

Business Graphics: An Efficient and Effective Tool for Management Decision Making

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ABSTRACT

Presently, one of the major dilemmas facing management is the communication of pertinent business information. In this paper we will address the subject of computer graphics as an efficient and effective solution to the problem of the "Information Explosion" faced by today's manager.

INTRODUCTION

Yosemite. To any of us who have been there, the name conjures up vivid recollections of the majesty of California's High Sierra. The stark, granite majesty of El Capitan rising over 3000 sheer, vertical feet from the floor of a pristine valley fed by the clear waters of the Merced River. Beautiful? Certainly, but for those who've seen the magnificence of the Yosemite Valley, or any other natural wonder, we realize that mere words fall far short of actually presenting a clear, concise mental image which does justice to the reality.

Although words have served admirably throughout man's history for the cataloging and storage of information in printed form, in today's complex and ever-changing business environment they frequently fall far short of presenting the full picture of the business event(s) they represent.

If you agree with this perception, then read on, for you are ready for the new age in computers, the "Graphics Age."

Graphics, as we know them, are not an invention of the twentieth century, or for that matter even the nineteenth century! In fact, graphics can trace its origins back to 1786 when William Playfair first published *The Commercial and Political Atlas* in which he presented what he called "lineal arithmetic,"¹ the progenitor of modern graphics.

Being practical, as most businessmen are, we may now ask ourselves, "Good, but how do graphics relate to me and my business?" The answers to that question lie in the following pages.

Presently, the computer industry is in a perpetual state of flux as new technological advances allow the costs of computer hardware to steadily decline, bringing

computerization well within the budgets of even the smallest businesses.

The old adage, "The more you got, the more you want," still holds true; as the data storage cost of computers decreases and capacity increases, the volume of "neccessary" data increases also, thus giving rise to a major dilemma facing today's manager, the "Information Explosion."

Today's manager is essentially the same as his counterpart of fifty years ago, a decision maker. However, the complexity of the present business environment is substantially greater and increasing daily!

Managers, being decision makers, are under extreme pressure to assimilate information, delineate that information which is useful and use it to make crucial business decisions as quickly as possible.

Keying on this we see that the most valuable commodity to today's manager is time. With the advent of computers and the birth of the "Information Explosion," managers are finding themselves buried under mountains of computer printouts containing the vital statistics of their businesses. Studies have shown that the average human can read at 600 to 1200 words per minute, with exceptions at both extremes.⁴ Combining this with the time it takes the brain to correlate and interpret the information read, we can see that it could take quite a while to delineate the trends contained in a 50 page line printer listing of business statistics.

Today, however, the old man-computer interface channel of the line printer listing can be rendered much more effective by being augmented with computer graphics. Given our previous example of a 50 page printout, the information can be mapped onto one well designed graph which only takes up a single page! Furthermore, when presented graphically trends can be spotted immediately, thus greatly minimizing the decision making time. Thus, where it once may have taken a manager two hours to make sense out of a printout, he can now do it at a glance!

It can now be seen that computer graphics provides managers with two fundamental benefits. Primarily, it

saves on the one resource always in short supply to all managers — time.

Secondly, computer graphics greatly enhances the effectiveness of the decision making process by making pertinent information easier to understand and trends easier to recognize.

USING BUSINESS GRAPHICS

There exist, primarily, two types of graphics reporting categories. First there are the special one-time uses such as forecasting, customer presentations and specific problem analyses, to cite some examples. Second, there are the management reporting functions. These provide a periodic set of charts which present a clear “state of the business” picture to the managers who use them.

Having defined the two primary areas of chart use, we must now ask ourselves, “How do I begin?” There are some preliminary criteria which must be satisfied by any enterprise attempting to implement a business computer graphics system. Familiarity with the data which forms the building blocks of the system is paramount, also the designer must choose specific quantities for measurement which correspond to definite measureable goals.

An easier way to approach it may be from the standpoint of the “5-Ws and H;” Who, What, Where, When, Why and How.

- WHO — Who will the intended audience be, an executive vice-president or a shop foreman.
- WHAT — What quantities are going to be measured, cash flow or inventory on hand.
- WHERE — What area of my business am I interested in, where among some or all of my divisions are my questions centered.
- WHEN — When, what time or associated interval do I want to survey; do I want a monthly comparison or just a daily trend analysis for a given month.
- WHY — For what reason do I want to investigate these quantities and their various relationships, what are my fundamental goals and what benefits will be derived.
- HOW — How will the data be presented, in linear form, pie or bar chart.
- These questions must be carefully and intelligently resolved by a joint effort between Management and the DP Staff prior to any graphics system implementation. You must know where you want to go in order to choose the right path and proper means of transportation.

Once the objectives have been set and the method of accomplishment determined, the next step is the design of what is called a “Graphics Operations Portfolio.”

A Graphics Portfolio is simply a predetermined set of charts generated on a regular basis to provide management with a clear and concise overview of the business. It should include not only charts, but their supporting

text and tabular data arranged such that they complement each other and are optimized for maximum effectiveness. It should be remembered during the entire process that there are some forms of data which do not lend themselves to graphical presentation; those where the absolute value of the quantity is the important criterion. Anyone can see that finding appropriate answers to the “5-Ws” is not too difficult for any manager well versed in his business. Experience has shown that answering the “How” is where most people begin to lose themselves, therefore we will now explore the various comparisons and their associated chart types.

There are five major types of comparison which may be used to define most data sets:

1. COMPONENT — compare relative magnitude of a particular segment in relation to the whole.
2. ITEM — compare the ranking of individual items.
3. TIME relative & absolute — compare the variation over a given time interval of an item(s).
4. FREQUENCY DISTRIBUTION — compare how a quantity is distributed among various categories.
5. CO-RELATIONSHIP — present a view of how an item varies in relation to variation in another item.

In general, most management reporting functions can be fulfilled by the three most fundamental types of charts — pie, bar (normal, stacked, comparative) and linear. Each chart type functions as a means to depict a specific type of comparison thus serving a different purpose when an element of the Graphics Portfolio.

We will now examine the various comparisons and their associated chart types.

Component

Component comparisons show the relative importance of any particular component in relation to the whole. There are two basic types of chart which lend themselves effectively to the representation of component comparisons: pie charts and stacked bar charts.

PIE CHARTS — Many mathematicians consider the circle the “perfect” geometric figure, and if we look at the anatomy of a circular or “pie” chart we can see that since progression flows continuously from start to finish, a pie provides us with an exceptionally vivid impression of a “whole,” making it an ideal figure for the representation of percentage type comparisons. An important rule to remember when designing a pie chart is to use as few “slices” as necessary, preferably less than 7.

STACKED (100%BAR/COLUMN) BAR CHARTS: The stacked bar provides us with the “skyscraper” effect, with the various segments being the “floors.” This is a great type of chart to show numerical component comparisons among multiple components.

A question now arises as to when a pie or a stacked bar chart should be used. Generally, due to the human tendency to think of things circular as “complete” a pie chart gives a more concise impression of a whole, fur-

thermore simple experimentation for ourselves will show us that the relative sizes of component segments are easier to determine accurately when arranged in a circular arrangement as opposed to a "cubed" stack of variable sized cubes, thus making the pie chart ideal for presenting the components of a single total. However,

sometimes we have the need to show the components of several totals simultaneously and for this the stacked bar chart is the ideal chart since multiple component comparisons can be placed adjacent to each other more easily than the pie chart. For example take the following data:

DIVISION	1980 XYZ COMPANY SALES				
	SALES \$	QTR1	QTR2	QTR3	QTR4
A	100	30	30	20	20
B	300	101	59	40	100
C	250	50	35	65	100

Looking at Figure 1 we see that the pie chart provides a better measure of the relative magnitude of the respective sales divisions. Figure 2 depicts a component comparison on a quarter by quarter basis by division. It can be easily seen that had we tried to use pie charts for this it would have taken four charts and been rather unwieldy, but more importantly not as effective.

Item Comparison

The item comparison treats two or more items and compares their relative sizes or quantities to each other. Bar charts, both horizontal and vertical, are the chart types best suited to the representation of this type of comparison. Much discussion has taken place concerning the relative advantages/disadvantages of using the vertical or horizontal bar chart over its counterpart. The primary argument against vertical bar charts is that some people tend to read in a time dependant relationship. It is for the chart designer to decide which type of bar chart to use in order to best suit the need of his audience. I have included examples of both in Figures 3 & 3A. We will now look at an example. Take the following data:

ABC COMPANY	
FISCAL 1980 SALES	
DIVISION	SALES \$
A	342
B	109
C	226
D	374

If we look at Figure 3 & 3A we can see how this item

comparison maps into both a horizontal and a vertical bar chart.

Time Comparison

Time comparison shows how a quantity fluctuates over a specified time interval; relative or absolute. The primary goal of a time comparison is to emphasize trends and their associated patterns by showing fluctuations in a quantity's value. Fundamentally, two types of charts are suited to the presentation of time comparisons: linear charts and bar charts (normal & comparative).

BAR CHART — The anatomy of a bar chart is such that when we are dealing with a minimal or small number of time periods, such as a 12 month analysis, then it is ideally suited for our presentation vehicle. Furthermore if we wish to compare several components per interval, the comparative bar chart is an excellent choice. The reason we do not wish to use bar charts for comparisons involving many time intervals is that after a certain point, the chart becomes cluttered with too many bars. Also, due to the visual perception of figures versus lines, if there exist large fluctuations in the data then the mental conceptualization of the trend is superior when it is represented by a bar chart than if a linear chart is used.

LINEAR CHART — Linear charts are usually drawn on Cartesian or Logarithmic axes. Due to the nature of these charts, a linear chart lends itself well to representing large numbers of data points.

Let us look at an example based on the following data:

KLN WIDGETS, INC.					
YEAR	SALES \$	QTR1	QTR2	QTR3	QTR4
1971	301	100	60	40	100
1972	400	75	95	100	130
1973	411	80	71	150	100
1974	401	200	100	70	30
1975	511	100	20	300	80
1976	494	100	204	100	90
1977	509	75	125	159	150
1978	564	264	100	110	90
1979	580	280	100	200	80
1980	600	174	176	100	150

In Figure 4 we see that since we are looking at only 5 discrete time intervals, then the bar chart is superior in representing magnitude of the item fluctuation, over the linear chart in Figure 4A. Figure 5 gives us an example of how a comparative bar chart can be used to show the fluctuation of several items over several time intervals. Looking at Figure 6, we can see that this time series comparison of a quarter by quarter sales record over ten years is ideally suited to a linear chart representation. Had we tried to depict these trends in a bar chart two things would have occurred: the bars would have been miniscule and the chart would have been so cluttered as to be quite difficult to effectively interpret.

Frequency Distribution

This type of comparison shows how the given quantity fluctuates over a given distribution. The key to this is that broad categories are used to define a distribution over which the data values are dispersed, rather than specific events. Two types of chart are suitable for representing this comparison, bar charts or linear charts. As with the time frequency comparison, when many points need to be graphed the linear chart is most effective. For a small number of categories, the bar chart is the most effective format. Bar charts used in this manner are commonly called Histograms. Figure 7 shows a sample histogram for the following data:

KLO WELDING	
1980 EMPLOYEE ILLNESS	
YEARS SERVICE	DAYS ILL
=====	
0 - 55	50
5 - 10	150
10 - 15	75
15 +	40

Co-relationship Comparison

This type of comparison functions to highlight pertinent patterns in the relative fluctuation of one item with respect to another. Scattergrams — linear charts with figures representing each data point — are the major chart type for representation of these types of comparisons.

SUMMARY

Summing up, we have seen that graphics, when properly understood and implemented can provide a powerful tool for a manager. Choosing the proper chart format and comparison for the relationship desired involves careful forethought and planning; just as a well designed Graphics Portfolio is a valuable managerial asset, a poorly designed one is almost useless. In closing, we can see that graphics, if properly implemented, greatly increases the efficiency and effectiveness of the decision making process.

BIBLIOGRAPHY

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- ³Cook, Peter G., *25 Years of Computer Graphics*, IGC Conference for MIS and Computer Graphics, February 1978.
- ⁴Patterson, Marvin, *Graphic Representation of Numeric Data*.

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1980 TOTAL SALES FOR XYZ COMPANY

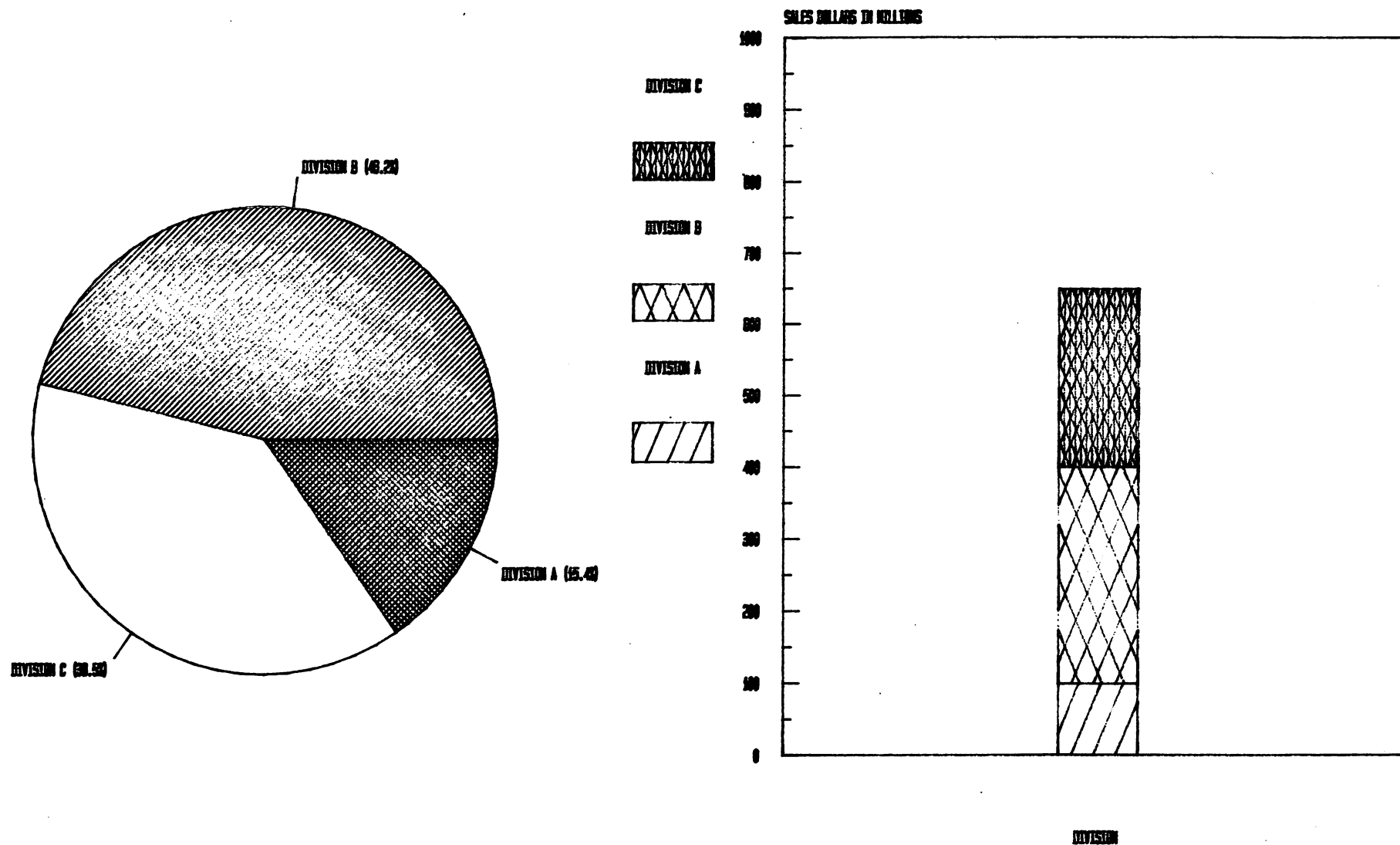


Figure 1

1980 TOTAL SALES FOR XYZ COMPANY BY QUARTER

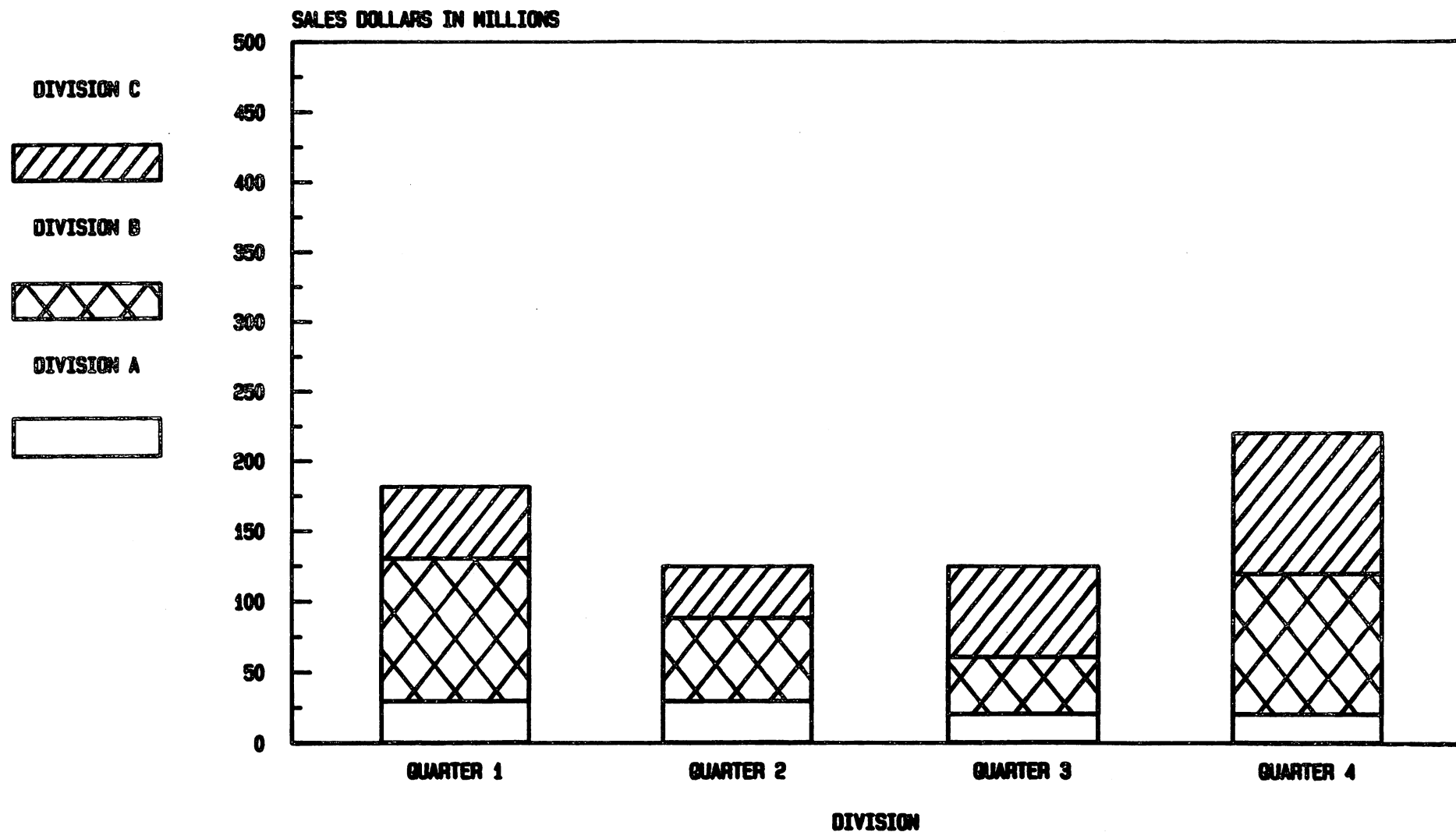


Figure 2

FISCAL 1980 SALES FOR ABC COMPANY BY DIVISION

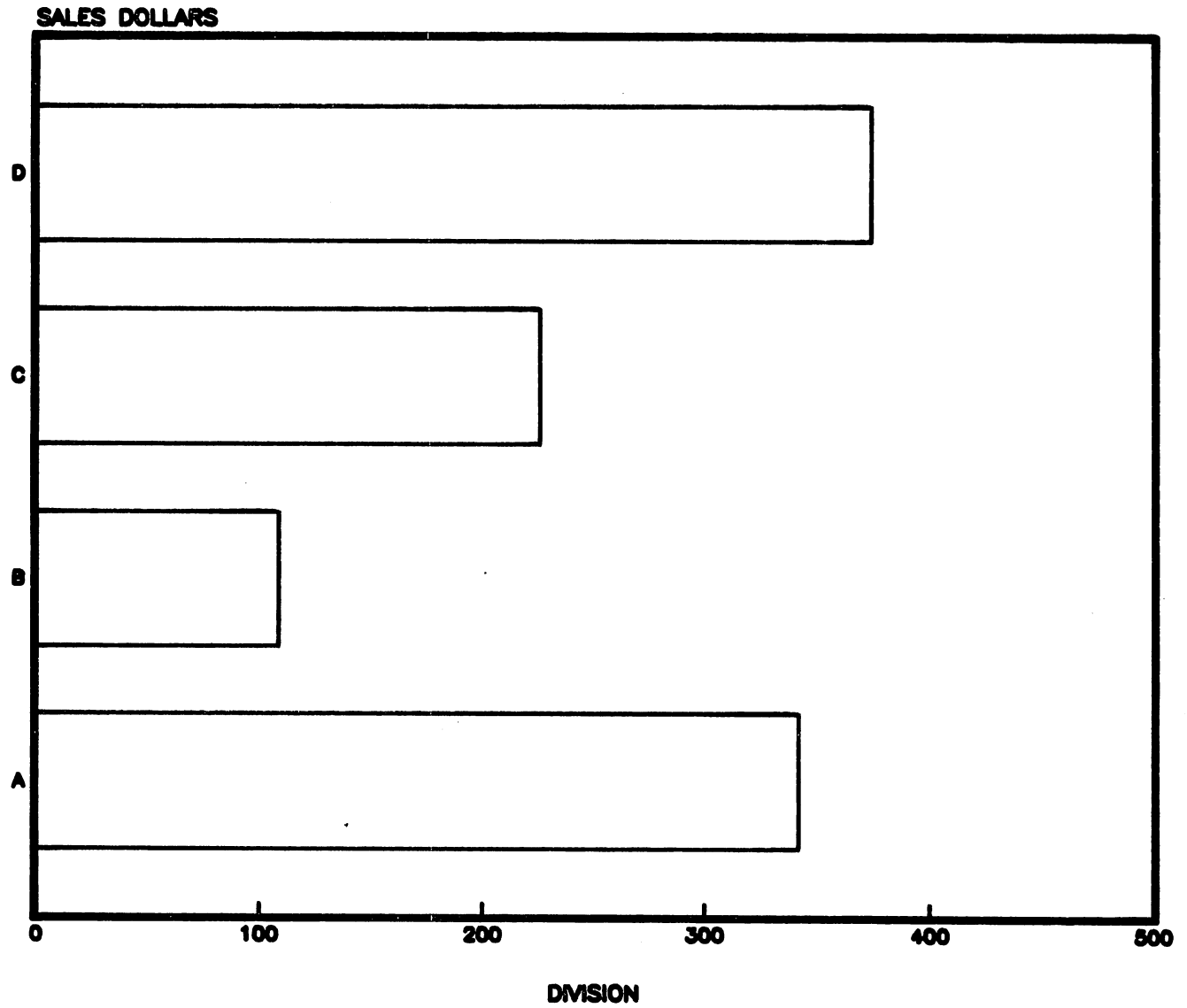


Figure 3

FISCAL 1980 SALES FOR ABC COMPANY BY DIVISION

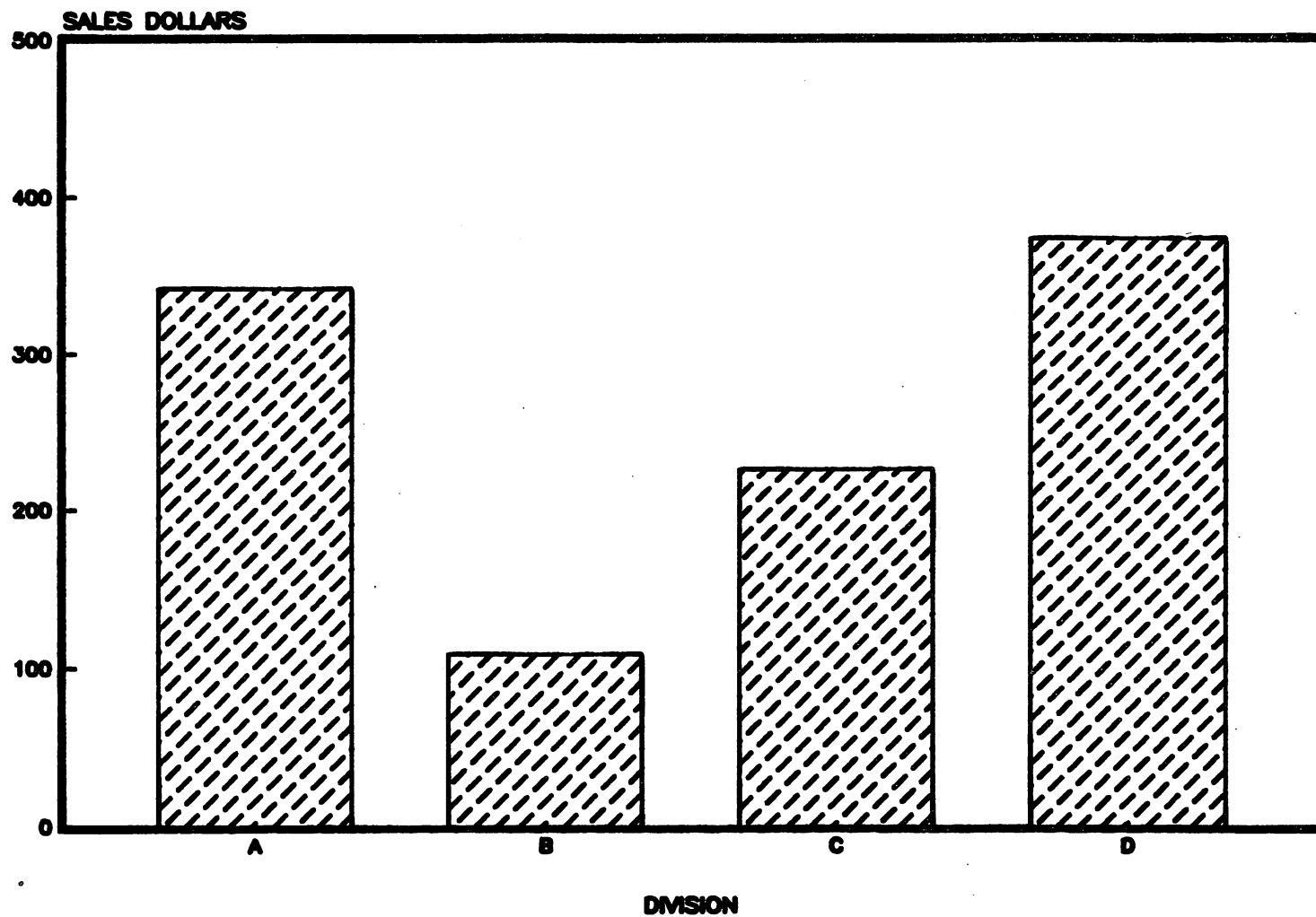


Figure 3A

KLN WIDGETS, INC. 5 YEAR SALES ANALYSIS

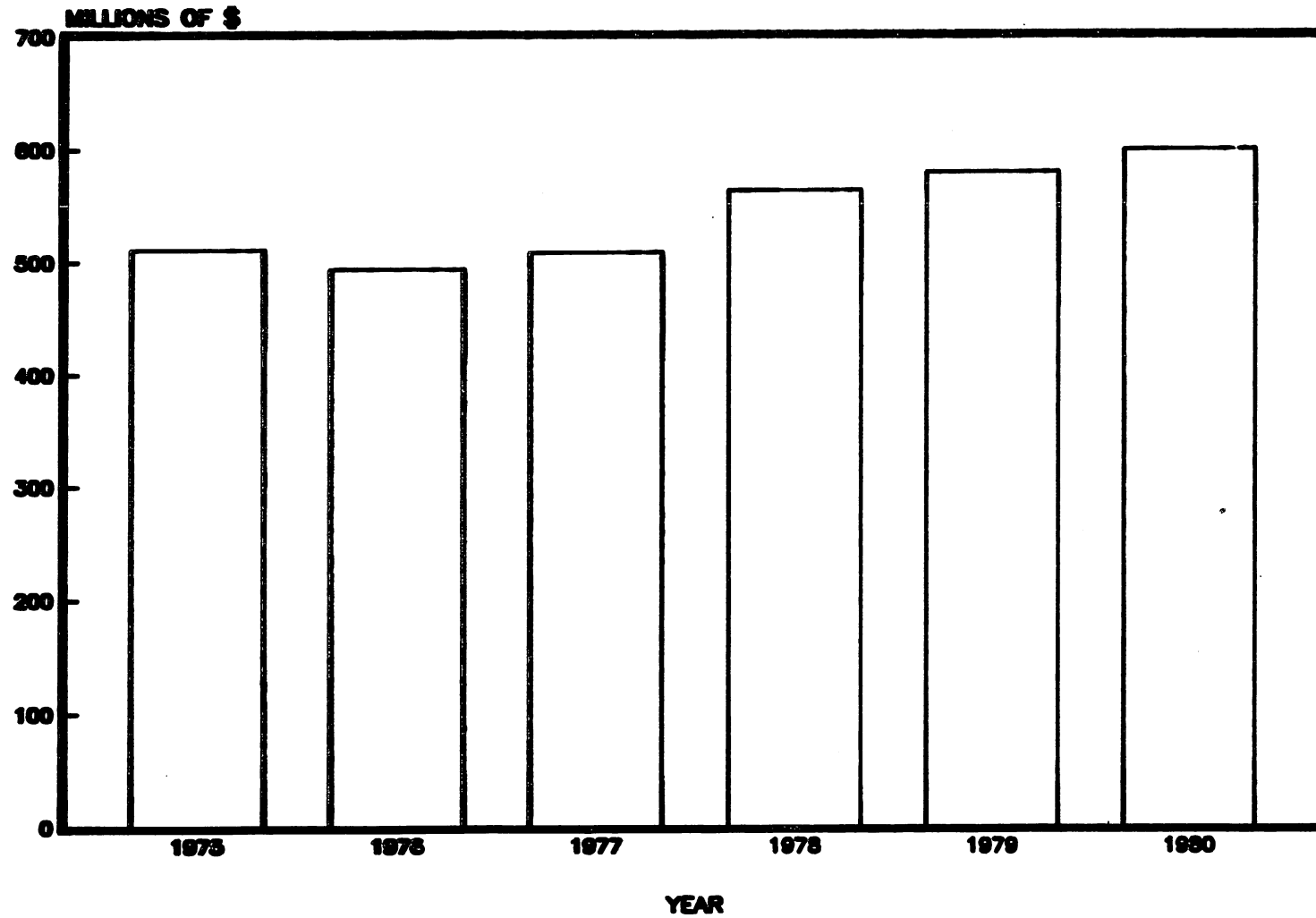


Figure 4

KLN WIDGETS 5-YEAR SALES ANALYSIS

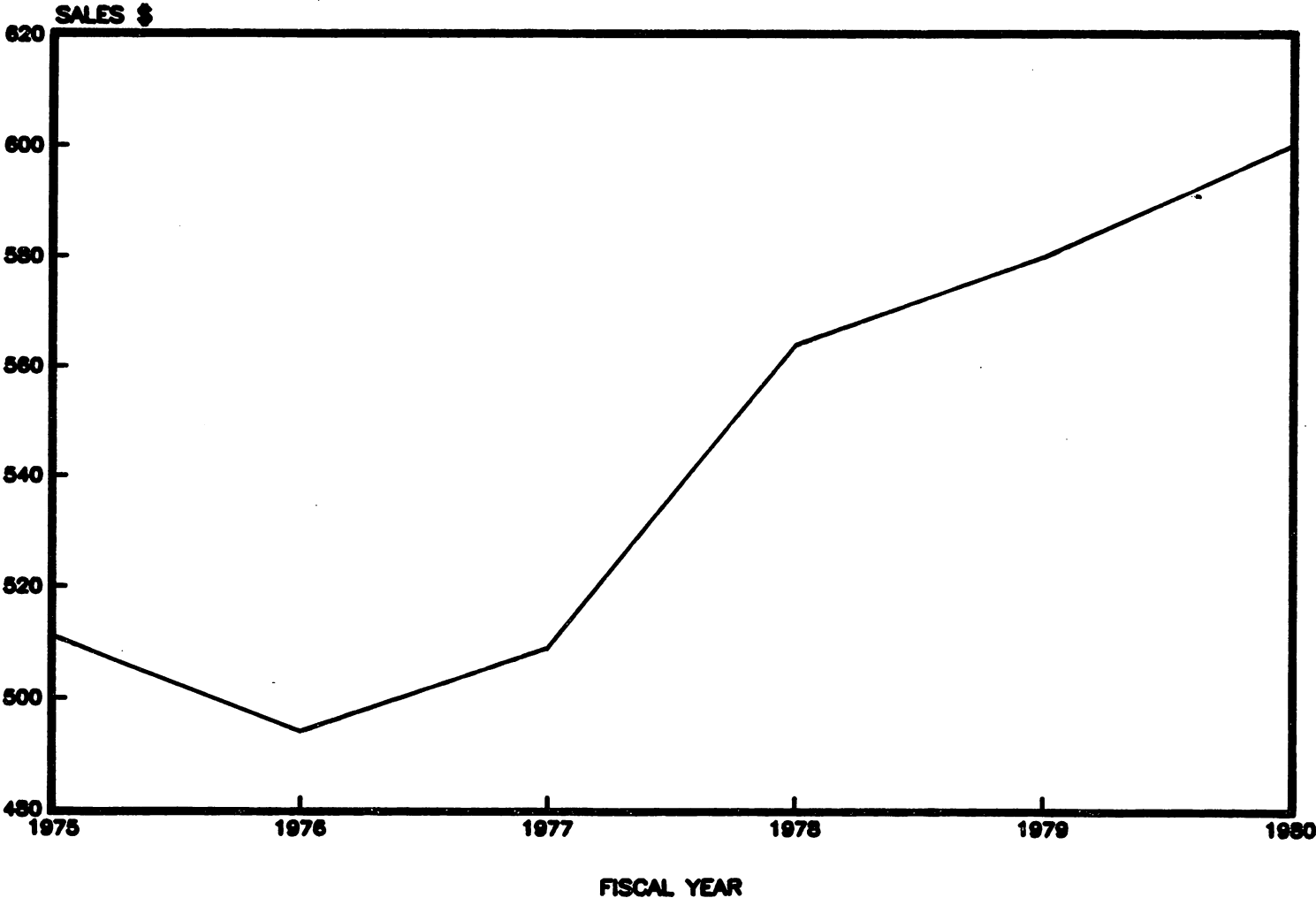


Figure 4A

KLN WIDGETS, INC. 5 YEAR QUARTERLY ANALYSIS

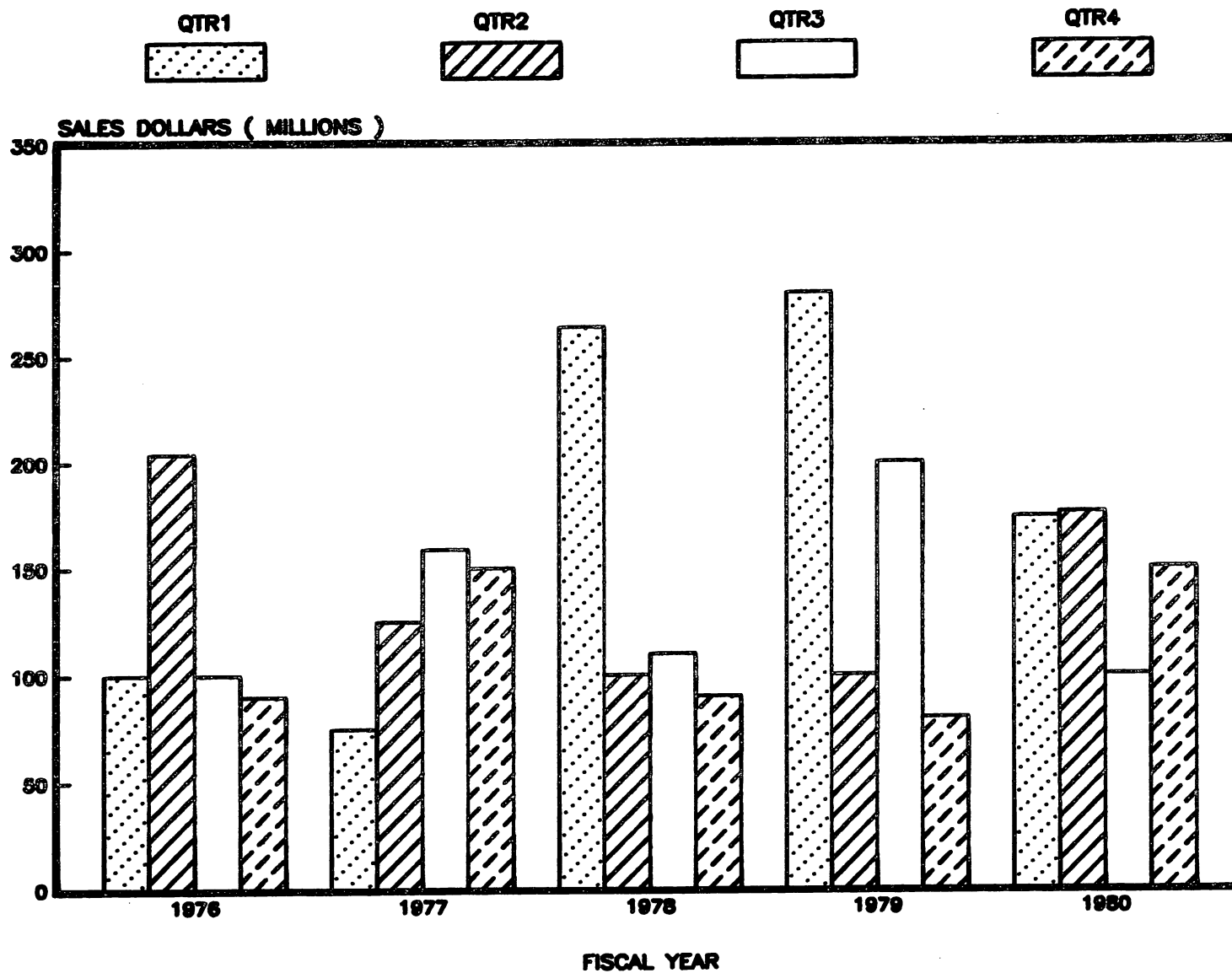


Figure 5

10 YEAR FISCAL QUARTERLY ANALYSIS

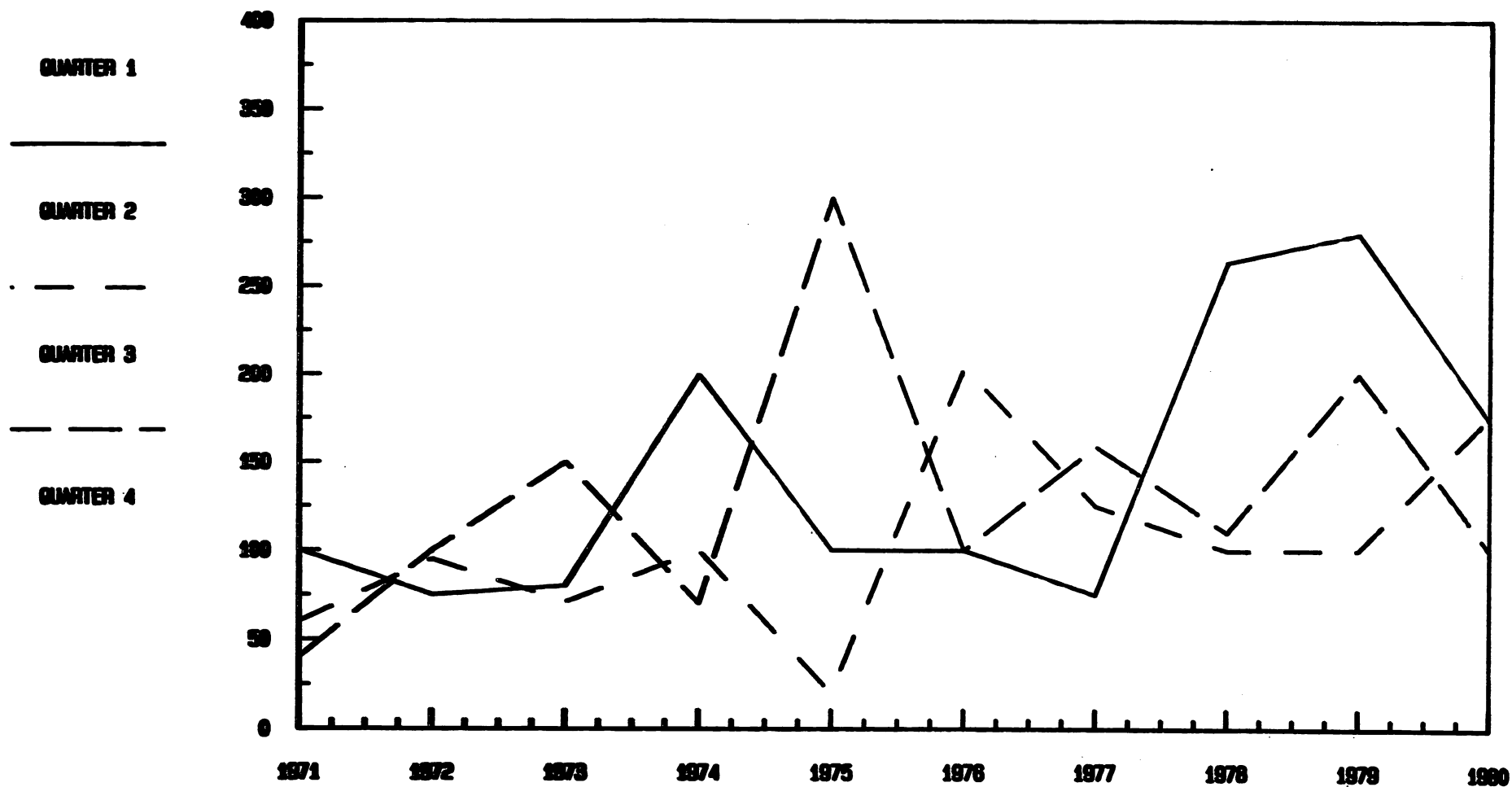


Figure 6

KLO WELDING : EMPLOYEE ILLNESS DISTRIBUTION

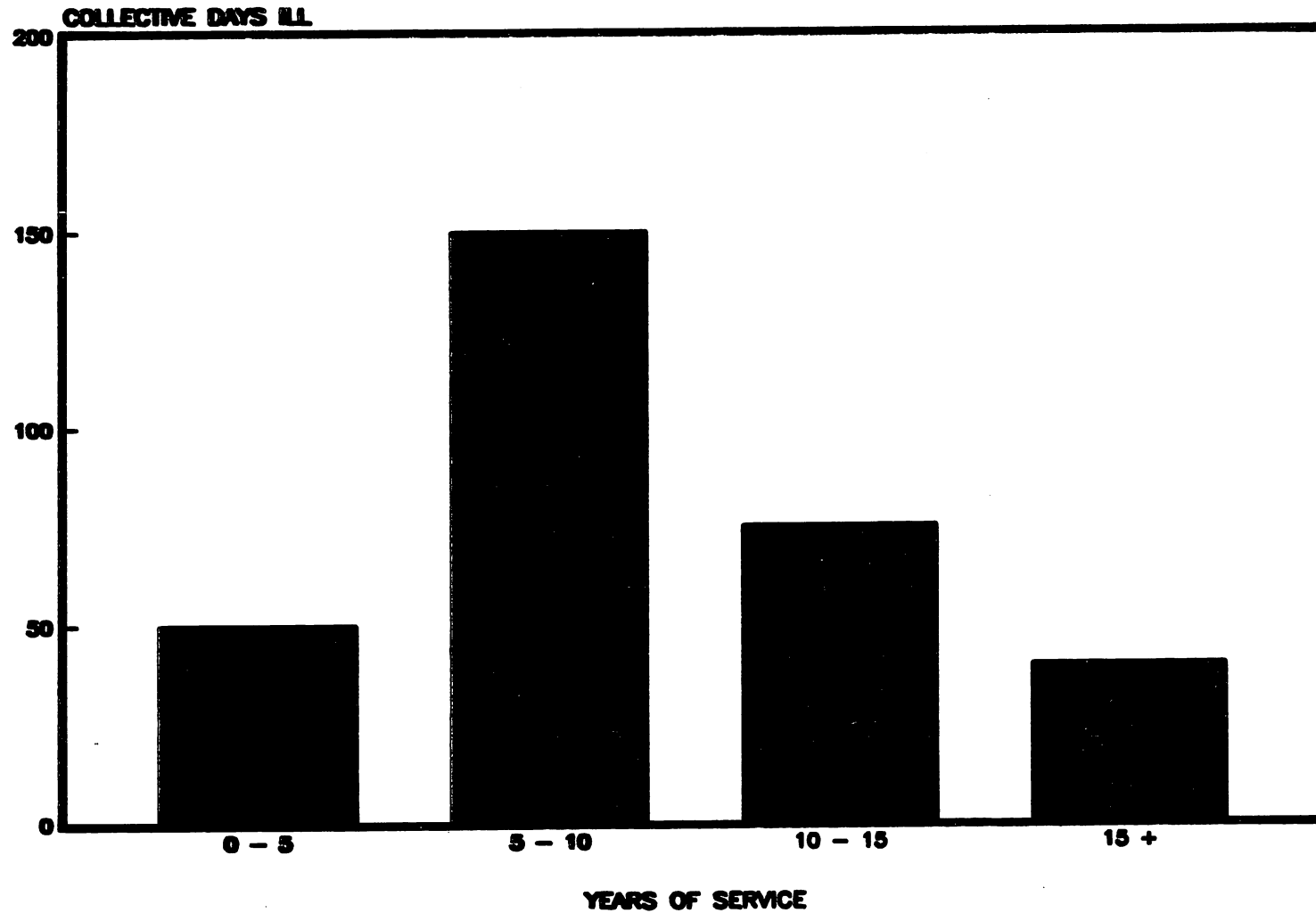


Figure 7

1. The first part of the document
describes the general situation
of the country and the
state of the economy.

2. The second part of the document
describes the state of the
economy and the state of the
country.

3. The third part of the document
describes the state of the
country and the state of the
economy.

4. The fourth part of the document
describes the state of the
economy and the state of the
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5. The fifth part of the document
describes the state of the
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economy.

6. The sixth part of the document
describes the state of the
economy and the state of the
country.