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A SYSTEM FOR THE PREFERENCE EVALUATION
OF CYCLE MENUS

John E. Rogozenski, Jr., et al

Army Natick Laboratories
Natick, Massachusetts

October 1974

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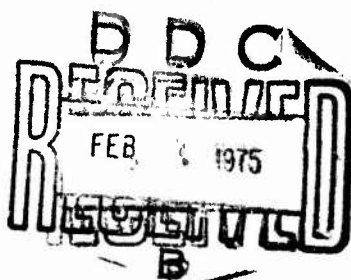
TECHNICAL REPORT
75-46-OR/SA

A SYSTEM FOR THE PREFERENCE EVALUATION OF CYCLIC MENUS

by

John E. Regozenski, Jr.

Howard R. Moskowitz



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SUMMARY

A quantitative method for evaluating the overall preference of cyclic menus is presented. The model developed consists of two separate factors relating to menu preference rating.

The first is the time-preference relationship for food items. From survey data, time-preference functions have been constructed which indicate how the hedonic rating of a food item varies with the time since the food was last served. The function assumes a quadratic form with entrees tending to be most time sensitive and salads and vegetables the least.

The second factor in the model is the meal component weights for the evaluation of an entire meal based on the consumer hedonic preference values for the generic components of the meal (entree, starch, vegetable, salad, and dessert). Regression techniques have been applied to survey data to generate the set of importance factors, or meal component weights, for each component. For example, the results indicate that the entree represents about 49% of the total preference value of the meal. This approach has provided a basis for an additive linear model for overall meal preference.

A general system for the overall evaluation of cyclic menus has been developed based on application of an additive linear model. The procedure accounts for the maximum preference values for food items, the time-dependency of the food item preference values, and the meal component weighting factors. The procedures can easily be adapted to the computer, as shown by a specific example.

The overall system appears to offer a logical, realistic, and integrated approach to reflecting time factors and the relative importances of the various components of meals in the evaluation of cyclic menus. Further research in this area is recommended to refine this model and test its validity in an operational environment.

ACKNOWLEDGEMENTS

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SECTION I

INTRODUCTION

During Fiscal Year 1974, the Operations Research/Systems Analysis Office conducted an investigation aimed at developing a Uniform Ration Cost System under Task 01 of Project No. IT762713AJ45, Identification of Existing Feeding Systems, System Components and Alternatives, of the Department of Defense Food Research, Development, Testing, and Engineering program. The objectives of this effort were to develop and evaluate a ration cost system which would be directly related to known consumer requirements, including the derivation of a supporting method for the computation of a recommended Basic Daily Food Allowance; to define a more flexible food service management system which would be more responsive to feeding requirements in military food service, and innovations and new technology in the food and food service fields; and to develop effective procedures for a cost-benefit evaluation of proposed changes in food service systems. The need for directly relating the ration cost system to consumer requirements subject to reasonable nutrition and cost constraints generated the effort reported herein.

The approaches to the ration cost system are covered in more detail in a separate report Uniform Ration Cost System - Summary Report, NLABS Technical Report 75-69-OR/SA (January 1975). The effort to develop the computer tools to evaluate a menu for cost and nutrition and the preference evaluation of menus based on the simple average of stated consumer preference values for all food items in the menu is also covered in a separate report A Computer System for Menu Evaluation and Related Applications, NLABS Technical Report 75-50-OR/SA, November 1974.

The particular effort described in this report was directed towards developing a better method of analyzing a menu as a function of stated consumer preferences. The specific improvements pursued were: (a) the capability to derive a proportionate hedonic value for particular food items based upon the amount of time that had elapsed since they were last served, and (b) the capability to weight the meal components for their relative importance to the preference value of the whole meal (i.e., entree more important than vegetables), thereby allowing the direct computation of realistic meal preference values from stated consumer food item preferences.

The development of these two capabilities, along with the incorporation of these capabilities into computer software, are presented in this report.

SECTION II

TIME-PREFERENCE RELATIONSHIPS FOR FOOD ITEMS

Background

The concept that food preferences may depend upon time was brought out in a series of papers by Balintfy and his colleagues.^{1,2,3} Their approach to the problem of time-preference relations was to develop quantitative models that predicted the change in preference with time. They utilized a 0 to 1 scale, with ratio properties, in contrast to the more commonly used Hedonic Scale of food preferences used by Peryam and Pilgrim.⁴ The Hedonic Scale has been widely used in military food preference surveys and is well known in both preference assessment of food names (through surveys) and in the sensory evaluation of specific food products.

This section details some theoretical aspects of time-preference functions for cyclic menus in which food items are repeated either at regular or irregular intervals within such a menu. The aim is to develop a series of mathematical expressions that can be used to predict: (a) how food items will change in preference as a function of their serving frequencies during multi-day menu cycle, and (b) the optimal frequency of serving for an item, resulting in its maximum contribution to the overall menu preference rating.

-
1. Balintfy, J. L.: A Non-Linear Programming Approach to Utility Maximized Menu Plans. Technical Report No. 9, University of Massachusetts, Dept. of General Business and Finance, August 1973.
 2. Balintfy, J. L., Duffy, W. J., and Sinha, P.: Modeling Food Preferences Over Time. Technical Report No. 3, University of Massachusetts, Dept. of General Business and Finance, July 1972.
 3. Balintfy, J. L. and Cadena, J.: Methods to Estimate the Probability of Nutritional Adequacy of Selective Menus. School of Business Administration, University of Massachusetts, Technical Report No. 4, 1972.
 4. Peryam, D. R., and Pilgrim, F. J.: Hedonic Scale Method of Measuring Food Preference. Food Technology, 9: 14, 1957.

Throughout this report the following terminology will be employed. A food item is the actual product that is served, i.e., beef stew, buttered peas and carrots, and strawberry shortcake. The term meal component is used in defining how food items are combined to make up a meal within a menu. The five meal components that are discussed here are: entree, starch, vegetable, salad, and dessert. The term menu implies an ordered sequence of complete meals over a predetermined number of days; a cyclic menu is one that returns to Day 1 of the menu after the last menu-day and repeats itself indefinitely.

General Approach

The approach used in this effort is the classic regression analysis technique wherein empirical data are collected and plotted, the plots then suggest appropriate functional relationships which are best fitted to the empirical data. The square of the correlation coefficient is then used to determine which functional relationship can best represent the relationship between the dependent and independent variables. If the relationship is well established, the selected functional relationship can then be used to determine the value of the dependent variable given the values of the independent variables.

In this effort, data were collected from customers as to how their preferences (hedonic values) for particular food items vary over variable times from the last serving. These data were plotted to appropriate scales. Appropriate functional relationships were selected and best fitted to the empirical data using regression techniques. The functional relationships were then examined to establish which function best represented the relationship between the hedonic values and the time from the last serving. The log quadratic function was selected as an excellent functional relationship to determine proportionate hedonic value based upon the period of time since a food item was last served.

Data Collection Method

The standard Point Hedonic Scale employed with food preference surveys has been used as the measuring tool to elicit food preference attitudes.^{5,6} This scale was used in this study to gather data on the time dependency of food preferences and the weighting of meal components within a standard menu framework.

5. Peryam and Flinn.

6. Meiselman, H., van Horne, W., Hasenzahl, B., and Wehrly, T.: The 1971 Fort Lewis Preference Survey. U.S. Army Natick Laboratories, Natick, Mass., Technical Report 72-43-PR, January 1972.

A survey questionnaire was developed to measure a respondent's stated preference for a given food item under the assumption that the time since he had last eaten the food was 3 months, 1 month, 2 weeks, 1 week, 3 days, and yesterday, respectively. For each time interval, the respondent was asked to assign a Hedonic Scale rating for the desirability of the food to him. The categories of acceptability on the Hedonic Scale range from 1 (dislike extremely), to 4 (dislike slightly), to a neutral category 5 (neither like nor dislike), and onwards to 6 (like slightly) through 9 (like extremely). The nine categories reflect graded degrees of acceptance. Figure 1 shows a sample page of the questionnaire. Note that the Hedonic Scale was available to the respondent on each page.

The survey consisted of 144 food items from five meal components (entrees, starches, vegetables, salads, and desserts) and was given in August 1973 to a group of 251 U.S. Marines while they were stationed aboard ship in the Mediterranean. The ship was anchored in port, the only activity being routine maintenance operations. From the group of 251 respondents, a subset of 173 completed questionnaires were selected. Criteria for selection were: (a) that a respondent's time-preference ratings for single food items would show no typical behavior, such as preferences increasing with shorter intervals (so that the food would be more preferred had it been eaten yesterday versus having been eaten three months ago), (b) that in at least one-third of the 144 foods there was a change in the preference ratings with time (some respondents failed to show any time-preference changes for any food), and (c) that the respondent gave some foods higher ratings than others (occasionally, a respondent would rate all foods the same, no matter what they were).

Analysis of Empirical Data and Functional Relationships

Logarithmic functions are often useful to relate rating-scale values (hedonic) to a physical variable such as time in this instance. A semi-logarithmic plot was made of time since last serving vs mean hedonic rating for a selected group of 15 food items. The plot is presented in Figure 2. Virtually all the functions in Figure 2 fail to conform to a linear function and show substantial curvilinearity. The 144 foods tend to fit one of two major patterns:

1. linear increase in preference for times up to one month, after which the preference stays almost constant, falling to increase by any substantial amount at three months, or
2. curvilinear changes in preference throughout the entire time period with preference increasing at a decreasing rate as time increases.

The analysis of the empirical data strongly suggest that overall foods considered, the time-preference relationship, $P(T)$, for each food item is best described by the logarithmic quadratic function:

$$P(T) = K_1 + K_2 [\log(T)] + K_3 [\log(T)]^2 \quad (1)$$

(where T is the time interval (in days) since last serving of the food item).

CARD NO.

2	0
---	---

Pickled Beet & Onion Salad

FOOD NO.				3 MOS	1 MO.	2 WKS	1 WK.	3 DAYS	Yester-day
1	1	5	4						

Brussels Sprouts

FOOD NO.				3 MOS	1 MO.	2 WKS	1 WK.	3 DAYS	Yester-day
1	1	6	3						

Chili con Carne

FOOD NO.				3 MOS	1 MO.	2 WKS	1 WK.	3 DAYS	Yester-day
1	1	7	1						

Sauerkraut

FOOD NO.				3 MOS	1 MO.	2 WKS	1 WK.	3 DAYS	Yester-day
1	1	8	3						

Chocolate Chip Cookies

FOOD NO.				3 MOS	1 MO.	2 WKS	1 WK.	3 DAYS	Yester-day
1	1	9	5						

Fried Oysters

FOOD NO.				3 MOS	1 MO.	2 WKS	1 WK.	3 DAYS	Yester-day
1	2	0	1						

RATINGS:

PLEASE USE THE FOLLOWING SCALE TO RATE THE FOODS:

- 0 - NEVER TRIED
- 1 - DISLIKE EXTREMELY
- 2 - DISLIKE VERY MUCH
- 3 - DISLIKE MODERATELY
- 4 - DISLIKE SLIGHTLY
- 5 - NEITHER DISLIKE NOR LIKE
- 6 - LIKE SLIGHTLY
- 7 - LIKE MODERATELY
- 8 - LIKE VERY MUCH
- 9 - LIKE EXTREMELY

Figure 1. Food Preference Survey Code Sheet

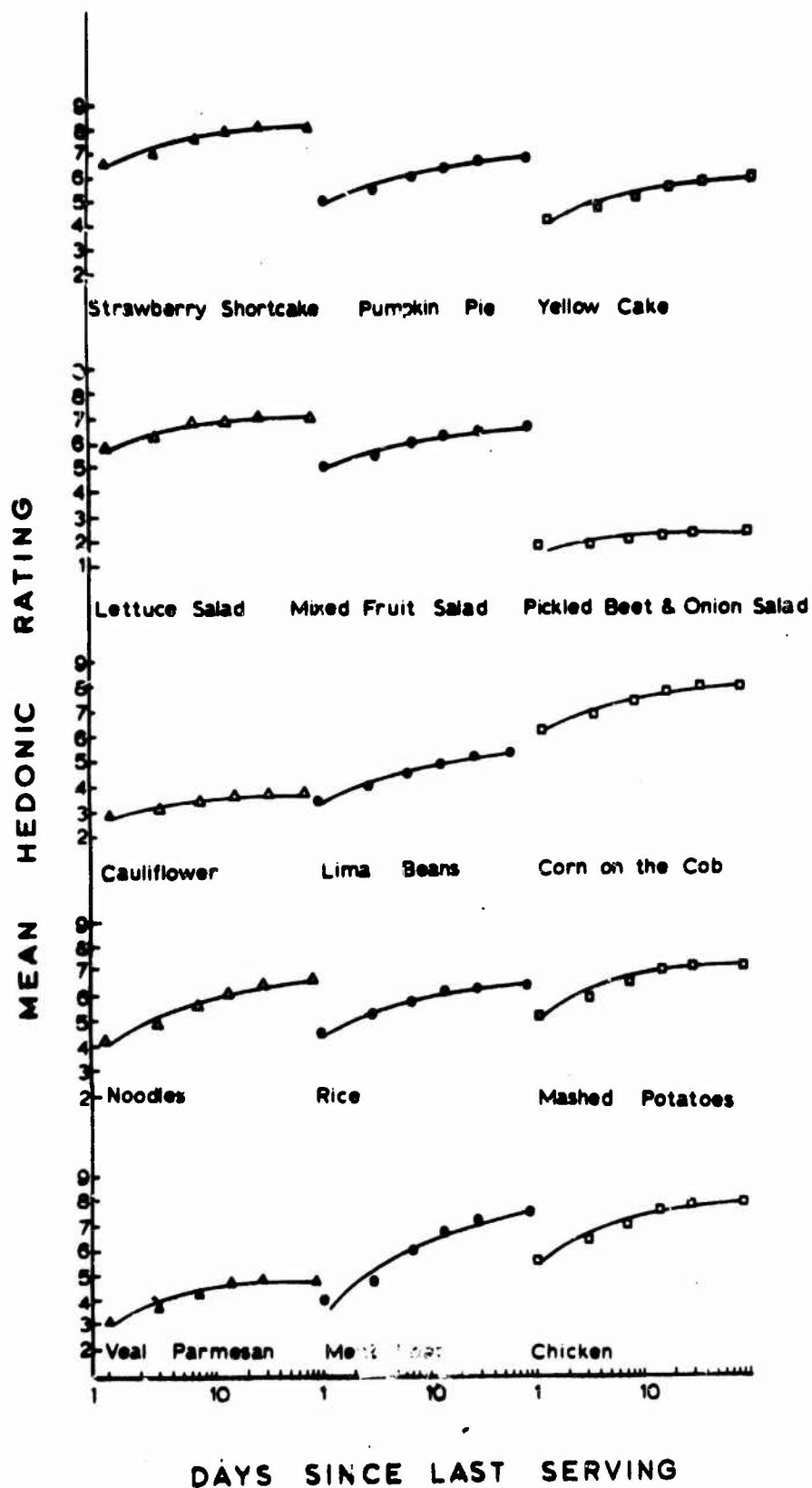


FIGURE 2. Plot of Days Since Last Serving Vs. Frequency of Occurrence

The quadratic function was best fitted to the empirical data for each food item using standard regression techniques. The values for the coefficients K_1 , K_2 , and K_3 were derived by the method of least squares. Table I presents the parameters of the time-preference curves (K_1 , K_2 , and K_3) for six food items using the average value of 173 individual responses for each time value, $T = 1$ day, 3 days, 1 week, 2 weeks, 1 month, and 3 months. The correlation coefficient squared, r^2 , is also shown for each item.

A complete list of all 144 food items surveyed is contained in Appendix A. With the foods surveyed, comparisons can be made among food items in the same meal component group, as well as food items across groups. From Table I it is apparent that different menu component groups exhibit different time-preference slopes as shown by the linear portion of the slope, given by the value K_1 . The quadratic portion (K_3) in Table I accounts primarily for the curvilinear portion at the greater time intervals. An analysis of variance of the linear portion (K_1) of the time-preference function generated the following mean slopes and standard deviations (s.d.) for the five groups:

Entrees ($n = 71$): mean slope = 1.97, s.d. = 0.45
 Starches ($n = 17$): mean slope = 1.93, s.d. = 0.31
 Vegetables ($n = 26$): mean slope = 1.35, s.d. = 0.37
 Salads ($n = 14$): mean slope = 1.12, s.d. = 0.32
 Desserts ($n = 16$): mean slope = 1.53, s.d. = 0.25

The F statistic for the analysis of variance was highly significant ($F = 22.97$, degrees of freedom = 4/39). This significant F statistic indicates that there exists a difference between meal component groups. The ranking of mean slopes from highest to lowest is: entrees, starches, desserts, vegetables, and salads. In contrast, in terms of variability of K_2 as expressed by its standard deviation, desserts show the least variable slopes and entrees the most variable. The wide variety of entree items compared to the limited selection of dessert items may be the cause for this difference in variability.

Extensions of the Survey Results

By taking advantage of the representative sample of time-preference slopes obtained from the aforementioned survey data, other data sources can be used to extend the results to a wider range of food items than the original 144. The approach is to define "equivalence-classes" of food items, which are nothing more than groups of foods. The items in each group are assumed to have similar time-preference slopes, although each item may have its own unique maximum preference value. By rearranging the time-preference functions, one can decompose the functions into two parts. One part involves the slopes (K_2 and K_3) and the other involves the maximum preference for the item (P_{max}). The value for

TABLE 1
PARAMETERS OF THE TIME PREFERENCE FUNCTION

$$P(T) = K_1 + K_2 (\log T) + K_3 (\log T)^2$$

Food	K ₁	K ₂	K ₃	r ²
Chicken	5.61	2.45	-.61	.99
Grilled Steak	6.19	2.13	-.49	.98
Baked Potato	4.75	1.96	-.44	.99
Carrots	4.08	1.40	-.32	.99
Lettuce & Tomato Salad	6.09	1.28	-.29	.99
Cherry Pie	5.56	2.01	-.49	.98

$P_{\max}$ is obtained from large-scale food preference surveys of items in which only one preference value was collected for each item.^{7,8}

The basic equation representing the time-preference curve is, as previously shown, the quadratic function:

$$P(T) = K_1 + K_2 (\log T) + K_3 (\log T)^2 \quad (3)$$

The data suggest that maximum preference, $P_{\max}$, is usually reached at the three month time interval (12 weeks times 7 = 84 days). Thus, restating the equation at $T = 84$ days and $P(84) = P_{\max}$ we have:

$$P_{\max} = K_1 + K_2 (\log 84) + K_3 (\log 84)^2 \quad (4)$$

Subtracting equation (4) from (3):

$$P(T) - P_{\max} = K_2 [\log T - \log 84] + K_3 [(\log T)^2 - (\log 84)^2] \quad (5)$$

or

$$P(T) = P_{\max} + K_2 [\log (T/84)] + K_3 [(\log T)^2 - (\log 84)^2] \quad (6)$$

Thus, the preference value $P(T)$ for a food item, can be obtained in terms of the item's maximum preference value (obtained through conventional food preference surveys) and quantities related to the time since the item was last served, T .

7. Meiselman, H.L.

8. Waterman, D., Meiselman, H.L., Reed, J., and Glick, L., Branch, Army Natick Laboratories, Natick, Mass., Technical Report (to be published Nov. 74).

SECTION III

MEAL COMPONENT WEIGHTS AND TOTAL MEAL PREFERENCE

Background

Many possible rules exist whereby an individual can evaluate a menu for its overall preference (hedonic value) or acceptability. Some of these rules can be elucidated in detail and concern measurable quantities. For example, if an individual gives equal weight to all of the meal components (e.g., entree, starch, vegetable), it is possible to calculate one single index number that represents the total meal preference merely by averaging the preferences for the individual food items in the meal. Numerous alternatives to this simple rule can be formulated. A preliminary series of reports on the preferences of individuals to food combinations, taken in pairs, were published by Eindhoven and Peryam,^{9, 10} but few general rules were developed. Rules for determining the aggregate preference of food items have been suggested by Eckstein.¹¹ Further, a method which does not require stated rules for food combinations but which uses computerized menu planning based upon optimizing food compatibilities has been suggested by Moskowitz, Wehrly, and Klarman.¹²

This section develops a model for the evaluation of overall meal and preference based upon the meal component preferences.

General Approach

The objective of this effort was to develop a model which would permit predicting overall meal hedonic values given the stated customer hedonic values for the major meal components.

-
9. Eindhoven, J. and Peryam, D.R.: Measurement of Preferences for Food Combinations. Food Technology 13: 379, 1959 (a).
 10. Eindhoven, J. and Peryam, D.R.: Compatibility of Menu Items. Quartermaster Food and Container Institute, Report 35-39, 1959 (b).
 11. Eckstein, E.F.: Menu Planning by Computer: The Random Approach. J.A. Dietitian Association, 5: 529, 1967.
 12. Moskowitz, J.R., Wehrly, T., and Klarman, L.E.: Food Compatibilities and Menu Planning. Unpublished manuscript (1974).

In our previous work,¹³ a simple model was utilized which involved adding food item values and averaging these values to derive the meal hedonic value. This model did not provide the required accuracy in predicting meal hedonic values when empirical data (i.e., stated meal hedonic values versus stated food item values) were analyzed. Further analysis of these data has lead to the development of a slightly more complex linear additive model which provides different weighting factors for each of the major meal components (i.e., entree, starch, vegetable, salad, and dessert).

The approach used was to collect empirical data on hedonic values for food items and entire meal hedonic values from the same customers. The data were then fitted to a multilinear function of food item hedonic values to obtain the coefficients or weighting factors for each meal component (i.e., entree, starch, vegetable, salad, and dessert) which would best predict the empirical meal hedonic values. The square of the Pearson multiple correlation was then used to determine whether the multilinear model with the derived coefficients (weighting factors) could be used to predict meal hedonic values given food item hedonic values.

The Additive Model of Acceptability

The basic model used provides a single number as an index of total meal preference; the additive model of acceptability is:

$$P_{\text{meal}} = W_1 P_e + W_2 P_{\text{st}} + W_3 P_v + W_4 P_{\text{sa}} + W_5 P_d + W_6 \quad (7)$$

where P_e - Hedonic rating for the entree item, at the maximum elapsed time since last served, 3 months,

P_{st} - Hedonic rating for the starch item, time = 3 months,

P_v - Hedonic rating for the vegetable item, time = 3 months,

P_{sa} - Hedonic rating for the salad item, time = 3 months,

P_d - Hedonic rating for the dessert item, time = 3 months, and

W_1 to W_5 represent the relative importance factors of the corresponding meal components for the entire meal. The value W_6 is the residual preference value for a meal and can be equal to zero for the analysis discussed here.

13. Rogozenski, J.E.: A Computer System for Menu Evaluation and Related Applications. U.S. Army Natick Laboratories, Natick, Mass., Technical Report (to be published Nov. 74).

The meal preference for this model is the linear sum of the weighted food item preferences. Low weights ($W_1, \dots, W_5$) signify that the meal component carries little weight, and the individual food item preference has less effect on the respondent's overall rating of the meal. Conversely in meal component groups with high weights the individual food item preferences are more important in the rating of the meal.

It should be pointed out that many alternative models are available to predict meal preferences from component weights and food item preferences. In particular, equation (7) could be expanded considerably to account for interaction terms between various food items in different meal component groups. This possibility would yield a more complex equation, with the requirement that more than five or six parameters $W_1, \dots, W_6$ would have to be estimated statistically. This additional degree of complexity has not been pursued in the development effort described here nor is it expected that it would add appreciably to the precision of the menu evaluation model.

Survey Data Applied to the Model

The food preference survey discussed previously was comprised of two sections. Part 1 (described in Section II) contained the time-preference questionnaire for 144 food items using the 9-point Hedonic Scale. In Part 2 of the survey, the respondent rated 136 different meals, each comprising an entree, a starch, a vegetable, a salad, and a dessert, taken from the list of 144 items in Part 1: 70 entrees, 16 starches, 26 vegetables, 13 salads, and 16 desserts (three items were repeated). For each meal presented, the respondent rated the overall acceptability, again with the 9-point Hedonic Scale.

Table A-2, found in Appendix A presents the 136 meals, along with the average preference rating and standard deviation for each. To explore the model of additive food preferences, the individual preference ratings for each meal were averaged across the 173 respondents to provide a matrix of preferences for the entire set of 136 meals. Merged with this matrix were the average preference ratings from the 173 responses for each food item of the respective meal. Using the multiple linear regression technique contained in the UCLA Biomedical Package,¹⁴ equation (7) was solved to yield the coefficients ($W_1, \dots, W_6$) for the additive function for total preference.

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14. Dixon, J.: BMD Biomedical Computer Programs Health Survey Computing Facility, Department of Biomathematics, School of Medicine, University of California, Los Angeles, University of California Press, January 1973.

The array analyzed constituted 136 separate observations of the form:

$$P_{Mi}, P_{1i}, P_{2i}, P_{3i}, P_{4i}, P_{5i}; i = 1, \dots, 136$$

The dependent variable in the regression was P_{Mi} , the average meal preference for each of the meals surveyed, and the five independent variables, $P_{1i}, P_{2i}, \dots, P_{5i}$, were the average values for P_{max} (Table A-1) for each food item in the respective meal.

Two computations with the Biomedical Package were made with W_6 taking on different values. In one, W_6 was free to seek its own value, i.e., when $P_1 \dots P_5$ were set equal to zero then $P_{meal} = W_6$, the residual value. The second case set $W_6 = 0$, so that $P_1 = P_2 \dots = P_5 = 0$, implied $P_{meal} = 0$.

A meal weighting factor was added prior to the analysis and is shown by restating equation (7).

$$P_{meal} \times N = W_1 (P_e) + W_2 (P_{st}) + W_3 (P_v) + W_4 (P_{sa}) + W_5 (P_d) + W_6 \quad (8)$$

Equation (8) states that the preference rating of a meal (on the 9-point Hedonic Scale) times the number of items in the meal (the meal weighting factor N ; here $N = 5$) is a linear combination of preference values. Based on the survey data, Table 2 gives the values for regression coefficients, $W_1, W_2, \dots, W_6$, with W_6 (intercept point) free and also forced to zero.

Discussion of Results

In addition to the regression coefficients presented in Table 2 the standard errors of the regression are shown for both cases. The standard error represents the standard deviation of the coefficients, or meal component weighting factors. The standard error of regression presented in Table 2 under W_6 indicates that we can predict meal preferences to within 0.35 of a scale point on the 9-point scale. This small variability results in part from averaging the estimates of 173 individuals to represent a single, "hypothetical" individual.

The value for the multiple correlation coefficients squared, $R^2 = 0.71$ with W_6 in the equation, indicates that 71% of the variance can be accounted for by the linear model with the coefficients shown. Statistically this model was a good estimator of the relationship between food item hedonic ratings and overall meal preference. Table 3 presents the normalized weights for the five meal components in the model with W_6 set equal to zero.

An exceptionally high weight is given to entree preferences as compared to the next highest rated components (starches and desserts), and it indicates that entrees account for almost half of the preference rating of a meal.

TABLE 2

COEFFICIENTS FOR MEAL PREFERENCE EQUATION:

$$P_{\text{meal}} \times N = W_1 P_e + W_2 P_{st} + W_3 P_v + W_4 P_{sa} + W_5 P_d + W_6$$

	Entree (W_1)	Starch (W_2)	Vegetables (W_3)	Solid (W_4)	Desert (W_5)	Intercept (W_6)
Case 1: W_6 Free*						
Mean Value	2.37	0.53	0.42	0.25	0.57	5.68
Standard Error	(.13)	(.12)	(.09)	(.08)	(.11)	(.35)
Case 2: $W_6 = 0$						
Mean Value	2.34	0.74	0.53	0.35	0.76	0
Standard Error	(.11)	(.11)	(.09)	(.08)	(.10)	—

*Case 1: Multiple Correlation Coefficient Squared, $R^2 = 0.71$

TABLE 3
NORMALIZED WEIGHTS OF FIVE MEAL COMPONENTS

	Entree	Starch	Vegetable	Salad	Dessert
Percent of Total Weight	49%	16%	12%	7%	16%

Thus, the results suggest that it is most productive to concentrate upon providing optimally acceptable entrees when maximum acceptability is desired, and to place proportionately less effort on providing varied vegetables and salads, since the latter two meal components carry very little weight in overall preference determinations.

To determine the distribution of weight for the 173 individuals, a total of 173 linear regressions were run, with the 136 meal evaluations made by each individual entered separately into a single regression computation. The multilinear regression program of the UCLA Biomedical Package was run to provide the five weights for the meal components, with the parameter W_6 set equal to 0. Figure 3 presents the histogram of the distribution of the five weights.

One of the most striking findings in Figure 3 is the variety of distributions of meal component weights. Entrees are characterized by a large scatter of individual weights, ranging towards the high values. The distribution is skewed to the left, with the central region relatively flat, possibly a uniform distribution. The other meal components are clustered around lower importance values. With the exception of desserts, they all seem to be unimodal, with a well defined maximum. Desserts show a bimodal distribution with skewness.

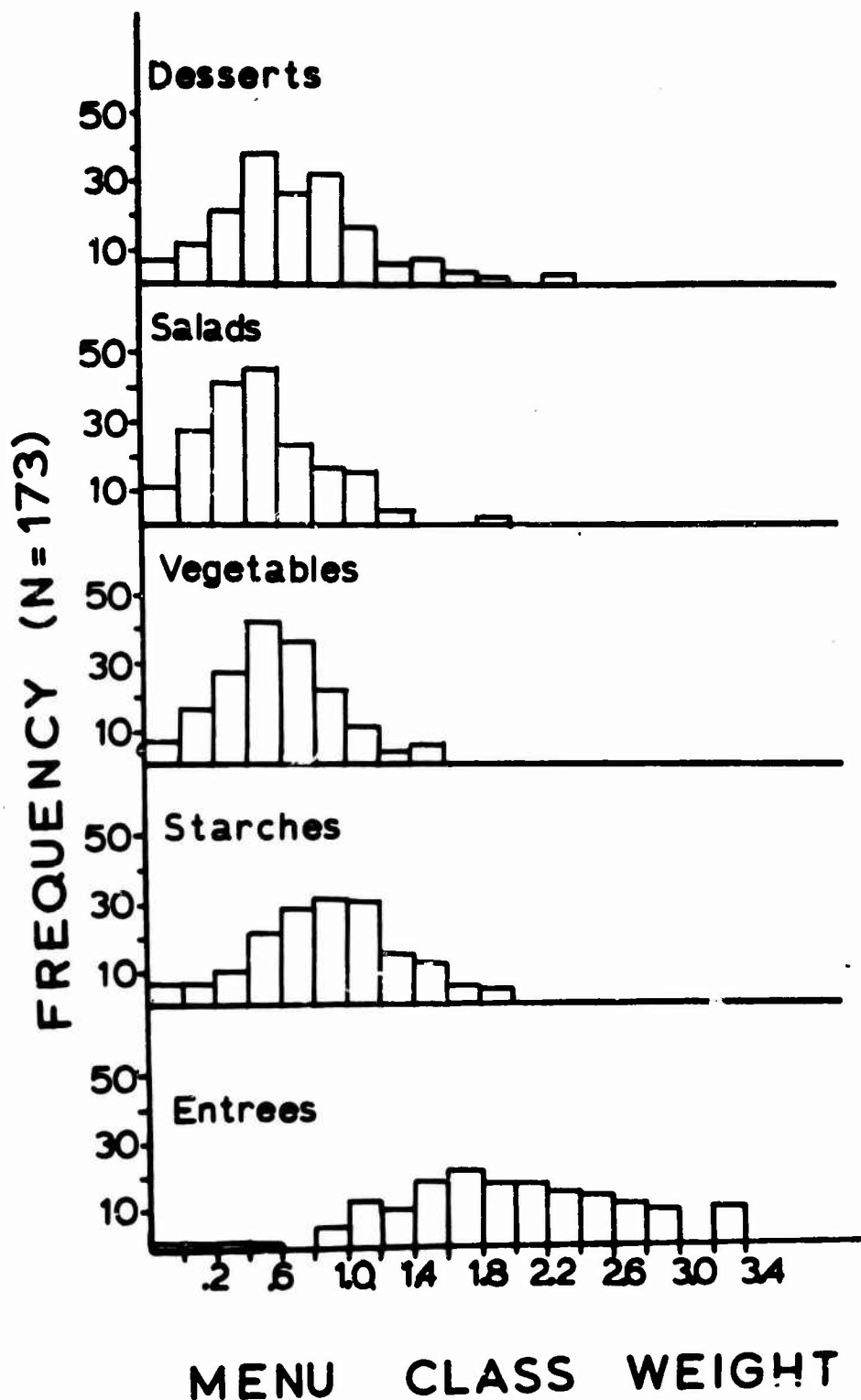


FIGURE 3. Histogram of Meal Component Weight Vs. Frequency of Occurrence

SECTION IV

A SYSTEM FOR THE OVERALL PREFERENCE EVALUATION OF MENUS

The Preference Evaluation Model

In the preceding sections of this report the two elements of the menu preference evaluation model have been developed. These elements are: (1) the time-preference relationships of food items, and (2) the meal component weights within a meal.

The basic model for time-preference relationships was stated as

$$P(T) = K_1 + K_2 (\log T) + K_3 (\log T)^2 \quad (9)$$

and the basic decrementing model using $P_{\max}$ as the highest value attainable was stated as

$$P(T) = P_{\max} + K_2 [\log (T/84)] + K_3 [(\log T)^2 - (\log 84)^2] \quad (10)$$

By using either of these models the food item preference dependent upon the elapsed time since the last serving can be calculated.

The second element required was the meal component weighting factor so that entire meals could be evaluated. The meal component weights, as derived in an earlier section, were: entrees - 2.34; starches - 0.74; vegetables - 0.58; salads - 0.35; and desserts - 0.76.

With the two required elements formulated, the preference evaluation model for predicting overall preference of a meal can be stated as:

$$P_{\text{meal}} = W_1 P(T)_e + W_2 P(T)_s + W_3 P(T)_v + W_4 P(T)_{sa} + W_5 P(T)_d \quad (11)$$

where $W_1, \dots, W_5$ are the respective meal component weights and $P(T)_e, \dots, P(T)_d$ are the time dependent preference values for the items offered.

The Evaluation of a 42-Day Cyclic Menu

The Armed Forces 42-day Master Menu (1974) was analyzed with the preference evaluation model. The sequence of events within the computer program is the following:

1. the entire menu is read in and the major food items (entrees, starches, vegetables, salads, and desserts) are sorted out;

2. the selected food items are located in the master recipe file and the values for K_1 , K_2 , K_3 , $P_{\max}$, and the meal component weight are accessed;
3. the menu days on which each item appears is stored and T , the elapsed time prior to each serving occurrence, is computed;
4. the elapsed time, T , is used in equation (10) to compute values for $P(T)$ for all items for all the meals in the menu;
5. $P(T)$ times the meal component weight is computed and accumulated for all the food items in the meal; and
6. the accumulated item ratings are divided by a meal weighting factor (9.54 for the master menu)¹⁵ to yield the meal preference value. These values are computed for every meal in the menu and are printed out in report form, shown in Figure 4.

The preference evaluation of cyclic menus using this model was an additional tool developed in the Uniform Ration Cost System program for the overall evaluation of menus for cost, nutrition, and preference.

15. Armed Forces Master Menu normally has two entrees, two starches, two vegetables, two salads, and two desserts for each meal (dinner and supper). The sum of the meal component weights for a typical meal is 9.54.

Menu Day	Meal	Recipe	Serv-G Interval	P(Max)	K(1)	K(2)	K(3)	Menu Class Wt	Item Preference
3	2	Pork Chop Suey	13. Days	5.69	3.23	1.96	-.36	2.34	13.315
3	2	Turkey Pot Pie	12. Days	6.19	4.89	1.98	-.38	2.34	14.485
3	2	O'Brien Potatoes	42. Days	6.78	4.12	1.97	-.43	.74	5.017
3	2	Steamed Rice	42. Days	5.71	4.44	1.82	-.42	.74	4.225
3	2	Buttered Carrots	7. Days	5.53	4.08	1.48	-.32	.58	3.207
3	2	Buttered Wax Beans	13. Days	5.31	2.68	1.15	-.72	.58	3.080
3	2	Lettuce Salad	2. Days	6.53	5.91	1.18	-.30	.36	2.285
3	2	Jellied Pear Salad	13. Days	5.57	2.69	1.03	-.21	.36	1.948
3	2	Pineapple Upside Down Cake	18. Days	6.41	5.56	2.01	-.49	.76	4.872
3	2	Brownies	17. Days	6.65	4.90	1.56	-.33	.76	5.064

***** OVERALL MEAL PREFERENCE VALUE IS 5.75 *****

Menu Day	Meal	Recipe	Serv-G Interval	P(Max)	K(1)	K(2)	K(3)	Menu Class Wt	Item Preference
3	3	Roast Beef	8. Days	7.31	4.68	2.80	-.58	2.34	17.105
3	3	Baked Ham	5. Days	6.80	5.29	2.34	-.52	2.34	15.912
3	3	Paprika Buttered Potatoes	4. Days	7.00	5.23	2.22	-.55	.74	5.180
3	3	Lyonnaise Carrots	42. Days	5.37	4.08	1.48	-.32	.58	3.115
3	3	Cauliflower Au Gratin	8. Days	4.08	2.80	.89	-.21	.58	2.366
3	3	Buttered Mixed Vegetables	5. Days	5.96	4.03	1.55	-.34	.58	3.457
3	3	Tossed Vegetable Salad	2. Days	6.22	6.05	.96	-.25	.36	2.177
3	3	Garden Cottage Cheese Salad	7. Days	5.07	3.19	1.23	-.24	.36	1.774
3	3	Sherbet	4. Days	6.29	7.18	1.22	-.31	.76	4.780
3	3	Refrigerator Cookies	8. Days	5.14	4.09	1.58	-.37	.76	3.906

***** OVERALL MEAL PREFERENCE VALUE IS 6.20 *****

FIGURE 4: SAMPLE COMPUTER PRINT-OUT FROM PREFERENCE EVALUATION SYSTEM

SECTION V

CONSIDERATIONS FOR FUTURE WORK

The Problem of Choice and Aggregation

Much of food preference surveying, whether for individual items or for complete meals, concerns the average respondent. Often, the average respondent does not adequately represent the diverse groups that make up the average. This problem becomes more important in evaluating selective menus for overall preference.

The standard cyclic menus under analysis typically contain two entrees, two starches, two vegetables, etc., at each meal. A basic question arises relative to the elapsed time since the last serving: is it a function of the time since last eaten, or since the last time offered on the menu? If the individual has the option of choosing only one of the entrees, then the chosen entree, and only that entree, should decline in preference immediately after the meal. The entree that was not chosen should continue to increase in preference value, since its mere presence on a menu without being chosen would not constitute sufficient cause to decrement its preference value.

The problem is whether individual behavior can be modeled in a more precise way to reflect the actual food selections made in a selective cyclic menu situation.

The Number of Meal Component Weights in the Linear Model

In the model presented here the five meal components that were analyzed were entrees, starches, vegetables, salads, and desserts. The next question that needs answering is what number of meal components provide the most efficient rating model for overall meal preference. It may well be that additional components should be included (i.e., beverages, breakfast foods). Conversely, a reduction from the basic five components to a linear model with three or four classes may yield the best indicator of overall menu acceptance.

Scaling Factor Problem

Another issue relative to the food item preference ratings used in the model is the application of scaling factors. In using preference ratings (hedonic) it may be difficult to discern the relative difference between meal values such as 5.90 and 6.30 on the 9-point Hedonic Scale even though these are quite significant in terms of actual preference. This scaling

problem arises because even though the Hedonic Scale has a range of 1-9, the meal preference ratings once analyzed have a range of only 5.0 to 8.0 for most meal selections. By applying the proper scaling factor to the meal ratings generated with the model, the values derived may better depict the significant differences in overall meal ratings.

Expanded Data Base and Equivalence Classes

With only 140 unique food items surveyed there were a large number of translations made to relate these data to the entire Armed Forces Recipe System. As a minimum, additional food items as well as varied menus should be surveyed to reduce any incorrect assumptions incurred when making translations. With an expanded data base, similar items can then be analyzed to determine if equivalence classes really do exist and what food items make up these equivalence classes (i.e., green salads may be grouped into one class, whereas poultry recipes may not).

Menu Preference Optimization Model

One important use of these survey data and the models developed could be a menu optimization model where the time-preference, weighting factor equation is the optimization function; and cost, nutrition, and compatibility functions would be the constraints of the system.

SECTION VI

CONCLUSIONS AND RECOMMENDATIONS

A quantitative method for evaluating the preference of cyclic menus has been developed. It is concluded that such evaluations can be improved by including the effects of two factors relating to menu acceptance: the time delay between food offerings and the weighting of meal components within the traditional menu structure.

The techniques developed, along with the cost and nutritional analyses of menus, will aid the menu planner in the design of cyclic menus. The task of identifying measures of consumer satisfaction with the food service system is a primary concern in ongoing research efforts. The preference evaluation of cyclic menus based on stated consumer hedonic ratings and the above-mentioned time and component importance factors represents a major step in the accomplishment of this task. Continued effort in the refinement of the model is highly recommended. Some problems to be resolved include the effect of food selection under a choice situation, the definition of equivalence classes, and the use of preference optimization models.

APPENDIX A

Food Items and Meals Surveyed

TABLE A-i

Parameters of the Time Preference Function:

$$P(T) = K_1 + K_2 (\log T) + K_3 (\log T)^2$$

	Food	K_1	K_2	K_3	r^2	$P_{\max}$
ENTREES						
1	Chicken	5.61	2.45	-.61	.99	8.04
2	Chicken a la King	4.18	2.07	-.42	.98	6.53
3	Chicken Cacciatore	2.95	1.39	-.25	.98	4.65
4	Fried Chicken	5.73	2.33	-.54	.99	8.16
5	Turkey	4.89	2.49	-.51	.99	7.72
6	Turkey Pot Pie	4.89	1.98	-.38	.99	7.82
7	Turkey Slices w/Gravy	4.63	2.30	-.40	.98	7.44
8	Beef Pot Pie	4.42	2.30	-.49	.98	6.95
9	Grilled Steak	6.19	2.13	-.49	.98	8.40
10	Pepper Steak	4.35	2.14	-.48	.99	6.62
11	Pot Roast	4.66	2.50	-.51	.98	7.47
12	Roast Beef	4.68	2.60	-.58	.99	7.47
13	Salisbury Steak	5.04	2.53	-.57	.99	7.74
14	Swiss Steak	5.23	2.56	-.60	.99	7.87
15	Beans w/Pork In Tomato Sauce	3.99	2.20	-.38	.98	6.40
16	Roast Pork	4.32	2.46	-.53	.98	6.98
17	Sliced Roast Pork w/Gravy	4.30	2.40	-.50	.99	7.01
18	Sweet & Sour Pork	2.81	1.15	-.18	.97	4.29
19	Meat Loaf	4.03	2.92	-.53	.98	7.58
20	Stuffed Cabbage	2.90	1.15	-.21	.98	4.27
21	Stuffed Green Peppers	3.43	1.71	-.38	.98	5.24
22	Swedish Meatballs	3.76	1.95	-.38	.98	6.01
23	Breaded Veal Steaks	4.65	2.35	-.53	.99	7.14
24	Vealburger	3.86	1.76	-.37	.99	5.80
25	Veal Parmesan	3.25	1.58	-.34	.98	4.96
26	Veal Roast	4.58	2.47	-.58	.99	7.12
27	Veal Scallopini	2.54	1.17	-.28	.97	3.86
28	Bacon	6.80	1.08	-.28	.99	7.88
29	Breakfast Ham	5.78	1.90	-.44	.99	7.73
30	Corned Beef Hash	3.34	1.56	-.29	.99	5.19
31	Ham	5.29	2.34	-.52	.99	7.81
32	Pork Sausage Patties	4.87	1.66	-.35	.98	6.74
33	Sausage Links	5.23	1.78	-.42	.99	7.04
34	Italian Sausage	3.64	1.69	-.36	.98	5.48
35	Polish Sausage	4.23	2.07	-.42	.99	6.58
36	Barbecued Beef Cubas	4.60	2.32	-.50	.99	6.93
37	Barbecued Spareribs	5.30	2.36	-.56	.98	7.73

TABLE A-1

Parameters of the Time-Preference Function:

$$P(T) = K_1 + K_2 (\log T) + K_3 (\log T)^2 \quad (\text{Cont'd})$$

	Food	K_1	K_2	K_3	r^2	$P_{\max}$
38	Spareribs w/Sauerkraut	3.77	1.62	-.28	.98	5.76
39	Chop Suey	3.23	1.96	-.36	.99	5.60
40	Chow Mein	3.27	1.56	-.30	.99	5.12
41	Hungarian Goulash	2.64	1.34	-.29	.98	4.09
42	Tacos	3.80	1.50	-.33	.99	5.42
43	Baked Macaroni & Cheese	4.54	2.47	-.56	.99	7.13
44	Baked Tuna & Noodles	3.51	1.92	-.36	.98	5.79
45	Chili con Carne	4.21	1.94	-.42	.98	6.32
46	Chili Macaroni	3.11	1.64	-.30	.98	5.08
47	Bologna Sandwich	4.16	1.96	-.30	.98	6.44
48	Fish Sandwich	4.62	2.50	-.59	.99	7.16
49	Grilled Cheese Sandwich	5.15	2.38	-.54	.98	7.65
50	Liverwurst Sandwich	2.73	1.02	-.18	.99	3.99
51	Meatball Submarine	4.16	1.67	-.33	.99	6.12
52	Submarine Sandwich	4.81	2.16	-.41	.98	7.37
53	Hot Roast Beef Sandwich w/Gravy	4.93	2.46	-.53	.98	7.60
54	Salami Sandwich	3.59	1.46	-.25	.98	5.39
55	Cheeseburger	5.81	2.42	-.66	.99	8.02
56	Frankfurter	3.82	2.46	-.51	.98	5.12
57	Hamburger	5.76	1.77	-.34	.99	8.01
58	Lasagna	4.27	2.11	-.48	.99	6.47
59	Pizza (1)	5.07	2.16	-.44	.99	7.53
60	Pizza (2)	5.02	2.23	-.50	.99	7.37
61	Ravioli	4.69	2.14	-.49	.99	7.08
62	Corned Beef	3.09	1.74	-.34	.99	5.11
63	Liver	3.15	1.42	-.26	.98	4.86
64	Fish Sticks	4.80	2.25	-.47	.98	7.30
65	Fried Oysters	3.06	.98	-.21	.91	4.17
66	Salmon	3.73	1.77	-.32	.97	5.85
67	Sardines	3.14	1.43	-.28	.99	4.84
68	Seafood Platter	4.66	2.47	-.51	.98	7.46
69	Breaded Shrimp	5.47	1.81	-.43	.93	7.31
70	Shrimp Creole	3.37	1.49	-.29	.98	5.09
71	Tuna Salad	3.99	2.01	-.36	.98	6.43

TABLE A-1

Parameters of the Time-Preference Function:

$$P(T) = K_1 + K_2 (\log T) + K_3 (\log T)^2 \quad (\text{Cont'd})$$

Food		K_1	K_2	K_3	r^2	$P_{\max}$
STARCHES						
72	Boston Baked Beans	4.06	2.02	-.50	.98	6.04
73	Fritters	2.70	.99	-.17	.98	3.91
74	Noodles	4.14	2.17	-.47	.98	6.53
75	Spaghetti	5.26	2.52	-.65	.98	7.65
76	Baked Potato (1)	4.75	1.96	-.44	.99	6.81
77	Baked Potato (2)	4.97	2.07	-.47	.98	7.13
78	French Fried Potatoes	6.29	1.87	-.46	.98	8.13
79	Hashed Brown Potatoes	5.28	1.88	-.42	.99	7.26
80	Mashed Potatoes	5.23	2.22	-.55	.99	7.41
81	Potato Chips	5.62	1.92	-.45	.99	7.61
82	Potato Salad	4.93	2.04	-.45	.99	7.12
83	Scalloped Potatoes	4.12	1.97	-.43	.98	6.24
84	Sweet Potato	3.99	2.05	-.44	.99	6.24
85	Rice	4.44	1.82	-.42	.99	6.40
86	Fried Rice	4.01	1.65	-.39	.99	5.70
87	Rice Pilaf	3.32	1.69	-.34	.98	5.25
88	Spanish Rice	3.75	1.99	-.45	.99	5.85
VEGETABLES						
89	Asparagus	3.23	1.08	-.24	.98	4.39
90	Beets	2.91	1.34	-.29	.99	4.39
91	Broccoli	3.02	1.13	-.27	.98	7.47
92	Brussels Sprouts	2.63	.84	-.16	.99	6.24
93	Cabbage	3.76	1.35	-.27	.99	5.30
94	Carrots	4.08	1.40	-.32	.99	5.72
95	Cauliflower	2.80	.89	-.21	.99	3.70
96	Cooked Onions	3.40	1.22	-.26	.99	4.75
97	Corn on the Cob	5.93	1.99	-.40	.98	7.94
98	Creamed Corn	5.27	1.82	-.43	.99	7.12
99	Eggplant	2.79	.86	-.12	.99	4.00
100	French Fried Onion Rings	4.70	1.91	-.40	.98	6.61
101	Green Beans	4.96	2.03	-.50	.99	6.98
102	Lima Beans	3.37	1.32	-.20	.99	5.12
103	Mustard Greens	2.13	1.89	-.20	.98	3.07
104	Okra	3.18	1.22	-.20	.97	4.67
105	Peas	4.91	1.72	-.40	.98	6.67

TABLE A-1

Parameters of the Time-Preference Function:

$$P(T) = K_1 + K_2 (\log T) + K_3 (\log T)^2 \quad (\text{Cont'd})$$

Food	K_1	K_2	K_3	r^2	$P_{\max}$
106 Peas & Carrots	4.03	1.55	-.34	.99	5.70
107 Radishes	4.12	.78	-.32	.99	5.15
108 Sauerkraut	3.11	1.62	-.34	.99	4.95
109 Sliced Tomatoes	5.70	1.42	-.35	.99	7.11
110 Spinach	3.21	1.23	-.25	.99	4.61
111 Stewed Tomatoes	3.44	1.42	-.32	.98	4.95
112 Succotash	2.33	.90	-.21	.99	3.25
113 Wax Beans	2.68	1.15	-.22	.97	4.03
114 Zucchini Squash	2.84	1.06	-.18	.97	4.18
SALADS					
115 Carrot, Raisin & Celery	2.18	.84	-.18	.98	3.09
116 Cole Slaw	4.81	1.30	-.28	.98	6.25
117 Jellied Banana Salad	2.69	1.03	-.21	.99	3.86
118 Jellied Fruit Salad	4.33	1.31	-.26	.99	5.82
119 Kidney Bean Salad	1.98	.59	-.07	.97	2.62
120 Lettuce Salad	5.91	1.18	-.30	.99	7.06
121 Lettuce & Tomato Salad	6.09	1.28	-.29	.99	7.45
122 Macaroni Salad	3.90	1.67	-.36	.99	5.66
123 Mixed Fruit Salad	5.15	1.41	-.33	.99	6.60
124 Pickled Beet & Onion Salad	1.73	.46	-.08	.99	2.26
125 Pineapple Cheese Salad	3.19	1.23	-.24	.98	4.63
126 Tossed Cucumber & Vegetable Salad (1)	4.30	1.30	-.28	.99	5.72
127 Tossed Cucumber & Vegetable Salad (2)	4.31	1.10	-.22	.98	5.58
128 Tossed Green Salad	6.05	.96	-.25	.98	6.95
DESSERTS					
129 Apricot Pie	2.69	1.10	-.24	.98	3.89
130 Banana Cream Pie	4.66	1.58	-.28	.94	6.59
131 Banana Split	6.65	1.65	-.43	.99	8.24
132 Bread Pudding	2.76	1.44	-.32	.99	4.30
133 Butterscotch Pudding	3.92	1.48	-.26	.98	5.74
134 Cherry Pie	5.56	2.01	-.49	.98	7.56
135 Chocolate Chip Cookies	5.99	1.50	-.30	.99	7.72

TABLE A-1

Parameters of the Time-Preference Function:

$$P(T) = K_1 + K_2 (\log T) + K_3 (\log T)^2 \quad (\text{Cont'd})$$

Food	K_1	K_2	K_3	r^2	$P_{\max}$
136 Chocolate Pudding	4.95	1.84	-.43	.98	6.85
137 Ice Cream	7.18	1.22	-.31	.99	8.36
138 Lemon Cookies	4.09	1.58	-.37	.99	5.71
139 Marble Cake	4.25	1.48	-.34	.98	5.79
140 Mincemeat Pie	2.64	1.06	-.18	.99	3.95
141 Peach Shortcake	4.98	1.80	-.43	.99	6.83
142 Pumpkin Pie	5.01	1.48	-.26	.98	6.88
143 Strawberry Short Cake	6.67	1.69	-.45	.99	8.22
144 Yellow Cake	4.90	1.56	-.33	.99	6.14

TABLE A-2

Means and Standard Deviations
of 136 Meals Surveyed

	<u>Meals</u>	<u>Mean</u>	<u>Stand. Dev.</u>
1.	Swiss Steak, Mashed Potatoes, Zucchini Squash, Lettuce Salad, Apricot Pie	6.48	1.71
2.	Pot Roast, French Fried Potatoes, Cabbage, Pineapple Cheese Salad, Lemon Cookies	5.87	1.68
3.	Sardines, Scalloped Potatoes, Peas and Carrots, Pickled Beets and Onion Salad, Marble Cake	4.20	2.10
4.	Meatball Submarine Sandwich, Baked Potato, Peas, Carrot Raisin and Celery Salad, Chocolate Pudding	5.67	2.18
5.	Ham, Hashed Brown Potatoes, Cauliflower, Kidney Bean Salad, Yellow Cake	6.01	1.91
6.	Chicken Cacciatore, Rice, Corn on the Cob, Jellied Fruit Salad, Cherry Pie	5.64	2.15
7.	Fish Sandwich, Spaghetti, Eggplant, Lettuce & Tomato Salad, Strawberry Shortcake	5.50	2.30
8.	Beef Pot Pie, Fried Rice, Lima Beans, Cole Slaw, Peach Shortcake	6.24	1.85
9.	Hamburger, Potato Chips, French Fried Onion Rings, Tossed Cucumber & Vegetable Salad, Pumpkin Pie	7.10	1.52
10.	Chop Suey, Rice, Spinach, Lettuce Salad, Chocolate Chip Cookies	5.75	2.12
11.	Corned Beef, Potato Salad, Cabbage, Tossed Green Salad, Bread Pudding	5.10	2.12
12.	Liver, Baked Potato, Broccoli, Cole Slaw, Cherry Pie	5.61	2.47
13.	Turkey, Rice, Creamed Corn, Mixed Fruit Salad, Strawberry Shortcake	6.54	1.75
14.	Liverwurst Sandwich, Baked Potato, Cauliflower, Lettuce & Tomato Salad, Lemon Cream Pie	5.05	2.12

TABLE A-2 (Cont'd)

<u>Meals</u>	<u>Mean</u>	<u>Stand. Dev.</u>
15. Stuffed Cabbage, Fried Rice, Eggplant, Kidney Bean Salad, Chocolate Pudding	5.65	2.47
16. Veal Parmesan, Spaghetti, Spinach, Carrot, Raisin & Celery Salad, Banana Split	6.64	1.73
17. Barbecued Spareribs, French Fried Potatoes, Sauerkraut, Jellied Fruit Salad, Bread Pudding	6.53	1.85
18. Shrimp Creole, Fritters, Cabbage, Tossed Green Salad, Peach Shortcake	5.85	1.94
19. Hungarian Goulash, Hashed Brown Potatoes, Zucchini Squash, Lettuce Salad, Mincedmeat Pie	5.12	2.15
20. Cheeseburger, Baked Potato, Tossed Cucumber & Vegetable Salad, Chocolate Chip Cookies	6.28	1.95
21. Baked Macaroni & Cheese, Beans w/Pork in Tomato Sauce, French Fried Onion Rings, Jellied Banana Salad, Apricot Pie	6.05	1.72
22. Fish Sticks, Scalloped Potatoes, Succotash (Lima Beans + Corn), Pineapple Cheese Salad, Marble Cake	6.15	1.73
23. Chicken, Mashed Potatoes, Stewed Tomatoes, Mixed Fruit Salad, Ice Cream	6.70	1.79
24. Salisbury Steak, French Fried Potatoes, Lima Beans, Kidney Bean Salad, Chocolate Pudding	6.80	1.65
25. Seafood Platter, Potato Salad, Carrots, Pickled Beet & Onion Salad, Marble Cake	6.12	1.88
26. Roast Pork, Mashed Potatoes, Okra, Jellied Fruit Salad, Peach Shortcake	6.22	1.87
27. Swedish Meatballs, Fried Rice, Eggplant, Lettuce Salad, Pumpkin Pie	6.12	1.89
28. Corned Beef Hash, Potato Chips, Radishes, Lettuce & Tomato Salad, Strawberry Shortcake	5.31	1.92
29. Polish Sausage, Rice Pilaf, Corn on the Cob, Tossed Green Salad, Chocolate Chip Cookies	6.10	1.70

TABLE A-2 (Cont'd)

	<u>Items</u>	<u>Mean</u>	<u>Stand. Dev.</u>
30.	Grilled Cheese Sandwich, Beans w/Pork in Tomato Sauce, Spinach, Cole Slaw, Lemon Cookies	6.53	1.70
31.	Veal Scallopini, Baked Potato, Sliced Tomatoes, Pineapple Cheese Salad, Banana Cream Pie	5.75	1.84
32.	Breaded Shrimp, Sweet Potato, Peas & Carrots, Tossed Cucumber & Vegetable Salad, Bread Pudding	5.61	2.21
33.	Frankfurters, Potato Salad, Wax Beans, Jellied Banana Salad, Chocolate Pudding	5.43	2.05
34.	Vealburger, Hashed Brown Potatoes, Mustard Greens, Lettuce Salad, Banana Split	6.02	2.00
35.	Pizza, French Fried Potatoes, Creamed Corn, Kidney Bean Salad, Chocolate Chip Cookies	6.32	1.79
36.	Sweet and Sour Pork, Fried Rice, Eggplant, Carrot Raisin & Celery Salad, Ice Cream	5.42	2.29
37.	Barbecued Beef Cubes, Mashed Potatoes, Wax Beans, Mixed Fruit Salad, Apricot Pie	5.89	1.71
38.	Hot Roast Beef Sandwich w/Gravy, Potato Chips, Succotash, Lettuce Salad, Cherry Pie	6.11	1.72
39.	Bologna Sandwich, Boston Baked Beans, Cabbage, Lettuce Salad, Mincemeat Pie	5.44	2.00
40.	Fried Oysters, Spanish Rice, Brussels Sprouts, Tossed Green Salad, Chocolate Pudding	5.35	2.23
41.	Chow Mein, Rice, Okra, Kidney Bean Salad, Strawberry Shortcake	5.82	2.10
42.	Lasagna, Beans w/Pork in Tomato Sauce, French Fried Onion Rings, Tossed Cucumber & Vegetable Salad, Marble Cake	6.36	1.85
43.	Breaded Veal Steaks, Hashed Brown Potatoes, Zucchini Squash, Pineapple Cheese Salad, Lemon Cookies	6.04	1.75
44.	Chicken a la King, Baked Potato, Stewed Tomatoes, Jellied Fruit Salad, Banana Cream Pie	6.17	1.78

TABLE A-2 (Cont'd)

	<u>Mears</u>	<u>Mean</u>	<u>Stand. Dev.</u>
45.	Submarine Sandwich, Fritters, Lima Beans, Pickled Beet & Onion Salad, Peach Shortcake	5.70	1.72
46.	Chili con Carne, Rice Pilaf, Cooked Onions, Cole Slaw, Pumpkin Pie	5.92	1.92
47.	Salami Sandwich, French Fried Potatoes, Peas & Carrots, Lettuce Salad, Chocolate Pudding	5.45	1.88
48.	Roast Pork, Scalloped Potatoes, Sliced Tomatoes, Tossed Green Salad, Pumpkin Pie	6.13	1.97
49.	Roast Beef, French Fried Potatoes, Green Beans, Jellied Fruit Salad, Ice Cream	6.40	2.05
50.	Barbecued Beef Cubes, Mashed Potatoes, Peas, Jellied Banana Salad, Peach Shortcake	6.04	2.12
51.	Salmon, Potato Salad, Corn on the Cob, Carrot Raisin & Celery Salad, Marble Cake	6.06	1.73
52.	Chicken a la King, Baked Potato, Broccoli, Pineapple Cheese Salad, Strawberry Shortcake	5.88	1.90
53.	Polish Sausage, Hashed Brown Potatoes, Radishes, Lettuce Salad, Yellow Cake	5.98	1.67
54.	Meat Loaf, Fried Rice, Beets Cole Slaw, Cherry Pie	5.94	2.13
55.	Veal Roast, Boston Baked Beans, Eggplant, Tossed Green Salad, Minced Meat Pie	6.15	1.97
56.	Seafood Platter, Fritters, French Fried Onion Rings, Tossed Cucumber & Vegetable Salad, Yellow Cake	6.13	2.07
57.	Lasagna, Spanish Rice, Succotash, Tossed Green Salad, Chocolate Pudding	6.02	1.82
58.	Liver, Hashed Brown Potatoes, Creamed Corn, Pickled Beet & Onion Salad, Ice Cream	5.36	2.31
59.	Ham, Baked Potato, Broccoli, Jellied Banana Salad, Pumpkin Pie	5.61	1.95

TABLE A-2 (Cont'd)

	<u>Meals</u>	<u>Mean</u>	<u>Stand. Dev.</u>
60.	Turkey, Baked Potato, Cauliflower, Kidney Bean Salad, Banana Cream Pie	5.86	2.02
61.	Tuna Salad, Potato Chips, Zucchini Squash, Lettuce & Tomato Salad, Bread Pudding	6.22	1.90
62.	Fried Oysters, Lima Beans, Mashed Potatoes, Jellied Fruit Salad, Pumpkin Pie	5.69	2.19
63.	Barbecued Spareribs, Potato Salad, Mustard Greens, Pineapple Cheese Salad, Chocolate Chip Cookies	6.06	2.12
64.	Veal Parmesan, Scalloped Potatoes, Zucchini Squash, Mixed Fruit Salad, Strawberry Shortcake	6.04	1.80
65.	Baked Macaroni & Cheese, French Fried Potatoes, Okra, Jellied Banana Salad, Lemon Cookies	6.06	1.69
66.	Chop Suey, Rice, Peas, Tossed Green Salad, Banana Split	6.09	2.12
67.	Corned Beef, Hashed Brown Potatoes, Asparagus, Cole Slaw, Cherry Pie	5.41	2.01
68.	Stuffed Green Peppers, Rice, Corn on the Cob, Lettuce Salad, Bread Pudding	5.47	2.16
69.	Fried Chicken, Mashed Potatoes, Peas, Carrot Raisin & Celery Salad, Banana Cream Pie	6.47	1.96
70.	Beef Pot Pie, Sweet Potatoes, Wax Beans, Tossed Green Salad, Chocolate Pudding	5.79	1.79
71.	Shrimp Creole, Spanish Rice, Eggplant, Cole Slaw, Mincemeat Pie	5.40	2.08
72.	Roast Pork, Baked Potato, Creamed Corn, Jellied Fruit Salad, Pumpkin Pie	6.10	1.77
73.	Vealburger, Spaghetti, Mustard Greens, Mixed Fruit Salad, Ice Cream	6.32	1.59
74.	Ravioli, French Fried Potatoes, Cooked Onions, Tossed Green Salad, Strawberry Shortcake	6.70	1.80

TABLE A-2 (Cont'd)

	<u>Meals</u>	<u>Mean</u>	<u>Stand. Dev.</u>
75.	Baked Tuna & Noodles, Fried Rice, Brussels Sprouts, Kidney Bean Salad, Apricot Pie	5.78	1.89
76.	Corned Beef Hash, Potato Salad, French Fried Onion Rings, Pineapple Cheese Salad, Cherry Pie	5.67	1.94
77.	Bologna Sandwich, Boston Baked Beans, Sliced Tomatoes, Carrot Raisin & Celery Salad, Banana Cream Pie	5.47	1.89
78.	Frankfurters, Mashed Potatoes, Sauerkraut, Tossed Cucumber & Vegetable Salad, Bread Pudding	5.66	1.79
79.	Chicken Cacciatore, Sweet Potato, Corn on the Cob, Pickled Beet & Onion Salad, Peach Shortcake	5.27	1.93
80.	Swedish Meatballs, Rice, Beets, Jellied Fruit Salad, Marble Cake	6.12	1.75
81.	Fish Sandwich, Fritters, Okra, Lettuce Salad, Chocolate Chip Cookies	5.95	1.94
82.	Baked Macaroni & Cheese, French Fried Potatoes, Spinach, Tossed Green Salad, Banana Cream Pie	6.35	1.75
83.	Tacos, Potato Chips, Succotash, Cole Slaw, Yellow Cake	5.86	2.19
84.	Veal Scallopini, Hashed Brown Potatoes, Cooked Onions, Kidney Bean Salad, Apricot Pie	5.31	1.84
85.	Fish Sticks, Rice Pilaf, Asparagus, Carrot Raisin & Celery Salad, Mincemeat Pie	5.42	1.80
86.	Salami Sandwich, Boston Baked Beans, Green Beans, Mixed Fruit Salad, Ice Cream	5.53	1.96
87.	Liverwurst Sandwich, Fried Rice, Radishes, Lettuce Salad, Bread Pudding	5.13	2.19
88.	Cheese Sandwich, Mashed Potatoes, Cauliflower, Mixed Fruit Salad, Apricot Pie	6.23	1.73
89.	Meatball Submarine Sandwich, French Fried Potatoes, Spinach, Tossed Cucumber & Vegetable Salad, Cherry Pie	5.44	1.70

TABLE A-2 (Cont'd)

	<u>Meals</u>	<u>Mean</u>	<u>Stand. Dev.</u>
90.	Breaded Shrimp, Scalloped Potatoes, Eggplant, Pineapple Cheese Salad, Chocolate Pudding	6.12	1.81
91.	Pizza, French Fried Onion Rings, Beans w/Pork in Tomato Sauce, Tossed Green Salad, Marble Cake	6.01	1.84
92.	Sliced Roast Pork w/Gravy, Sweet Potato, Brussels Sprouts, Tossed Cucumber & Vegetable Salad, Mince-meat Pie	5.16	1.97
93.	Submarine Sandwich, Potato Salad, Okra, Mixed Fruit Salad, Peach Shortcake	5.96	1.75
94.	Hungarian Goulash, Noodles, Lima Beans, Lettuce & Tomato Salad, Strawberry Shortcake	5.96	1.96
95.	Swiss Steak, Hashed Brown Potatoes, Asparagus, Tossed Cucumber & Vegetable Salad, Lemon Cookies	6.32	1.73
96.	Turkey Slices w/Gravy, Potato Chips, Green Beans, Mixed Fruit Salad, Marble Cake	5.76	2.11
97.	Pepper Steak, Rice Pilaf, Cauliflower, Lettuce Salad, Chocolate Pudding	6.03	1.72
98.	Italian Sausage, Potato Salad, Zucchini Squash, Pineapple Cheese Salad, Banana Split	5.78	1.88
99.	Sweet & Sour Pork, Baked Potato, Carrots, Jellyed Banana Salad, Chocolate Chip Cookies	5.70	2.05
100.	Sardines, Fritters, French Fried Onion Rings, Kidney Bean Salad, Pumpkin Pie	5.18	2.21
101.	Lasagna, Rice Pilaf, Corn on the Cob, Lettuce Salad, Mincemeat Pie	5.88	1.95
102.	Hamburger, French Fried Potatoes, Okra, Pineapple Cheese Salad, Apricot Pie	6.42	1.61
103.	Turkey Pot Pie, Scalloped Potatoes, Cauliflower, Pickled Beet & Onion Salad, Lemon Cookies	5.72	1.75
104.	Stuffed Cabbage, Mashed Potatoes, Peas & Carrots, Lettuce & Tomato Salad, Peach Shortcake	6.03	2.13
105.	Chili Macaroni, Potato Chips, French Fried Onion Rings, Mixed Fruit Salad, Pumpkin Pie	6.55	1.68

TABLE A-2 (Cont'd)

	<u>Meals</u>	<u>Mean</u>	<u>Stand. Dev.</u>
106.	Spareribs w/Sauerkraut, Potato Salad, Stewed Tomatoes, Tossed Cucumber Salad, Cherry Pie	6.61	1.97
107.	Hot Roast Beef Sandwich w/Gravy, Hashed Brown Potatoes, Okra, Jellied Banana Salad, Bread pudding	6.23	1.53
108.	Breaded Veal Steaks, Mashed Potatoes, Beets, Lettuce & Tomato Salad, Chocolate Pudding	6.50	1.59
109.	Tuna Salad, Scalloped Potatoes, Radishes, Cole Slaw, Apricot Pie	5.40	1.89
110.	Pot Roast, Boston Baked Beans, Spinach, Jellied Fruit Salad, Banana Cream Pie	5.83	1.58
111.	Chili con Carne, Fritters, Asparagus, Kidney Bean Salad, Pumpkin Pie	5.38	1.85
112.	Grilled Cheese Sandwich, French Fried Potatoes, Carrots, Lettuce Salad, Chocolate Chip Cookies	6.78	1.66
113.	Salisbury Steak, Mashed Potatoes, Beets, Lettuce Salad, Strawberry Shortcake	6.86	1.78
114.	Grilled Steak, Baked Potato, Peas & Carrots, Pickled Beet & Onion Salad, Cherry Pie	6.78	1.64
115.	Frankfurters, Potato Salad, Green Beans, Pineapple Cheese Salad, Ice Cream	6.07	1.77
116.	Chicken, Spanish Rice, Creamed Corn, Carrot Raisin & Celery Salad, Bread Pudding	6.08	1.82
117.	Chow Mein, Sweet Potato, Okra, Mixed Fruit Salad, Yellow Cake	5.59	2.03
118.	Veal Roast, Boston Baked Beans, Stewed Tomatoes, Pineapple Cheese Salad, Banana Cream Pie	6.25	1.67
119.	Salmon Beans w/Pork In Tomato Sauce, Creamed Corn, Pickled Beet & Onion Salad, Apricot Pie	5.59	2.00
120.	Fried Chicken, Baked Potato, Brussels Sprouts, Kidney Bean Salad, Lemon Cookies	6.89	1.67
121.	Stuffed Green Peppers, Fritters, Corn on the Cob, Lettuce Salad, Chocolate Pudding	6.02	1.94

TABLE A-2 (Cont'd)

	<u>Meals</u>	<u>Mean</u>	<u>Stand. Dev.</u>
122.	Italian Sausage, Potato Chips, Mustard Greens, Cole Slaw, Banana Split	5.99	1.92
123.	Tuna Salad, French Fried Potatoes, Zucchini Squash, Lettuce & Tomato Salad, Marble Cake	5.95	1.96
124.	Chili Macaroni, Rice, Peas & Carrots, Jellied Banana Salad, Yellow Cake	5.85	1.88
125.	Ham, Baked Potato, Radishes, Tossed Green Salad, Chocolate Pudding	5.94	1.75
126.	Pepper Steak, Hashed Brown Potatoes, French Fried Onion Rings, Jellied Fruit Salad, Bread Pudding	6.35	1.64
127.	Meat Loaf, Fritters, Peas & Carrots, Jellied Banana Salad, Pumpkin Pie	6.25	1.82
128.	Grilled Steak, Hashed Brown Potatoes, French Fried Onion Rings, Jellied Fruit Salad, Lemon Cookies	7.10	1.39
129.	Roast Beef, Baked Potato, Broccoli, Kidney Bean Salad, Apricot Pie	5.95	1.63
130.	Turkey Slices w/Gravy, Sweet Potato, Mustard Greens, Jellied Banana Salad, Ice Cream	5.90	1.64
131.	Spareribs w/Sauerkraut, Mashed Potatoes, Wax Beans, Kidney Bean Salad, Cherry Pie	5.04	2.28
132.	Turkey Pot Pie, Potato Salad, Cooked Onions, Lettuce & Tomato Salad, Chocolate Pudding	5.99	1.84
133.	Baked Tuna & Noodles, Rice, Cauliflower, Cole Slaw, Pumpkin Pie	5.39	1.93
134.	Sliced Roast Pork w/Gravy, Spanish Rice, Cabbage, Jellied Fruit Salad, Banana Split	6.39	1.78
135.	Tacos, French Fried Potatoes, Sauerkraut, Kidney Bean Salad, Mincemeat Pie	5.61	2.04
136.	Grilled Cheese Sandwich, Macaroni Salad, French Fried Onion Rings, Lettuce & Tomato Salad, Lemon Cookies	6.34	1.77