past monthly census trends adjusted for expected population growth, changes in available services or medical staff and, particularly in smaller hospitals, medical staff vacation and convention plans.

  Inpatient ancillary services, tests, or examinations can be calculated for each department based upon the historical number of services used by each inpatient admission multiplied by projected inpatient days. An adjustment for trends or anticipated changes in the intensity of future usage should be considered.

  A projection of outpatient volume can be prepared in a similar manner by relating outpatient visits to population and then calculating the average number of ancillary service units provided during each visit. A careful analysis of the trend of outpatient volume is very important to project properly the current rise in outpatient volume. It may be useful to analyze outpatient volume over a longer period, say five to seven years, and to employ trend analysis programs available at most time-sharing services.

- **Revenues** Revenues should be projected utilizing the volume of services

projections described above. The computation is as simple or as detailed as is necessary. A very simple approach and possibly a good starting point is to calculate merely the average total revenue per patient day and/or outpatient visit in the most recently completed year and to insert that into the model for extension by the projected volume.

Based on the results of this first simple projection of revenues, it may appear to be desirable to use more detailed data. It is possible to use departmental revenues per day, departmental revenues per ancillary service, separate inpatient and outpatient revenues per ancillary service, or trend factors for some or all of these items in the computerized model with relatively few changes in the program. Limitations imposed by present day economic controls may be reflected in the projections to determine their effect upon the results of operations. Additionally, prospectively determined rates for specific classes of patients may be included, as well as the effect of contractual allowances resulting from third-party contracts. Any of these factors may be included at various rates or levels of volume to determine their effect upon the results of operations.

- **Expenses** The first step in designing expense projections is to determine so far as practical which expenses are predominantly "fixed" and which are "variable." This might be done on a department-by-department basis, or each expense or group of expenses might be considered individually.

For the variable expense projection, the number of labor hours required for each inpatient day or appropriate ancillary service, test or examination in the most recently completed year should be calculated as well as the expected change in each due to anticipated changes in efficiency. This may possibly include an analysis of the labor force in each department and a consideration of whether or not each employee is being properly utilized. Wage cost per man-hour and expected increases are calculated in a similar manner. The expected effects of changes in minimum wage laws or proposed changes in staffing patterns can be recognized in the projection.

Supply and other variable costs also may be projected using the historical costs per work unit adjusted each period for the expected changes in price and usage.

Fixed departmental expenses should be calculated for the base period and projected by considering the effects of anticipated inflationary increases and of the points at which increased levels of service would cause increased fixed expenses. Certain fixed expenses such as interest or depreciation may be calculated based on base period amounts and projected as absolute amounts.

AN EXAMPLE

Let us assume that we wish to prepare a projection for the twelve months of 1973. By analyzing the past three or four years, we can arrive at the expected number of inpatient days for each type of service for each of the twelve months. We then wish to project, as part of the whole, the revenue to be realized from inpatient radiology services. By analyzing 1972, we could determine that, on average, we provided .25 x-rays for each inpatient day and that from 1968 through 1972 the number of x-rays provided per day had increased about 2 percent each year. By the same procedure, we could determine that we had realized an average charge of $20 per x-ray in 1972 and that average charges had been increasing about 8 percent annually.

At this point, we might decide that medical-surgical patients may require more x-rays than obstetrical or pediatric patients and also that there might well be a difference in the average charge for each type of patient. If we had the necessary historical statistics, we could calculate the needed data for each category of patient separately and use them in our projection.

When this data has been accumulated and determined to be representative, we can load the computer with expected inpatient days,the number of x-rays per day and the average charge per x-ray experienced in 1972 plus the expected monthly change in each and literally "punch the button" to command the computer to calculate and print out our 12-month projection of inpatient radiology revenues for 1973.

Upon reviewing the projection of inpatient radiology revenue, we may remember that unit revenues should not increase 8 percent in 1973 because Price Commission regulations generally limit price increases to 6 percent and we do not plan to increase prices by more than that. We now merely readdress the computer program and change *one* line to show that monthly increases in charges per x-ray are expected to be .5 percent (6 percent annually) rather than .67 percent (8 percent annually) and once again command the computer to write out the new projection. Additional revisions can be made as conditions change or new assumptions appear to be needed.

Similar treatment could then be afforded each inpatient and outpatient revenue department to obtain a complete revenue projection. Had we been deeply involved in making the arithmetic calculations involved in the projection, as we would have had to be if we were preparing it "by hand," we might possibly have forgotten the fact that x-ray charges should not, in our illustration, be expected to increase by more than 6 percent in 1973.

Let us carry our example of the radiology department a little farther. In

analyzing labor costs in that department, we may find that in the base period the hospital employed a radiologist, a department head, and five x-ray technicians. If the radiologist is paid a fee which represents a percentage of radiology revenues with a guaranteed monthly minimum, we could instruct the computer to calculate his fees for the projection period by applying the appropriate percentage to projected radiology revenues and also add a condition that in any month in which the result of this calculation is less than a stipulated minimum, to substitute instead the minimum amount. If the fee is a stated amount per procedure, the projected fee could be based upon a multiplication of the average fee per x-ray times the expected number of x-rays to be provided in each of the future periods.

In looking at the salary of the department head, we might decide to treat her monthly salary as a predominantly "fixed" expense, assuming that she is not entitled to overtime pay. Accordingly, it might be entered into the computer at $675 per month for the first six months, at which time it could be increased to $725 to reflect an annual salary increase. We might also decide that at a certain level of volume, an additional supervisor would be needed and so enter an additional salary at that point.

SUMMARY

We could continue to consider various possible situations almost as endlessly as they occur in a hospital. Those given here may provide an idea of how some of them can be dealt with. The greatest need is sufficient time for the hospital financial manager to sit down and identify each possibility; use of a computerized financial model should provide some of this valuable time.

The first attempt at using a model may turn out to be a lengthy process. This would be so particularly if the input data and assumptions had to be worked up from scratch. It is, therefore, advisable to use quite broad data at first, and then to incorporate additional details as time and needs for refinement dictate. Once the basic model has been developed and captured on computer tape, alterations of the assumptions are accomplished easily and responses to changes in input data—the "what if" questions—are resolved almost instantaneously. ●