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**Validation of a self-instructional foodservice inventory control
system module**

Kim, Il-Sun Yang, Ph.D.

Iowa State University, 1989

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Ann Arbor, MI 48106



**Validation of a Self-instructional Foodservice
Inventory Control System Module**

by

Il-Sun Yang Kim

**A Dissertation Submitted to the
Graduate Faculty in Partial Fulfillment of the
Requirements for the Degree of
DOCTOR OF PHILOSOPHY**

**Departments: Family and Consumer Sciences Education
Hotel, Restaurant, and Institution Management**

**Co-majors: Home Economics Education
Hotel, Restaurant, and Institution Management**

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**Iowa State University
Ames, Iowa**

1989

TABLE OF CONTENTS

	Page
DEDICATION	vii
INTRODUCTION	1
Explanation of Dissertation Format	3
REVIEW OF LITERATURE	5
Components of Inventory Control System	5
The basic components	5
The advanced components	12
Application of Inventory Control Theory in Foodservice Operations	16
Self-Instruction in Dietetic and Foodservice Education	24
 ARTICLE I. INVENTORY CONTROL SYSTEM ACHIEVEMENT TEST FOR DIETETIC AND FOODSERVICE MANAGEMENT STUDENTS	30
 ABSTRACT	31
 INTRODUCTION	32
 METHOD	35
Development of the Test	35
Sample	36
Data Analysis	37
 RESULTS AND DISCUSSION	38
 REFERENCES	41

	Page
ARTICLE II. A FOODSERVICE INVENTORY CONTROL SYSTEM MODULE: THE EFFECT OF INSTRUCTION ON ACHIEVEMENT AND ATTITUDE	46
ABSTRACT	47
INTRODUCTION	48
METHOD	52
Experiment Treatments	52
Instrumentation	53
Experiment	55
Subjects	55
Data Analysis	56
RESULTS AND DISCUSSION	58
Achievement Test	58
Attitude Inventory	60
CONCLUSIONS AND RECOMMENDATIONS	61
REFERENCES	62
SUMMARY AND RECOMMENDATIONS	71
Summary	71
Recommendations	75
BIBLIOGRAPHY	77
ACKNOWLEDGEMENTS	83

	Page
APPENDIX A. UNIVERSITY COMMITTEE ON THE USE OF HUMAN SUBJECTS IN RESEARCH APPROVAL	85
Informed Consent Statement	87
APPENDIX B. INVENTORY CONTROL SYSTEM CONTENT AREAS AND ASSOCIATED OBJECTIVES	88
APPENDIX C. TABLE OF SPECIFICATIONS FOR THE 114-ITEM TEST	94
Table of Items in 114-item Achievement Test Associated with Categories in the Table of Specifications	96
Inventory Control Test	97
Answer Key	119
APPENDIX D. TABLE OF ITEMS IN 50-ITEM ACHIEVEMENT TEST ASSOCIATED WITH CATEGORIES IN THE TABLE OF SPECIFICATIONS	120
Final Inventory Control Test	122
Answer Key	134
Table of Difficulty Differences for 50-item Test by Instructional Strategy	135
APPENDIX E. DEMOGRAPHIC QUESTIONNAIRE AND ATTITUDE INVENTORY	137

LIST OF TABLES

	Page
Table 1. Table of specifications for inventory control system test	43
Table 2. Test statistics for achievement test	44
Table 3. Profile of experimental groups	65
Table 4. Analysis of covariance between experimental treatments	66
Table 5. Pre- and posttest statistics for achievement test scores	67
Table 6. Difficulty index difference by content areas and experimental groups	68
Table 7. Attitude scale scores by item for the self-instruction group	69
Table C1. Table of specifications for the 114-item test	95
Table C2. Items in 114-item achievement test associated with categories in the table of specifications	96
Table D1. Items in 50-item achievement test associated with categories in the table of specifications	121
Table D2. Difficulty differences for 50-item test by instructional strategy	135

LIST OF FIGURES

	Page
Figure 1. Sample test items measuring complex levels of achievement in inventory control system	45
Figure 2. Difficulty index difference by experimental group	70

DEDICATION

This work is dedicated with love to my husband, Chul-Jai, and my daughter, Ah-Young, who support every moment of my life in Ames, especially when I am tired, homesick, and have no mental capacity.

Most of all, it is dedicated to the Lord.

INTRODUCTION

Economic conditions, inter-institutional competition, cost-containment, and quality assurance challenge the management skills of dietitians and foodservice managers in the foodservice industry (Brendel, Bickel, Rose, Bordeaux, and Jenkins, 1985). Although cost-containment has received the most attention, long-term cost effectiveness is probably the biggest concern. Cost-effectiveness requires effective manipulation of the resources, capital and time. Effective manipulation of these resources plays a key role in the overall success of foodservice operations. Therefore, dietitians and foodservice managers must become more cost-conscious and effective in resource management to attain desired performance outcomes.

Some of the skills and characteristics essential to managerial effectiveness involve the ability to use the management science techniques in the areas of inventory control, capital investment, and forecasting. These abilities facilitate decision-making and achievement of long-term cost effectiveness (Hoover, 1983). Inventory control, one of the management science techniques, includes the procurement, storage, and movement of inventory items; effective inventory control ensures cost containment throughout the foodservice system. Foodservice managers need to be able to use optimum inventory control techniques to meet today's economic pressures.

The assumption on which inventory control is based is that organizational inventory problems result from explainable causes and that

these problems can be systematically studied and resolved. The dominant characteristics of inventory control are that the system involves an interdisciplinary approach to problem solving, scientific methods of study, and quantitative methods of analysis. Even though inventory control theory has been widely developed and implemented in business and industry, transfer of inventory control theory into dietetic practice has been slow (Brown and Hoover, 1988). Therefore, it is incumbent upon educators to help practitioners bridge this gap.

This gap can be narrowed by educational institutions integrating inventory control techniques into their courses (Tersine, 1982). Both basic and advanced knowledge of inventory control theories and inventory control technique models need to be taught so that the managerial competencies of dietetics and foodservice managers can be improved.

One approach to teaching inventory control techniques is the self-instructional method. Unlike the traditional method, the self-instructional method focuses on the individual student. In the self-instructional approach, educators provide the tools, but the individual is responsible for his/her own learning (Gagne, 1971). Programs can be used with many types of students and subjects matters, either by themselves or in combination with other instructional programs (Holcomb and Milligan, 1974).

Some research has been conducted on self-instructional programs with effective results in dietetic and foodservice management education. A need for effective instructional programs related to inventory control has been identified. A survey of the literature showed, however, that

little has been done to provide inventory control self-instructional programs for students in dietetic and foodservice management educational settings.

Therefore, the purpose of this study was to develop a self-instructional module on inventory control systems and to evaluate the effectiveness of the self-instructional method using a nonequivalent control group design. Such a self-instruction program could provide an alternative to the traditional lecture method. Dietitians and foodservice managers could study inventory control techniques through the self-instructional program as desired during the manager's free time. As a consequence, the self-instruction program would help busy dietitians and foodservice managers to not only acquire the basic factual knowledge but also to improve their managerial competencies.

Explanation of Dissertation Format

The format for this dissertation has been approved by the Graduate Faculty at Iowa State University. In this format research is presented in manuscript form suitable for publication in professional journals.

The dissertation begins with an introduction and review of the literature which provides background for the total research study. The body of the dissertation is composed of two articles which address two distinct aspects of the research. The first article is a manuscript describing the development of a valid and reliable inventory control achievement test. The second manuscript details the development of the

self-instructional module on inventory control and provides the results of the quasi-experiment to assess the effectiveness self-instructional module. Both manuscripts were written to submit to the Journal of The American Dietetic Association.

The authorship for both two manuscripts is shared with Drs. Alyce M. Fanslow and DoriAnn H. Finley, major professors for the dissertation. The research was partially funded by the Family and Consumer Sciences Research Institute.

The final chapter is a summary of the total research and presents overall findings. Recommendations for future research also are included in this chapter.

REVIEW OF LITERATURE

The literature investigation focused on three major objectives. The first was to identify the basic and advanced components of an inventory control system, the second was to review the literature on the application of inventory control theory in foodservice operations, and the third was to review the literature on self-instruction in dietetic and foodservice education.

Components of Inventory Control System

The basic components

Receiving, storing, issuing, inventory control, inventory valuation, and inventory control computer systems are included as basic components in the inventory control system. Receiving can be defined as a process for ensuring that the products delivered by vendors are those that were ordered in the purchasing process (Spears and Vaden, 1985). Stefanelli (1985) stated that receiving is the act of inspecting and either accepting or rejecting deliveries. The receiving process involves accepting, validating, and signing for delivered merchandise.

The objectives of receiving are obtaining the specific products ordered in the acceptable condition, in the right quantities, at the desired time, at the agreed-upon price, and from an authorized supplier. The main objectives of receiving are to verify that the delivered order meets these criteria. Another important objective of receiving is

controlling these received products and services. Once the receiving clerk accepts the items, they become the property of the foodservice operation (Stefanelli, 1985). Receiving, thus, can be classified as an important part of an inventory control system.

In the overall foodservice operation, storage of products is an important link between receiving and production. Powers and Powers (1984) defined storing as a process of physical arrangement and the management of the food and supplies in the storage areas. The basic goal of storing food and supplies is to prevent loss of merchandise due to theft, pilferage, and spoilage (Stefanelli, 1985).

Inventory held in storage represents a significant investment of the organization's assets. Therefore, careful consideration must be given to the appropriate storage of food and supplies once they are delivered. For inventory control to be effective, access to storage areas should be controlled carefully, authorized requisitions should be required for removing goods from storage, and inventory levels should be monitored carefully (Spears and Vaden, 1985).

Issuing is defined as the process used to supply food to the production units after it has been received (Spears and Vaden, 1985). Products may be issued directly from the receiving area or dry storage or low temperature storage to the production units. Control of issues from storage includes two important aspects. First, goods should not be removed from the storeroom without proper authorization. Second, only the required quantity for production and service should be removed from storage. A requisition procedure is used to provide these controls.

Inventory control is a technique used to maintain items in inventory at desired levels in order to minimize cost and obtain the desired quantities of an item. Two economic decisions must be made to obtain these results: 1) when to order, and 2) how much to reorder (Finley, 1988). The objectives of inventory control as stated by Andrews (1969) are to: 1) prevent production schedule interruptions, 2) purchase supplies at a minimum cost, 3) minimize losses due to theft, obsolescence, and spoilage, and 4) keep investment in inventories at a minimum consistent with production requirements.

The two types of inventory control systems primarily used in foodservice operations are perpetual and physical inventory (Knight and Kotschevar, 1979). The process of maintaining a continuous record of all purchases and food issues is called a perpetual inventory. This process provides a continuous record of the quantity on hand at any given time, as well as the value of food and supplies (Spears and Vaden, 1985).

The perpetual inventory has both advantages and disadvantages (Stefanelli, 1985). The perpetual inventory has the primary advantage of providing information to the foodservice manager so that an optimal inventory level can be maintained with a tight degree of control (Kim, Finley, and Fanslow, 1989). Consequently, the perpetual inventory system enables the foodservice manager to determine the inventory value at any given time. Disadvantages of a perpetual inventory system are that it is costly and requires considerable labor when maintained manually. In addition to the labor cost involved, perpetual inventory records often contain a good deal of human error, often to the point of making the

inventory value questionable.

The greatest use of perpetual inventory systems for total inventory control is found in operations that have a computer and in which the departments are integrated into the computer control system (Stefanelli, 1985). Although it is simple to maintain a perpetual inventory record in theory, in practice, it can be quite difficult to maintain the records accurately either by manual and/or computer-assisted systems (Kim et al., 1989). This is because all additions and withdrawals are not always recorded with accuracy. Therefore, when perpetual inventories are used, they must be checked for accuracy.

The other type of inventory control system is called a physical inventory. Spears and Vaden (1985) defined the physical inventory as the periodic actual counting of products on hand in all storage areas. Bell (1984) stated that a physical inventory is the actual counting and recording of stocks and is usually completed monthly. This figure becomes the closing inventory for one period and the opening inventory for the next period.

The process of taking a physical inventory commonly involves two people. One person physically counts the actual number of units of each item on hand while the other person records the information on a physical inventory recording form (Kim et al., 1989).

The purpose of taking a physical inventory as reported by Stefanelli (1985) is twofold: 1) to provide accountants with the necessary information to determine various product costs, and 2) to check and reconcile the balance noted on perpetual inventory records. Kasavana

(1984) supported that a physical inventory is routinely taken to prove the perpetual inventory levels.

In inventory control, effective management demands that sufficient supplies of food be available for use when needed. However, excessive amounts on hand lead to: 1) spoilage, 2) excessive capital tied up in inventory, 3) higher than necessary labor costs to handle the greater amount of food, 4) greater than necessary space allocated to storage, and 5) unwarranted opportunities for theft (Dittmer and Griffin, 1984).

Thus, optimal levels of foods should be kept in inventory.

One commonly accepted method of evaluating inventory control is to calculate how often the inventory of food on hand has been ordered and used during a period of time (Dittmer and Griffin, 1984). This amount will vary from place to place and will be determined by many factors including the amount of cash available for inventory, sales volume, the storage facilities and capabilities, supplier's capabilities and delivery policies, menu, and type of food purchased (Bell, 1984).

To measure how often food has been ordered and used, foodservice managers historically have calculated the frequency of turnover of the food in the inventory (Dittmer and Griffin, 1984). Inventory turnover is an indicator of the movement of materials through the organization and is defined as the ratio of the annual cost of goods sold to the average or current inventory level (Tersine, 1982). This ratio indicates the number of times the inventory has turned over during the year.

An inventory turnover ratio may be used as a guide for evaluating the investment in inventory (West, Wood, Harger, and Shugart, 1977).

Inventory turnover ratios are designed to relate the size of inventories to the sales volume of the business (Fay, Rhoads, and Rosenblatt, 1976). This relationship shows the number of times that the inventory is used up and replenished during the year. Bell (1984) stated that an effort should be made to determine the lowest stock level necessary to support a given level of business. The inventory turnover value resulting from this inventory level would be set as the standard turnover value.

Inventories represent a significant portion of current assets in most foodservice operations. Valuing the inventory at the end of the accounting period is important because it will indicate how much money is tied up in food and supplies. One of the principal difficulties, when calculating the value of the physical inventory, is determining unit cost or value for each item (Kim et al., 1989).

Five methods are used to assign values to units of commodities in inventory. The five principal methods are: actual purchase price, weighted average purchase price, FIFO (first-in, first-out), LIFO (last-in, first-out), and latest purchase price (Dittmer and Griffin; 1984). Each method may provide a different inventory value at the end of any given period. In a foodservice operation, the foodservice manager in consultation with an accountant, will select the appropriate method for a particular situation. The method chosen for valuing inventory, however, is important because it will affect the determination of cost of goods sold, which in turn will affect the profit or loss figure (Spears and Vaden, 1985).

Computer assisted-foodservice management systems have been developed

and widely used to assist foodservice managers in their decision making. Computer systems to control inventory were one of the earliest applications of computer technology in foodservice systems (Spears and Vaden, 1985). Wilcox, Moore, and Hoover (1978) indicated that the purpose of an inventory control computer system was to optimize inventory levels of food items, while minimizing stock outages.

The initial step in designing an inventory control computer system for a foodservice operation involves development of food item data file (FIDF). The FIDF serves as the data base for inventory control applications (Kim et al., 1989). The FIDF generally includes the following fields of information to enable interaction with software applications containing inventory and recipe functions: identification number, ingredient name, purchase unit, purchase weight, issue unit, issue units per purchase unit, volume per purchase unit weight, count per purchase unit and or issue unit, sub-file group assignment, yield factors, cost per purchase unit, and storage location (Baltzer, Sawyer, and Gregorie, 1988).

Once the FIDF is developed, it is stored and used as a data base. Several types of transactions can be processed using an inventory control computer system and the FIDF. Examples of transactions include items received, items stored, items issued, and items returned to vendor (Dittmer and Griffin, 1984).

The advanced components

With the increasing size and complexity of foodservice operations, inventory control and management have become more complicated and critical. A variety of techniques are available to assist managers in determining quantities for purchase, recommended inventory levels, and costs of maintaining inventories (Spears and Vaden, 1985). Techniques used for inventory control include the economic order quantity (EOQ) method, ABC method, minimum-maximum method, and Materials Requirement Planning (MRP) method.

EOQ is defined as the size of an order that minimizes the total inventory cost (Tersine, 1982). Levin, Rubin, and Stinson (1986) stated that the EOQ method is the oldest and best-known inventory method. The purpose of using the EOQ method is to find the precise quantity to purchase in order to minimize total inventory costs (Montag and Hullander, 1971).

The two basic inventory costs are ordering costs and carrying costs. Ordering costs are basically the costs of getting an item into the firm's inventory. Carrying costs, also referred to as holding costs, are basically the costs incurred because a firm owns or maintains inventories (Levin et al., 1986).

The EOQ concept is derived from a sensible balance of ordering costs and inventory holding costs. The order cost diminishes rapidly as the size of the order is increased, whereas the holding costs of the inventory increase directly with the size of the order. The EOQ procedure may be utilized by the solution of a mathematical formula or

by the use of tables that are the result of formula calculations (Spears and Vaden, 1985).

In an analysis of different inventory control models, Kaimann (1970) stated that the EOQ model has two advantages; one is ease of calculation. The EOQ and associated total costs can be computed in two steps and need not be recalculated until significant changes in inputs occur. Another advantage is that when there is variability in the demand for an item, the total cost provided by EOQ is not much more than the other methods analyzed.

Fulbright (1979) suggested situations where the EOQ method is appropriate. He concluded that if the inventory consists of items with relatively stable demand, EOQ should prove useful in minimizing total order costs and inventory carrying costs. However, if demand for inventory varies significantly, as with seasonal fluctuation, EOQ should not be used. According to Montag (1970), the EOQ method can improve decision making in foodservice operations concerning inventory, but it is not a cure-all for all inventory problems.

In most foodservice operations, a small percentage of inventory items accounts for the major portion of the inventory purchase value; therefore, a method for classifying purchased items according to value is often advisable. One approach is the ABC inventory analysis method. The ABC analysis concept is a common application of Pareto's Law in inventory management.

In the ABC method, items in inventory are divided into three categories. The A category includes high value items whose dollar volume typically accounts for 75-80% of the value of the total inventory, while representing only 15-20% of the inventory items. The B category contains lesser value items whose dollar volume accounts for 10-15% of the value of the inventory, while representing 20-25% of the inventory items. The C category are low value items whose volume accounts for 5-10% of the inventory value but represents 60-65% of the inventory items (Tersine, 1980). The purpose of classifying items into groups is to establish appropriate levels of control over each category of item.

The A (and B) items are considered planned inventory, and are subject to tight planning and control. At the other extreme, the C items, which have low value are considered probability inventory and are handled by rough statistical means with minimal planning and control (Reuter, 1976).

The accomplishments generated by applying Pareto's Law to inventory control using the ABC concept include: 1) identification of both extremes concerning the "vital few" and the "trivial many", 2) facilitation of the development of appropriate policies, systems, and procedures suitable to bringing about improved control according to differing characteristics of the established inventory classification, and 3) a consensus view concerning priorities (Reuter, 1976). The adoption of the ABC method results in a temporary increase in carrying charges, such as interest, obsolescence, insurance, and taxes; however, this disadvantage becomes an advantage when the total inventory value is

reduced below its former level.

One widely used method of controlling inventory involves the establishment of minimum and maximum inventory levels, commonly called the mini-max method. In this method when inventory levels fall to a minimum level, the order quantity will bring stock levels to the maximum level (Finley, 1988). Plossl (1985) stated that the mini-max method is merely a variation of the order point. The minimum is, in fact, an order point and the maximum is the order point plus the order quantity. Spears and Vaden (1985) also indicated that in the mini-max method, a safety stock is established, which becomes the minimum point below which the inventory does not fall under normal circumstances. The maximum inventory consists of the safety stock plus the correct order quantity. The safety stock is determined by two factors: lead time and usage rate. Lead time is the interval between the time that a requisition is initiated and receipt of merchandise, which may vary greatly depending upon source of the product.

Materials Requirement Planning (MRP) is a new name applied to an old concept. The synthesis of modern computers and old concepts has resulted in a system that can be used effectively to both plan and control production and material flows. The logic of MRP is based on the fact that the demand for materials, parts, and components depends on the demand for an end product (Miller and Sprague, 1975).

MRP is a computer-based production planning and inventory control system and is concerned with both production scheduling and inventory control (Tersine, 1982). MRP provides a precise scheduling system, an

efficient material control system, and a rescheduling mechanism for revising plans as changes occur. MRP keeps inventory levels at a minimum while assuring that required materials are available when needed. The major objectives of the MRP system are simultaneously to: 1) ensure the availability of materials, components, and products for planned production and for customer delivery, and 2) maintain the lowest possible level of inventory, delivery schedules, and purchasing activities. Miller and Sprague (1975) also stated that if the current production control system is resulting in extremely high inventories and/or poor delivery performance, the net result of MRP installation is likely to be very rewarding.

Application of Inventory Control Theory in Foodservice Operations

The control and maintenance of inventory is a problem common to all organizations in any sector of the economy. Inventory problems have been encountered by every society, but it was not until the twentieth century that analytical techniques were developed to study them. The initial impetus for analysis came from manufacturing industries (Tersine, 1982). Therefore, information on the subject of inventory theory is abundant in the literature on industrial operations.

The foodservice industry is one that has much in common with other industries in the United States. Like most industries, the foodservice industry requires capital planning, efficient utilization of the work force, effective marketing policies, and accurate forecasting of the

supply and cost of raw materials and the demand for finished products. Consequently, many of the inventory control concepts and techniques used in analyzing other industrial operations are applicable to the foodservice industry. Therefore, the literature was searched to identify the application of theories about the basic functions of inventory control in foodservice operations.

In the past, inventory and cost controls have been achieved predominantly by manual methods in hospital foodservice departments. Because of the manual methods, inventory control has long been one of the most time-consuming jobs that foodservice managers perform. As foodservice operations have become more diverse and complex, inventory control has become even more complicated. Often it is impractical to use manual methods for summarizing purchases and issues into reports that would be helpful for specific intervals of time.

Therefore, to attain sufficient current reports for analysis but with a minimum amount of labor, computerized inventory control systems are considered highly desirable. In general, computerization allows managers to keep better control of their inventories. The most important aspect of an inventory system is computation of percentage of sales to cost of preparation. Prices and portions of foods can be reduced or increased in order to maintain desired gross margins.

Computerization, however, is not the answer to all inventory problems as it can create problems as well as solving them. If employees are not interested in or capable of operating and managing the use of this technology, efforts to implement a computer-assisted system may

actually create additional problems.

The literature was searched to determine the use of electronic data processing as a technique for inventory control in the foodservice industry. Nine systems were found; some systems are theoretical only while others have been tried.

The system employed at the University of Missouri-Columbia utilizes electronic data processing. Computer programs were developed to determine optimum reorder points and reorder quantities (Andrews, 1969; Andrews and Tuthill, 1968; Johnson and Moore, 1966). Economic reorder points are based on menus and production forecasts. Economic reorder quantities are based on storage costs, which fluctuate directly with the amount of inventory. Generally, a reorder quantity is the amount of inventory used in the period of time that lapses between the generation of purchase orders. Economic reorder points and reorder quantities help control the amount of capital involved in maintenance of the inventory.

By 1970, four additional computer subsystems were developed for foodservice applications at the University of Missouri-Columbia. The four subsystems were food cost accounting, patient nutrient intake, production control, and inventory control. The food cost accounting subsystem identifies weekly, monthly, and yearly food costs for each cost center in the department. The patient nutrient intake subsystem allowed clinical dietitians to calculate a patient's daily nutrient intake and to prepare diet modifications. In addition, the nutrients in the menus were calculated and compared with the departmental standard. Computer-generated adjusted recipes and consolidated stores requisitions are

output from the production control subsystem. The inventory control subsystem maintains a perpetual inventory, generates recommended quantities to purchase, and provides summary reports of purchases by vendor and of issues by cost center (Moore and Tuthill, 1974).

When the inventory control subsystem was originally designed, minimum and maximum stock levels, based on forecasted maximum demand throughout a three-week menu cycle, were determined manually for all items, including frozen foods. Stock outages, however, occurred occasionally when demand was greater than average. Therefore, a study was conducted to design an automatic system which would reduce or eliminate these and other problems (Wilcox et al., 1978). The problem of stock outages was improved by calculating an order quantity based on a menu item forecast and current stock levels by the automatic system.

The economic order quantities (EOQ) and economic reorder points for determination of inventory levels also were used in order to complete a component in the ultimate goal of developing a computer-assisted menu planning system in the University of Iowa Hospitals Nutrition Department (Yost, 1972). EOQ, quantities where minimum ordering and inventory costs would be incurred, were calculated for ten items carried in the Nutrition Department inventory. Economic reorder points, points where purchase orders of the calculated EOQ were issued, were determined along with reserve stock levels. Average consumption patterns for these ten food items were determined. Actual costs of food, procurement, and maintenance were compared to projected costs which were based on EOQ, economic reorder points, and reserve stock levels.

In determining the EOQ, costs of inventory procurement were weighed against inventory carrying costs. Inventory control models must reflect the characteristics of an actual system while eliminating unnecessary features. Otherwise, results obtained may be unsatisfactory. Cost minimization also was the criterion for selecting the optimal decision rules in the basic EOQ models (Andrews, 1969; Montag and Hullander, 1971).

Two types of inventory systems, the fixed-order-period system with amalgamation of orders (Pa) and the fixed-order-quantity system (Q), were evaluated to determine their effect upon increasing the number of entree selections on the hospital menu (Matthews and David, 1971). Using combinations of entrees with their associated portion costs, it was found that total inventory costs under the Pa models reflected the economic advantage of amalgamating orders to one supplier regardless of the number of entrees offered.

Increasing the number of entree selections on the menu did not appreciably increase the financial investment in food inventory under the Pa models but did under the Q models. Inventory levels in the Pa models were more stable than in the Q models during periods of great variability in stock levels, resulting in a wide range of storage space requirements. Computer simulation and inventory theory demonstrated that requirements for storage space facilities, which are dependent on the inventory system used, may be predetermined and consequently provide useful techniques for designing future foodsystems.

A computerized food cost control system was designed in order to

provide information to management in the areas of forecasting, purchasing needs, inventories, costs, and revenues for hotels (Wrisley, 1983). Data were entered and maintained in six files, the most important of which were the inventory (ingredient) file, the recipe file, and the menu file. The inventory file contained all food items used in the establishment along with the purchase price, limit of purchase, specification of the unit by which the item is inventoried and issued, inventory units on hand, and storeroom location. The recipe file contained the recipes of the establishment with each ingredient listed. The menu file contained the menu for a particular dining room. It was hoped that the development of a system capable of being utilized in the time-sharing mode would encourage development of systems to provide needed information in other areas of the typical foodservice industry, such as wage information and financial data of all kinds.

The use of mathematical models to obtain optimum decision rules for operating inventory systems in foodservices was described by Montag (1970). EOQ models can improve decision-making in foodservice operations concerning inventory, but EOQ models are not a cure-all for all inventory problems. Even when some of the conditions encountered in operating situations vary appreciably from those assumed in the basic EOQ model, the basic model will approximate optimum decisions. However, when the assumptions are seriously violated, the basic model requires adjustments. Therefore, in these situations the EOQ model must be used in combination with executive, managerial, and staff judgements to ensure adequate information for sound decision making.

Four hypothetical food procurement information system models were formulated, simulated, and evaluated (Matthews, 1970). The simulation models were used as a technique for defining the mathematical relationships existing among variables within four procurement information systems, operating these systems under selected decision rules, and observing the effect of the four systems on five measures of effectiveness. These variables were: (1) cost of food used; (2) cost of ordering and carrying prepared frozen entrees in inventory; (3) total cost of inventory and food used; (4) financial investment in food inventory; and (5) requirements for storage space and facilities during the 100-day period.

Another inventory application in obtaining total food costs information in the dietary departments of health care facilities, with special reference to smaller hospitals and nursing homes was reported by Montag (1975). The four methods of obtaining total food costs were: (1) recipe method, (2) requisition method, (3) inventory method, and (4) record of purchase method. These methods were assessed based on the various indexes of system effectiveness, records maintained, and use made of cost information accumulated. The inventory method provided the foodservice manager with valuable historical food cost information and was particularly effective if a running record is kept of purchases classified by commodity groups.

A food inventory system, including an order card system was implemented, as an interdepartmental plan between the Nutrition Services and the Central Purchasing, Supplies and Distribution Department (CPSD),

at Community Memorial Hospital in Menomonee Falls, Wisconsin (Siegert, 1983). The purchasing and storage of nonperishable food items were translated to CPSD and information relevant to normal usage and par levels of those items was supplied so that CPSD could coordinate storage and ordering. After CPSD had established a food inventory system, non-production hours were reduced by 2% per week. Implementing such an approach could have an effect on inventory costs through closer monitoring, productivity, and employee morale.

The minimum and maximum inventory control method, commonly called the mini-max method was presented in order to overcome inventory problems in a foodservice (Waskey, 1986). In this method when inventory levels fall to a minimum level, the order quantity will bring stock levels to the maximum level. Mini-max is a hands-on, easy to install, easy to use, and easy to teach system that is appropriate for use with a relatively unsophisticated staff.

Studies on the application of inventory control techniques in the dietetic and foodservice operations were reported by researchers in the literature but the use by practitioners has not been documented. Due to the lack of this information, Finley and Kim (1986) conducted a study to determine the value and use of management science techniques with 200 members of one American Dietetic Association (ADA) practice group in healthcare foodservice systems. They found that inventory control was the most important and valuable of the management science techniques and was most frequently used by practitioners in foodservice. They also indicated that the major problem areas facing the foodservice managers

today is cost and production control. The need for education programs in inventory control systems was also supported by the minimum competencies identified for entry-level dietitians and beginning foodservice managers (Loyd and Vaden, 1977; Mariampolski, Spears, and Vaden, 1980). Therefore, effective instructional programs related to inventory control are needed for students in dietetic and foodservice management educational settings and practitioners.

Self-Instruction in Dietetic and Foodservice Education

One alternative approach to education is self-instruction. Unlike the group-oriented, teacher-directed instruction, self-instruction focuses on the individual student as the center in the teaching-learning system. In the self-instructional approach educators provide the tools but the individual is responsible for his own learning, which is the essence of self-instruction. Self-instructional programs are educational materials from which students learn. Programs can be used with many types of students and academic subjects, either by themselves, or in combination with other instructional techniques.

Programmed instruction (PI) is the teaching technique based on self-instructional programs (Jacobs, Maier, and Stolurow, 1966). The PI movement originated in papers published by Skinner at Harvard University during the 1950s (Skinner, 1954; Skinner, 1958). His programming technique is based on operant-conditioning learning theory. According to this theory, learning is established when desired behaviors are

reinforced often enough to establish the behavior in the organism (Chidester, 1967).

The programmed technique identified with Skinner has the characteristics one would expect considering his learning theory. Material to be learned is presented in very small steps; at each step, the student is required to actively participate by constructing a response; immediately after a response, the student receives reinforcement. To assure that reinforcement actually takes place, the steps or frames include cues or prompts designed to predetermine the response.

In the relatively short time since programmed instruction was introduced, many schools, institutions, and industries have used this technique (Kiang, 1970; Wittkopt, 1972; Fiel and Ways, 1972; Shannon, 1976). Descriptors for this process of nongroup instruction have included individualized instruction, programmed instruction, self-instructional modules and many other similar variations.

Individualized instruction is an important consideration in the foodservice industry because of the need for the individual manager to acquire skills without being involved in formal class work. Several dietetic educators have developed self-instructional packages and have found them useful.

A self-instruction unit on interviewing concepts was developed and compared with the traditional lecture method in the course, "Instructional Competencies for Dietetic Students" at Kansas State University (Bates and Spears, 1977). The study indicated that the two

instructional methods were equally effective. Therefore, they concluded that the self-instruction unit was an acceptable educational method for teaching interviewing concepts to dietetic students.

Employee counseling interviews were the basis of a self-instruction unit that was developed, tested, and evaluated with Coordinated Undergraduate Dietetic Program (CUDP) students (Gines and Tindall, 1979). The findings also indicated that the self-instructional unit was effective in improving interviewing performance.

The critical incident technique self-instructional module was developed and evaluated in a Foodservice Systems class for Coordinated Undergraduate Program (CUP) students at Kansas State University (Dameron and Spears, 1979). The study revealed that the self-instructional module was as effective as the lecture/discussion in teaching the concepts of the critical incident technique.

Roach and Wakefield (1974) developed a self-instructional six-unit module on quantity purchasing. The module was designed for students enrolled in a Quantity Foods course at Kansas State University. They found no difference in post-cognitive achievement and post-enthusiasm scores between students who used the self-instruction module and those who had the same subject matter presented in lectures. However, students in the self-instruction group rated the effectiveness of the teaching method significantly higher than did those in the lecture group.

A study reported by Pietrzyk, Brittin, and Chamberlain (1978) compared the achievement and attitude scores following a programmed instruction unit on institutional purchasing. Students using the unit

included those enrolled in CUPs, dietetic internships (DIs), and dietetic traineeships (DTs). The findings indicated that the institutional purchasing programmed unit was effective because the achievement posttest scores were significantly higher than pretest scores. An attitude scale showed favorable attitudes by the students toward the programmed instructional unit.

Three subject matter areas (nutrition, planning type-A lunch, and menu making for foodservice personnel training) were developed as a self-instructional program and evaluated using pre- and posttests with three groups of selected school foodservice managers in Iowa (Acacio, McKinley, and Scruggs, 1972). Three groups were included in the experiment; a group of 21 who studied a self-instructional package administered as a home study course, another group of 21 who attended three short courses, and a control group of 19 who received no training. The criteria used in the selection of the participants were length of experience in foodservice and level of education. The findings indicated that regardless of length of experience in foodservice and level of education employees who had programmed instruction learned as much as those in the short courses for the three subject matter areas. The mean knowledge gain scores of the self-instruction and short course groups also were significantly higher than those of the control group irrespective of the length of their experience in foodservice.

Two nutrition education modules for inservice training of hospital workers from foodservice departments at Pennsylvania State University were developed and evaluated (Looker, Walker, Hamilton, and Shannon

(1982). Each module included a self-instruction leader's guide and a teaching package to aid leaders in conducting learning sessions for their audiences. All participants were assigned to either a treatment or a control group; each group responded to pre- and posttests. The results of the study revealed that the treatment group participants scored significantly higher on both module posttests than the control group indicating that this mode of presenting nutrition education increased nutrition knowledge.

Miller (1986) developed and evaluated self-instructional modules on the use of a menu item forecasting technique using a one group pre- and posttest design. Undergraduate and graduate students at 10 colleges and universities participated in the study. The results indicated that the self-instructional modules were useful instructional approaches for training both practitioners and dietetic students in menu item forecasting techniques.

Cloninger, Messersmith, and McEwan (1988) conducted an experimental study to evaluate a microcomputer simulation to teach the management concepts of perpetual and periodic inventory systems to university students. The study revealed that the simulation was effective in enhancing students' understanding of the management concepts of perpetual and periodic inventory systems. There was greater improvement in the experimental group than in the control group in terms of knowledge gained.

Each of the nine studies reported in the 1970s and 1980s have demonstrated that the self-instructional approach is equally effective or

more effective than the traditional lecture method in dietetic and foodservice management education. Therefore, the self-instructional technique seems appropriate for foodservice management education in view of the constraints facing educators.

The dilemma facing educators today is that costs continue to rise as traditional instructor/student ratios and teaching methods are maintained. Roid (1974) suggested that programmed self-instructional materials have the seductive quality of promising long range savings in comparison to the rising costs of professor's salaries. Although the development costs are high, the promise is that use by many students over many years can allow an amortization of this expense so that the cost per student per year can be reduced. Therefore, a renewed interest in self-instructional programs in the 1980's is anticipated because of the current concern about cost-effectiveness in education.

Due to the multi-dimensional responsibilities of foodservice managers and their critical need for continuing education within limited time parameters, self-instructional modules can be developed for use during the managers' free time which sporadically arises within their respective schedules. Because self-instructional modules can help dietitians and foodservice managers promote their self-directed learning at their own pace, a module on inventory control was developed and evaluated using a nonequivalent control group design.

**ARTICLE I. INVENTORY CONTROL SYSTEM ACHIEVEMENT TEST FOR DIETETIC AND
FOODSERVICE MANAGEMENT STUDENTS**

ABSTRACT

The purpose was to develop an inventory control system achievement test that measures cognitive achievement of students in a foodservice management information systems course. Objectives for each content area were developed; the content areas were receiving, storing, issuing, inventory control, inventory valuation, and inventory control computer systems. A table of specifications was developed to coincide with the emphasis found in the objectives. Based on the table of specifications, 114 test items in a multiple choice format were developed. A sample of 105 students responded to the test; each had previously received 3 hours of instruction on inventory control systems in a foodservice management information systems course. Based on adherence to the table of specifications and item-analysis data, the best 50-items were selected for the final form of the inventory control system achievement test. The 50-item test was reliable as indicated by a Kuder-Richardson 20 value of 0.84. The test may be used to evaluate individual student's achievement, to evaluate the effectiveness of instruction, and to compare the achievement related to inventory control of different groups.

INTRODUCTION

The challenge during the 1980s in the foodservice industry is to provide a high level of service, cost effectively, in a competitive environment and under considerable economic pressure (Hoover, 1983). With increased pressures for cost containment in all types of foodservice operations, the need for inventory control has become more important.

Finley and Kim (1986) determined the value and use of management science techniques with 200 members of The American Dietetic Association Practice Group, Members with Management Responsibilities in Health Care Delivery Systems, who resided in the north central region of the United States. They found that inventory control was the most important and valuable of the management science techniques and was most frequently used by managers in foodservice. They also indicated that the major problem areas facing the foodservice managers today are cost and production control. The need for education programs in inventory control systems also has been supported by the minimum competencies identified for entry-level dietitians and beginning foodservice managers (Loyd and Vaden, 1977; Mariampolski, Spears, and Vaden, 1980). In response to this challenge for foodservice operations, effective education programs and adequate evaluation of students' achievement related to inventory control are needed.

Achievement tests can assess both simple and complex achievement through written test items. The use of achievement tests to evaluate simple achievement makes an important contribution to performance as

students need to comprehend what it is they are trying to do before they can be expected to apply it to complex work situations. Achievement tests can measure complex achievement effectively through evaluation of the student's logical thinking processes and critical evaluation of conclusions and problem-solving techniques. Students who have reached this level are able to attach meaning and significance to knowledge (Grnlund, 1985). The inventory control systems require learning at both simple and complex levels in specified content areas. Therefore, achievement tests can be developed to meet these specifications.

Desirable attributes of achievement tests are the characteristics of content validity, reliability, objectivity, and usability (Borg and Gall, 1983). Content validity is the degree to which a test measures the intended content area. Content validity is of prime importance for achievement tests. A test score can not accurately reflect a student's achievement if it does not measure what the student was supposed to learn.

Reliability is the degree to which a test consistently measure whatever it measures. As a test becomes more reliable, the greater is the opportunity for test scores to repeat themselves on readministration of the test (Gay, 1987).

Objectivity of a test refers to the degree to which equally competent scorers obtain the same results. If test items are of the objective type and the resulting scores are not influenced by the scorer's judgement or opinion, the achievement tests are high in objectivity. In addition to validity, reliability, and objectivity,

it is also important to consider the usability of tests, including such practical features as ease of administration, time required to administer, ease of scoring, ease of interpretation, and cost of testing (Gronlund, 1985).

The use of achievement tests in inventory control systems for dietetic and foodservice management students has not been reported in the literature. Therefore, the purpose of this study is to develop a valid and reliable achievement test in the area of inventory control systems that assesses achievement of foodservice management information systems students.

METHOD**Development of the Test**

An achievement test was developed for students enrolled in a foodservice management information systems course to measure cognitive achievement of inventory control systems. The content areas were identified from a content analysis of inventory control systems using textbooks such as those by Dittmer and Griffin (1984), Spears and Vaden (1985), Powers and Powers (1984), Stefanelli (1985), West, Wood, Harger, and Shugart (1977), Pedersen (1981), Knight and Kotschevar (1979), and Kasavana (1984). The identified content areas were receiving, storing, issuing, inventory control, inventory valuation, and inventory control computer systems.

Objectives for each content area were developed. A panel of 3 faculty members with expertise in inventory control systems verified content areas and the accuracy of the objectives. All content areas were divided into the cognitive domains: knowledge and comprehension, application and analysis, and synthesis and evaluation. A table of specifications was developed to coincide with the emphasis found in the objectives, as shown in Table 1.

INSERT TABLE 1 ABOUT HERE

A total of 114 test items was developed in multiple-choice format. Items used to measure complex achievement were presented as mini-case studies and had several associated test items. An example of a case study item to measure complex achievement is shown in Figure 1.

INSERT FIGURE 1 ABOUT HERE

A panel of 3 faculty members with expertise in inventory control systems verified the accuracy of the content of the test items. Evaluation specialists examined each test item for adherence to item-writing principles. Finally, a total of 14 students enrolled in a foodservice management information systems course pilot-tested the achievement test to evaluate the usability and clarity of the items. An item analysis was completed for the pilot test. Suggestions for improvement received from the panels and evaluation specialists were adopted for the inventory control achievement test items.

Sample

The sample used in the field test received 3 hours of instruction on inventory control system. The test was administered to 105 students enrolled in a foodservice management information system courses during the 1987-1988 school year.

Data Analysis

Item analysis was done on the field test. The item statistics for the 114-item field test device were examined to select the best items for a final 50-item achievement test according to the table of specifications. Item analysis data consisted of 3 components for each test item: difficulty index, discrimination index, and distracter analysis (Gronlund, 1985). The items most closely meeting the criteria for discrimination and difficulty were selected from each content area of the table of specifications to create the final 50-item of the achievement test. Dual criteria were used for selection of items. They were first adherence to the table of the specifications and second, a difficulty index between 30 and 70% (Gronlund, 1985). The Kuder-Richardson 20 formula was used to calculate the reliability coefficient.

RESULTS AND DISCUSSION

An achievement test suitable for use in a variety of situations should possess the characteristics of content validity, reliability, objectivity, and usability and should have available test statistics against which to judge students performance (Gronlund, 1985).

The inventory control system achievement test was content valid because concepts identified as important for inventory control system were used. The inventory control system achievement test was evaluated by experts in inventory control system. They found the test items measured content as specified in the table of specifications.

A reliability coefficient of 0.70 or above is considered acceptable for the purposes of group measurement or individual measurement if the test score is used in conjunction with scores from other sources (Nunnally, 1982). The reliability for the inventory control system achievement test was 0.84. Therefore, the resulting evaluation device was reliable. The inventory control system test, therefore, is appropriate to use for individual or group measurement.

The item-selection procedure for the final form of the achievement test helped to ensure test reliability. Because reliability coefficients are based on variability of test scores, high reliability occurs when there is variance among students' scores, that is, when test items discriminate among students with high and low total test scores.

The inventory control achievement test utilizes multiple choice items, which generally are considered to be objective. Therefore, the

inventory control achievement test possesses the desired characteristic of objectivity.

The device is easy to administer in a 45-50 minute block of time and can be machine- or hand scored. Therefore the inventory control achievement test also possesses the desired characteristic of usability.

Statistical data for the test provide a basis for interpreting individual or group performance. The resulting test statistics for the test are shown in Table 2. The final test had a mean score of 37.52, and a range of 12 to 50. The standard error of measurement was 2.72 and the standard deviation was 6.70. The reliability was 0.84, using the Kuder-Richardson 20 formula. The average difficulty was 75%; the test was a little above the desired range of difficulty of 30 to 70%.

INSERT TABLE 2 ABOUT HERE

The results of the study showed that the inventory control system achievement test would be useful in efficiently measuring achievement of inventory control system concepts, evaluating the effectiveness of instruction by measuring the group gain from pretest to posttest, and comparing the inventory control achievement of different groups. The results of the test also can be used to evaluate students' progress by providing information on specific areas of strengths and weaknesses. From this study, it is apparent that the inventory control achievement

test can be used by educators and practitioners to obtain a content valid and reliable measurement of inventory control achievement of entry-level dietitians and beginning foodservice managers.

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Table 1. Table of specifications for inventory control system test

Content area	Cognitive levels			Total %
	Knowledge & Comprehension %	Application & Analysis %	Synthesis & Evaluation %	
Receiving	9	3	-	12
Storing	10	2	-	12
Issuing	3	3	-	6
Inventory control	22	14	10	46
Inventory valuation	6	8	2	16
Inventory control computer system	8	-	-	8
Total	58	30	12	100

Table 2. Test statistics for achievement test

Test characteristic	Test statistics
Number of items in test	50
Number of students responding	105
Reliability coefficient^a	0.84
Mean score	37.52
Range of scores	12 - 50
Standard error of measurement	2.72
Standard deviation	6.70
Average difficulty	75%

^aReliability coefficient was calculated by the Kuder-Richardson 20 formula.

A new manager has recently taken over the purchasing and storing of products for a large college foodservice. The previous manager liked to order items in very large quantities because of price discounts for volume purchases and the availability of storage space. The inventory turnover rate for the last year was 0.73. The foodservice director has indicated there is a lack of capital for improvement projects and has asked all managers to propose solutions to the problem. The cooks complain that the quality of products is poor to average.

1. The larger amount of stock on hand will lead to
 - A. increased efficiency.
 - * B. increased cost.
 - C. decreased waste.
 - D. decreased old stock.
2. The cause of the cooks complaint about low product quality may be due to
 - * A. lengthy storage time.
 - B. inappropriate receiving practices.
 - C. poor purchasing practices.
3. The low turnover rate is caused by
 - A. low total food sales.
 - * B. high inventory levels.
 - C. low level of available capital.
 - D. high capacity for storage.

* Indicates correct answer.

Figure 1. Sample test items measuring complex levels of achievement in inventory control system.

**ARTICLE II. A FOODSERVICE INVENTORY CONTROL SYSTEM MODULE: THE EFFECT
OF INSTRUCTION ON ACHIEVEMENT AND ATTITUDE**

ABSTRACT

The purposes of this study were to: (a) develop a self-instructional module on inventory control system, and (b) evaluate the self-instructional module using a nonequivalent control group design; experimental treatments were lecture and self-instruction. The self-instructional module was developed based on content analyses of leading textbooks and judgement of three faculty members with specialization in foodservice management. The identified content areas were receiving, storing, issuing, inventory control, inventory valuation, and inventory control computer systems. Subjects consisted of 88 students, with 46 in the lecture group and 42 in the self-instruction group. All the subjects completed a pretest and a posttest. Data were analyzed using an analysis of covariance. The difference in posttest adjusted mean scores between the lecture and self-instruction groups was significant ($p < 0.05$) with students in the self-instructional group having higher adjusted mean scores. Therefore, the inventory control self-instructional module was judged at least equally as good as the lecture method in enhancing student's understanding of inventory control system concepts.

INTRODUCTION

An inflation continues to affect the economy, increased food prices inflate the investment of foodservice operations in their inventories. This trend forces foodservice and dietetic managers towards centralization of purchasing, attempts to predict demand, and management of inventory in an effort to contain costs. As pressures for cost containment have increased in all types of foodservice operations, dietitians and foodservice managers must become more cost conscious and efficient in resource management to attain desired performance outcomes (Hoover, 1983).

The skills and characteristics essential to managerial effectiveness involve acquisition of management science techniques. One of the important management science techniques is inventory control; effective inventory control has become essential to foodservice operations under this economy because an effective inventory control system ensures that supplies are purchased at minimum cost while desired qualities are maintained.

Evidence supporting the importance of inventory control is found in a study by Finley and Kim (1986). They surveyed directors of health care foodservice systems concerning the use of 17 management science techniques and found that inventory control is the most important and valuable of the management science techniques. They also indicated that the major problem areas facing the foodservice managers today is cost and production control.

The need for foodservice managers to use inventory control systems is also supported by the minimum competencies identified for entry-level dietitians and beginning foodservice managers (Loyd and Vaden, 1977; Mariampolski, Spears, and Vaden, 1980). Buergermeister (1983) surveyed 150 members of the Council on Hotel, Restaurant, and Institutional Education (CHRIE) concerning the important competencies for beginning managers. The findings indicated that technical skills in inventory control are highly desirable for beginning managers in hospitality industry.

Although theory for inventory control in business is well developed the application of inventory control to foodservice operations is just beginning. This gap will narrow as educational institutions integrate inventory control techniques into their courses (Tersine, 1982).

One approach to teaching inventory control techniques is self-instruction. Unlike teacher-directed instruction, self-instruction focuses on the individual student. In the self-instructional approach, educators provide the tools but the individual is responsible for his/her own learning. Programs can be used with many types of students and subject matters, either by themselves or in combination with other instructional programs. The teaching technique based on self-instructional programs is called programmed instruction (PI) (Jacobs, Maier, and Stolzow, 1966).

In the relatively short time since programmed instruction was introduced in the 1970s, many schools, institutions, and industries have used this technique (Kiang, 1970; Wittkopt, 1972; Fiel and Ways, 1972;

Shannon, 1976). Self-instruction offers many advantages. Each individual receives the same quality of standardized information, not dependent on the knowledge, teaching skills, or available time of the instructor. The student participates in a guided program of self-study that is pursued independently. The programmed material enables the students to know immediately whether their responses are correct and students progress at their own rate of speed (Hughes and Reid, 1975).

Due to the multi-dimensional responsibilities of foodservice managers work in a variety of practice settings and their critical need for continuing education within limited time parameters, self-instruction offers a sound alternative to traditional forms of instruction (Holli, 1982). The self-instruction program can be studied as desired during the manager's free time which sporadically arises within his/her respective schedules. Therefore, a well-prepared self-instruction program offers help to busy dietitians and foodservice managers to not only acquire the basic factual knowledge but also to apply knowledge to their professional life situations.

In an attempt to use programmed instruction in dietetic and foodservice education, several dietetic and foodservice educators have found the use of self-instructional packages equally as good as traditional instructional methods (Hutton and Davidson, 1979; Roach and Wakefield, 1974; Pietrzyk, Brittin, and Chamberlain, 1978). Although some research has been conducted on self-instructional programs with effective results in dietetic and foodservice management education, no educational programs have been developed on inventory control for

**dietetic and foodservice management students and practitioners in
foodservice operations.**

METHOD

The purposes of this study were to (1) develop a self-instructional module on inventory control, and (2) evaluate the self-instructional foodservice inventory control system module using a nonequivalent control group design.

Experiment Treatments

The experimental treatments used in the study were lecture and self-instruction. A self-instructional module entitled, "Inventory Control System Self-Instructional Module", was developed (Kim, Finley, and Fanslow, 1989). The module was divided into six sections with a total of 228 frames. The content areas were identified from a content analysis of inventory control systems using textbooks and consultation with Hotel, Restaurant, and Institution Management department faculty at Iowa State University. Textbooks used were by Dittmer and Griffin (1984), Spears and Vaden (1985), Powers and Powers (1984), Stefanelli (1985), West, Wood, Harger, and Shugart (1977), Pedersen (1981), Knight and Kotschevar (1979), and Kasavana (1984).

The content areas identified were receiving, storing, issuing, inventory control, inventory valuation, and inventory control computer system. All content areas were divided into the cognitive domains: knowledge and comprehension, application and analysis, and synthesis and evaluation. Objectives for each content area were developed at each

cognitive level. A panel of three faculty members verified the accuracy of the objectives. Therefore, in this self-instructional module, complex levels of learning are included. As such, the module overcomes the inherent weakness of most programmed instruction units that only knowledge objectives are included (Chamberlain and Kelly, 1975).

For the lecture group on inventory control systems, the six content areas were presented from outlines developed for the self-instructional module. Questions were answered as they arose, and a reading assignment supplemented the lectures.

Instrumentation

Devices used in this study consisted of an achievement test and an attitude inventory. Each of these devices was developed specifically for this study.

The achievement test was developed from a table of specifications and based on the content areas of the module. The achievement test consisted of 114 multiple-choice items, each with a single correct response. A panel of three faculty members verified the accuracy of the content of the test items. Evaluation specialists examined each test item for adherence to item-writing principles.

The test was administered to 105 students following instruction in inventory control techniques. Difficulty and discrimination indices were calculated. The best 50-items were selected for the final form of the inventory control test. Dual criteria were used for selection of items.

The first criterion was adherence to the table of specifications, and the second, the selection of an item with a difficulty index between .30 and .70^a in conjunction with a discrimination index > 0.20 (Kim, Fanslow, and Finley, 1988).

The Kuder-Richardson formula 20 was used to calculate the reliability coefficient of the 50-item test. The reliability was 0.84, above the recommended 0.70 if the test is used in basic research (Nunnally, 1982).

An instrument, Attitudes Toward Inventory Control System Module, was developed to measure student responses toward the inventory control system self-instructional module. The seventeen items were stated positively and negatively. A nine-point scale of agree and disagree was used with 1 being strongly disagree and 9 being strongly agree. The response pattern was reversed for the items that described undesirable characteristics of the self-instructional module so that a high score would indicate positive feelings toward the module.

The content validity of the attitude scale statements was established through the use of a panel of experts. The reliability coefficient of the total scale was 0.90 using the coefficient alpha procedure.

Questions were developed to obtain demographic information from the subjects. The questions requested information about the subjects' sex, age, academic class standing, academic major, college grade point average (GPA), and work experience in foodservice.

Experiment

A nonequivalent control group design was used for this study. The experimental treatments were lecture and self-instruction. The researcher selected two consecutive, 90-minute class periods in which the inventory control unit was to be taught.

The pretest and demographic data were collected at the beginning of each semester. The posttest was administered after each experimental treatment. The self-instruction group also responded to an attitude inventory.

The inventory control system self-instructional module was utilized by the self-instructional group. Students studied the self-instructional module independently during the two, 90-minute class periods. Students were allowed to study the module between the second class period and the posttest.

Students in the lecture method were instructed via lecture plus assigned readings. These students also studied their lecture notes and assigned readings prior to the posttest.

Subjects

The subjects included 88 students enrolled in foodservice management information systems courses during the 1987-1988 school year at Iowa State University. Students in Fall 1987 were assigned to the lecture group ($N = 46$) and those in Spring 1988 were assigned to the self-

instructional group (N = 42).

When background characteristics of students were compared between the two experimental treatment groups using either chi-square or t-test, no significant differences were found (Table 3). In both groups, one-third of the students were males and two-third were females. Seniors were reported as the most common academic class (80%), while juniors were second. Over 70% were hotel and restaurant majors and approximately 19% were dietetic majors. Students essentially had no work experience related to the inventory control content area.

INSERT TABLE 3 ABOUT HERE

Students in both groups had identical mean grade point averages of 2.70 on a 4-point scale. The lecture group had a mean age of 21.34 and the self-instruction group had a mean of 21.98. It is apparent that both experimental groups were almost identical on what were considered relevant background variables.

Data Analysis

Correlation coefficients were computed between pretest, major, and GPA and posttest scores for both experimental groups and across the total samples. The three correlation coefficients between major and posttest

for the total group, lecture and self-instruction group were not significant indicating that major was not associated with final achievement. Not surprisingly, the correlation coefficients between GPA and posttest scores were significant and were lecture, 0.51; self-instruction, 0.44; and total group, 0.45. These results demonstrated that students with high GPAs scored higher on posttest than did those with lower GPAs.

The coefficients between pretest and posttest scores were lecture, 0.55; self-instruction, 0.49, and total group, 0.59. Because the size of the coefficients indicated a relationship between pre- and posttest scores, an analysis of covariance was judged to be the appropriate analysis.

An analyses of covariance was calculated to determine whether there was a significant difference in the posttest adjusted mean scores between the two experimental treatments. The analysis of covariance also was used to statistically control most of the effect that pretest performance might have had on the posttest mean scores.

Difficulty indices by item by instructional strategy, i.e., lecture versus self-instruction, were calculated. Difficulty differences were plotted and summarized. Plots were studied to determine if some content areas were easier than others by instructional method.

Individual item means and the overall mean were calculated for the attitude inventory. Results were inspected to determine what students liked or disliked about the self-instructional module.

RESULTS AND DISCUSSION

Achievement Test

Pretest scores were significantly different by group ($F = 49.86$, $p < 0.001$) as determined by the analysis of covariance. The mean pretest score was 26.76 for the lecture group and 30.57 for the self-instructional group (Table 4). Because these initial differences existed between groups, the effect of most of these differences in prior knowledge was removed through the use of analysis of covariance and the calculation of adjusted mean scores.

The adjusted mean scores on the achievement posttest between the lecture and self-instructional groups were significantly different ($F = 6.22$, $p < 0.05$) (Table 4). For the instructional effect, the lecture group had a posttest adjusted mean score of 37.7; the self-instructional group had a score of 40.2. The lecture group had an unadjusted posttest mean score of 36.7 while the self-instructional group had a score of 41.2. The difference of posttest unadjusted mean score between the two experimental groups was 4.51 while the difference of posttest adjusted mean score between the two experimental groups was 2.48 (Table 5). Therefore, groups were more similar on posttest adjusted mean score after analysis of covariance than before.

A reduction occurred in the numeric size of the difference between the pretest and posttest mean scores after adjustment. This numeric reduction suggests that the self-instructional module is at least as good

as the lecture method. Although the self-instructional module may be better than the lecture method, sufficient degrees of freedom were not available in the quasi-experiment for a more precise testing of the hypothesis.

INSERT TABLES 4 AND 5 ABOUT HERE

Difficulty differences between instructional strategy by item and content areas are plotted in Figure 2 and shown in Table 6. If the difficulty index difference was $> 5\%$ between the two experimental treatments, then one experimental treatment was judged more effective than the other. If the difficulty index difference range was from -5% to $+5\%$ between the two experimental treatments, then the two experimental treatments were judged equal. These values were arbitrarily set by the investigators.

Inspection of Table 6 shows that the self-instruction treatment had more items that were easier after instruction than did the lecture method. Content areas that were easier were: receiving, storing, issuing, and inventory control computer systems. Perhaps a reason for students finding items easier after studying the self-instructional module than exposure to the lecture method was the close and hands-on experience associated with the self-instructional method.

INSERT TABLE 6 AND FIGURE 2 ABOUT HERE

Attitude Inventory

Nine of the 17 attitude items had mean scores > 6 with a minimum 6.10 and maximum 6.98. Inspection of the mean scores of these nine items indicated that students had positive feelings toward the self-instruction as a method of learning, felt they learned about inventory control techniques through use of the module, and believed the frames that contained questions reinforced their learning. Collectively, the findings suggested that the students had positive attitudes toward the self-instructional module, as indicated by the mean attitude scale score of 6.15 out of a possible 9 points (Table 7).

INSERT TABLE 7 ABOUR HERE

CONCLUSIONS AND RECOMMENDATIONS

The results of experiment showed that self-instructional module was as effective or better than the lecture method in enhancing students' understanding of the inventory control concepts when implemented in the college classroom. Both individual attitude items and the overall attitude scale score showed favorable attitudes by students toward the self-instructional module.

Because the experiment was implemented in a college setting using only two classrooms, it would be desirable to replicate the experiment in the college setting using at least 4 to 6 more classrooms. If it were possible to randomly assign students to classrooms then a study could be conducted using a true-experimental design, i.e., a pre- and posttest design with control group.

Finally, the module also might be assessed in a field experiment using dietitians and foodservice and hospitality managers. Such a study would be appropriate because of the similarity of inventory control practices among the three types of managers. If the field experiment were to be implemented, one experimental treatment would be the study of the self-instructional module by practitioners in conjunction with a full-time job; the other experimental treatment could be studying inventory control in a continuing education setting. Such a study would verify the usability of the self-instructional module by practitioners in a field setting.

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Table 3. Profile of experimental groups

Characteristic	Lecture		Self-instruction	
	Number	Percentage	Number	Percentage
Sex				
Male	16	34.8	14	33.3
Female	30	65.2	28	66.7
Grade				
Junior	6	13.0	7	16.7
Senior	37	80.4	34	81.0
Graduate	3	6.6	1	2.3
Majors				
Hotel and restaurant management	33	71.7	32	76.2
Foodservice management	1	2.2	1	2.4
Hotel, restaurant, and institution management	2	4.3	1	2.4
Dietetics	9	19.6	8	19.0
Business administration	1	2.2	-	-
Part-time work experience				
Storeroom clerk				
No	44	95.7	38	90.5
Yes	2	4.3	4	9.5
Receiving clerk				
No	42	91.3	38	90.5
Yes	4	8.7	4	9.5
Full-time work experience				
Storeroom server				
No	45	97.8	42	100.0
Yes	1	2.2	0	0.0
Receiving clerk				
No	45	97.8	42	100.0
Yes	1	2.2	0	0.0
Supervisor				
No	41	89.1	39	92.9
Yes	5	10.9	3	7.1
Assistant manager				
No	42	91.3	39	92.9
Yes	4	8.7	3	7.1
Manager				
No	44	95.7	40	95.2
Yes	2	4.3	2	4.8

Table 4. Analysis of covariance between experimental treatments

Source of Variance	df	Sum of squares	Mean squares	F-ratio
Covariate	1	940.47	940.47	49.86***
Treatments	1	117.30	117.30	6.22*
Residual	85	1603.31	18.86	

***p < 0.001.

*p < 0.05.

Table 5. Pre- and posttest statistics for achievement test scores

Group	Pretest		Posttest		Adjusted Posttest Mean
	Mean	SD	Mean	SD	
Lecture (N = 46)	26.76	5.12	36.70	5.39	37.67
Self-instruction (N = 42)	30.57	4.80	41.21	4.70	40.15

Table 6. Difficulty index difference by content areas and experimental groups

Number of items	Content area	Self-instruction more effective than lecture ^a	Lecture more effective than self- instruction ^b	Two groups are equal ^c
		No.	No.	No.
6	Receiving	4	0	2
6	Storing	4	1	1
3	Issuing	2	0	1
23	Inventory control	11	1	11
8	Inventory valuation	3	2	3
4	Inventory control computer system	3	1	0

^aSelf-instruction was judged more effective than lecture if the difficulty index differences were > 5%.

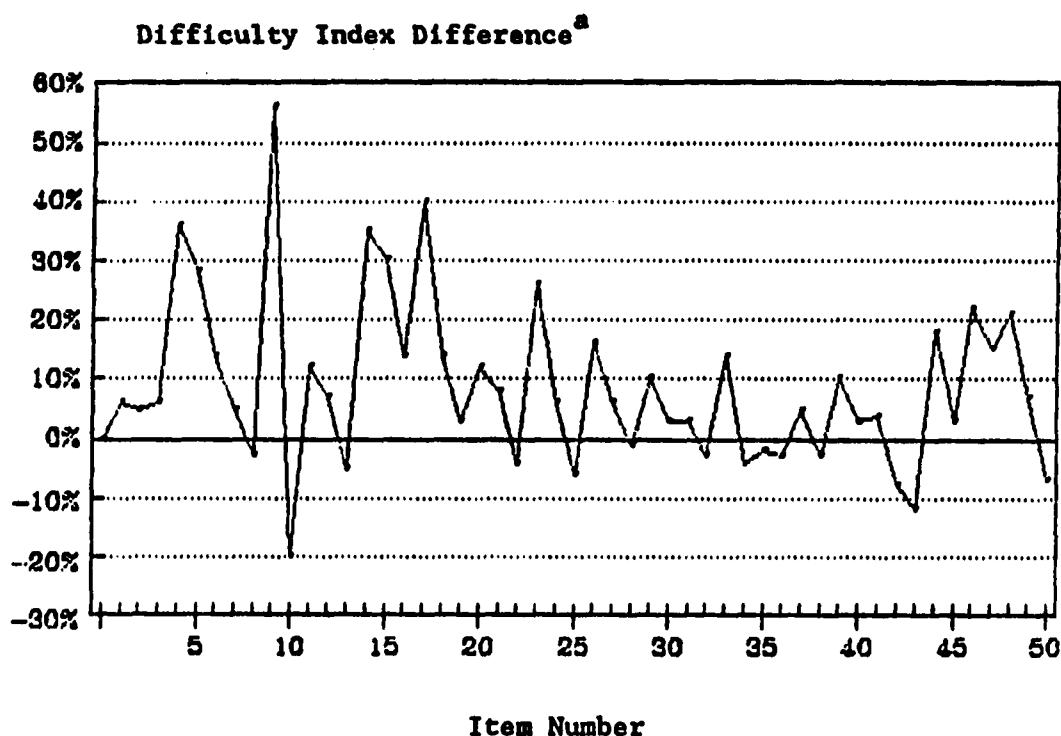
^bLecture was judged more effective than self-instruction if the difficulty index differences were < -5%.

^cThe difficulty index differences were between -5% and +5% between the two experimental groups.

Table 7. Attitude scale scores by item for the self-instruction group

Item	Mean	SD
The module did not meet the hopes that I had or it.	6.98 ^a	1.04
It was a waste of time to study this module.	6.95 ^a	1.07
The module helped me to learn about the inventory control system.	6.76	1.02
When I hear the word self-instruction, I have a feeling of dislike.	6.54 ^a	1.57
The module helped me to apply the inventory control system to the foodservice operation or healthcare foodservice systems.	6.51	1.25
The questions in the module were so simple that they were boring.	6.46 ^a	1.69
I would like more opportunity to use this type of self-instruction in other areas.	6.37	1.58
The questions in the module helped me to grasp the content.	6.34	1.83
I retained the knowledge of inventory control system because of the self-instructional teaching method.	6.10	1.55
The content of the self-instructional module was dull.	5.98 ^a	1.74
The questions in the module were an incentive to complete the module.	5.90	1.61
I found the content of the module interesting.	5.88	1.76
Every expectation I had for this module has been exceeded.	5.81	1.38
I wish I was not in the group to use the self-instructional module.	5.71 ^a	1.59
I need to study the self-instructional inventory control system module more thoroughly.	5.56	1.72
The content of the module gave me an understanding of inventory control systems.	5.46	1.87
My feelings about the self-instructional module are positive.	5.22	1.78
Total	6.15	0.97

^aResponse pattern was reversed because the items described undesirable characteristics of the self-instructional module.



^aPoints plotted above 5% suggest that the items were easier for students who were instructed by the self-instructional module than by the lecture method; points plotted below -5% suggest the items were easier for those instructed by the lecture method.

Figure 2. Difficulty index difference by experimental group

SUMMARY AND RECOMMENDATIONS

Summary

The major purposes of this study were to develop an inventory control system achievement test for students in a foodservice management information systems course, to develop a self-instructional module on inventory control systems, and to evaluate the module using a nonequivalent control group experimental design. Experimental treatments were lecture and self-instruction.

The content areas were identified from a content analysis of information on inventory control systems from leading textbooks. The identified content areas were receiving, storing, issuing, inventory control, inventory valuation, and inventory control computer systems. Objectives for each content area were developed. All content areas were divided into the cognitive domains: knowledge and comprehension, application and analysis, and evaluation and synthesis (Appendix B). A table of specifications was developed to coincide with the emphasis found in the objectives.

Based on the table of specifications, a total of 114 test items in a multiple choice format were developed (Appendix C). A panel of 3 faculty members with expertise in inventory control systems verified the accuracy of the content of the test items. Evaluation specialists evaluated the items for adherence to item writing principles. Finally, the device was pilot tested with 14 students for usability and clarity of the items.

As a result of the comments from judges and students, certain items were revised.

A sample of 105 students enrolled in a foodservice management information system courses during the 1987-88 school year responded to the test. Item statistics were computed for the 114 test items along with reliability, standard error of measurement, standard deviation, and mean test scores. Item analysis data were examined.

The best 50 items were selected for the final form of the inventory control system achievement test (Appendix D). Dual criteria were used for selection of items: they were adherence to the table of specifications and a difficulty index between 30 and 70% with a discrimination index > 0.20 . The Kuder-Richardson formula 20 was used to calculate the reliability coefficient.

The 50-item inventory control system achievement test was reliable as indicated by a Kuder-Richardson 20 value of 0.84, was judged as content valid, and was considered to be objective and usable. The resulting test statistics indicated that the 50-item test had a mean score of 37.52, and a range of 12 to 50. The standard error of measurement was 2.72, the standard deviation was 6.70, and the average difficulty was 75%.

An instrument, "Attitudes Toward Inventory Control System Module", was developed to measure student reactions toward the inventory control system self-instructional module (Appendix E). The reliability coefficient of the total scale was 0.90 using the coefficient alpha procedure. A demographic questionnaire was developed and used to obtain

background information from each subject (Appendix E).

Two experimental treatments were developed for the quasi-experiment: self-instruction and lecture. Both were developed based on the identified areas. The self-instructional module entitled, "Inventory Control System Self-Instructional Module", was divided into 6 sections with a total of 228 frames (Kim, Finley, and Fanslow, 1989). The six content areas were divided into the cognitive domains: knowledge and comprehension, application and analysis, and synthesis and evaluation. Objectives for each content area were developed at each cognitive level. A panel of three faculty members verified the accuracy of the objectives. For the lecture group, the 6 content areas were presented from outlines developed for the self-instructional module.

The subjects consisted of 88 students, with 46 in the lecture group and 42 in the self-instructional group. All the subjects completed a pretest and demographic questionnaire, and a posttest. The self-instruction group also responded to an attitude inventory.

Background characteristics of students were very similar between the two experimental treatment groups. Of the 88 students, one-third were males and two-third were females with a mean age of 22. Seniors were reported as the most common academic class (80.7%), while 14.8% of the students were juniors. Approximately, 80% were hotel, restaurant, and institution management majors and 20% were dietetic majors. Average college GPA was 2.70. A majority of students had no inventory control-related work experience in the foodservice industry.

Descriptive statistics, Pearson product-moment correlations, and

analysis of covariance were used to analyze the data. The difficulty differences between instructional strategy by item and content areas were calculated.

The size of the correlation coefficients for both experimental groups and across the total sample indicated relationships between pre- and posttest scores. Therefore, an analysis of covariance was judged to be the appropriate analysis. Results showed that the adjusted mean scores on the achievement posttest between the two experimental groups were significantly different. However, groups were more similar on posttest adjusted mean scores than they were on the unadjusted posttest mean scores. These findings indicated that the inventory control self-instruction method may be more effective or equally as good as the lecture method.

Inspection of the difficulty difference indices showed that the self-instruction treatment had more items that were easier after instruction than did the lecture method in the content areas of receiving, storing, issuing, and inventory control computer systems. A reason for students finding items easier after studying inventory control using the self-instructional module may be the close and hands-on experience associated with the self-instructional method.

Nine of the 17 attitude inventory items had mean scores > 6 with a minimum of 6.10 and maximum of 6.98. The overall mean score for the attitude inventory was 6.15. These findings indicated that students had positive feelings toward self-instruction as a method of learning, perceived the module helped them learn about inventory control

techniques, and believed the frames that contained questions reinforced their learning. Collectively, students in the self-instruction group had overall favorable attitudes toward the module.

The results of the study showed that the inventory control system achievement test would be useful to evaluate individual student's achievement, to evaluate the effectiveness of instruction, and to compare the inventory control achievement of different groups. From this study, it is apparent that the inventory control achievement test can be used by educators and practitioners to obtain a content valid and reliable measurement of inventory control achievement of entry-level dietitians and beginning foodservice managers.

Recommendations

The following recommendations are made for future research:

1. Administer the 50-item achievement test to 300 students after completion of at least 3 hours of instruction in inventory control. Data from this number of students would provide a more stable estimate of the reliability coefficient of the achievement test.
2. Repeat the experiment using more replications. A minimum recommendation would be to replicate the experiment with 4 to 6 additional classrooms. Additional replications would increase the degrees of freedom and permit a more precise test of the hypothesis.
3. Conduct the experiment using a true experimental design rather than a quasi-experimental design. Ideally, the experiment would be

conducted as a pretest-posttest control group design. A true experimental design would permit random assignment of subjects to groups and hence, would have greater internal validity than the quasi-experimental design employed in this study.

4. Assess the usability of the self-instructional module in a field experiment using dietitians and foodservice managers. One experimental treatment could be the study of the self-instructional module by full-time practitioners; the other experimental treatment could be the study of inventory control techniques in a continuing education setting. Such a field experiment would be desirable because results would show the utility, or the lack thereof, of the self-instructional module in a field setting.

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APPENDIX A.

UNIVERSITY COMMITTEE ON THE USE OF HUMAN SUBJECTS

85

IN RESEARCH APPROVAL

Informed Consent Statement

87

INFORMATION ON THE USE OF HUMAN SUBJECTS IN RESEARCH

IOWA STATE UNIVERSITY

(Please follow the accompanying instructions for completing this form.)

1. Title of project (please type): Validation of a Self-Instructional Foodservice Inventory Control System Module

2. I agree to provide the proper surveillance of this project to insure that the rights and welfare of the human subjects are properly protected. Additions to or changes in procedures affecting the subjects after the project has been approved will be submitted to the committee for review.

Il-Sun Yang Kim

Typed Name of Principal Investigator

Date

Signature of Principal Investigator

4 MacKay Hall

294-4865

Campus Address

Campus Telephone

3. Signatures of others (if any) Date Relationship to Principal Investigator

John J. n. Finley

9-22-87

Co-Major professor

John J. n. Finley

9-22-87

Co-Major professor

4. ATTACH an additional page(s) (A) describing your proposed research and (B) the subjects to be used, (C) indicating any risks or discomforts to the subjects, and (D) covering any topics checked below. CHECK all boxes applicable.

- Medical clearance necessary before subjects can participate
- Samples (blood, tissue, etc.) from subjects
- Administration of substances (foods, drugs, etc.) to subjects
- Physical exercise or conditioning for subjects
- Deception of subjects
- Subjects under 14 years of age and(or) Subjects 14-17 years of age
- Subjects in institutions
- Research must be approved by another institution or agency

5. ATTACH an example of the material to be used to obtain informed consent and CHECK which type will be used.

 Signed informed consent will be obtained. Modified informed consent will be obtained.

6. Anticipated date on which subjects will be first contacted: Month Day Year

Sept 3 1987

Anticipated date for last contact with subjects:

Dec 15 1988

7. If Applicable: Anticipated date on which audio or visual tapes will be erased and(or) identifiers will be removed from completed survey instruments:

Month Day Year

8. Signature of Head or Chairperson Date Department or Administrative Unit

James G. Karas 9-22-87 HRIM

9. Decision of the University Committee on the Use of Human Subjects in Research:

Project Approved Project not approved No action required

George G. Karas

Name of Committee Chairperson Date Signature of Committee Chairperson

**Use of Human Subjects in Research
Iowa State University**

INSTRUCTIONS FOR PARTICIPANTS

Prior to the distribution of a packet of materials, the following information/instruction will be provide the prospective participants:

1. The purpose of this study is to evaluate a self-instructional module on inventory control system using a pre- and posttest control group experimental design.
2. You are being asked to participate in this study. The items which you will complete requires approximately 50 to 60 minutes and ask questions about inventory control systems.
3. Your participation in the study will be confined to regular class time and includes your responses to the pre- and posttest.
4. No risks and/or discomforts to you are anticipated.
5. Final exam of this course will cover the same information as this test and will be used as one component in determining your final course grade.
6. All individual data will be confidential. The results of the study will be reported as group means.
7. Based on the result of this study, the effectiveness of self-instructional foodservice inventory control system module as an instructional method will be identified and recommendations will be made for further research.

APPENDIX B.

**INVENTROY CONTROL SYSTEM CONTENT AREAS AND
ASSOCIATED OBJECTIVES**

88

RECEIVING

Cognitive level	Specific objectives
Knowledge	Describe the principal characteristics of effective receiving procedures.
Knowledge	List the primary types of receiving records and their purposes.
Knowledge	Identify the three reasons for maintaining receiving records.
Analysis	Identify ways to improve receiving procedures for a given foodservice operation.

STORING

Cognitive level	Specific objectives
Knowledge	Describe proper storage methods for various foods and supplies.
Knowledge	Describe factors in storage control.
Analysis	Identify ways to improve storage methods of a specific foodservice operation.

ISSUING

Cognitive level	Specific objectives
Knowledge	Describe the recommended procedure for issuing foods and supplies in foodservice operation.
Analysis	Distinguish between issuing Directs and Stores.

INVENTORY CONTROL

Cognitive level	Specific objectives
Knowledge	Identify two types of inventory control systems.
Knowledge	List the steps to complete a physical inventory.
Knowledge	List the steps in maintaining a perpetual inventory system.
Knowledge	Identify the role of physical and perpetual inventory systems in foodservice management.
Knowledge	Describe the application of the ABC method of inventory control in a foodservice operation.
Knowledge	List the advantages and disadvantages of a physical inventory system.
Knowledge	List the advantages and disadvantages of a perpetual inventory system.
Analysis	Select the optimum inventory system for a specific foodservice operation.
Application	Compute inventory turnover for the month given appropriate figures.
Analysis	Recognize records used for the two types of inventory control systems.
Synthesis	Revise an existing system to improve management control.
Evaluation	Interprete the significance of a change in inventory turnover rate.

INVENTORY VALUATION

Cognitive level	Specific objectives
Knowledge	Define book value, actual value, opening inventory, and closing inventory.
Knowledge	Identify the five basic methods of inventory valuation.
Comprehension	Explain the causes for differences between book and actual inventory.
Application	Compute costs of closing inventory using five methods.
Analysis	Compare the values of closing inventory calculated by five methods.
Application	Compute the daily inventory balance given appropriate figures.
Analysis	Determine the difference between book and actual inventory values.
Evaluation	Compare the difference found between book and actual inventory values with an acceptable range.
Evaluation	Evaluate the use of book value and actual value in a foodservice operation.

INVENTORY CONTROL COMPUTER SYSTEM

Cognitive level	Specific objectives
Knowledge	Identify the basic components of a computer assisted foodservice inventory control system.
Knowledge	Identify ways the computer can assist a manager in establishing controls for the purchasing, storing, and issuing of foods.
Knowledge	Identify how a computer system can assist a manager in determining the value of inventory.

APPENDIX C.

TABLE OF SPECIFICATIONS FOR THE 114-ITEM TEST	94
Table of Items in 114-item Achievement Test Associated with Categories in the Table of Specifications	96
Inventory Control Test	97
Answer Key	119

Table C1. Table of specifications for the 114-item test

Content area	Cognitive level							
	Knowledge & Comprehension		Application & Analysis		Synthesis & Evaluation		Total	
	No.	%	No.	%	No.	%	No.	%
Receiving	11	10	3	3	-	-	14	13
Storing	14	12	3	3	-	-	17	15
Issuing	3	3	3	3	-	-	6	6
Inventory control	22	19	14	12	10	9	46	40
Inventory valuation	6	4	11	10	4	3	21	17
Inventory control computer systems	10	9	-	-	-	-	10	9
Total	66	57	34	31	14	12	114	100

Table C2. Items in 114-item achievement test associated with categories in the table of specifications

Content area	Cognitive level		
	Knowledge & Comprehension	Application & Analysis	Synthesis & Evaluation
Receiving	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11	18, 19, 20	
Storing	12, 13, 14, 15, 16, 17, 24, 25, 26, 27, 28, 29, 30, 31	21, 22, 23	
Issuing	32, 33, 34	35, 36, 37	
Inventory control	38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59	60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 73, 74, 80	71, 72, 75, 76, 77, 78, 79, 81, 82, 83
Inventory valuation	84, 85, 86, 87, 88, 89	90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100	101, 102, 103, 104
Inventory control computer systems	105, 106, 107, 108, 109, 110, 111, 112, 113, 114		

Inventory Control Test¹

DIRECTIONS

Write your name and social security number on the answer sheet. Mark the circles corresponding to your name and social security number.

The questions in the test give several possible answers. One answer is better than the others. Find the best answer and darken the corresponding space on the answer sheet using a No.2 pencil.

1. When unsatisfactory merchandise is delivered, the receiving clerk
 - A. accepts the delivery and reports the condition of merchandise to the manager.
 - B. prepares a credit memo in duplicate and sends to the office.
 - C. calls the supplier to tell them about the merchandise.
2. Effective receiving procedures can be maintained with
 - A. proper delivery equipment.
 - B. confident receiving personnel.
 - C. adequate receiving equipment.
3. The appropriate sequence of steps for receiving of products is

Step

1. completion of receiving records
 2. removal to storage
 3. inspection against purchase orders
 4. inspection against the invoice
 5. acceptance or rejection of the orders
- A. 4-3-5-2-1
 - B. 3-4-1-2-5
 - C. 4-3-1-5-2
 - D. 3-4-5-2-1

¹Il-Sun Kim and DoriAnn Finley. Department of Hotel, Restaurant and Institution Management, College of Family and Consumer Sciences. Iowa State University. July 1987.

4. When food and supplies are received from the vendor, a check for quality is usually done by the
 - A. records clerk.
 - B. shift manager.
 - C. receiving clerk.
5. When the quantity of items received is insufficient, the receiving clerk prepares
 - A. a request for credit memo.
 - B. an invoice stamp.
 - C. an average weight chart.
 - D. a receiving record.
6. An invoice is prepared by the
 - A. buyer.
 - B. customer.
 - C. vendor.
7. Receiving stamps are used when a
 - A. requisition is filled for a department in the foodservice establishment.
 - B. delivery is accompanied by an invoice, invoice duplicate, or vendor's delivery ticket.
 - C. merchandise is dated with a code, especially perishables.
8. Meat tags are used to tag items that are to be
 - A. sent to the kitchen for immediate use.
 - B. held in inventory for a few days.
 - C. left over after preparation.
9. A receiving ticket is used to verify when the receiving clerk
 - A. accepts the merchandise without invoice.
 - B. stamps the receiving date.
 - C. duplicates the information found on the invoice.
 - D. marks the perishable merchandise.
10. The reason for maintaining receiving records is to
 - A. determine stolen items.
 - B. establish control over receiving.
 - C. cost recipe ingredients for menus.

11. The primary reason for maintaining receiving records is to provide a basis for
 - A. controlling costs.
 - B. determining how much stock is stolen.
 - C. costing recipe ingredients.
12. The proper storage method for fruits and vegetables in a walk-in refrigerator is storing them
 - A. at least eight inches off the floor.
 - B. with cracked ice.
 - C. away from foods that absorb strong odors.
13. The proper procedure for the use of refrigeration units includes
 - A. keeping foods wrapped in soiled outside wrappings.
 - B. putting perishable and nonperishable foods together.
 - C. keeping foods with strong odors tightly covered containers.
 - D. putting food in slowly over time.
14. The proper storage method for frozen foods includes
 - A. refreezing foods that have thawed.
 - B. placing new stock in front to use first.
 - C. keeping frozen foods up to 3 years.
 - D. keeping frozen foods at 0 °F (-18 °C) or below.
15. Which food should be cross-stacked in the refrigerator?
 - A. Fish.
 - B. Eggs.
 - C. Fruits.
 - D. Vegetables.
16. The foods that require the lowest refrigeration temperature are
 - A. cereal products.
 - B. dairy products.
 - C. fish and meat.
 - D. raw fruits and vegetables.
17. All items placed in the freezer should be wrapped to prevent
 - A. freezer burn.
 - B. hydration.
 - C. spoilage.
 - D. temperature fluctuation.

Use the following case study to answer questions 18 through 23.

You are manager of a large hospital foodservice. The head a.m. cook is responsible for receiving duties because the receiving area is next to the cook's area. Deliveries are made at peak production times so that the head cook assigns an assistant cook to receive the goods, sign the invoices, and put the goods on the floor in the appropriate storage area. The assistant cook, however, is needed back in the cook's area immediately. A part-time high school student finishes putting the goods away later in the afternoon and is generally unsupervised. Everyone has free access to the storage areas. You notice that a lot of produce has been discarded because of spoilage. Also, the cooks have been complaining that the managers have not been ordering enough meat items to prepare the required amounts of food. You have determined that the shortage of meat items is due to pilferage.

18. Which of the following would be recommended to improve control during receiving?
 - A. Insist that the head cook does the receiving.
 - B. Train all assistant cooks to do the receiving.
 - C. Make the a.m. manager responsible for all receiving.
19. What is the most important problem in receiving meat items?
 - A. Failure to check the meat items in against the invoice and the specifications.
 - B. Failure to weigh and tag the meat items.
 - C. Failure to get meat into the freezer quickly.
 - D. Failure to take the temperature of meat when delivered.
20. Which receiving practice would reduce produce waste due to spoilage?
 - A. Checking goods in against invoice
 - B. Inspecting goods before accepting them
 - C. Writing up specifications for goods
 - D. Weighing all goods before storing
21. What is the probable cause of spoilage of produce?
 - A. There are mechanical problems with the refrigeration units.
 - B. Stock is not being rotated when put away.
 - C. Food was of poor quality when delivered.

22. Which practice can be implemented to reduce theft from storage areas?
- A. Implement a perpetual inventory system.
 - B. Hire a security guard to search employees as they leave work area.
 - C. Sponsor an inservice training session to deter pilferage.
 - D. Limit access to storage areas, especially those that contain the most expensive items.
23. What action would facilitate getting deliveries quickly and properly into storage?
- A. Place orders earlier.
 - B. Have deliveries made at nonpeak production times.
 - C. Increase the number of deliveries.
 - D. Have everyone help put deliveries away.
24. Dry storage areas should
- A. be air-tight.
 - B. have maximum temperature from 72 to 80 °F.
 - C. be well ventilated.
 - D. have relative humidity below 30%.
25. New stock placed in dry storage should be
- A. placed in front of older stock.
 - B. arranged alphabetically by product type.
 - C. arranged randomly.
26. Temperatures for deep freezers that keep foods solidly frozen are between
- A. -10 to 0 °F (-23.3 to -17.8 °C).
 - B. -10 to 32 °F (-23.3 to 0 °C).
 - C. 30 to 32 °F (-1.1 to 0 °C).
 - D. 38 to 40 °F (3.3 to 5 °C).
27. Refrigerated fresh fish and poultry have a maximum storage time of
- A. 1 day.
 - B. 3 days.
 - C. 5 days.
 - D. 7 days.

28. The maximum storage time in a refrigerator for most fruits and vegetables is
- A. 3 days.
 - B. 7 days.
 - C. 14 days.
 - D. 20 days.
29. Which procedure helps to maintain an appropriate arrangement for food items in storage?
- A. Having definite locations for each item
 - B. Keeping the least-used items readily available
 - C. Storing new items in front of old items
30. Good storage control is implemented by
- A. maintaining orderly arrangements.
 - B. informing vendors of quantities needed.
 - C. verifying quality of items.
 - D. assisting in deliveries.
31. Maintaining good storage control includes
- A. honesty of vendors.
 - B. arrangement of deliveries.
 - C. location of preparation areas.
 - D. security of food products.
32. A written request for issuing foods and supplies is called a
- A. requital.
 - B. reimbursement.
 - C. request.
 - D. requisition.
33. An accepted guideline for issuing is that
- A. regular issuing hours should be maintained.
 - B. supplies should be issued without a requisition.
 - C. storage should be open at all times.
34. The orderly issuing of all goods is enhanced by
- A. using requisitions properly.
 - B. controlling deliveries adequately.
 - C. costing items correctly.

Use the following receiving clerk's daily report to answer questions 35 through 37.

Receiving Clerk's Daily Report

Date July 11, 19XX

Quant	Unit	Description	Unit price \$	Amount \$	Total Amount \$	Purchase Journal Distribution		
						Food Directs	Food Stores	Sundries
		I.S.U. Meat Lab						
30	lbs	Frzn Ribeye steak	5.45	163.50				
10	lbs	Frzn B-B-Q Ribs	1.85	18.50				
					182.00			
		EISNER						
1	case	Tomato Sauce (#10CN)	30.00	30.00	30.00			
		Smith Produce & Fruit						
1	case	Lettuce	6.75	6.75				
1	case	Oranges	8.00	8.00				
					14.75			
		Save-V More						
1	box	Detergent	16.80	16.80	16.80			
					243.55	243.55		

35. What is the total cost of Stores?

- A. \$ 14.75
- B. \$ 31.55
- C. \$212.00
- D. \$232.00

36. What is the total cost of Directs?

- A. \$14.75
- B. \$31.55
- C. \$44.75
- D. \$51.55

37. Which of the following items will be charged as received to daily food cost?

- A. Rib eye steak
- B. Tomato sauce
- C. Oranges
- D. Detergent

38. The actual counting of products on hand in all storage areas is called a

- A. perpetual inventory.
- B. physical inventory.
- C. periodic inventory.
- D. regular inventory.

39. The process of maintaining a continuous record of all purchases and food issues is called a

- A. perpetual inventory.
- B. physical inventory.
- C. periodic inventory.
- D. regular inventory.

40. The appropriate sequence of steps for completing a physical inventory is

Step

1. total the cost of all items
2. count the items on hand
3. multiply the total count on hand by the cost of the item
4. record the inventory on the inventory record form

- A. 2-1-3-4
- B. 2-1-4-3
- C. 2-4-3-1
- D. 2-4-1-3

41. A physical inventory can be conducted more easily if items are arranged

- A. in alphabetical order.
- B. according to the recording form.
- C. by product group.

42. In a perpetual inventory system which step is completed when issuing storeroom items?
- Subtract the amount of each issued item from the balance on hand.
 - Check off each issued item from the daily delivery receipt.
 - Place each issued item on the monthly ending inventory reconciliation.
 - Check off each issued item on the weekly purchase orders.
43. When storeroom items are received, the perpetual inventory is maintained by adding each item to the
- monthly beginning inventory reconciliation.
 - balance on the bin card.
 - daily supplier's report.
 - daily storeroom food and supply ledger.
44. The appropriate sequence of steps to determine the monthly cost of food used in perpetual inventory system is
- Steps
1. subtract the present inventory on hand
 2. add the daily food purchases
 3. list the total cost of food at the beginning of the inventory period
- 3-2-1
 - 3-1-2
 - 2-1-3
 - 2-3-1
45. A physical inventory is conducted by foodservice managers to
- compare book and actual value.
 - insure that extra food is on hand.
 - add the daily food purchases.
 - check the quality of goods on hand.
46. A perpetual inventory system is maintained to
- provide accurate information of food and supplies on hand.
 - assist in determining vendors.
 - provide data for damaged food and supplies.
 - assist manager in preparing product specifications.

47. Physical and perpetual inventory systems are used to indicate the
- rate of delivery.
 - dollar value of stock.
 - amount of unit price.
 - size of storage.
48. A physical inventory provides managers with the ability to
- confirm the actual number of items on hand.
 - plan the storeroom employee's work schedule.
 - determine pilferage.
49. The A category items in the ABC method of inventory control consist of 15% of the inventory that has a
- low dollar volume.
 - moderate dollar volume.
 - large dollar volume.
50. Effort, time, and money in the ABC inventory method are allocated among items in proportion to inventory
- quantity.
 - value.
 - quality.
51. The perpetual inventory system is best suited to items in the
- A category.
 - B category.
 - C category.
52. The ABC classification system is based on
- Pearson's Law.
 - Pareto's Law.
 - Parkinson's Law.
53. In a commercial foodservice establishment with both food and beverage operations, liquor inventories would be categorized as
- A category.
 - B category.
 - C category.

54. Which of the following are C category items?
- A. Meats
 - B. Fruits
 - C. Vegetables
 - D. Condiments
55. In the ABC method, 35% of the inventory that has a moderate dollar volume is
- A. A
 - B. B
 - C. C
56. The major disadvantage of completing a physical inventory in comparison to maintaining a perpetual inventory system is the
- A. amount of time consumed.
 - B. inaccuracy of the counting techniques.
 - C. required storage sequences.
 - D. number of personnel needed at all times.
57. A physical inventory gives a manager these facts EXCEPT the
- A. actual number of items on hand.
 - B. actual dollar cost.
 - C. visual inspection of items.
 - D. immediate reconciliation of a shortage.
58. One advantage of the perpetual inventory system is that it
- A. requires minimum personal experience.
 - B. provides tight stock control.
 - C. reduces human error.
59. A disadvantage of the perpetual inventory system is that it
- A. requires additional staff time to maintain written records.
 - B. reduces the accuracy of the month's ending inventory.
 - C. requires an additional storage area for the reception of daily deliveries.
 - D. reduces storeroom security.

Use the following data to answer questions 60 and 61.

The record of Restaurant A for the month of May 1984 shows that the opening inventory is \$5,800; the closing inventory is \$5,400; and food cost is \$9,800.

60. The average inventory for the month of May 1984 is

- A. \$5,600
- B. \$5,800
- C. \$7,600
- D. \$7,800

61. The inventory turnover for the month of May 1984 is

- A. 1.26
- B. 1.29
- C. 1.69
- D. 1.75

62. Which formula is used to calculate inventory turnover for the month?

- A. $I = C/O$
- B. $I = C/F$
- C. $I = F/A$
- D. $I = F/C$

where, O = Opening inventory,
 F = Food cost for the month,
 A = Average food inventory,
 C = Closing inventory, and
 I = Inventory turnover for the month.

63. The form below would be used in which of the following types of inventory systems?

Item	Unit	On hand	Unit Cost	Total Cost

- A. Perpetual inventory
- B. Periodic inventory
- C. Physical inventory

Use the following information to answer questions 64 and 65.

The record of foodservice operation B for the month of July 1985 shows that food cost is \$13,320, and closing inventory is \$3,322.

64. If the average inventory for the month of July is \$3,304.5, the opening inventory is

- A. \$3,287.00
- B. \$3,313.00
- C. \$3,346.75
- D. \$6,693.50

65. If inventory turnover rate for August is the same as July and the average inventory is smaller than July, then the food cost for August is

- A. less than July.
- B. equal to July.
- C. greater than July.

66. The record of the Bear House shows that the total cost of food sold was \$400,000 and the average food inventory was \$16,000 for the year ending, Dec. 31, 1986. The food inventory turnover for 1986 was

- A. 0.04
- B. 2.50
- C. 4.00
- D. 25.00

67. The form below would be used in which of the following types of inventory systems?

						MINIMUM:
						MAXIMUM:
DATE	COMPANY & BRAND	PRICE		No. REC'D	No. ISSUED	BALANCE
		PER	UNIT			ON HAND

- A. Perpetual inventory
- B. Regular inventory
- C. Physical inventory

Use the following case study to answer questions 68 through 72.

A foodservice manager has noticed that customer demand for one of the high profit items, entree A, is unmet on the weekends. When entree A is not available customers order a lower profit item, entree B, instead. The operation is losing some potential profit and may be producing dissatisfied customers. Currently a physical inventory is conducted and orders are placed on Fridays. Deliveries are made Monday. Inventory turnover rate is 3.2. The manager decides to check inventory and order in needed items for the weekend on Thursday which are delivered on Friday in addition to taking the regular inventory and placing orders on Friday. The cost per item is higher because smaller quantities are being purchased; however, more high profit items are being sold. The inventory turnover rate is 2.7 under the revised system.

68. Which inventory system would be best to help maximize profit?
- A. Perpetual inventory system with increased stock levels
 - B. Physical inventory system with increased stock levels
 - C. Perpetual and physical inventory system with increased stock levels
69. The best overall inventory system would be the
- A. original physical inventory system.
 - B. revised inventory system.
 - C. perpetual inventory system with increased stock levels.
70. Implementing a perpetual inventory system with the same maximum stock level but a higher reorder point would increase
- A. profits.
 - B. food cost.
 - C. inventory turnover rate.
 - D. sales of low profit items.
71. The current revised inventory system will
- A. increase profits.
 - B. decrease labor costs.
 - C. increase food costs.
 - D. decrease holding costs.

72. The inventory turnover rate dropped from 3.2 to 2.7 because
- A. total food sales decreased.
 - B. total food sales increased.
 - C. inventory costs decreased.
 - D. inventory costs increased.
73. Bin cards are used to maintain a
- A. physical inventory record.
 - B. perpetual inventory record.
 - C. periodic inventory record.
74. Bin cards contain all of the following information about a product EXCEPT
- A. receiving.
 - B. issuing.
 - C. balance.
 - D. price.
75. A short cut that could speed up taking a physical inventory is
- A. assigning everyone to help with the inventory one day a week.
 - B. counting only the full cases and boxes.
 - C. taking inventory for every item on one day.
76. If only some items can be put on a perpetual inventory system, which items would be selected first?
- A. Dry goods
 - B. Paper items
 - C. Canned goods
 - D. Meat items
77. An inventory turnover rate of less than 1 suggests that the amounts of goods on hand are
- A. excessive.
 - B. ideal.
 - C. insufficient.
78. The Burger Queen has had an extreme decrease in inventory turnover rate. An expectation is that
- A. capital is flexible in inventory.
 - B. goods are spoiled in storage.
 - C. labor cost can be reduced in handling goods.
 - D. storage space can be reduced.

Use the following case study to answer questions 79 through 83.

A new manager has recently taken over the purchasing and storing of products for a large college foodservice. The previous manager liked to order items in very large quantities because of price discounts for volume purchases and the availability of storage space. The inventory turnover rate for the last year was 0.73. The foodservice director has indicated there is a lack of capital for improvement projects and has asked all managers to propose solutions to the problem. The cooks complain that the quality of products is poor to average.

79. The larger amount of stock on hand will lead to
- A. increased efficiency.
 - B. increased cost.
 - C. decreased waste.
 - D. decreased old stock.
80. The most appropriate change to ensure inventory control is to
- A. determine the maximum stock level.
 - B. increase the maximum stock on hand.
 - C. maintain the higher reorder point.
81. The cause of the cooks complaint about low product quality may be due to
- A. lengthy storage time.
 - B. inappropriate receiving practices.
 - C. poor purchasing practices.
82. The lack of capital could be resolved by
- A. reducing the inventory turnover rate.
 - B. ordering less costly food items.
 - C. reducing inventory levels.
 - D. increasing meal price.
83. The low turnover rate is caused by
- A. low total food sales.
 - B. high inventory levels.
 - C. low level of available capital.
 - D. high capacity for storage.

84. The best definition of the opening (or beginning) inventory is the total dollar value of foods
- A. ordered for the next period.
 - B. on hand at the end of the previous period.
 - C. available for sale at the end of the previous period.
85. The actual value of the closing inventory is the value of all items in the
- A. physical inventory.
 - B. perpetual inventory.
 - C. book inventory.
 - D. financial inventory.
86. Which method is the easiest and quickest way to determine the value of the closing inventory?
- A. Actual purchase price method
 - B. Last-in, first-out method
 - C. Latest purchase price method
 - D. Weighted average purchase price method
87. Which closing inventory valuation method depends on the assumption of rotation of stock?
- A. Actual purchase price method
 - B. First-in, first-out method
 - C. Lastest purchase price method
 - D. Weighted average method
88. To determine what caused a difference between book and actual value, the foodservice manager would
- A. review control procedures for issuing food.
 - B. review the vendor list and select a new vendor.
 - C. revise the food quality specification.
89. Book inventory value may be less than actual inventory value because of
- A. occasional human error in costing.
 - B. actual theft of food.
 - C. issue of foods without requisition.

Use the following data to answer questions 90 through 94.

The inventory records of the Skyway Restaurant show the following information about one of the items carried in the food inventory for the month of January.

<u>DATE</u>	<u>Activity</u>	<u>Quantity</u>	<u>Price</u>
1/1	opening inventory	10 cans	\$2.35/can
1/12	purchased	24 cans	\$2.40/can
1/26	purchased	12 cans	\$2.30/can

On January 31, the physical inventory shows 20 cans left in stock.

90. Determine the value of ending inventory using the FIFO (first-in, first-out) method.
- A. \$46.00
 - B. \$46.80
 - C. \$47.00
 - D. \$47.50
91. Determine the value of ending inventory using the LIFO (last-in, first-out) method.
- A. \$46.00
 - B. \$46.80
 - C. \$47.00
 - D. \$47.50
92. The value of the ending inventory for January using the weighted average method is
- A. \$46.24
 - B. \$46.74
 - C. \$47.00
 - D. \$47.20
93. Which of the following methods assigns the greatest dollar value to the inventory?
- A. FIFO (first-in, first-out) method
 - B. LIFO (last-in, first-out) method
 - C. Weighted average method
 - D. Latest purchase price method
94. The dollar value difference between the last-in, first-out (LIFO) and latest purchase price method for the inventory is
- A. \$0.70
 - B. \$0.80
 - C. \$1.26
 - D. \$1.50

Use the information given below to prepare a daily and cumulative analysis of inventory balances on a given form. The opening inventory figure for October 1 is \$8,360.

October 1: From the Receiving Sheet; Directs, \$206, and Stores, \$463.
 Meat Tags; \$320. Requisitions; \$247.
 Sales; \$2,350.

October 2: From the Receiving Sheet; Directs, \$260, and Stores, \$105.
 Meat Tags; \$184. Requisitions; \$282.
 Sales; \$2,740.

Date	Directs	Meat	Stores requi- rements	Total Cost		Total Sales		Food Cost &		Food Inventory		
				Today	To Date	Today	To Date	Today	To Date	Purch	Issue	Balance
Previous												\$8,360
Oct. 1												
Oct. 2												

95. The value of issues for October 1 is

- A. \$247
- B. \$526
- C. \$567
- D. \$710

96. The inventory balance for October 1 is

- A. \$8,176
- B. \$8,256
- C. \$8,319
- D. \$8,639

97. The value of purchases for October 2 is

- A. \$105
- B. \$365
- C. \$444
- D. \$466

98. The inventory balance for October 2 is

- A. \$7,895
- B. \$7,999
- C. \$8,418
- D. \$8,801

99. The XYZ restaurant's inventory record for the month of June shows opening inventory: \$2,180, Purchases: \$6,300, Issues: \$6,450. However, the actual value of closing inventory was \$2,100. The book value of the closing inventory for the month of June for the XYZ restaurant was
- A. \$1,730
 - B. \$1,830
 - C. \$1,930
 - D. \$2,030
100. The ABC Foodservice determines the book value of the closing inventory for October using the following information: Issues: \$6,490, Purchases: \$6,320, Opening inventory: \$2,180. If the actual value of the closing inventory was \$1,900, the dollar difference between book and actual inventory for the month of October is
- A. -\$ 30
 - B. -\$110
 - C. -\$224
 - D. -\$340
101. Based on the dollar difference determined in question No. 100, what is the difference between book and actual closing inventory figure as a percentage of issues?
- A. 0.46%
 - B. 1.69%
 - C. 3.45%
 - D. 5.24%
102. If the acceptable range is a 3.00% difference, the calculated difference as a percentage of issues in question No. 101 is
- A. above the acceptable range.
 - B. below the acceptable range.
 - C. within the acceptable range.
103. The ABC Foodservice relies primarily on the perpetual inventory system for calculating food costs. The use of this system results in
- A. an overestimation of purchases.
 - B. an inaccurate food cost.
 - C. a true and actual value of inventory.
 - D. a precise measure of goods used.

104. In XX foodservice the book value is calculated by the weighted average purchase price method and actual value is calculated by the FIFO method. In a period of consistent inflation, the book value would be
- the same as actual value.
 - higher than actual value.
 - lower than actual value.
105. The basic software elements in a computer assisted inventory control system include the
- food item file.
 - terminal
 - printer.
 - disk drive.
106. The major functional unit of a computer system is the
- software interface unit.
 - integrated communications program unit.
 - central processing unit.
 - key-operated patent protection unit.
107. The computer data base for an inventory control system is the
- food item file.
 - recipe file.
 - menu file.
108. Computer assisted inventory control systems include the following types of data EXCEPT
- maximum cost.
 - reorder point.
 - purchase unit.
 - minimum stock level.
109. When using a computer assisted inventory system to make purchasing decisions, it is important that
- purchase data are accurate.
 - perpetual inventory cards are maintained.
 - daily receiving clerk's reports are correct.
110. If automatic reorder points and quantities were maintained by a computer assisted inventory system, the new system would improve
- vendor product quality.
 - accuracy of scheduled orders.
 - reordered inventory specifications.

111. What is one way a computer assisted inventory control system can help a manager with storing food items?
- A. Stock quality
 - B. Stock labeling
 - C. Stock rotation
112. Computers can assist managers in issuing foods and supplies by
- A. reimbursement based on stock quality.
 - B. requisitions based on needs.
 - C. issuing hours based on regulation.
113. Computers can assist managers in maintaining a perpetual inventory record of foods and supplies by
- A. checking all data listed on the invoices.
 - B. collecting a list of items above reorder point.
 - C. storing a book inventory in computer memory.
114. Which of the following is not a procedure that assists a manager in determining the value of inventory in a computer system?
- A. Maintaining a perpetual inventory and calculating extended costs.
 - B. Taking a physical inventory and calculating extended costs.
 - C. Keeping a regular inventory record and calculating extended costs.

ANSWER KEY**114 - Item Test**

Item no.	Correct response	Item no.	Correct response	Item no.	Correct response
1	B	39	A	77	A
2	C	40	C	78	B
3	D	41	B	79	B
4	C	42	A	80	A
5	A	43	B	81	A
6	C	44	A	82	C
7	B	45	A	83	B
8	B	46	A	84	B
9	A	47	B	85	A
10	B	48	A	86	C
11	A	49	C	87	B
12	A	50	B	88	A
13	C	51	A	89	A
14	D	52	B	90	B
15	B	53	A	91	D
16	C	54	D	92	D
17	C	55	B	93	B
18	B	56	A	94	D
19	B	57	D	95	C
20	B	58	B	96	B
21	B	59	A	97	D
22	D	60	A	98	B
23	B	61	D	99	C
24	C	62	C	100	C
25	B	63	C	101	C
26	A	64	A	102	B
27	B	65	A	103	C
28	B	66	D	104	B
29	A	67	A	105	C
30	A	68	C	106	C
31	D	69	C	107	A
32	D	70	B	108	A
33	A	71	C	109	A
34	A	72	D	110	B
35	C	73	B	111	C
36	A	74	D	112	B
37	C	75	B	113	C
38	B	76	D	114	C

APPENDIX D.

TABLE OF ITEMS IN 50-ITEM ACHIEVEMENT TEST ASSOCIATED WITH CATEGORIES IN THE TABLE OF SPECIFICATIONS	120
Final Inventory Control Test	122
Answer Key	134
Table of Difficulty Differences for 50-item Test by Instructional Strategy	135

Table D1. Items in 50-item achievement test associated with categories in the table of specifications

Content area	Cognitive		
	Knowledge & Comprehension	Application & Analysis	Synthesis & Evaluation
Receiving	1, 2, 6, 7, 9,	18	
Storing	12, 26, 28, 30, 31	22	
Issuing	35	36, 37	
Inventory control	40, 41, 43, 44, 45, 49, 52, 53, 55, 58, 59	60, 61, 62, 63, 64, 73, 74	71, 77, 79, 81, 83
Inventory valuation	84, 85, 88	92, 94, 95, 96	104
Inventory control computer systems	105, 107, 110, 113		

Final Inventory Control Test¹**DIRECTIONS**

Write your name and social security number on the answer sheet. Mark the circles corresponding to your name and social security number.

The questions in the test give several possible answers. One answer is better than the others. Find the best answer and darken the corresponding space on the answer sheet using a No.2 pencil.

1. When unsatisfactory merchandise is delivered, the receiving clerk
 - A. accepts the delivery and reports the condition of merchandise to the manager.
 - B. prepares a credit memo in duplicate and sends to the office.
 - C. calls the supplier to tell them about the merchandise.
2. Effective receiving procedures can be maintained with
 - A. proper delivery equipment.
 - B. confident receiving personnel.
 - C. adequate receiving equipment.
3. An invoice is prepared by the
 - A. buyer.
 - B. customer.
 - C. vendor.

¹Il-Sun Kim and DoriAnn Finley. Department of Hotel, Restaurant, and Institution Management, College of Family and Consumer Sciences. Iowa State University. 1988.

4. Receiving stamps are used when a
 - A. requisition is filled for a department in the foodservice establishment.
 - B. delivery is accompanied by an invoice, invoice duplicate, or vendor's delivery ticket.
 - C. merchandise is dated with a code, especially perishables.
5. A receiving ticket is used to verify when the receiving clerk
 - A. accepts the merchandise without invoice.
 - B. stamps the receiving date.
 - C. duplicates the information found on the invoice.
 - D. marks the perishable merchandise.
6. The proper storage method for fruits and vegetables in a walk-in refrigerator is storing them
 - A. at least eight inches off the floor.
 - B. with cracked ice.
 - C. away from foods that absorb strong odors.

Use the following case study to answer questions 7 and 8.

You are manager of a large hospital foodservice. The head a.m. cook is responsible for receiving duties because the receiving area is next to the cook's area. Deliveries are made at peak production times so that the head cook assigns an assistant cook to receive the goods, sign the invoices, and put the goods on the floor in the appropriate storage area. The assistant cook, however, is needed back in the cook's area immediately. A part-time high school student finishes putting the goods away later in the afternoon and is generally unsupervised. Everyone has free access to the storage areas. You notice that a lot of produce has been discarded because of spoilage. Also, the cooks have been complaining that the managers have not been ordering enough meat items to prepare the required amounts of food. You have determined that the shortage of meat items is due to pilferage.

7. Which of the following would be recommended to improve control during receiving?
- A. Insist that the head cook does the receiving.
 - B. Train all assistant cooks to do the receiving.
 - C. Make the a.m. manager responsible for all receiving.
8. Which practice can be implemented to reduce theft from storage areas?
- A. Implement a perpetual inventory system.
 - B. Hire a security guard to search employees as they leave work area.
 - C. Sponsor an inservice training session to deter pilferage.
 - D. Limit access to storage areas, especially those that contain the most expensive items.
9. Temperatures for deep freezers that keep foods solidly frozen are between
- A. -10 to 0 °F (-23.3 to -17.8 °C).
 - B. -10 to 32 °F (-23.3 to 0 °C).
 - C. 30 to 32 °F (-1.1 to 0 °C).
 - D. 38 to 40 °F (3.3 to 5 °C).
10. The maximum storage time in a refrigerator for most fruits and vegetables is
- A. 3 days.
 - B. 7 days.
 - C. 14 days.
 - D. 20 days.
11. Good storage control is implemented by
- A. maintaining orderly arrangements.
 - B. informing vendors of quantities needed.
 - C. verifying quality of items.
 - D. assisting in deliveries.
12. Maintaining good storage control includes
- A. honesty of vendors.
 - B. arrangement of deliveries.
 - C. location of preparation areas.
 - D. security of food products.

Use the following receiving clerk's daily report to answer questions 13 through 15.

Receiving Clerk's Daily Report

Date July 11, 19XX

Quant	Unit	Description	Unit price \$	Amount \$	Total Amount \$	Purchase Journal Distribution		
						Food Directs	Food Stores	Sundries
		I.S.U. Meat Lab						
30	lbs	Frzn Ribeye steak	5.45	163.50				
10	lbs	Frzn B-B-Q Ribs	1.85	18.50				
					182.00			
		EISNER						
1	case	Tomato Sauce (#10CN)	30.00	30.00	30.00			
		Smith Produce & Fruit						
1	case	Lettuce	6.75	6.75				
1	case	Oranges	8.00	8.00				
					14.75			
		Save-V More						
1	box	Detergent	16.80	16.80	16.80			
					243.55	243.55		

13. What is the total cost of Stores?

- A. \$ 14.75
- B. \$ 31.55
- C. \$212.00
- D. \$232.00

14. What is the total cost of Directs?
- A. \$14.75
 - B. \$31.55
 - C. \$44.75
 - D. \$51.55
15. Which of the following items will be charged as received to daily food cost?
- A. Rib eye steak
 - B. Tomato sauce
 - C. Oranges
 - D. Detergent
16. The appropriate sequence of steps for completing a physical inventory is
- Step
- 1. total the cost of all items
 - 2. count the items on hand
 - 3. multiply the total count on hand by the cost of the item
 - 4. record the inventory on the inventory record form
- A. 2-1-3-4
 - B. 2-1-4-3
 - C. 2-4-3-1
 - D. 2-4-1-3
17. A physical inventory can be conducted more easily if items are arranged
- A. in alphabetical order.
 - B. according to the recording form.
 - C. by product group.
18. When storeroom items are received, the perpetual inventory is maintained by adding each item to the
- A. monthly beginning inventory reconciliation.
 - B. balance on the bin card.
 - C. daily supplier's report.
 - D. daily storeroom food and supply ledger.

19. The appropriate sequence of steps to determine the monthly cost of food used in perpetual inventory system is

Steps

1. subtract the present inventory on hand
2. add the daily food purchases
3. list the total cost of food at the beginning of the inventory period

- A. 3-2-1
- B. 3-1-2
- C. 2-1-3
- D. 2-3-1

20. A physical inventory is conducted by foodservice managers to

- A. compare book and actual value.
- B. insure that extra food is on hand.
- C. add the daily food purchases.
- D. check the quality of goods on hand.

21. The A category items in the ABC method of inventory control consist of 15% of the inventory that has a

- A. low dollar volume.
- B. moderate dollar volume.
- C. large dollar volume.

22. The ABC classification system is based on

- A. Pearson's Law.
- B. Pareto's Law.
- C. Parkinson's Law.

23. In a commercial foodservice establishment with both food and beverage operations, liquor inventories would be categorized as

- A. A category.
- B. B category.
- C. C category.

24. In the ABC method, 35% of the inventory that has a moderate dollar volume is

- A. A
- B. B
- C. C

25. One advantage of the perpetual inventory system is that it
- A. requires minimum personal experience.
 - B. provides tight stock control.
 - C. reduces human error.
26. A disadvantage of the perpetual inventory system is that it
- A. requires additional staff time to maintain written records.
 - B. reduces the accuracy of the month's ending inventory.
 - C. requires an additional storage area for the reception of daily deliveries.
 - D. reduces storeroom security.

Use the following data to answer questions 27 and 28.

The record of Restaurant A for the month of May 1984 shows that the opening inventory is \$5,800; the closing inventory is \$5,400; and food cost is \$9,800.

27. The average inventory for the month of May 1984 is
- A. \$5,600
 - B. \$5,800
 - C. \$7,600
 - D. \$7,800
28. The inventory turnover for the month of May 1984 is
- A. 1.26
 - B. 1.29
 - C. 1.69
 - D. 1.75
29. Which formula is used to calculate inventory turnover for the month?
- A. $I = C/O$
 - B. $I = C/F$
 - C. $I = F/A$
 - D. $I = F/C$

where, O = Opening inventory,
F = Food cost for the month,
A = Average food inventory,
C = Closing inventory, and
I = Inventory turnover for the month.

30. The form below would be used in which of the following types of inventory systems?

Item	Unit	On hand	Unit Cost	Total Cost

- A. Perpetual inventory
- B. Periodic inventory
- C. Physical inventory

Use the following information to answer question 31

The record of foodservice operation B for the month of July 1985 shows that food cost is \$13,320, and closing inventory is \$3,322.

31. If the average inventory for the month of July is \$3,304.5, the opening inventory is

- A. \$3,287.00
- B. \$3,313.00
- C. \$3,346.75
- D. \$6,693.50

Use the following case study to answer question 32

A foodservice manager has noticed that customer demand for one of the high profit items, entree A, is unmet on the weekends. When entree A is not available customers order a lower profit item, entree B, instead. The operation is losing some potential profit and may be producing dissatisfied customers. Currently a physical inventory is conducted and orders are placed on Fridays. Deliveries are made Monday. Inventory turnover rate is 3.2. The manager decides to check inventory and order in needed items for the weekend on Thursday which are delivered on Friday in addition to taking the regular inventory and placing orders on Friday. The cost per item is higher because smaller quantities are being purchased; however, more high profit items are being sold. The inventory turnover rate is 2.7 under the revised system.

32. The current revised inventory system will

- A. increase profits.
- B. decrease labor costs.
- C. increase food costs.
- D. decrease holding costs.

33. Bin cards are used to maintain a
- A. physical inventory record.
 - B. perpetual inventory record.
 - C. periodic inventory record.
34. Bin cards contain all of the following information about a product EXCEPT
- A. receiving.
 - B. issuing.
 - C. balance.
 - D. price.
35. An inventory turnover rate of less than 1 suggests that the amounts of goods on hand are
- A. excessive.
 - B. ideal.
 - C. insufficient.

Use the following case study to answer questions 36 through 38.

A new manager has recently taken over the purchasing and storing of products for a large college foodservice. The previous manager liked to order items in very large quantities because of price discounts for volume purchases and the availability of storage space. The inventory turnover rate for the last year was 0.73. The foodservice director has indicated there is a lack of capital for improvement projects and has asked all managers to propose solutions to the problem. The cooks complain that the quality of products is poor to average.

36. The larger amount of stock on hand will lead to
- A. increased efficiency.
 - B. increased cost.
 - C. decreased waste.
 - D. decreased old stock.
37. The cause of the cooks complaint about low product quality may be due to
- A. lengthy storage time.
 - B. inappropriate receiving practices.
 - C. poor purchasing practices.
38. The low turnover rate is caused by
- A. low total food sales.
 - B. high inventory levels.
 - C. low level of available capital.
 - D. high capacity for storage.

39. The best definition of the opening (or beginning) inventory is the total dollar value of foods
- ordered for the next period.
 - on hand at the end of the previous period.
 - available for sale at the end of the previous period.
40. The actual value of the closing inventory is the value of all items in the
- physical inventory.
 - perpetual inventory.
 - book inventory.
 - financial inventory.
41. To determine what caused a difference between book and actual value, the foodservice manager would
- review control procedures for issuing food.
 - review the vendor list and select a new vendor.
 - revise the food quality specification.

Use the following data to answer questions 42 and 43.

The inventory records of the Skyway Restaurant show the following information about one of the items carried in the food inventory for the month of January.

<u>DATE</u>	<u>Activity</u>	<u>Quantity</u>	<u>Price</u>
1/1	opening inventory	10 cans	\$2.35/can
1/12	purchased	24 cans	\$2.40/can
1/26	purchased	12 cans	\$2.30/can

On January 31, the physical inventory shows 20 cans left in stock.

42. The value of the ending inventory for January using the weighted average method is
- \$46.24
 - \$46.74
 - \$47.00
 - \$47.20
43. The dollar value difference between the last-in, first-out (LIFO) and latest purchase price method for the inventory is
- \$0.70
 - \$0.80
 - \$1.26
 - \$1.50

Use the information given below to prepare a daily and cumulative analysis of inventory balances on a given form. The opening inventory figure for October 1 is \$8,360.

- October 1: From the Receiving Sheet; Directs, \$206, and Stores, \$463.
 Meat Tags; \$320. Requisitions; \$247.
 Sales; \$2,350.
- October 2: From the Receiving Sheet; Directs, \$260, and Stores, \$105.
 Meat Tags; \$184. Requisitions; \$282.
 Sales; \$2,740.

Date	Directs	Meat	Stores requi- rements	Total Cost		Total Sales		Food Cost &		Food Inventory		
				Today	To Date	Today	To Date	Today	To Date	Purch	Issue	Balance
Previous												\$8,360
Oct. 1												
Oct. 2												

44. The value of issues for October 1 is

- A. \$247
- B. \$526
- C. \$567
- D. \$710

45. The inventory balance for October 1 is

- A. \$8,176
- B. \$8,256
- C. \$8,319
- D. \$8,639

46. In XX foodservice the book value is calculated by the weighted average purchase price method and actual value is calculated by the FIFO method. In a period of consistent inflation, the book value would be

- A. the same as actual value.
- B. higher than actual value.
- C. lower than actual value.

47. The basic software elements in a computer assisted inventory control system include the

- A. food item file.
- B. terminal
- C. printer.
- D. disk drive.

48. The computer data base for an inventory control system is the
- food item file.
 - recipe file.
 - menu file.
49. If automatic reorder points and quantities were maintained by a computer assisted inventory system, the new system would improve
- vendor product quality.
 - accuracy of scheduled orders.
 - reordered inventory specifications.
50. Computers can assist managers in maintaining a perpetual inventory record of foods and supplies by
- checking all data listed on the invoices.
 - collecting a list of items above reorder point.
 - storing a book inventory in computer memory.

ANSWER KEY**50 - Item Test**

Item no.	Correct response	Item no.	Correct response
1	B	26	A
2	C	27	A
3	C	28	D
4	B	29	C
5	A	30	C
6	A	31	A
7	C	32	C
8	D	33	B
9	A	34	D
10	B	35	A
11	A	36	B
12	D	37	A
13	C	38	B
14	A	39	B
15	C	40	A
16	C	41	D
17	B	42	D
18	B	43	C
19	A	44	B
20	A	45	C
21	C	46	B
22	B	47	C
23	A	48	A
24	B	49	B
25	B	50	C

Table D2. Difficulty differences for 50-item test by instructional strategy

Content area	Item number ^a	Self-instruction	Lecture	Difficulty difference
Receiving	1 (1)	81	75	6
	2 (2)	51	46	5
	3 (6)	100	94	6
	4 (7)	86	50	36
	5 (9)	84	56	28
	6 (18)	84	79	5
Storing	7 (12)	72	58	14
	8 (22)	95	98	-3
	9 (26)	81	25	56
	10 (28)	63	83	-20
	11 (30)	100	88	12
	12 (31)	86	79	7
Issuing	13 (35)	84	89	-5
	14 (36)	86	51	35
	15 (37)	74	44	30
Inventory control	16 (40)	91	77	14
	17 (41)	98	58	40
	18 (43)	79	65	14
	19 (44)	86	83	3
	20 (45)	95	83	12
	21 (49)	98	90	8
	22 (52)	84	88	-4
	23 (53)	93	67	26
	24 (55)	98	92	6
	25 (58)	67	73	-6
	26 (59)	72	56	16
	27 (60)	100	94	6
	28 (61)	95	96	-1
	29 (62)	98	88	10
	30 (63)	91	88	3
	31 (64)	91	88	3
	32 (71)	47	50	-3
	33 (73)	81	67	14
	34 (74)	60	64	-4
	35 (77)	86	88	-2
	36 (79)	93	96	-3
	37 (81)	95	90	5
	38 (83)	93	96	-3

^aItem number in parentheses is the item number from the 114-item test.

Table D2. continued

Content area	Item number ^a	Self-instruction	Lecture	Difficulty difference
Inventory valuation	39 (84)	91	81	10
	40 (85)	70	67	3
	41 (88)	98	94	4
	42 (92)	67	75	-8
	43 (94)	63	75	-12
	44 (95)	49	31	18
	45 (96)	51	48	3
	46 (104)	51	29	22
	47 (105)	98	83	15
	48 (107)	100	79	21
Inventory control	49 (110)	84	77	7
	50 (113)	70	77	-7

APPENDIX E.

DEMOGRAPHIC QUESTIONNAIRE AND ATTITUDE INVENTORY

137

NAME: _____

ID No.: _____

Demographic Questionnaire**DIRECTIONS**

Please answer each question in the blank provided. All answers will be kept confidential.

1. Age at last birthday _____
2. Previous paid work experience in foodservice.
Please check all that apply for the experience in the left side blank and indicate the number of months to the right side blank.

<u>Part-time Experience</u>	<u>Number of months in job</u>
_____ _____ _____ _____ _____ _____ _____	Waiter/Waitress _____ Kitchen helper/Cook _____ Cafeteria server _____ Storeroom clerk _____ Receiving clerk _____ Others (please specify) _____

<u>Full-time Experience</u>	<u>Number of months in job</u>
_____ _____ _____ _____ _____ _____ _____ _____ _____	Waiter/Waitress _____ Kitchen helper/Cook _____ Cafeteria server _____ Storeroom server _____ Receiving clerk _____ Supervisor _____ Assistant Manager _____ Manager _____ Others (please specify) _____

NAME: _____

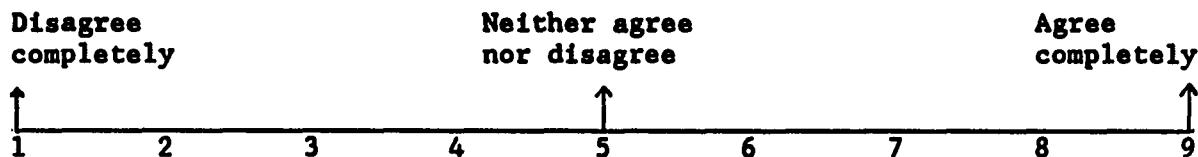
ID No.: _____

ATTITUDE TOWARD INVENTORY CONTROL SYSTEM MODULE

INSTRUCTION: You are asked to respond to each statement below in terms of your agreement with the idea expressed. Please respond to each of the statements using any number from 1 to 9. Use the following scale:

- Write 9 in the answer blank if you agree completely.
- Write 1 in the answer blank if you disagree completely.
- Write 5 in the answer blank if you neither agree nor disagree.
- Use a number from 6 to 9 if you agree to some degree.
- Use a number from 1 to 4 if you disagree to some degree.

The general scale is shown below:



1. Every expectation I had for this module has been exceeded. 1. _____
2. The content of the module gave me an understanding of inventory control systems. 2. _____
3. The questions in the module helped me to grasp the content. 3. _____
4. It was a waste of time to study this module. 4. _____
5. I retained the knowledge of inventory control system because of the module. 5. _____
6. The content of the module was dull. 6. _____
7. Having the content in frames helped me to understand the material. 7. _____
8. The module did not meet the hopes that I had for it. 8. _____
9. The questions in the module were so simple that they 9. _____
10. I wish I was not in the group to use the module. 10. _____

- | | |
|--|-----------|
| 11. I would like more opportunity to use this type of instruction in other areas. | 11. _____ |
| 12. The module helped me to learn about the inventory control systems. | 12. _____ |
| 13. The module helped me to apply the inventory control systems to foodservice operations. | 13. _____ |
| 14. The questions in the module were an incentive to complete the module. | 14. _____ |
| 15. My feelings about the module are positive. | 15. _____ |
| 16. I need to study the inventory control system module more thoroughly. | 16. _____ |
| 17. I found the content of the module interesting. | 17. _____ |