Systems Analysis and Design

TENTH EDITION

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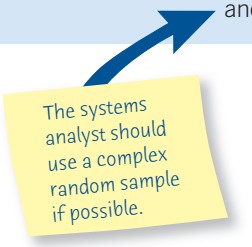
CONSULTING OPPORTUNITIES

FIGURE 5.1

Four main types of samples a systems analyst has available.

	Not Based on Probability	Based on Probability
Sample elements are selected directly without restrictions	Convenience	Simple random
Sample elements are selected according to specific criteria	Purposive	Complex random (systematic, stratified, and cluster)



data from the last two months are sufficient, or if an entire year's worth of reports are needed for analysis.

Similarly, when deciding whom to interview, the systems analyst has to determine whether the population should include only one level in the organization or all the levels. Perhaps the analyst will need to go outside the system and include the reactions of customers, vendors, suppliers, or competitors as well. These decisions are explored in more detail in upcoming sections.

CHOOSING THE TYPE OF SAMPLE A systems analyst can use one of four main types of samples, as shown in Figure 5.1. They are convenience, purposive, simple random, and complex random. Convenience samples are unrestricted and nonprobability samples. A sample could be called a convenience sample if, for example, the systems analyst posts a notice on the company's intranet asking for everyone interested in working with the new sales performance reports to come to a meeting Tuesday morning. Obviously, this sample is the easiest to arrange, but it is also the least reliable. A purposive sample is based on judgment. The systems analyst chooses a group of individuals who appear knowledgeable and who are interested in the new information system. Although this sample is based on criteria—knowledge about and interest in the new system—purposive sampling is also a nonprobability sample and is only moderately reliable. If the analyst chooses a simple random sample, the sample must come from a numbered list of the population to ensure that each document or person in the population has an equal chance of being selected. This step often is not practical, especially when sampling involves documents and reports. Complex random samples that are most appropriate for a systems analyst are (1) systematic sampling, (2) stratified sampling, and (3) cluster sampling.

In the simplest method of probability sampling, systematic sampling, the systems analyst would, for example, choose to interview every *k*th person on a list of company employees. This method has certain disadvantages, however. The analyst would not want to use it to select every *k*th day for a sample because of the potential periodicity problem. Furthermore, a systems analyst would not use this approach if the list were ordered (for example, a list of banks, from the smallest to the largest) because bias would be introduced.

Stratified samples are perhaps the most important tool for a systems analyst. Stratification is the process of identifying subpopulations, or strata, and then selecting objects or people for sampling in these subpopulations. Stratification is often essential if the systems analyst is to gather data efficiently. For example, if the analyst seeks opinions from a wide range of employees on different levels of the organization, systematic sampling would select a disproportionate number of employees from the operational control level. A stratified sample compensates for this. Stratification also is called for when a systems analyst wants to use different methods to collect data from different subgroups. For example, the analyst may use a survey to gather data from middle managers but use personal interviews to gather similar data from executives.

Sometimes a systems analyst must select a group of people or documents to study. This process is referred to as *cluster sampling*. Suppose an organization has 20 help desks scattered

across the country. The analyst may select one or two of these help desks, under the assumption that they are typical of all the help desks.

DECIDING ON THE SAMPLE SIZE If everyone in the population viewed the world the same way or if each of the documents in a population contained exactly the same information as every other document, a sample size of one would be sufficient. Of course, this is not the case, so it is necessary to set a sample size greater than one but less than the size of the population itself.

It is important to remember that the absolute number is more important in sampling than the percentage of the population. We can obtain satisfactory results sampling 20 people in 200 or 20 people in 2,000,000.

The Sample Size Decision

The sample size often depends on the cost involved or the time required by the systems analyst, or even the time available from people in the organization. This subsection provides guidelines for determining the required sample size under ideal conditions—for example, to determine what percentage of input forms contain errors or what proportion of people to interview.

A systems analyst follows seven steps, some of which involve subjective judgments, to determine the required sample size:

1. Determine the attribute (in this case, the type of errors to look for).
2. Locate the database or reports in which the attribute can be found.
3. Examine the attribute. Estimate p, the proportion of the population having the attribute.
4. Make the subjective decision regarding the acceptable interval estimate, i.
5. Choose the confidence level and look up the confidence coefficient (z value) in a table.
6. Calculate σ_p, the standard error of the proportion, as follows:

$$\sigma_p = \frac{i}{z}$$

7. Determine the necessary sample size, n, using the following formula:

$$n = \frac{p(1-p)}{\sigma_p^2} + 1$$

The first step, of course, is to determine which attribute to sample. Once this is done, find out where these data are stored, perhaps in a database, on a form, or in a report.

It is important to estimate p, the proportion of the population having the attribute, to set the appropriate sample size. Many textbooks on systems analysis suggest using a heuristic of 0.25 for $p(1-p)$. This value almost always results in a sample size larger than necessary because 0.25 is the maximum value of $p(1-p)$, which occurs only when $p = 0.50$. When $p = 0.10$, as is more often the case, $p(1-p)$ becomes 0.09, resulting in a much smaller sample size.

Steps 4 and 5 are subjective decisions. The acceptable interval estimate of ±0.10 means the analyst is willing to accept an error of no more than 0.10 in either direction from the actual proportion, p. The confidence level is the desired degree of certainty, such as 95 percent. Once the confidence level is chosen, the confidence coefficient (also called a z value) can be looked up in a table similar to the one found in this chapter.

Steps 6 and 7 complete the process by taking the parameters found or set in Steps 3 through 5 and entering them into two equations to eventually solve the required sample size.

EXAMPLE

The foregoing steps can best be illustrated by an example. Suppose the A. Sembly Company, a large manufacturer of shelving products, asks you to determine what percentage of orders contain errors. You agree to do this job and perform the following steps:

1. Determine that you will be looking for orders that contain mistakes in names, addresses, quantities, or model numbers.
2. Locate copies of order forms from the past six months.
3. Examine some of the order forms and conclude that only about 5 percent (0.05) contain errors.

CONSULTING OPPORTUNITY 5.1

Trapping a Sample

"Real or fake? Fake or real? Who would have thought it, even five years ago?" howls Sam Pelt, a furrier who owns stores in New York, Washington, D.C., Beverly Hills, and Copenhagen. Sylva Foxx, a systems analyst with her own consulting firm, is talking with Sam for the first time. Currently, P & P, Ltd. (which stands for Pelt and Pelt's son) is using a networked computer that supports package software for a select customer mailing list, accounts payable and accounts receivable, and payroll.

Sam is interested in making some strategic decisions that will ultimately affect the purchasing of goods for his four fur stores. Although the computer might help, he believes other approaches should be considered as well.

Sam continues, "I think we should talk to all the customers when they come in the door. Get their opinions. You know, some of them are getting very upset about wearing fur from endangered species. They're very environmentally minded. They prefer fake to real, if they can save a baby animal. Some even like fakes better, calling them 'fun furs.' And I can charge almost the same for a good look-alike."

"It's a very fuzzy proposition, though. If I get too far away from my suppliers of pelts, I may not get what I want when I need it. They see the fake fur people as worms, worse than moths! If I deal with them, the real fur men might not talk to me. They can be animals. On the other hand, I feel strange showing fakes in my stores. All these years, we've prided ourselves on having only the genuine article."

Sam continues, in a nearly seamless monologue, "I want to talk to each and every employee too."

Sylva glances at him furtively and begins to interrupt, "But that will take months, and purchasing may come apart at the seams unless they know soon what . . ."

Pelt interrupts, "I don't care how long it takes if we get the right answers. But they have to be right. Not knowing how to solve this dilemma about fake furs is making me feel like a leopard without its spots."

Sylva talks to Sam Pelt a bit longer and then ends the interview by saying, "I'll talk it all over with the other analysts at the office and let you know what we come up with. I think we can outfox the other furriers if we use software to help us sample opinions rather than trapping unsuspecting customers into giving an opinion. But I'll let you know what they say. This much is for sure: if we can sample and not talk to everybody before making a decision, every coat you sell will have a silver lining."

As one of the systems analysts who is part of Sylva Foxx's firm, suggest some ways that Sam Pelt can use software to adequately sample the opinions of his customers, store managers, buyers, and any others you feel will be instrumental in making the strategic decision regarding the stocking of fake furs in what has always been a real fur store. In a paragraph, suggest a type of sample for each group and justify it. The constraints you are subject to include the need to act quickly to remain competitive, the need to retain a low profile so competing furriers are unaware of your fact gathering, and the need to keep costs of data gathering to a reasonable level.

4. Make a subjective decision that the acceptable interval estimate will be ±0.02.
5. Choose a confidence level of 95 percent. Look up the confidence coefficient (z value) in Figure 5.2. The z value equals 1.96.
6. Calculate σ_p as follows:

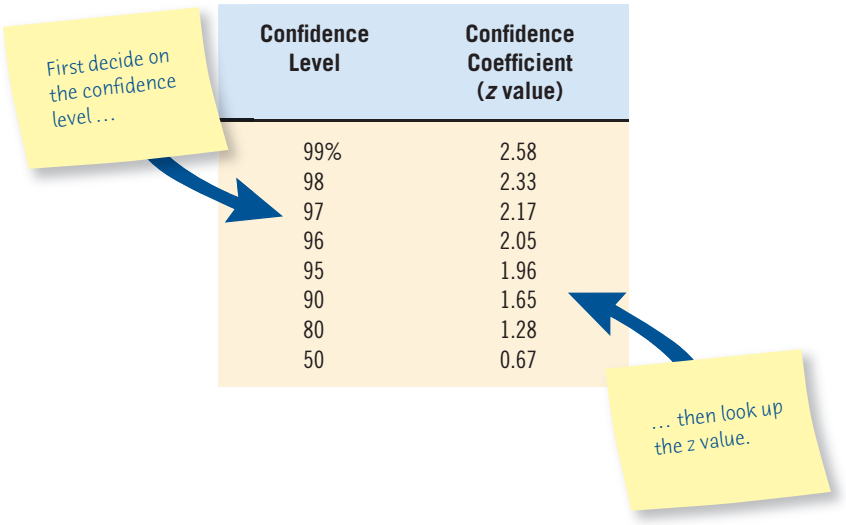
$$\sigma_p = \frac{i}{z} = \frac{0.02}{1.96} = 0.0102$$

7. Determine the necessary sample size, n, as follows:

$$n = \frac{p(1-p)}{\sigma_p^2} + 1 = \frac{0.05(0.95)}{(0.0102)\,(0.0102)} + 1 = 458$$

The conclusion, then, is to set the sample size at 458. Obviously, a greater confidence level or a smaller acceptable interval estimate would require a larger sample size. If we keep the acceptable interval estimate the same but increase the confidence level to 99 percent (with a z value of 2.58), the necessary sample size becomes 1,827, a figure much larger than the 458 we originally decided to sample.

DETERMINING SAMPLE SIZE WHEN INTERVIEWING There are no magic formulas to help a systems analyst set the sample size for interviewing. The overriding variable that determines how many people a systems analyst should interview in depth is the time an interview takes. A true in-depth interview and a follow-up interview are very time consuming for both the interviewer and the participant.



Confidence Level	Confidence Coefficient (*z* value)
99%	2.58
98	2.33
97	2.17
96	2.05
95	1.96
90	1.65
80	1.28
50	0.67

FIGURE 5.2

A systems analyst can use a table of area under a normal curve to look up a value once he or she decides on the confidence level.

A good rule of thumb is to interview at least three people at every level of the organization and at least one from each of the organization's functional areas (as described in Chapter 2) who will work directly with a new or updated system. Remember also that it is not necessary to interview more people just because it is a larger organization. If the stratified sample is done properly, a small number of people will adequately represent the entire organization.

Analyzing Quantitative Documents

Investigation is the act of discovery and analysis of data. When investigating evidence in an organization, an analyst acts like Sherlock Holmes, the fabled detective from 221B Baker Street.

As a systems analyst works to understand users, their organization, and its information requirements, it becomes important to examine different types of hard data that offer information unavailable through any other method of data gathering. Hard data reveal where the organization has been and where its members believe it is going. To piece together an accurate picture, the analyst needs to examine both quantitative and qualitative hard data.

Many quantitative documents are available for interpretation in any business, and they include reports used for decision making, performance reports, records, and a variety of forms. All of these documents are targeted for specific purposes and audiences.

Systematically Examining Quantitative Documents

A systems analyst needs to obtain some of the documents used in running the business. These documents often are paper reports regarding the status of inventory, sales, production, and employee and customer satisfaction. Many of these reports are not complex, and they can provide feedback for quick action. For example, a sales report may summarize the amount sold and the type of sales. In addition, sales reports might include graphical output comparing revenue and income over a set number of periods. Such reports enable the decision maker to spot trends easily.

Production reports include recent costs, current inventory, labor, and plant information. Service reports include the delivery of services and reports on employee performance and customer satisfaction. In addition to using these key reports, decision makers use many summary reports to provide background information, spot exceptions to normal occurrences, and afford strategic overviews of organization plans. The following reports, records, and forms deserve special attention.

PERFORMANCE REPORTS Most performance reports take the general form of actual versus intended performance. One important function of performance reports is to assess the size of the gap between actual and intended performance. It is important to be able to determine whether that gap is widening or narrowing as an overall trend in whatever performance is being measured. Figure 5.3 shows a clear improvement in sales performance over two to three months. The analyst will want to note whether a performance measurement is available and adequate for key organization areas.

RECORDS Records provide periodic updates of what is occurring in the business. If the record is updated in a timely fashion by a careful recorder, it can provide much useful information to a

CONSULTING OPPORTUNITY 5.2

A Rose by Any Other Name . . . Or Quality, Not Quantities

"I think we have everything we need. I've sampled financial statements, sales figures for each branch, waste for each shop—we have it all. With all these numbers, we should be able to figure out how to keep Fields in the green, or at least at the forefront of the flower business. We can even show Seymour Fields himself how his new computer system can make it all happen," says Rod Golden, a junior systems analyst working for a medium-sized consulting group.

The firm, under the supervision of its head systems analyst Clay Potts, has been working on a systems project for the entire chain of 15 successful florist shops and indoor floral markets called Fields. Each of three Midwestern cities has five Fields outlets.

"Although it's just a budding enterprise now, eventually we want to grow with offshoots to half a dozen states," says Seymour Fields, the owner. "I want to reap the benefits of all the happiness we've sown so far. I think we can do it by playing my hunches about what is the best time to purchase flowers at each European market we buy from, and then we should prune back our purchases."

"Over the past three years, I've written lots of memos to our managers about this plan. They've written some good ones back too. I think we're ready to stake out some territory on this soon," continues Seymour, painting a rosy picture of Fields's future.

"I agree," says Rod. "When I come back from my analysis of these figures," he says, indicating a large stack of material he has unearthed from Fields field offices, "we'll be able to deliver."

Three weeks later, Rod returns to Clay with wilting confidence. "I don't know what to make of all this. I can't seem to get at what's causing the company's growth, or how it's managed. They've been expanding, but I've been through all the figures, and nothing really seems to make sense yet."

Clay listens empathetically, and then says, "You've given me a germ of an idea. What we need is some cross-pollination, a breath of fresh air. We need to dig a little deeper. Did you examine anything but their bottom line?"

Rod looks startled and replies, "No, I—uh—what do you mean?"

How can Clay Potts tactfully explain to Rod Golden that examination of qualitative as well as quantitative documents could be important in delivering an accurate assessment of Fields's potential to be a more fruitful enterprise? In a paragraph, recommend some specific documents that should be read. List the specific steps Rod should follow in evaluating qualitative documents obtained from Fields. Write a paragraph to explain how qualitative documents help in presenting an overall account of Fields's success.

FIGURE 5.3

A performance report showing improvement.

Week	Number of Batches Produced	Number of Batches Rejected	Percentage Rejected	Amount Away from 5% Goal
2/2	245	19	7.8	2.8
2/9	229	19	8.3	3.3
2/16	219	14	6.3	1.3
2/23	252	13	5.2	0.2
3/2	245	13	5.3	0.3
3/9	260	13	5.0	***
3/16	275	14	5.1	0.1
3/23	260	13	5.0	***
3/30	260	13	5.0	***
4/6	244	12	4.9	***
4/13	242	11	4.5	***
4/20	249	11	4.4	***
4/27	249	11	4.4	***

*** indicates met or exceeded the < 5% goal

Performance reports show goals . . .

. . . and trends.

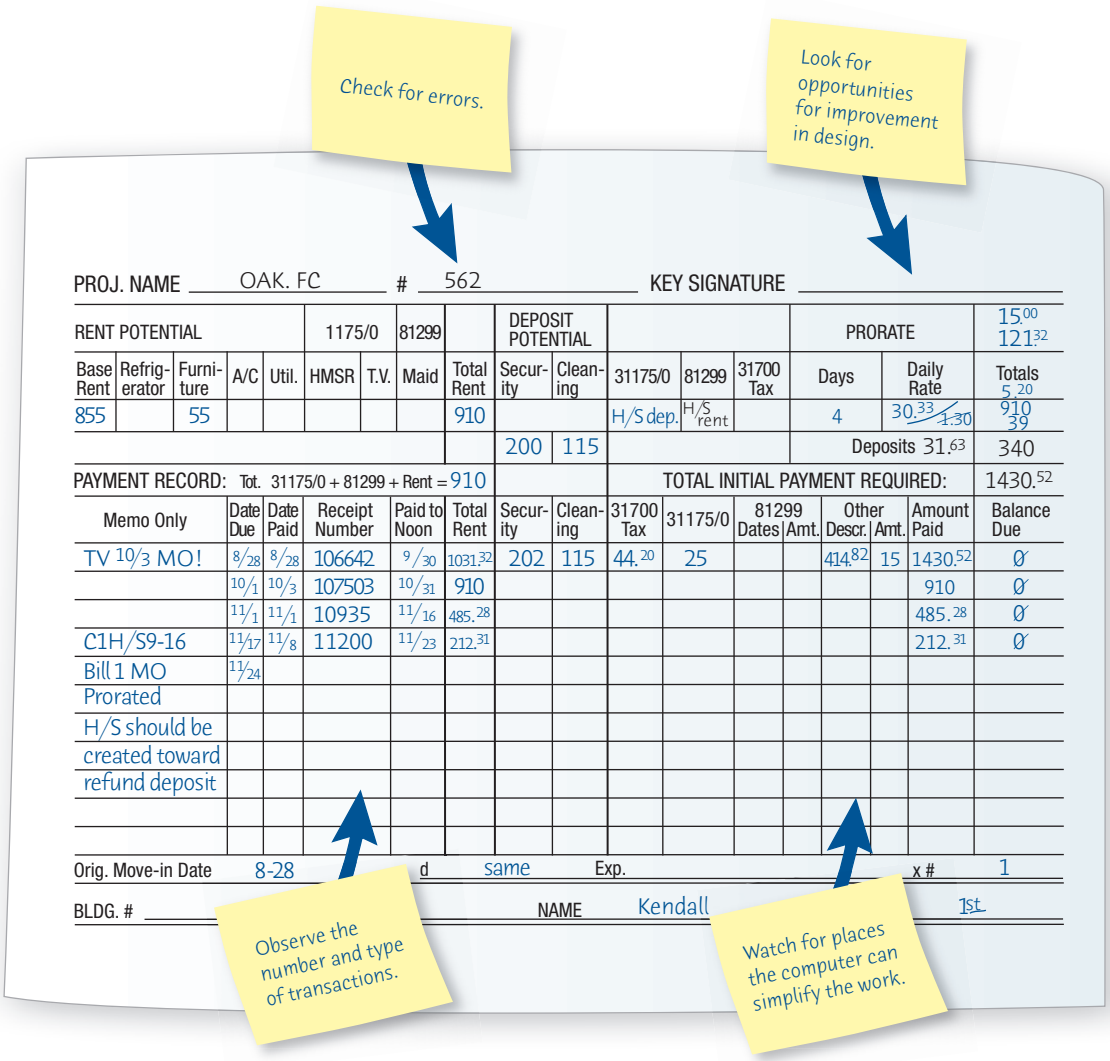


FIGURE 5.4

A manually completed payment record.

systems analyst. Figure 5.4 is a manually completed payment record for an apartment rental. An analyst can inspect a record in different ways, many of which are indicative of their usability:

1. Checking for errors in amounts and totals
2. Looking for opportunities for improving the recording form design
3. Observing the number and type of transactions
4. Watching for instances in which the computer can simplify the work through calculations and other data manipulation

DATA CAPTURE FORMS Before you set out to change the information flows in an organization, you need to be able to understand the system that is currently in place. Check with managers to determine which forms are available online to customers as well as those that are exclusively used internally by employees. You or one of your team members may want to download, collect, and catalog a blank copy of each form (official or unofficial) that is in use. (Sometimes businesses have a person already charged with forms management, who would be your first source for actual forms in use.) Remember to print out any Web-based forms that require users to print them. Alternatively, electronic versions that can be submitted via the Web or email can be identified and stored in a database for later inspection.

Blank forms, along with their instructions for completion and distribution, can be compared with filled-in forms to see whether any data items are consistently left blank on the forms; whether the people who are supposed to receive the forms actually do get them; and if they follow standard