MULTIPLE AGREEMENT ANALYSIS

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This is to certify that the

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MULTIPLE AGREEMENT ANALYSIS

by

Peter Wing Hemingway

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ABSTRACT

MULTIPLE AGREEMENT ANALYSIS

by Peter Wing Hemingway

This study reports the development and application of a method for the objective classification of objects on the basis of their common characteristics or patterns.

A review of the literature reveals that one of the major problems of pattern analytic methods is the large number of potential patterns. The goal of such methods is to isolate the patterns which are most meaningful or useful. In those methods where no external criteria are available for determining the utility of obtained classes, analysis tends to yield a proliferation of overlapping classes, with no basis for selecting the more relevant or meaningful ones.

The method presented here offers a strict criterion for the termination of classes based upon the maximization of information contained in each class. Information is defined as the product of the class size (number of members) times the pattern size (number of common characteristics). This criterion achieves the purpose of both maximizing the amount of information accounted for by each obtained class and minimizing the number of classes obtained.

This method, multiple agreement analysis, is largely derived from McQuitty's 1956 paper on agreement analysis, and the principles of taxonomic classification. A theoretical framework is presented, and the computational procedure outlined. This procedure, developed for computer use, is basically an iterative procedure of reductive matrix partitioning. Beginning with a matrix of n persons recorded as either possessing or not possessing each of r characteristics, successive sub-

matrices are extracted. These submatrices are of maximum product size, each having identical rows (characteristics) for all class subjects.

In order to investigate the ability of the method to yield useful results, a set of 20 senators with a predetermined class structure was analyzed, using their votes on 32 issues as the characteristic set. Results indicated the reliability, meaningfulness and utility of the obtained classes satisfied the theoretical claims for the method.

Application of the method to the full body of senators, using the voting records of 88 senators on 95 issues, resulted in a hierarchical classification structure. This consisted of 15 major classes, of which seven contained only two members each. The eight larger major classes were further broken down into subclasses, the larger of these were further divided into subsubclasses. Of all 44 obtained classes, which utilized 72% of the available information, not one contained both a Republican and a Democrat. Further, none of the subclasses contained members of more than one major class. Prediction of the passage or failure of 96 additional issues on the basis of the votes given by a senator from each of the eight larger major classes gave 88% correct prediction.

While the method in its present form is useful as a classification technique, restrictions of the computational procedure not required by the theoretical assumptions imply that results obtained are conservative approximations of the "true" class structure existing in the populations studied. Further investigations as to the relative value of this method compared to other methods is suggested, as well as potential modifications of the computational procedure for particular classification problems.

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"By the classification of any series of objects is meant the actual, or ideal, arrangement together of those which are like, and the separation of those which are unlike; the purpose of this arrangement being to facilitate the operations of the mind in clearly conceiving and retaining in the memory, the characters of the objects in question."

T. H. Huxley. *An Introduction to the Classification of Animals*. London, John Churchill & Sons. 1869.

CHAPTER I

MULTIPLE AGREEMENT ANALYSIS

Introduction and Background

This paper reports the development and application of a multivariate classification technique designed to isolate significant patterns in unordered data, such as individual item responses. The technique is based upon McQuitty's original method of agreement analysis (1956), with several modifications designed to provide objective criteria for termination of classes and sequential reduction of the response matrix. It is a method best suited for electronic computers, due to the lengthy computations required, and has been programmed for MISTIC, the computer at Michigan State University.

The development of objective pattern analytic methods is a comparatively recent phenomenon in psychological research, although the concept of patterning has been utilized by many fields for a much longer period. Even in the ancient histories, we find that Aristotle spoke of patterns in his classification of animal life, and it is in this area, animal classification, that we find the most formal classification system based upon patterns of characteristics. As Cain (1954) illustrates in his summary of the chapter defining the concepts of toxonomic classification, the "definition" of a particular species may be based either upon one or more unique (to that specie) characteristics or to a configuration of non-unique characteristics. He goes on to explain that there are recognized species which have no characteristics which, in themselves, are definitive, yet which provide, in combination with other such characteristics, precise definition of the specie.

The concept of patterns as significant indicators of relationships has been a part of many human activities, both scientific and non-scientific. Philosophers and scientists in many fields have discussed and defined patterns of all sorts, from the prehistoric observers who perceived mythological figures in the patterns of the stars to the present day sociologists who write of patterns of delinquency. The usual methods for isolating patterns have tended to be subjective, arbitrary, and selective observational techniques, where the observers usually began with a particular characteristic, searched for another which would give increased precision to their model, and, over a period of years, they would realize a fairly elaborate structure defining their criterion, whether it was resemblance to a mythological beast or delinquent behavior on the part of a subject. The problem with patterns derived by such methods was their difficulty in remaining invariant; different observers, by selecting different subsets of the characteristics, obtained different results. Also, the development of statistical methods which examined only linear relationships produced such powerful advances in relational and correlational analysis that the characteristics which had been considered as elements in patterns were now studied either individually, or in dimensional groups, with the result that those characteristics dependent wholly on configural (nonlinear) effects were ignored. It is only recently that linear methods have been sufficiently analyzed and refined so that some investigators have felt it worthwhile to go back and attempt to bring patterns into consideration of configural effects as objective, measurable phenomena, and the study of patterns has now become reasonable within the framework of measurement, with statistical and mathematical methods for their analysis being feasible.

Patterns in Psychology

The recent increase of interest of psychological investigators in patterns, or interactions, among sets of characteristics or variables appears to arise from two sources. One is the increasing feeling that the refinements of the standard linear techniques for studying multivariate relationships have become increasingly complex and mathematically sophisticated, and so are attempting to analyze data in much more detail than the data themselves meaningfully contain. Thus, the focus has switched from analysis of the "real" data to analysis of the mathematical models which are hypothesized as isomorphic to the phenomena which give rise to the "real" data. The other and closely related reason for interest in patterns is the feeling that linear models have reached an asymtote in their ability to account for multivariate (and univariate) relationships. Essentially, the present linear techniques are sufficient to determine the linear relations within a set of data. Further advances must therefore necessarily be accompanied by either more precise measurement or by new methods which explore more than the linear effects, or, most desirably, both.

This interest in "patterns" in psychology has stemmed primarily from the focus of the clinical psychologist on configurations supposedly representing the complex interrelations of differing aspects of "the whole person" in making his subjective evaluations and predictions. The desire of the clinician to utilize objective (i.e. "scientific") measures and the failure of available linear models to perform successfully in clinical situations has done much to create the current interest in objective configural methods of data analysis.

The general area of configural analysis has been rather widely studied in terms of profile analysis, but these techniques differ from pattern analysis in their dependence upon linear (dimensional) variates for their starting point. That is, all subjects are measured on a number of tests (variables) and the similarity of their profiles are examined, using one or more combinations of their profile measures, such as shape, level, or scatter, to compare individuals and groups. Such methods, while of considerable interest, involve many assumptions not required by the method presented here, and more appropriately may be considered as complex non-linear multivariate techniques.

Thus, pattern analysis, in its most general form, is an attempt both to remain more nearly at the data level and to allow non-linear relationships to be expressed if they exist. As McQuitty (1957a) has pointed out, there are two basic modes of pattern-analytic methods; the cumulative and the reductive.

The cumulative approach, as typified by the studies by Lubin and Osburn (1957), is the more traditional in form; the object is to determine those patterns of response which are optimally related to an external criterion for the group under investigation. Patterns are built up serially, beginning with that item which best predicts the criterion, pairing this with every other item to find the optimal triad, etc. The procedure terminates when addition of a further item does not further increase the predictive power of the pattern. The features of this method which tend to reduce its effectiveness are the dependence upon an external criterion for determining the optimal solutions, the unitary addition of items which ignores any conjunctive effects of item pairs or larger groups, and concentration upon a single optimal pattern or set of items, neglecting the possibility that different persons may be optimally related to the criterion in terms of different sets of items.

The reductive method is the opposite of the cumulative; it begins with an individual response pattern covering all items of the test, and reduces this to one or more patterns of less than all the items by eliminating those items which do not have identical responses for a person or persons grouped with the initial individual. The advantages of this method are that combinatorial effects are retained, different patterns may be realized for different individuals or groups, and the procedure may be used either with or without the inclusion of external criteria in the analysis.

One of the major difficulties inherent in any reductive method which does not utilize external criteria for selecting patterns is the extremely large number of possible patterns which may exist. If the items are binary, such as true-false, agree-disagree, etc., there are 2^n possible patterns for n items. If the items are multiple-choice with k alternative responses, there are k^n possible patterns. In both cases it is assumed that the available responses are mutually exclusive; if not, the possible patterns are further increased. For example, if a true-false item can be responded to by checking either, both, or neither alternative, it is equivalent to a multiple-choice item with four alternatives, thus capable of yielding 4^n possible patterns. Thus a test of ten such items could contain 4^{10} or 1,048,576 patterns. It is figures like this which have made this type of analysis rather a forbidding task.

The alternative approach of the cumulative method without use of a criterion leads to an even larger class of possible patterns. Under this approach, it would be possible to classify the subjects into groups giving identical responses to the first item, then further classify each of these groups on the basis of their responses to the next item, and so forth until either the items or the subjects are exhausted. Presuming that all items were utilized, there would be again k^n possible patterns. But, as the order of the items affects the composition of any particular group, and there are $n!$ possible orderings, there would be $k^n.n!$ possible patterns in all. Thus, the cumulative method becomes even less attractive than the reductive method when no criterion is available for determining the order of the items. The purpose of any classificatory system which is independent of external criteria is to place together individuals or groups which are most similar, and to separate individuals or groups which are most dissimilar. Using patterns to define groups, it is evident that, for a set of subjects and a set of responses of approximately the same (finite) magnitude, there will exist many more possible patterns than subjects. Similarly, it is unlikely that more than a few subjects will possess identical patterns of response on the complete set of items. Thus the use of the complete response set usually gives little classification beyond the pair level. However, the elimination of responses and the corresponding reduction of possible patterns allows an increase in the size of the groups. This procedure may be followed, sequentially, building up larger and larger classes which are differentially defined by fewer and fewer responses.

This is the approach now used in taxonomy--the science of biological classification. As Cain (1954) points out in considerable detail, species are differentially defined on the basis of a comparatively large number of morphological characteristics; some subset of these characteristics is used to define the genus, and still smaller subsets define the higher levels, such as family, order, etc. It should be noted that this system allows different sets of characteristics to define different groups on the same level, but does not allow for cross-classification of individuals or groups.

The taxonomic method represents a culmination of centuries of study which, while often fragmentary and subjective in its approach, has finally yielded an objective and comprehensive classificatory system. The one principal advantage of this system has been the selection of certain "marker" characteristics for the definition of classes (i.e., the inability of different species to reproduce when crossbred). Using such markers, it then becomes a comparatively simple task to list other defining characteristics of already delimited classes. The current problem in taxonomy (aside from frequent disagreements as to appropriate "markers") is in developing the system below the specie level. Here, where markers have not been determined, taxonomy is beginning to concern itself with analytic methods of classification, especially objective methods of isolating predominant patterns of characteristics (Cain, 1954).

One other field which is becoming intensely concerned with objective classification methods is in the area of information classification, such as library and museum cataloging. This area differs from the taxonomic in that cross-classification is not only allowed but highly desired. The classification of material possessing many characteristics, where the inclusion of all relevant material under any specific characteristic is essential and yet simplicity of the system is required, becomes a highly challanging task. The system presented by Perry and Kent (1957) is one of the first attempts to present a comprehensive theory for such a system, and yet the method proposed is surprisingly similar to the method developed by Toops (1948) for studying patterns of characteristics in the psychological area.

In the reductive methods developed in the psychological area, provision is sometimes made for cross-classifications, so that subjects classified in a particular group on the basis of one set of responses may be further classified with another group of subjects on some other set, even though the responses defining the two patterns may be either distinct or overlapping. These two types of classification involve rather different assumptions. The hierarchical type, which does not allow cross-overs, assumes that the placement of a subject into the first (lowest) level of classification is the terminal point for subject classification. The higher levels are realized by the combination of the lower levels, each first-level class being considered as a unit, and these classes then being the "subjects" which are combined by the method at the higher level. In the methods which allow cross-classification, a rather different basis is utilized for classifications beyond the first level. The individual subjects are in effect released from their initial classes, and allowed to form new classes on the basis of other patterns. The hierarchical systems thus require that higher-level classes be characterized by patterns made up of subsets of the characteristics forming the patterns of the first level classes; while the cross-class systems are more general, later classes being characterized by patterns consisting of <u>any</u> different subset of the available characteristics. The primary problem with such cross-class methods is the development of systematic methods for searching for appropriate subsets without returning to previously utilized subsets. Another problem is the reporting of such a complex classificatory scheme.

We might summarize existing pattern-analytic methods at this point before we turn to a consideration of the experimental evidence as to their value. The most widely used methods have been the cumulative, primarily due to the comparative ease with which the patterns most highly related to the criterion can be isolated. The reductive methods have been more extensively developed in terms of the number of techniques (see for example, McQuitty, 1954a, 1956, 1957c). There are two main reasons for this. First, the freedom from dependence upon a criterion offers more alternative approaches to the selection of appropriate patterns, allowing the techniques to be treated purely as classificatory systems, with no requirement that the classes realized be related to any specific criterion, the assumption being that the classes are related only to some unknown one. Secondly, the methods are usually evaluated on a logical rather than an empirical basis. Hence different methods can be easily constructed to handle specific logical constructs, without actually putting them to empirical tests as to their comparative efficiency in predicting any further relationships.

McQuitty (1954b) has developed a number of schemes for the empirical classification of persons (and/or stimuli) in such a way that configural similarities and differences are the basis for defining classes. These procedures are held to be useful due to the fact that a given response may have different meanings in different contexts. These methods characteristically provide a hierarchical classification structure, so that any attempt to use them in prediction provides the opportunity of finding the level of the hierarchy which minimizes errors of prediction.

Jenkins and Lorr (1954) have used methods similar to those of McQuitty's with the exception that a priori configurations serve as the basis for classifying the members of a sample.

Meehl (1954) has devised an example in which two dichotomous items each correlated zero with the criterion (and hence the multiple correlation with the criterion was also zero), but such that when all four response configurations are considered, perfect prediction of the criterion is possible. This has been referred to as the "Meehl paradox." However, the paradoxical aspects of this situation were removed when Horst (1954) showed that appropriate coefficients a_1, a_2, and a_{12} could be found for the polynomial

$$T = a_o + a_1x_1 + a_2x_2 + a_{12}x_1x_2$$

such that the criterion, T, was predicted perfectly from the two items, x_1 and x_2 (where the criterion, T, and the items each have possible values one and zero). A similar form of "configural scoring" has been used by Stouffer et al (1952) in an attempt to increase the reproducibility of Guttman scales. Here, items were grouped into clusters of two or more, and each cluster was scored as a single item according to the "pattern" of response to the cluster as a whole.

A solution and generalization of the Meehl paradox is also possible in terms of elementary probability theory. If a set of items, $X_1, \ldots X_j, \ldots X_t$, (each assumed to have a finite number of possible response alternatives) are each unrelated to the criterion, T, so that $P(T|x_j) = P(T)$ for all j, then we have the situation in which all of the item-criterion correlations are zero. In other words, the criterion is <u>pairwise</u> independent of each and every item. However, pairwise independence does <u>not</u> imply mutual independence. That is, although pairwise independence may hold, it is not necessarily true that $P(T|x_{j1}, \ldots x_{j_r}) = P(T)$ for all the subsets $(j_1, \ldots j_r)$ which may be taken from the set of item subscripts (1, 2, . . . t) with r taking on values 2, 3, . . . t. For the two-item case, suppose we have x_1 and x_2 and that we wish to predict the criterion, T. Then, if $P(T|x_1) = P(T)$ and $P(T|x_2) = P(T)$, the correlation of each of the items with the criterion will be zero. But it does not follow from this that $P(T/x_1 \text{ and } x_2) = P(T)$. This two-item situation is one of the cases with which Meehl (1950) dealt in his first discussion of the "paradox."

The above discussion can be summarized in the following way: Pairwise stochastic independence of each item with the criterion implies zero correlations of each item with the criterion and hence a zero multiple correlation. However, pairwise independence does not imply that the items and criterion will be independent when we consider pairs of items in relation to the criterion, triplets of items in relation to the criterion, etc.

It is of interest to note that Feller believes "practical examples of pairwise independent events which are not mutually independent apparently do not exist," (Feller, 1957, p. 117). In other words, Feller doubts the existence of actual data such as those represented by the extreme case of the Meehl paradox. However, whether the relation of predictors to criterion can be enhanced by considering "higher order" dependence for a given set of data must be determined empirically. Perhaps the clinical psychologist's insistence on considering the "whole person" or the "configuration of traits" displayed by the individual is a reflection of such higher order dependence.

Using Horst's solution for the Meehl paradox, Lubin and Osburn (1955) developed their methods for predicting a quantitative variable from response patterns. Briefly, the procedure is as follows: for each of the 2^t configurations obtainable from a t-item test (in which the items are dichotomous), a corresponding mean on the criterion is obtained, i.e., the mean criterion value is calculated for each group of persons giving exactly the same response configuration. The result is a set of 2^t criterion means which is designated the configural scale. One value on the configural scale is then associated with each of the 2^t response patterns. The predicted value for an individual giving a particular response pattern is the value on the configural scale corresponding to that pattern.

Rao (1948) has given a general proof of the ability of the maximum likelihood solution to produce the minimum number of misclassifications, whether the predictors are quantitative or qualitative. Lubin and Osburn (1955) have shown that the least squares solution is equivalent to the maximum likelihood when the distribution of criterion scores within each response pattern is normal.

The empirical studies which have compared configural methods with linear methods have produced conflicting results. Better prediction has been claimed using the pattern approach by Meehl (1954), Saunders (1955) and Lubin and Osburn (1955), while the linear (multiple regression) methods have been equally as good or better predictors in the studies done by Bell (1957), Lee (1954), and Ward (1954).

An additional point of confusion in evaluating configural methods is due to differences inherent in the reductive and cumulative approaches. The cumulative methods, such as Lubin and Osburn's, focus upon the maximization of predictive power (hence the necessity of an external criterion), whereas the reductive methods, such as many of McQuitty's, are primarily concerned with classification of the subject based upon the total set of available information (item responses). Such classification methods may or may not yield predictions as efficient as either cumulative or linear methods, depending upon the criterion chosen and the level of classification being utilized.

Configural methods, which search for non-linear variable relations, are generally at a disadvantage in empirical comparisons with linear methods, because of the much greater number of free parameters. Thus, unless the number of subjects is very large, the greater susceptibility of the non-linear methods to shrinkage on cross-validation tends to weaken the comparative effectiveness of these methods.

The method to be presented in this paper is of the classificatory, reductive type. It provides for, but does not require, cross-classification and is based upon a theoretical view of organisms as possessors of traits which are not necessarily linearly related, but which are so related that type concepts (in terms of the organisms) can be meaningfully examined regardless of the linearity or lack thereof in the trait relationships.

CHAPTER II

METHOD

The computational procedure to be presented in this section is based upon McQuitty's original paper (1956) on Agreement Analysis. McQuitty's method will be discussed in some detail in relation to the method and theory employed in the present study.

Agreement Analysis

While McQuitty and several others have presented numerous special techniques for classifying subjects on the basis of patterns of item responses, McQuitty's (1956) paper on Agreement Analysis proposes a procedure which is both general and comprehensive. The basic postulate of the method is "that there are various kinds of underlying psychological structures or predispositions (not just dimensional ones), which result in patterns of responses." (p. 7) These patterns are then the expressions of the particular classes or categories of subjects in the population. This implies that types, as defined by the classes, exist and are determinants of differential behavior (i.e., responses).

The general method of agreement analysis was itself based on Zubin's (1938) definition of the agreement score as a measure of the similarity between subjects. McQuitty uses the agreement score as the tool for combining subjects into classes, adding a correction factor to correct for the amount of agreement by chance on irrelevant responses. This correction factor, while necessary in agreement analysis, will be shown to be unnecessary in multiple agreement analysis by modifying the order in which classes are formed.

The method proposed by McQuitty in this 1956 paper can be briefly described as a hierarchical sequence of combining smaller classes into larger and larger classes based on the magnitude of the corrected agreement scores. The result is a complete system of classes, from individuals to (potentially) one final class consisting of all subjects. Its basic procedure is that of combining that pair of individuals who have the highest corrected agreement score, recomputing the agreement scores between this two-class and all remaining individuals, and repeating this procedure, treating each two-(or larger) class as a new individual. Thus, at any particular point in the process, the next class may be formed either by combining two classes of the same size or a larger class with a smaller one. In the ideal, or at least the simplest, situation, the method would, beginning with N subjects, yield in sequence N/2 two-classes, N/4 four-classes, and so on until there would be one N-class.

This approach to agreement analysis has two obvious shortcomings, both of which have provided the basis for multiple agreement analysis. The first, which is hardly a fault of the method, but rather of the inability of humans, is that the results are too complete and comprehensive. If an investigator is concerned with the relation between classes and some external criteria, he may be forced to compare more classes than he originally had subjects in order to determine which level (n-classes) of classification is best differentiated by each criterion, and then face the possible problem of having different levels or classes most meaningfully related to different criteria.

Obviously, a method which yielded a more limited number of classes would be helpful, but only if the limitation could yield the potentially meaningful classes, while suppressing those which were of less value.

The second shortcoming of agreement analysis is its hierarchical nature. While the method as McQuitty presents it in detail and even illustrates with an example is strictly hierarchical, one sentence points out the possibility of a non-hierarchical system of analysis and indeed, in combination with another statement, provided the basis of multiple agreement analysis. McQuitty states that "responses which do not fit these patterns can be used later to reclassify the subjects in terms of less predominant patterns if it seems worth while." (p. 9). Immediately before this sentence he has defined predominant patterns as those which include the greatest possible number of responses. These two concepts, the maximization of the number of responses in a class, and the use of previously unused responses for reclassification, will be shown to provide both a theoretical and computational basis for multiple agreement analysis.

Theoretical Considerations

The basic assumption of any method which classifies subjects into distinct classes is that such groupings allow simplification of the subject set by reducing it from an n-size group of subjects to an r-size ($r<n$) set of classes. This reduction in the number of classes is further assumed to be accomplished without appreciable loss of relevant information. These assumptions infer the existence of a typal structure in the subject population. The definition of a type is,

then, a set of subjects who are sufficiently similar so that the behavior (i.e. response) of any one member is the expected (most probable) response of any other member. The implications that are customarily associated with a "type" theory (see for example Humphreys, 1957) have tended to make psychologists avoid both theories and methods which have utilized typal constructs in their systems. Such unfavorable response has been often justified by the extreme positions taken by some "type" theories, but, as Cattell (1957) has pointed out, "traits" and "types" are simply reciprocal, complementary and mutually dependent abstractions which can be arrived at from analysis of the same data.

The use of typal concepts in Multiple Agreement Analysis is based on two elements; the use of McQuitty's Agreement Analysis as the foundation for the method, and the use of taxonomic theories and methods of classification (such as presented in Cain, 1954) in support of the anticipated value of the results derived from appropriate application of this method.

The fundamental assumption, then, is that there exist a number of classes in the subject population. These classes are defined by the subject matter of the investigation and are not assumed to be relevant outside of this area, although they may be. As such classes are defined by a syndrome (pattern) of all relevant characteristics, it follows that each such class will exhibit less variance in respect to <u>any</u> of these characteristics than will any group composed of members of more than one hypothetical class.

As in any method for analysis of data, there is assumed to be some defined purpose to work toward in investigating any set of phenomena. The purpose of the investigation thus determines which phenomena are selected for study. Just as the taxonomist limits his classification to consideration of morphological characteristics, the psychologist usually limits his classifications to psychological characteristics. If he is concerned with investigating the determinants of intelligence, he selects for study those phenomena which he judges to be primarily influenced by intelligence. Therefore he will tend to concentrate on behavioral phenomena which supposedly reflect the intelligence of the subjects, such as problem solving, reasoning, verbal abilities, etc., and disregard those phenomena presumed to be relatively unrelated to intelligence, such as physical structure, personality factors, attitudes, etc. The purpose of the investigation then determines the set of characteristics to be sampled. Again it is the judgement of the investigator which determines the method of sampling this set. Just as the taxonomist has an almost limitless supply of morphological characteristics to work with, the psychologist has a vast collection of behavioral phenomena within any defined area of investigation. Rather than take a random sample of such a set, the investigator tends to select those characteristics which he judges to be the more important in terms of generality, relatedness to his purpose, independence, and consistency. For example, the investigator studying intelligence of American children selects items of behavior which are common to the majority of the subjects he is studying, such as knowledge of the meaning of English words rather than Russian words; and related to the purpose, such as ability to perceive relationships rather than ability to perceive distant objects, etc.

If we assume the purpose of any psychological investigation to be at least in part directed towards isolating differences among the subjects in terms of the phenomena studied, then classification is an integral part of the investigation.

It is interesting to note that taxonomy, like psychology, has long dealt with differences among groups, but that the modern concepts of taxonomic theory are concerned with similarities rather than differences (Cain, 1954). While this shift in emphasis is based upon a subtle distinction between definitions based on the two approaches, it has provided new impetus to a field once thought to be essentially complete. It remains to be seen if the current psychological concern with configural effects will lead to a similar change in emphasis in behavioral concepts.

Our complete model therefore consists of some defined population of subjects and some defined area of interest which encompasses a population of characteristics. In the typical investigation, neither population is studied in its entirety; rather, a sample of subjects is drawn by some systematic device (randomly, selectively, etc.) and determination of the presence or absence of each of the characteristics selected for the characteristic sample is made for each subject in the sample. Based on the assumption that classes exist in the population, each such class being defined by a set of characteristics (a syndrome), then the identification of these classes on the basis of the information available in the sample studied is the primary task of the investigator. In the simplest case, where only one dichotomous characteristic is studied, the classification is straightforward. There are two obtained classes--those that possess the characteristic and those that do not--and the relation of the obtained classes to the assumed population classes is a function solely of the error in the determination of the characteristic value for each subject. The problem in this case is the selection of the characteristic. If the characteristic is diagnostic (having one value in some classes and another value in other classes) and free from error, then the obtained classes are representative of the population classes to the extent that the two-way classification suffices for the purposes of the investigation. For example, if research is directed at studying differences between men and women, the first classification applied may be based on the one characteristic which best differentiates these two classes. The characteristic chosen, however, may be any one of the set which makes up the syndrome. The errors of classification will then be a function of the diagnostic value of the chosen characteristic and the reliability of its determination for each subject. One physical characteristic, possession of a glans penis, may give extremely good classification in matching the obtained classes to the population classes, while another, such as presence of facial hair, may give less valid results, although both characteristics are part of the syndrome. Other syndrome characteristics such as "wears dresses," "is a mother," etc., may give even less valid results.

Syndrome characteristics may thus be classified into four types: Absolute, Relative-Absolute, Relative, and Associated. Absolute characteristics are those found in all members of one class and in no member of any other class. Relative-absolute characteristics are those found in all members of one class and only in some members of other classes, or those found in some members of one class and in no members of any other classes. Relative characteristics are those which occur more often in one class than in another. Associated characteristics are those which in themselves show no differences among classes, being equally common or uncommon in several classes, but which are diagnostic (differentiating) when considered in conjunction with other characteristics. While the first three types have been long recognized and utilized in linear methods, the Associated characteristics have usually been overlooked in psychological investigations until the recent advent of configural methods.

For examples of these, we may return to our previous problem. Our population is defined as human beings (a biological classification); the two classes are male and female. It is practically impossible to find any absolute characteristic, but possession of a glans penis would come fairly close to this definition. Absolute-relative characteristics are quite common; "has given birth to offspring" is a characteristic never found in the male human, but quite commonly in the female. "Is presently wearing lipstick" and "cleans house regularly" are relative characteristics, more often occuring in females than in males. Examples of associative characteristics are rather difficult to find which are not simply reflections of the type of the other characteristic, such as "likes children" <u>and</u> "has given birth to offspring." While such an association is diagnostic, it offers no information not given by the latter item alone. The truly associative characteristics, where <u>none</u> of the items singly give any class information while their combination does give some (such as occurs in the Meehl Paradox, as set forth by Meehl, 1950) may or may not be fairly common in any particular area, but as few psychological investigators have ever looked for such combinations, it is difficult to point to any accepted instance where such combinations are known in differentiating males and females. A theoretical example is easily constructed, however, if we accept two common positions used by humorists. If we ask, "Are you married?" we get approximately the same frequencies of yes and no responses from members of both classes. Assuming that we find the same situation holds when we ask the subjects, "Are you happy?" then neither of these characteristics offers any information as to the class membership of the subjects. Now if we accept the humorists' view that women want or need marriage for happiness and that men consider marriage a form of punishment, then the combination of responses to the two questions should be related to the population classes, as women would be expected to respond either "yes-yes" or "no-no" to the two questions while men tend to give either "yes-no" or "no-yes" responses. Thus the combinations would be diagnostic, although the individual items were not.

There remains one further type of characteristic, the non-functional. This is any characteristic which exists in the population but is not related in any differential way to the classes under investigation. The inclusion of such characteristics (such as perhaps hair or eye color in our study of males and females) is an error in defining the population of characteristics, and will tend to confound the classification, especially if such a characteristic is diagnostic of other classes existing in the population of subjects being investigated. Such characteristics will tend to yield classifications related to these other classes, which may confound the classes originally intended by the investigation. For example, if a characteristic diagnostic of development (adult-child) were included in the classification by sex, this would yield definite classes, but they would not be those classes desired by the purpose of the investigation. This problem is further compounded by the fact that a single characteristic may be diagnostic of more than one class, thus actually giving the investigator more classification than was intended. In the case of the characteristic "has given birth to offspring," which is diagnostic in differentiating males from females, we find that this characteristic is also diagnostic for such classes as adult-child, married-single, fertile-sterile, etc., but may not differentiate humans from primates, intelligent from unintelligent, itroverts from extroverts, etc. The problem of determining of which class a particular characteristic is diagnostic becomes a problem in adequately sampling the syndromes of the classes sought by the investigator with minimal sampling of syndromes of non-relevant classes.

The compounding of classes created by utilizing improper or multiclass characteristics causes great error when the system used is a sequential classification, as every class realized after the improper characteristic is thereby confounded. In the more "natural" classification systems, where all characteristics are considered at the same time, an improper characteristic is more likely to be overshadowed by proper characteristics and thus not enter into the system until the later stages of classification. Thus confounding of classes would be expected only in the less reliable classes realized after the major structures have already been determined. If there has been a systematic sampling of improper characteristics which are members of a syndrome of an existing class not intended (non-relevant) for inclusion in the investigation, the classes realized will also tend to be non-relevant. In completely natural classification, there are no improper characteristics; for the purpose of such classification is to determine the total structure of a population, so that the syndromes of all classes are representatively sampled. In such a case, all classes are realized, and the size (number of subjects) of each class determines the generality of the syndrome.

Multiple Agreement Analysis

Multiple agreement analysis starts with a matrix of responses for a group of subjects (which may be objects, stimuli, responses, etc., as well as persons). The responses are assumed to represent an adequate sample of the population characteristics related to the investigation, and the subjects to represent an adequate sample of the population for which the research is planned. We assume that the population of subjects contains N classes related to the purpose of the study, with each such class having a syndrome of characteristics. The basic assumption of the method is that subjects who are highly similar in their responses are members of the same class. As none of the subjects may be identical in terms of all of the characteristics and all of the subjects may be identical in terms of some few characteristics, the goal of the method is to select those persons and those characteristics most likely to be representative of each class. By definition, such a class is one in which the persons in the class are more alike than any such person is like any person not in that class. The most efficient way to insure the fulfillment of this criterion is to require all members of the obtained class to be identical in terms of those characteristics which define the obtained class. Thus all members are equally identical, and any person not in the class who is as like any member of the class as any other member of the class necessarily becomes a member of the class.

The criterion for terminating any obtained class is a logical consequence of the method of forming a class. If the inclusion of a subject into a class adds information, the class is said to be better defined; if such an inclusion causes a loss of information, the class is less well defined. The information contained in a class is simply the number of responses accounted for by that class, expressed as the product of the number of subjects in the class times the number of characteristics defining the class. For example, if an obtained class consists of 10 persons and a pattern of 10 characteristics, 100 bits of information would be accounted for by that obtained class. If one additional person is added to the class, but only by a reduction of the pattern to 9 characteristics in order to retain the identicalness of all the subjects, we find that the product (11 x 9) has fallen to 99, a loss of information. However, if still another person is added, with no loss in the pattern, the product term (12 x 9) now exceeds 100 by 8 points, indicating that the 12 subject and 9 characteristic class is to be preferred. It will be evident that a logical termination point in forming an obtained class is at the point where the information accounted for (i.e., subject-characteristic product) is at a maximum.

The procedure for forming an obtained class is thus the problem of selecting from the response matrix that sub-matrix (or partition) of maximum size with identical rows or columns, whichever represents the responses. Obviously the effect can be obtained only once; it then becomes necessary to reduce the original response matrix by eliminating this sub-matrix. The same procedure is then repeated on the reduced response matrix; the identical-rowed sub-matrix of maximum size (product) is determined, eliminated, and the procedure continues until all desired information is extracted. Even if the procedure is continued until there remains no agreement among any of the subjects on any characteristic, there may still be information (responses) left in the matrix. These do not necessarily represent unusable information, for they may represent a lack of precision on the part of the method, error in the subject, or unreliability in the determination of the characteristic.

To summarize, this is the logical basis of multiple agreement analysis. An agreement is defined as possession of the same characteristic by two persons; their agreement score is simply the sum of the number of characteristics or responses which they have in common. Classification by means of multiple agreement analysis is defined as the sequential partitioning of the response matrix so that each partition consists of identical rows. Each partition contains the maximum possible information, as defined by the subject-response product. The sets of subjects so obtained are postulated to be estimates of the classes which exist in the population under investigation. The computational procedure to be presented is an objective method for obtaining such sets.

Computational Procedure

The practical problem is of the following form; we have a set of n items, each having k alternative responses which are mutually exclusive. Non-mutually exclusive data can be handled by treating each response as a separate category. A group of p subjects, a sample from some defined population, have recorded their responses to the items. Under the assumption that members of different classes should show more variance than members of the same class, we hypothesize that subjects who belong to the same class will tend to have more responses in common than will members of different classes.

If we further assume that some items are non-functional for some classes, then the problem is to determine which items yield the response patterns which best define the population classes. There will exist different patterns for every possible subset of items, and for an item subset of size $r (r<n)$ there are $\frac{n!}{(n-r)!\, r!}$ different subsets, each having k^r possible patterns. The goal of this method is to determine objectively those patterns from among the $\sum_{r=1}^{n} \frac{n! \cdot k^r}{(n-r)!\, r!}$ number available which will (a) best represent the class structure of the population and (b) use the maximum possible information in representing these classes.

We have seen the logic of the method to be to partition the response matrix into submatrices of the maximum size which are invariant across a set of subjects. This procedure is designed to meet two objectives; (a) the subjects are classified into the minimum number of classes, while (b) utilizing the maximum amount of information. Multiple classification of subjects is allowed and also multiple use of responses, with the restriction that the same response cannot be used more than once for the same subject.

The computational scheme has been designed with special reference to electronic computers, and programmed for the MISTIC computer.

The complete MISTIC program is set forth in Appendix C. The calculations may be broken down into nine major steps. A hypothetical example will be used to illustrate each of these steps. The responses of 9 subjects to 6 binary items are given in Table 1 (Y denotes a yes response and N a no response).

Step 1. The agreement score (number of identical responses) between each person and every other person in the response matrix is computed. This requires $\frac{n(n-1)}{2}$ computations. These scores are listed for the example in Table 2.

Step 2. That pair of persons with the maximum agreement score is selected as the starting point for the initial obtained class. In the event of a tie among two or more pairs for maximum agreement score, an empirical test has revealed that the same structure is obtained regardless of which pair is used. Hence the computer program arbitrarily selects the last pair to attain the maximum as the starting point. The maximum scores are circled on the agreement matrix of the example. Pair HI. being the last computed, was selected as the initial starting point.

Step 3. Those responses upon which this pair agree are selected to form the initial scoring key. This scoring key is then used to compute the agreement scores of all remaining persons with the initial pair. In the example, this would be all 6 of the I and H responses.

Step 4. That person agreeing most highly with the initial pair is tentatively chosen as the next member of the class. Again ties are

TABLE 1

THE RESPONSE MATRIX

Subjects

Items	A	B	C	D	E	F	G	H	I
1	Y	Y	Y	Y	Y	N	N	N	N
2	N	N	N II	N	N	Y	Y	Y	Y
							I		
3	Y	Y	Y	Y	Y	N	N	N	N
4	Y	Y	Y	N	N	N	N	N	N
		IV							
5	N	N	N	Y	Y	Y	Y	N	N
					III			V	
6	Y	N	N	Y	Y	Y	Y	Y	Y

TABLE 2

The Original Agreement Score Matrix

Subject	A	B	C	D	E	F	G	H	I
A	-	5	5	4	4	1	1	1	1
B		-	6	3	3	0	0	1	1
C			-	3	3	0	0	1	1
D				-	6	3	3	2	2
E					-	3	3	2	2
F						-	6	5	5
G							-	5	5
H								-	6

settled by the rule that the last person to tie for the highest agreement score be the one selected by the computer. Thus person G, with an agreement of 5, is the first tentative choice.

Step 5. The products of the two sets are now compared. If the inclusion of the new person does not reduce the information accounted for by the class, he is accepted as a class member. If the product is less when he is included, his classification remains tentative.

Step 6. A new scoring key is now prepared, based on the responses common to the augmented set of persons, regardless of the outcome of step 5. Steps 3, 4, 5, and 6 are repeated until all persons who agree with the current scoring key on at least two responses are tentatively included in the set. In the example, persons G and F are included and the procedure terminated, as no remaining subject agrees with the four-item scoring key on more than one item.

Step 7. That point in the formation of the set with the maximum product is now chosen as the best estimate of a hypothetical class. Again ties are settled by taking the last maximum. The computer therefore prints out the persons and the response pattern which form this obtained class. In the example, this corresponds to the class FGHI, with response pattern NYNN--. The product of this class is 16 (4 subjects times 4 responses).

Step 8. The submatrix corresponding to the first class is now eliminated from the original response matrix. This is in accordance with the requirement that no response be used more than once to classify the same subject. In the example, this corresponds to the elimination of that submatrix labeled I in Table 1.

Step 9. Steps 1 through 8 are repeated on the reduced response matrix. This cycle of operations is repeated, with each cycle defining a new class, until there remains in the response matrix no agreement score equal to or greater than some predetermined criterion. For the example, these classes are presented in Table 3 in their detail of formation, but without showing the recomputation of the agreement matrix of Table 2 for each cycle.

The complete analysis of the example, with the criterion that no agreement score less than two will be used in forming classes, results in the class structure listed in Table 3. Several characteristics of the method are illustrated. First, the first two classes classify all the subjects, giving a complete classification corresponding to major mutually inclusive classes. Second, class 3 is a cross-classification, containing members of both major classes. Third, classes 4 and 5 are sub-classes of the major classes. The responses defining the major classes are those listed. Those defining the sub-classes include those listed plus those defining their respective major classes. The cross-class is defined by those responses listed, plus a No response to Item 4, which would not be realized as it had been previously used to classify the class 1 subjects. Thus, patterns of subclasses consist of their common responses plus the common responses of their major classes, while cross-class patterns can be completely determined only by inspection of the original response matrix.

This method of analysis differs in several respects from Agreement Analysis, as originally reported by McQuitty (1956).

TABLE 3

MULTIPLE AGREEMENT ANALYSIS: CLASS STRUCTURE OBTAINED

			OUTPUT	
First Classification:				
HI - 6	Product - 12			
HIG - 5	Product - 15			
HIGF - 4	Product - 16 MAX.	FGHI	Key:	N Y N N * *
Second Classification:				
DE - 6	Product - 12			
DEA - 4	Product - 12			
DEAC - 3	Product - 12			
DEACB - 3	Product - 15 MAX.	ABCDE	Key:	Y N Y * * *
Third Classification:				
DE - 3	Product - 6			
DEG - 2	Product - 6			
DEGF - 2	Product - 8 MAX.	DEGF	Key:	* * * * Y Y
Fourth Classification:		ABC	Key:	* * * Y N *
Fifth Classification:		HI	Key:	* * * * Y N

Firstly, the inclusion of the product maximization criterion for termination of obtained classes reduces the number of hierarchical classes obtained. This criterion allows an objective method for isolating what McQuitty terms "predominant patterns."

Secondly, the sequential addition of individuals to a class, working on only one class at a time, means that McQuitty's correction (for chance agreement on irrelevant items) of agreement scores is not required. As only individuals are considered for inclusion, the correction is proportioned to the magnitude of the agreement scores, thus not affecting the order in which unclassed individuals are considered for inclusion in the class.

Thirdly, the freedom for individuals to be considered for more than one class on the basis of previously unused responses allows both a flexibility to yield cross-classifications and maximal use of all available information for all subjects.

Finally, the programming of this method for computer use allows analysis of large subject-response matrices which would be entirely unfeasible to calculate by hand methods. It should be noted that these modifications have been greatly influenced by some of McQuitty's subsequent articles developing pattern analytic methods (see McQuitty, 1957a, 1957c, 1960).

CHAPTER III

EMPIRICAL INVESTIGATION

The purpose of the investigations reported in this chapter was to ascertain some of the properties and uses of multiple agreement analysis. To this end several kinds of questions were asked and analysis performed to answer these questions.

The first, and most important question was: would the method yield meaningful results? Specificly, would analysis of data from a set of subjects with a known (i.e. predetermined) structure result in reproduction of that structure? A question closely related to this concerned the uniqueness of the results, especially whether a similar structure could be obtained from random data possessing the same marginal frequencies (i.e., item difficulty levels). Another question was: are the results reliable, in that a repeated analysis of the same subjects on different sets of responses yields comparable results?

Another group of questions were asked as to the stability of the results under modification of the basic method. These questions were: What is the effect of analyzing different types of responses (i.e., yes and no) separately rather than together? What happens if the analysis begins from different starting points? What results are obtained if the analysis is by items rather than subjects? The purpose of investigating these questions was to attempt to determine the optimal method of analysis and the comparability (stability) of results from these various approaches.

A final set of questions was asked as to the potential utility of the results. Essentially, these questions concerned the use of the results in prediction. The two questions asked were: Can the results be used to predict the appropriate classes of subjects not previously included in the analysis? And, can responses to new items be predicted from a knowledge of subject and/or item classes?

This chapter reports the results of the analyses performed to answer these questions.

The Assumed Class Structure

The set of subjects utilized in all these investigations consisted of twenty United States Senators in the 83rd Congress. This selection was based upon the results of a study by Fitch (1958) in which he used both factor analysis and similarity analysis in investigating the structure of the U. S. Senate as revealed by their voting records. The Senators chosen belong to four groups which were differentiated on the basis of both his analyses. Five representatives of each of these groups were selected on the basis of their similarity and representativeness of their respective groups. These groups have been designated as Liberal Democrats, Southern Democrats, Eisenhower Republicans and Conservative Republicans, in accordance with the political commentators' labels generally attached to the Senators chosen.

The Senators are listed by name under their assumed classes in Table 4. It should be noted that Senator Morse of Oregon was a self-

TABLE 4

THE ASSUMED CLASS STRUCTURE OF 20 SENATORS

I Republicans

A. "Conservative"	B. "Eisenhower"
1. Goldwater, B. (Ariz.)	6. Knowland, W.F. (Calif.)
2. Dworshak, H.C. (Idaho)	7. Milliken, E.D. (Colo.)
3. Welker, H. (Idaho)	8. Smith, H.A. (N. J.)
4. Jenner, W.E. (Ind.)	9. Duff, J.H. (Pa.)
5. Barrett, F.A. (Wyo.)	10. Flanders, R.E. (Vt.)

II Democrats

A. "Southern"	B. "Liberal"
11. McClelland, J.L. (Ark.)	16. Humphrey, H.H. (Minn.)
12. Smathers, G.A. (Fla.)	17. Mansfield, M. (Mont.)
13. George, W.F. (Ga.)	18. Murray, J.E. (Mont.)
14. Russell, R.B. (Ga.)	19. Monroney, A.S. (Okla.)
15. Johnson, L.B. (Texas)	20. Morse, W. (Ore.)

designated Independent at the time, although Fitch's analysis indicated his voting behavior to be similar to that of the Liberal Democrat group.

The data used in these analyses were the voting records of these Senators during the two sessions of the 83rd Congress, as reported in the Congressional Quarterly Almanac, Vols IX and X (1953, 1954). These are the same data as used by Fitch, although a more limited sample of issues was used in these analyses. The actual votes of each member are recorded in Appendix A, with a 1 signifying an affirmative position on an issue, and 0 signifying the negative position. A brief summary of each issue is included in Appendix B. When no position was stated upon an issue, votes were randomly assigned to either the 1 or 0 catagory, so that there would be no missing information. This was done primarily to enable comparisons to be made of the various approaches to the analysis using a complete set of data.

The hypothesis to be tested by Multiple Agreement Analysis applied to this data was that the assumed structure would be reproduced. Error would occur to the extent that subjects were misclassified.

The Obtained Class Structure

The initial analysis of these data was by the "double-entry" method, where both affirmative and negative votes were used in the same analysis. An affirmative vote on the first issue was recorded on the IBM card as "punch-no punch" in columns two and three of row Y; a negative vote as a "no punch-punch" in the same location. (For complete details of the preparation and operation of the computer program, see Appendix C).

In order to study the complete results, the analysis was continued until there remained no two subjects who agreed upon more than one item. This allowed use of practically all information in the response matrix, but meant that many small groups were isolated. However, with no rationale as to the required size of a "meaningful" group, and the assumption that all responses (except the randomly assigned responses for "no response" data) were meaningful, there was no a priori basis for cutting off the classification at any particular point.

Table 5a summarizes results of this first analysis, and Table 5b rearranges these results into a hierarchical classification system based on the assumed structure. Results will be seen to reproduce the predicted structure quite well. The assumed structure is represented by the first seven classes, which account for 503 of the 640 available bits of information, or 78.6 per cent. The last ten classes account for only 12.2 per cent of the information. After forming these seventeen classes, 9.2 per cent of the votes remain unclassified. In order to discuss these ten small classes obtained after the formation of the seven larger classes, it is necessary to understand one characteristic of the analysis. This is that, when the criterion for beginning a class is set at a low level, as it was in this case, classes of at least pair size are forced to form even when only a small number of common items are left in the response matrix. This is not to imply that such groups are meaningless, but formation of such groups is largely a function of the quantity of residual responses left for a particular subject after the formation of the main classes. Subjects who are relatively unique in their response patterns are the ones most

TABLE 5

OBTAINED CLASSES, GROUP A ISSUES

a. The Obtained, Classes: Double-Entry Method, Using 32 Group A Issues to Classify 20 Senators

Class Number	Members by Senator's Number	Common Responses	Product
1	1-2-3-4-5-6-7-8-9-10	15	150
2	12-13-15-16-17-18-19-20	14	112
3	11-14	29	58
4	16-17-18-19	11	44
5	1-2-3-4-	12	48
6	6-7-8-9-10	11	55
7	12-13-15-	12	36
8	16-18-19-20	3	12
9	5-12-20	4	12
10	6-7	5	10
11	8-10	4	8
12	17-18	4	8
13	3-4	4	8
14	13-15	3	6
15	1-5	3	6
16	19-20	2	4
17	5-9	2	4
		Total =	581*

*581 of the 640 available responses used in forming 17 classes.

b. The Apparent Structure of the First Seven Obtained Classes on 32 Group A Issues

Major Classes

Republican	?	Democrat
1-2-3-4-5-6-7-8-9-10	11-14	12-13-15-16-17-18-19-20

Subclasses

"Conservative"	"Eisenhower"	"Southern"	"Liberal"
1-2-3-4	6-7-8-9-10	12-13-15	16-17-18-19

likely to have large residuals after the formation of the major classes, and thus to be forced into small classes on the basis of only a few common responses with other such unique individuals. For example, in class 9, three senators agree on four responses. At the time this class was formed, Senator Barrett had 17 residual responses; Senator Smathers, 6; and Senator Morse had 15. Thus Senators Barrett and Morse were obviously quite unique, having necessarily less than seven common responses in order to allow Senator Smathers to join with them on only four responses. Their uniqueness was not only between themselves, but also from the remaining 18 Senators, for at the completion of the first seven classes, none of the other Senators had more than 7 residual responses, while Senators Barrett and Morse had 17 and 18 respectively.

While I have been reluctant to attribute much meaning to the last ten classes realized, feeling that they may be based as much upon the operation of the program as upon any "true" classification, it is interesting to note that these classes generally "make sense." That is, of the ten smaller classes, eight represent combinations of subjects who belong to the same assumed classes (i.e., Liberal Democrats), one (class 17) represents a cross-classification of a Conservative Republican with an Eisenhower Republican, and the only one which is a complex cross-classification (class 9, combining a conservative Republican, a Southern Democrat, and a Liberal Democrat) is the one discussed earlier as possibly being due primarily to the large number of residual responses available for two of these subjects. Thus it would appear that, while these small classes may be of limited interest in terms of amount of information provided, they still continue to contribute to the over-all pattern of the classification system. The point at which one wishes to stop classifying and label the remaining residual responses as individual uniqueness would appear to be primarily a function of the interest of the investigator in the degree of classification he will accept as sufficient for his specific purposes.

Turning now to consideration of the first seven classes, there is little difficulty in assigning labels to these results. The first class consists of all Republicans, and completely supports the assumed structure. The second class consists of only eight of the ten Democrats. Thus the assumed structure is represented with 80 per cent accuracy in this case. The third class consists of only two Southern Democrats, and supposedly represents two Senators who are so similar to each other and sufficiently dissimilar to the second class that they "stand alone" as a significantly discrete class. The four remaining classes represent with varying degrees of accuracy the assumed classes within each party of Liberals and Southerners, Conservatives and Eisenhowers. Overall, it can be stated that the group analyzed, which was assumed to have a structure of two major classes, each having two sub-classes, was found to have three major classes, two of which each had two sub-classes. Thus the only discrepancy between the assumed structure and the obtained structure was class three, which had not been predicted.

The relation between the predicted and obtained classes may be measured in various ways. One simple method is to state that the six predicted classes were "covered" by the first seven obtained classes. Another method is to consider the individual errors in classification. Thus Class I has no errors (10 our of 10 correctly classified), Class

II has two errors (8 out of 10 correct). If we take the additional liberty of excluding the third obtained class from consideration, then class IA has one error (obtained class 5), Class IB has no errors (class 6), Class IIA has two errors (class 7) and Class IIB has one error (class 4), for a total of six errors. Adopting a more liberal criterion of error and speaking of misclassifications (a subject combined with members of other assumed classes) we find no errors in the first seven obtained classes, and only one error (Senator Barrett in class 9) in all 17 classes.

Regardless of which method one uses to count the errors in the system, two points are quite obvious. First, under any view the assumed (predicted) structure and the obtained structure are highly alike, although the obtained structure is more complex (and therefore more complete?). Secondly, as there is no absolute criterion for the predicted structure, there is no way to tell which structure, the assumed or the obtained, is in error, or, more precisely, corresponds more closely to reality. In order to examine this second point, and the additional questions as to the possibility that other factors might be responsible for the obtained structure, several additional analyses were performed and are reported in the next section under considerations of the reliability and uniqueness of the results obtained by this technique.

The Reliability of Multiple Agreement Analysis

Any attempt to establish the reliability of a classification system must face one of two problems, depending upon what particular aspect of reliability is investigated. One method is to see if the class system "holds up" when a new sample of subjects from the same population is classified on the same characteristics. The problem in this method is the comparability of the two samples of subjects. Any differences in the class structure obtained on the second group from that obtained on the first goup may be due to the lack of reliability of the method, or to differences in the two samples, or to both sources. In the alternative method, the same subjects may be reclassified using a new sample of characteristics from the same population. Again, any differences in the resulting class structure may be due to either the method unreliability or to the sample differences, or both. In the present situation, only the latter method is feasible, as the subjects were not drawn at random, but strictly on the basis of systematically representing a particular structure.

The first investigation of the reliability of this method was based upon the use of another sample of items (characteristics). As the first 32 items of Fitch's Group A issues (obviously not a random sample!) had been used for the first analysis, the first 32 items of Fitch's Group B issues were used for the reliability analysis. As Fitch had sorted systematically his issues into two equivalent groups, A and B, the item group most comparable to the first 32 A issues should be the first 32 B items.

The analysis was run in the same manner as the first, using the double-entry method of entering the responses. Table 6a gives a summary of the results of this analysis, and Table 6b a schematic of the structure given by the first seven Group B classes.

While it is immediately apparent that the two analyses did not give identical results, the B analysis "makes sense" in terms of the

TABLE 6

OBTAINED CLASSES, GROUP B ISSUES

a. The Obtained Classes: Double-Entry Method, Using 32 Group B Issues to Classify 20 Senators

Class Number	Members by Senator Number	Common Responses	Product
1	1-2-3-4-5-6-7-8-10	15	135
2	16-17-18-19-20	17	85
3	11-12-13-14-15	20	100
4	6-8-9-10	11	44
5	16-18	14	28
6	1-2-3-4-5	9	45
7	5-7-11-13-15	4	20
8	11-14	7	14
9	9-17	6	12
10	7-13-20	4	12
11	12-15	6	12
12	8-10	5	10
13	2-3	5	10
14	5-7	4	8
15	1-4	4	8
16	19-20	3	6
17	17-19	3	6
18	17-20	2	4
19	3-9	2	4
20	4-12	2	4
21	2-6	2	4
		Total =	571

b. The Apparent Structure of the First Seven Obtained Classes on 32 Group B Issues

Major Classes

Republican	"Southern"	"Liberal"
1-2-3-4-5-6-7-8-10	11-12-13-14-15	16-17-18-19-20

Subclasses

"Conservative"	"Eisenhower"	?	"Liberal II"
1-2-3-4-5	6-8-9-10	5-7-11-13-15	16-18

assumed structure through the first six classes. The seventh class is very mixed, however, in its membership, and none of the remaining 14 classes, which also include several more mixed classes (classes 9, 10, 14, 19, 20, 21) match any of the last ten classes of the A analysis. If we match the first seven classes of the two analyses as shown in Table 7, we note that the agreement of the matched classes as to membership is quite good (80 per cent or better) for classes 1, 5, and 6 while considerably reduced for classes 2 (60 per cent), 3 (40 per cent), 4 (40 per cent), and 7 (40 per cent). It is interesting to note that in both A and B, it is the Democratic groups which are involved in the larger discrepancies, both between the A and B groups and between both of the groups and the assumed structure. It would appear from these results that the Democrats form a less homogeneous set than the Republicans.

The results of this analysis have provided little evidence for or against the reliability of the method, primarily because of the lack of any standard technique for assessing reliability of classes. Working at the individual subject level, we find that both analyses made no errors of misclassification through the first six classes (the first seven in Group A), when using the assumed structure as the criterion. The reliability of the remaining classes appears to be nil, as there is no agreement between the pair size classes in the two analyses, and considerable misclassification of individuals, especially in the B analysis. This would support the contention that, after the significant (i.e. meaningful) classes are realized, further classification is forced upon the members who still have unused responses in the residual matrix.

TABLE 7

COMPARISON OF THE FIRST SIX OBTAINED CLASSES WITH THE ASSUMED CLASSES
GROUP A AND GROUP B ISSUES

Class	Members
Assumed Class I (Republican)	1-2-3-4-5-6-7-8-9-10
Obtained Class 1, A Issues	1-2-3-4-5-6-7-8-9-10
Obtained Class 1, B Issues	1-2-3-4-5-6-7-8- 10
Assumed Class IA (Conservative)	1-2-3-4-5
Obtained Class 5, A Issues	1-2-3-4
Obtained Class 6, B Issues	1-2-3-4-5
Assumed Class IB (Eisenhower)	6-7-8-9-10
Obtained Class 6, A Issues	6-7-8-9-10
Obtained Class 4, B Issues	6- 8-9-10
Assumed Class II (Democrat)	11-12-13-14-15-16-17-18-19-20
Obtained Class 2, A Issues	12-13- 15-16-17-18-19-20
Obtained Class 2, B Issues	16-17-18-19-20
Assumed Class IIA (Southern)	11-12-13-14-15
Obtained Class 3, A Issues	11- 14
Obtained Class 3, B Issues	11-12-13-14-15
Assumed Class IIB (Liberal)	16-17-18-19-20
Obtained Class 4, A Issues	16-17-18-19
Obtained Class 5, B Issues	16- 18

If we accept the results of these two analyses as indicating that the results are meaningful, at least to the extent that few misclassifications are made until the major part of the available information is utilized, another issue may be raised. This is the possibility that the classifications obtained are primarily a function of the number of affirmative or negative votes cast on the issues involved. This issue has little relation to the "significance" of the membership of the classes, but is primarily concerned with the "significance" of the product magnitudes. If we can obtain classes which account for the same amounts of information solely on the basis of the "item difficulties" (i.e., marginal proportions), then it can be hypothesized that the same results could be obtained (and much more easily) simply by moving across the columns (items) of the response matrix after ordering the items from high (high proportion of either "yes" or "no" votes) to low (50% of each response). With the appropriate reordering of subjects, the class submatrices could be readily determined, very much like the use of a Guttman scalogram board. However, this would imply unidimensionality, and also ordering of subjects within the dimension. While this approach has been extended to suborderings of the items, giving multiple Guttman scales (Lingoes, 1960), the assumption of dimensions requires ordering of all subjects on each scale and thus certain items may remain unused (being unscalable) for all subjects. However, the reproduction of the class products obtained by Multiple Agreement Analysis on the basis of marginal frequencies alone would indicate that the results were primarily a function of linear relationships and that little has been gained by allowing for patterns, or nonlinear effects. It should be noted that this in no way negates the meaningfulness of the classes as far as subject composition is concerned, for this remains to be determined as an issue in validity.

However, it seemed desirable to investigate to what extent the obtained classes, in terms of size (product) alone, can be duplicated solely by random responses with essentially the same marginal frequencies of each response for each item. Therefore a matrix of random 0's and 1's was constructed by use of a table of random numbers to duplicate within sampling limits the same marginal frequencies as the group A data. This matrix is presented in Appendix A, with the actual (observed) and original (expected) group A marginal totals (number of 1 responses) given. A chi square test of the goodness of fit was insignificant ($p > .50$). This matrix was analyzed by Multiple Agreement Analysis in the same manner as group A and B. Results are given in Table 8.

Two major differences between these results and those of the Group A analysis are readily apparent. First, the number of obtained classes is much larger for this data, and the classes themselves fall rapidly in member (subject) size, only the first two and the thirteenth containing more than two or three subjects. Next, the cumulative number of utilized response runs systematically less than in the A results, the first seven classes using only 51% of the data, the first seventeen using only 74%. Another difference, not quite so obvious, is the relative lack of a reasonable hierarchical structure in the groups, with many "mixed" groups in terms of subjects, and repeated recombinations of one subject with several different subjects in different classes.

TABLE 8

OBTAINED CLASSES: DOUBLE-ENTRY METHOD, USING 32 RANDOM RESPONSE COLUMNS TO CLASSIFY 20 SUBJECTS

Class Number	Members by Subject Number	Common Responses	Product
1	5-6-8-10-14-15-16-18-19-20	8	80
2	1-2-4-7-17	12	60
3	9-11-13	14	42
4	5-15-19	14	42
5	8-10-20	12	36
6	3-12	17	34
7	16-18	16	32
8	1-7	12	24
9	6-14	11	22
10	2-4	11	22
11	13-17	8	16
12	9-12	7	14
13	10-15-19-20	3	12
14	9-13	5	10
15	8-20	5	10
16	6-11	5	10
17	5-19	5	10
18	11-14	4	8
19	12-17-18	2	6
20	10-12-14	2	6
21	3-10-15	2	6
22	5-8	3	6
23	4-7	3	6
24	3-16	3	6
25	2-11	3	6
26	1-2	3	6
27	5-15-17	2	6
28	14-18	2	4
29	11-13	2	4
30	9-10	2	4
31	7-9	2	4
32	3-6-20	2	6
33	6-16	2	4
34	4-17	2	4
35	3-17	2	4
36	3-13	2	4
			Total = 576

While these results show that the formation of a class may be partially a function of the marginal response proportions, they also show that these marginals do not appear sufficient in themselves to account for the "stronger" classes, both in product and in structure, which resulted from the Group A analysis. These "stronger" obtained classes can therefore be reasonably assumed to be a result of the similarity of members of the same class, while the marginal frequencies are a function of the similarity of several different classes on the same item (characteristic).

Accepting for the moment the possibility that the classes obtained from the application of Multiple Agreement Analysis to meaningful (non-random) data are reasonably reproducible on repeated sampling of items, it becomes feasible to ask whether this apparent stability of structure holds up under various modifications of the method such as the manner of formation of the classes and the type of response which is used. The investigation of these questions is reported in the next section.

The Effects of Alternative Solutions

In this section results of three alternative methods of analysis will be reported. The purpose of all three was to see if certain changes in the original method would provide further information about the classification operation, or even prove to be more efficient in realizing the dual criteria of the method as a classification system. These criteria, originally stated by McQuitty (1957b), are that the better method will (a) realize the minimum number of classes, and (b) utilize the maximum amount of information.

The three alternative investigations were designed to see if better solutions (in terms of these criteria) would be achieved by (a) using the two types of responses (affirmative and negative) separately; (b) using some other pair than the one with the highest agreement score as the starting point for the analysis; and (c) classifying items rather than subjects (i.e., analysis of the transposed matrix). They were also intended to shed further light on the operational characteristics of the basic method.

Separate Analyses of Affirmative and Negative Responses

Data of Group A were again utilized for these analyses. The 1 (affirmative) and 0 (negative) responses on the 32 items by the 20 Senators were divided into two response matrices. Each matrix was then analyzed separately; results are presented in Table 9. When both yes and no responses for the 20 Senators responding to 32 items were analyzed, it will be recalled that 17 groups (classifications) were obtained and that these accounted for 581 (91%) of the 640 responses. Using yes and no responses separately (i.e., doing two analyses), we find 13 groups (classifications) from each analysis accounting for 251 (1 responses) plus 311 (0 responses) for a total of 562 (88%) of the 640 votes. Considering only those classes considered appropriate in terms of the hypothesized structure, we utilized 78% of the information (503 bits) in the first 7 classes under the double-entry method. In the two separate analyses, we find, considering the first seven classes in each, that only 492 bits (216 affirmative, 276 negative) are utilized, or 77%. Thus the double-entry method has two advantages: first, it accounts for a slightly larger percentage of the responses

TABLE 9

OBTAINED CLASSES: SINGLE-ENTRY, GROUP A ISSUES

a. The Obtained Classes: Affirmative Votes Only, Using 32 Group A Issues to Classify 20 Senators

Class Number	Members by Senator Number	Common Responses	Product
1	1-2-3-4-5-6-7-8-9-10	7	70
2	11-12-13-14-15-16-17-18-19	6	54
3	2-3-4-11-14	4	20
4	16-18-19-20	6	24
5	6-7-8-10	5	20
6	11-13-14-15	3	12
7	1-2-3-4	4	16
8	12-13-15	3	9
9	16-17-18	2	6
10	1-12-20	2	6
11	9-20	2	4
12	11-14-20	2	6
13	6-7	2	4
		Total =	251

b. The Obtained Classes: Negative Votes Only, Using 32 Group A Issues to Classify 20 Senators

Class Number	Members by Senator Number	Common Responses	Product
1	2-3-4-5-6-7-8-9-10	9	81
2	12-13-15-16-17-18-19-20	8	64
3	1-11-12-13-14-15	5	30
4	6-7-8-9-10	7	35
5	16-17-18-19	7	28
6	11-14	9	18
7	1-2-3-4-5	4	20
8	12-13-15	3	9
9	5-9-10	2	6
10	3-4-5	2	6
11	12-20	2	4
12	1-2-3	2	6
13	6-10	2	4
		Total =	311

and second, we have no problem of combining the two separate classifications into a single set. If this is not done, then we have more classes (13 + 13 = 26) under the double analyses method than under the double entry method, violating our rule of parsimony. And any method of combining these 26 classes into a reduced set requires that we sacrifice either items or persons to accomplish this reduction, automatically increasing the amount of non-utilized information (responses). Thus the double-entry method has been used in all further analyses as being the one more likely to meet the criteria both of minimizing the number of classes needed to classify completely the subjects at any particular level and at the same time maximizing the amount of information used.

Effect of Different Ordering of the Operations

Recognizing the arbitrariness of starting with the pair possessing the highest agreement score which may be due simply to chance, several different pairs were used as the starting point of the analysis. The first pair (2 - 7) consisted of Senators Dworshak and Milliken, which tied with pair 3 - 4 (Senators Welker and Jenner) for the highest agreement score. The results of this analysis were identical with those of the original analysis, the only change being in the order in which the first class was built up. The second pair chosen was 8 - 15, (Senators Smith and Johnson), who agreed most highly (on 22 items) and yet were members of different major hypothesized classes. These results are presented in Table 10a, giving only the first 8 classes, as the remaining 10 classes all consisted of only pairs, with products of 14 or less. It is interesting to note that

TABLE 10

OBTAINED CLASSES, ARBITRARY PAIRS

a. The Obtained Classes: Arbitrary Pair Number Two, Using Senators Smith and Johnson as the Initial Starting Point (First 8 Classes)

Class Number	Members by Senator Number	Common Responses	Product
1	1-3-5-6-7-8-9-10-12-13-15	11	121
2	11-12-13-14-15-16-17-18-19-20	11	110
3	1-2-3-4	18	72
4	6-7-8-9-10	15	75
5	16-17-18-19	14	56
6	11-14	18	36
7	2-4	11	22
8	12-20	9	18

b. The Obtained Classes: Arbitrary Pair Number Five, Using Senators McClelland and Russell as the Initial Starting Point (6 Classes)

Class Number	Members by Senator Number	Common Responses	Product
1	11-12-13-14-15-16-17-18-19-20	11	110
2	1-2-3-4-5-6-7-8-9-10	15	150
3	16-17-18-19	14	56
4	11-12-13-14-15	9	45
5	1-2-3-4	12	48
6	6-7-8-9-10	11	55

this combination had little effect on the structure, with the results being highly comparable to the original except for the presence of several Democrats in the first class.

The next two pairs used, 3 - 6 (Senators Welker and Knowland) and 15 - 16 (Senators Johnson and Humphrey), were the members of the original first two classes who had the least in common (lowest agreement score). Pair 3 - 6 gave results (classes) identical with the original analysis, as did pair 15 - 16, again with only a different order of class formation. The final pair, 11 - 14 (Senators McClelland and Russell) was the one which originally formed a separate major class. When the analysis was begun with this pair, the results given in Table 10b were obtained. The chief effect of this beginning point was to include this originally separate class in whith the original class 2, giving a more exact representation of the hypothesized structure. However, in the use of each of these pairs as the starting point, the major effect was to either retain or change only slightly the original structure, and the effect of changing the structure was to either increase the number of classes or lower the amount of information utilized, or both. This effect is shown in Table 11, which lists the cumulative amount of information accounted for under all analyses so far reported.

Analysis by Items

The final analysis in this section was accomplished by transposing the original group A double-entry response matrix so that the issues would now be classified on the basis of subjects (Senators). It was hoped that such an analysis would not only provide further evidence

TABLE 11

CUMULATIVE AMOUNT OF INFORMATION (PRODUCT)
UTILIZED UNDER VARIOUS CONDITIONS

Class Number	Double-Entry			Single-Entry		Arbitrary Pairs		
	Group A	Group B	Random	1(yes)	0(no)	1,3,4	2	5
1	150	135	80	70	81	150	121	110
2	262	220	140	124	145	262	231	260
3	320	320	182	144	175	320	303	316
4	364	364	224	168	210	364	378	361
5	412	392	260	188	238	412	434	409
6	467	437	294	200	256	467	470	464
7	503	457	326	216	276	503	492	482
			(Arbitrary	Cutoff	Point)			
8	515	471	350	225	285	515	510	500
9	527	483	372	231	291	527	524	512
10	537	495	394	237	297	537	534	524
11	545	507	410	241	303	545	544	534
12	553	517	424	247	307	553	552	542
13	561	527	432	251	311	561	560	550
14	567	535	442			567	566	558
15	573	543	452			573	570	564
16	577	549	462			577	574	570
17	581	555	472			581	578	574
18		559	480				582	578
19		563	486					582
20		567	492					
21		571	498					
.			.					
.			.					
.			.					
36			572					

of the stability of the original obtained classes, but would also indicate the various types of issues which "went together" in achieving the obtained classifications.

Results of the analysis of this transposed matrix are shown in two forms in Table 12. Table 12a presents the eight item classes, which accounted for all 32 items. Table 12b shows the Senator numbers which defined these item classes, broken down into the groups with 1 responses and those with 0 responses. Again we find that these results, while not giving as "strong" classes as the original results, do separate the assumed classes quite well.

Comparison of these item classes with the item patterns defining subject classes (presented in Table 13 in the next section) gives a fairly complete picture of the complexity of the class structure. These items may be classified into several types on the basis of their differential roles in defining the obtained classes. For example, item one discriminates none of the classes from another, the only Senator not giving an affirmative response being Senator Morse. Item four is a maximally discriminating item, the affirmative response characterizing one class, the negative response identifying other classes, and lack of agreement being associated with still other classes. It must be remembered that each response defining a major class also defines (but does not differentiate) all subclasses of that major class. For example, classes five (four Conservative Republicans) and six (five Eisenhower Republicans) both agree on the 15 items defining class one (ten Republicans). Thus class five members actually have 27 common items, and class six members have 26. Of these items 21 are common to both Republican subclasses. Of the total 32 items there

TABLE 12

OBTAINED CLASSES, 20 SENATOR GROUP

a. The Obtained Classes: Double-Entry Method, Using 20 Senators to Classify 32 Group A Issues

Class Number	Members by Issue Number	Common Senators	Product
1	10-17-21-22-23-25	13	78
2	5-6-7-9-13-19-20-27-28	10	90
3	1-4-8-31	10	40
4	11-14-15-16	13	52
5	12-18-26-29	12	48
6	2-24-30	13	39
7	3-13-19-20-27	7	35
8	5-6-7-28-32	7	35

b. Senator Classes Derived from the Issue Classes

Issue Class	Senators Responding 1 (Yes)	Senators Responding 0 (No)
1	1-2-3-4	11-12-13-14-16-17-18-19-20
2	16-18-19-20	3-4-5-6-7-10
3	1-5-6-7-8-9-10-12-13-15	
4	6-7-8-10	1-3-4-5-12-17-18-19-20
5	2-3-4-11-14	6-8-9-10-16-18-19
6		1-2-3-5-6-7-8-9-10-12-13-15-19
7	11-12-13-14-15-17	2
8		9-11-12-13-14-15-17

are 11 items upon which all members of one of these subclasses agree in response while members of the other subclass do not; 15 items where all members of both subclasses agree upon the same response; and six items where all members of one subclass agree on one response while all of the members of the other subclass agree upon the other response. It is these six items which may be expected to produce the major part of any nonlinear effects in the differentiation of the Republican class from the Democrat class. The ability of these patterns to separate classes will be the subject of investigation in the next section of this chapter.

Validity of the Obtained Class Patterns

The purpose of the next two investigations is to ascertain the effectiveness of the obtained response patterns in (a) discriminating among classes and in (b) predicting the class membership of previously unclassified members of the same subject population. The results obtained in the original double-entry group A analysis were used as the patterns defining the classes.

The first study deals with the similarity of non-members of a class to the defining characteristics (pattern) of a class. At least on a theoretical basis, we would hope that a well-defined class would include all of its members, and that non-members would resemble members only on a chance basis. To investigate this particular assumption, the voting pattern of each of the seven classes was used as a scoring key for all twenty members of the sample.

The scoring keys are shown in Table 13, result of their use in Table 14, distributions are given for each of the four *assumed*

TABLE 13

RESPONSE PATTERN FOR EACH OF THE FIRST SEVEN CLASSES
DOUBLE-ENTRY GROUP A

Issue Number	Class Number						
	1 (10R)*	2 (8D)	3 (2SD)	4 (4LD)	5 (4CR)	6 (5ER)	7 (3SD)
1	1		1	1			1
2	0		1	0			0
3		1	1		0	1	
4	1			0			1
5	0		0	1			0
6	0		0	1			0
7	0		0	1			0
8	1		1	0			1
9	0		0				
10		0	0		1		
11		0			0	1	
12			1	0	1		
13		1	1			0	
14			1		0		
15			1	0		1	
16		0	0		0		
17	1	0	0				
18			1			0	1
19	0	1	1				
20	0	1	1				
21	1	0	0				
22	1	0	0				
23			0	0	1		
24	0		0				0
25		0	0		1	0	
26		0	1		1	0	
27		1	1		0		
28			0			0	0
29			1	0	1	0	
30			1			0	0
31	1	1					
32			0		1	0	0
Pattern Size	15	14	29	11	12	11	12

* The number in the parentheses is the member size of each class. The letters indicate the assumed type of each class; D for Democrat, R for Republican, S for "Southern", L for "Liberal", C for "Conservative", E for "Eisenhower".

TABLE 14

PATTERN SCORES BY ASSUMED CLASS FOR THE 20 SENATORS ON EACH KEY

Class 1 Key					Class 2 Key					Class 3 Key				
Score	LD	SD	CR	ER	Score	LD	SD	CR	ER	Score	LD	SD	CR	ER
15			5	5	14	5	3			29		2		
14					13					28				
13					12		1			27				
12					11		1			26				
11					10					25		1		
10		1			9					24				
9		1			8				1	23		1		
8		3			7					22		1		
7					6				1	21				
6					5			1	1	20				
5					4			1	2	19				
4	2				3			3		18				
3	2									17	3			
2	1									16	1			1
										15	1		1	2
										14			2	1
										13			1	1
										12			1	

	Class 4 Key				Class 5 Key				Class 6 Key				Class 7 Key			
Score	LD	SD	CR	ER	LD	SD	CR	ER	LD	SD	CR	ER	LD	SD	CR	ER
12							4							3		
11	4											5				5
10														1	5	
9														1		
8							1			2						
7	1								1							
6					1					3	1					
5			1	2		1			1				1			
4		3	1	2	1	2		1	3		1		2			
3		1	2	1	2	2		1			1		1			
2		1	1		1			1			2					
1								2					1			

subclasses. Distributions one (Republican) and two (Democrat) are distinctly proficient in discriminating each of these groups, and the Republican pattern also appears to discriminate between Liberal and Southern Democrats. Distribution three, based on a group of only two Southern Democrats, pulls the other three assumed Southern Democrats away from the remaining subjects, who are not well differentiated on this rather unique key. It should be noted that in this respect this key is much more proficient than the other key (distribution 7) based on the remaining three Southern Democrats. Key seven discriminates the Liberal Democrats, but does not differentiate the other Southern Democrats from either Republican group. Each of the other keys, four, five, and six well differentiates its class from the other classes, but does not differentiate among these other classes.

Another potential use of patterns is as scoring keys to "measure" the relation of a new group of subjects to the obtained classes. This is the typical cross-validity approach, where the ability of the obtained scoring keys to discriminate among subjects not included in the original analysis is examined. The patterns obtained in the first analysis were now used as scoring keys for the remaining 68 Senators' votes on the 32 issues. These scores are presented in Table 15 with separate distributions for Democrats and Republicans. The patterns of classes I and II, which defined "Republican" and "Democrat" groups for the original 20 Senators, separate the remaining 66 Senators quite well by their party affiliations. The one glaring discrepancy is the one Republican who received a score of 4 on the Republican pattern. This was Senator Langer of North Dakota, widely recognized as a rather idiosyncratic type of Republican.

TABLE 15

PATTERN SCORES BY PARTY FOR THE REMAINING 68 SENATORS ON EACH KEY

Score	Scoring Key													
	1		2		3		4		5		6		7	
	R	D	R	D	R	D	R	D	R	D	R	D	R	D
27						1								
26														
25														
24						2								
23						2								
22						1								
21						1								
20						2								
19						6								
18					1	1								
17					9	6								
16					5	2								
15	20				7	3								
14	3			5	8	4								
13	4			7	4	2								
12	2	1		9		1								
11	1	3		5				2					1	3
10	3	1	2	3				9	1		3		13	3
9		3	1	2				8	2		6	1	9	1
8		4	4	2			3	3	5	1	7	3	3	4
7		1	3	1			2	1	8	3	3	4	4	1
6		3	8					2	7	2	8	10	3	1
5		3	8				5	2	3	5	3	7		3
4	1	5	1				7	2		7	3	5		4
3		6	3				12	4	4	10	1	2		9
2		2	2				5	1	1	1		1	1	1
1		2	2						3	3		1		2
0										2				1
N	34	34	34	34	34	34	34	34	34	34	34	34	34	34
Pattern Size	(15)		(14)		(29)		(11)		(12)		(11)		(12)	

Differences between Democrats and Republicans are not as pronounced on the other keys, although in each case a Median Test showed highly significant differences between the two groups. While it might be possible to derive efficient predictors of the four assumed subgroups on the basis of differential weighting of all seven of the keys for each subgroup, such a procedure would imply that these seven groups were the major groups in the entire Senate. Rather than accept this structure, based on the analysis of a selected set of Senators and only 32 items, it would appear more reasonable to examine all Senators on the largest possible set of items and see what sort of structure this analysis would yield. The next chapter presents the results of such an analysis.

Summary

Empirical investigations conducted to ascertain the reliability and validity of Multiple Agreement Analysis have been reported. The results of these investigations have shown that this method yields subject classes which are both reliable and meaningful. Also, the response patterns defining classes can be utilized both in differentiating the obtained classes and in predicting class membership of new subjects.

Thus far the method has been given as a logical system based on the stated theoretical assumptions of Chapter II, with some empirical evidence of its capabilities and shortcomings presented in this chapter. A major omission to date has been any examination of the content of the issues which have differentially defined the obtained classes. We have found that different items seem to be effective in making different discriminations, but thus far no mention has been made of what these items mean in terms of content. The interested reader will find the issues summarized in Appendix B, but rather than looking at the issues used in this chapter, this topic will be discussed in the following chapter in a more complete analysis of the structure of the entire Senate.

The results of the investigations made up to this time have illustrated several properties of the method. One of these is that the use of the maximum amount of information (the double-entry method) gives the more stable and meaningful class structure. For this reason the double-entry method will be utilized in the study presented next. Also, as the analysis by subjects gives more discrete subject classes than analysis by items, the next response matrix to be used will not be transposed. Finally, as the use of alternative pairs as the starting point of an analysis has little effect on the class structure, the use of the pair with the highest agreement score will continue to be used as the starting point, with increased confidence in the stability of the resultant structure.

The next chapter will report on the results of the application of Multiple Agreement Analysis to a more extensive set of issues for the full U. S. Senate. Based upon the results obtained from the analyses reported in this chapter, the double-entry method will be used and the analysis will be by subjects, for the purpose of obtaining the clearest classification of the subjects used in the study.

CHAPTER IV

AN EMPIRICAL APPLICATION OF MULTIPLE AGREEMENT ANALYSIS

In this chapter results of a full-scale study of the structure of the United States Senate of the 83rd Congress will be reported. The purpose of this investigation is to determine, within the capabilities of the method of Multiple Agreement Analysis, the group structure of this Senate. Another purpose is to establish further the abilities and limitations of the previously presented analytic method in yielding meaningful and reliable classifications. The procedure will be shown to simplify complex behavior, such as legislative voting, and to give fuller understanding of the factors which influence it.

Data and Method

The subjects were the 88 Senators of the 83rd Congress who were in office during both sessions (1953-1954) of this Congress. The adequacy of this group to be considered a representative sample of U. S. Senators over a longer period of time is debatable. In view of the rapid changes which have occurred during this century, it is doubtful that any one Senate may be considered a representative sample for any larger set of Senators. On this basis, this particular Senate will be treated as a discrete population, and no attempt will be made to generalize to larger sets of Senators on the basis of these results.

Voting records (responses) were analyzed for 95 issues. These were Fitch's Sample A issues numbered from 33 to 127. The first 32 A issues had already been used in the methodological studies reported in the previous chapter; issue 128, the only other A issue, was omitted because of lack of computer capacity. Voting records of the Senators will be found in Appendix A; the content of each issue is summarized in Appendix B.

In contrast with Fitch's procedure, omissions (no vote) were left as omissions, rather than being assigned a yes or no value based upon the response of the Senator most similar to the non-voting Senator on other issues. This change from Fitch's procedure may have made it more difficult to obtain clear results, but was considered desirable for two reasons. First, substituting for missing data on any basis other than random assignment has the appearance of "stacking the deck" in favor of the investigator. Second, the "no-vote" may be meaningful, being used in some instances by Senators who, on that particular problem, do not want to be on record either for or against the issue.

The analysis was run utilizing the double-entry method, because of the findings already reported. Approximately 28 hours of computer time were required, with formation of 44 classes. Because of the lack of reliability of the classes with the smaller products reported previously, the criterion for the formation of the initial pair of a class was set at a minimum agreement score of 19. This meant that only classes with products of at least 40 (or .005 of the available information) would be obtained.

Results

A. The Senate Structure

Results are summarized in Table 16, which places the classes into their apparent hierarchical structure. Table 17 lists the names of the Senators forming the major classes, with the subclasses within major class blocked and indicated at the side. The issues (response patterns) defining the first eight major classes are listed in Table 18.

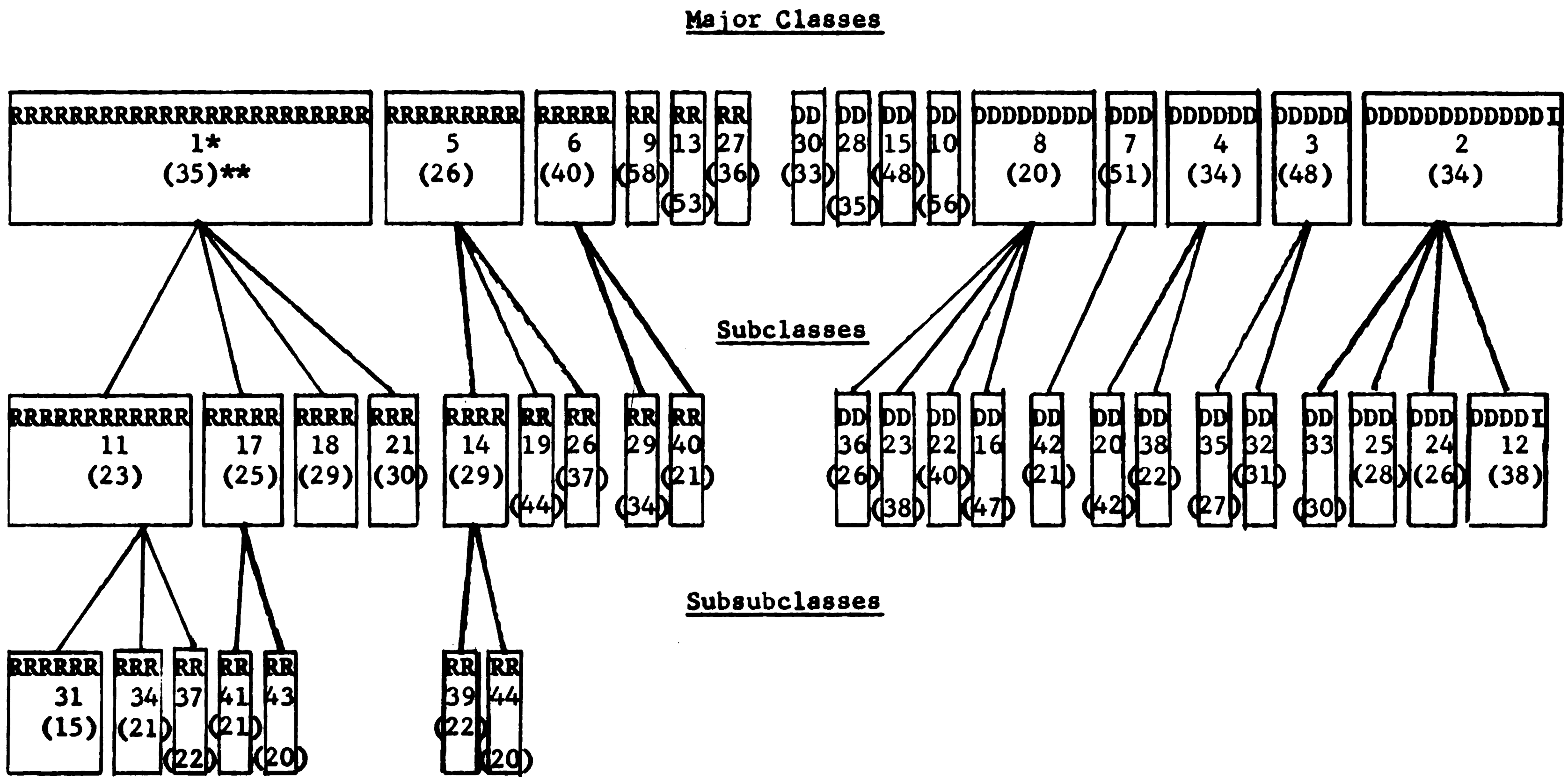
These results, while complete in a descriptive sense, do not offer a great deal of information about the meaning of the obtained structure in this summary form. The only obvious statements which can be made on the basis of these results are that the structure is composed of many more major classes than is true of the earlier reported studies, and there appears to be a very simple hierarchical structure, with no cross-classes consisting of both Democrats and Republicans, and no cross-classification of members of different major classes.

B. The Effects of Omissions

One problem of the method is how far down the class structure one gets classes of general interest and importance. As mentioned earlier, the fact that the program forces classes of pair size to be formed until the criterion is reached implies that such classes might as reasonably be considered in terms of the individuals. In the results obtained in this analysis, we find major classes of pair size occurring with the ninth class, and three of these major classes, 27, 28, and 30 arise after most of the larger subclasses. It would appear reasonable to exclude such classes from consideration as meaningful major classes, especially if their separate formation could be

TABLE 16

OBTAINED STRUCTURE OF THE U. S. SENATE



* The class number (in the order obtained).
** The number of common responses defining each class.

TABLE 17

OBTAINED CLASS MEMBERSHIP, U. S. SENATORS

Senator		Classes		
Number	Name	Major Class	Subclass	Subsubclass
18.	Payne (R, Maine)	1	11	31
43.	Smith (R, Maine)	1	11	31
83.	Ferguson (R, Mich.)	1	11	31
78.	Smith, H. A. (R, N. J.)	1	11	31
21.	Knowland (R, Calif.)	1	11	31
77.	Hickenlooper (R, Iowa)	1	11	31
19.	Bennett (R, Utah)	1	11	
70.	Potter (R, Mich.)	1	11	34
45.	Watkins (R. Utah)	1	11	34
81.	Aiken (R, Vermont)	1	11	37
79.	Carlson (R, Kansas)	1	11	37
48.	Barrett (R. Wyo.)	1	11	
82.	Hendrickson (R, N. J.)	1	17	41
47.	Milliken (R, Colo.)	1	17	41
73.	Purtell (R, Conn.)	1	17	
72.	Bush (R, Conn.)	1	17	43
46.	Saltonstall (R, Mass.)	1	17	43
85.	Butler (R, Maryland)	1	18	
26.	Martin (R, Pa.)	1	18	
71.	Beall (R, Maryland)	1	18	
51.	Jenner (R, Indiana)	1	18	
50.	Schoeppel (R, Kansas)	1	21	
76.	Cordon (R, Oregon)	1	21	
44.	Dirksen (R, Illinois)	1	21	
15.	Jackson (D, Wash.)	2	12	
40.	Murray (D, Montana)	2	12	
61.	Morse (I, Oregon)	2	12	
67.	Magnuson (D, Wash.)	2	12	
60.	Mansfield (D, Montana)	2	12	
14.	Humphrey (D, Minn.)	2	24	
63.	Neely (D, W. Va.)	2	24	
59.	Douglas (D, Illinois)	2	24	
10.	Clements (D, Ky.)	2	25	
34.	Hennings (D, Mo.)	2	25	
8.	Symington (D, Mo.)	2	25	
58.	Anderson (D, N. M.)	2	33	
12.	Green (D, R. I.)	2	33	
6.	Johnson, L. (D, Texas)	3	32	
33.	Danial (D, Texas)	3	32	
55.	Long (D, La.)	3		
53.	Holland (D, Florida)	3	35	
7.	Smathers (D, Florida)	3	35	

TABLE 17 (Continued)

37.	Hill (D, Ala.)	4	20	
56.	Monroney (D, Okla.)	4	20	
64.	Fulbright (D, Ark.)	4		
41.	Lehman (D, N. Y.)	4	38	
66.	Kilgore (D, W. Va.)	4	38	
11.	Sparkman (D, Ala.)	4		
25.	Welker (R, Idaho)	5	14	44
52.	Dworshak (R, Idaho)	5	14	44
84.	Williams (R, Delaware)	5	14	
24.	Goldwater (R, Ariz.)	5	14	39
22.	Bricker (R, Ohio)	5		39
69.	Case (R, S. D.)	5	19	
23.	Mundt (R, S. D.)	5	19	
88.	Malone (R, Nevada)	5	26	
86.	Capehart (R, Indiana)	5	26	
16.	Thye (R, Minn.)	6	29	
74.	Ives (R, N. Y.)	6	29	
17.	Kuchel (R, Calif.)	6		
80.	Duff (R, Pa.)	6	40	
75.	Bridges (R, N. Y.)	6	40	
13.	Kennedy (D, Mass.)	7	42	
38.	Pastore (D, R. I.)	7	42	
39.	Hayden (D, Ariz.)	7		
2.	Johnson (D, Colo.)	8	16	
30.	Stennis (D, Miss.)	8	16	
35.	Kerr (D, Okla.)	8	22	
31.	Johnston (D, S. C.)	8	22	
27.	Russell (D, Ga.)	8	23	
57.	Gore (D, Tenn.)	8	23	
32.	George (D, Ga.)	8	36	
1.	McClellan (D, Ark.)	8	36	
4.	Eastland (D, Miss.)	8		
29.	Robertson (D, Va.)	9		
54.	Ellender (D, La.)	9		
36.	Langer (R, N. D.)	10		
87.	Young (R, N. D.)	10		
20.	Flanders (R, Vt.)	13		
68.	Cooper (R, Ky.)	13		
28.	Frear (D, Delaware)	15		
65.	Gillette (D, Iowa)	15		
42.	Wiley (R, Wisc.)	27		
49.	McCarthy (R, Wisc.)	27		
9.	Chaves (D, N. M.)	28		
62.	Kefauver (D, Tenn.)	28		
3.	Byrd (D, Va.)	30		
5.	McCarran (D, Nevada)	30		

TABLE 18

RESPONSE PATTERNS, FIRST EIGHT CLASSES

Issue Number	Class Number 1	2	3	4	5	6	7	8
1.		1					1	
2.			1		1			
3.			0					
4.				1			1	1
5.		0				0		
6.						0	0	
7.						0		
8.		0	1			0	0	
9.		1				1		
10.				1				
11.							0	
12.							1	
13.	1	1	1			1		
14.								
15.	1		1	0	1	1	0	1
16.		0		0	1		0	
17.				0	1		0	
18.			1		1		0	1
19.			1		1		0	1
20.	1							
21.			0			0		
22.		0	0	0	1		0	0
23.		1		1			1	
24.	0		0					
25.								
26.						1	1	
27.		0						1
28.		1					1	0
29.								
30.	0	0	0			0	0	
31.	0			1				
32.						1	1	
33.			1					
34.								
35.			1			0	1	
36.			1			0		
37.				0				
38.			0				0	
39.			0	1			0	
40.			1					
41.	0		0					
42.			1	1			0	1
43.	0	1	1	1				1
44.	1				1			
45.	1			1	1		1	
46.	0		1			0	1	
47.		1				0	1	
48.				0			0	
49.			1	1		1	1	1
50.	1				1	1		
51.	1	0	0	0	1	1	0	0
52.		1		1				1
53.	0		0		0	0		
54.	0		0			0	0	
55.	0		0			0	0	
56.						0		
57.		1		1				
58.			0	1	0	0	1	
59.		1	1	1		1		
60.	1	0			1	1		
61.		1		1				
62.	1	0	0	0	1		0	
63.						1		
64.	0		0			0		
65.	0	1						
66.	0		0	1			1	
67.	1	0		0			0	
68.	1		1	0		1		
69.								
70.		1	1			1	1	
71.	1		1		1		1	
72.					1	0	0	
73.			1			1	1	
74.			0					
75.				0			1	
76.	0			1			0	
77.	0			1			0	
78.		0	0				0	
79.	0				0	0		
80.	0				0	0	0	
81.	0	1	1		0		1	1
82.	1	1	1		1	1	1	1
83.	1	1	1		1	1	1	
84.	1		1		1	1	1	
85.		1	1	1	0		1	1
86.	1	1	1	1	1	1	1	1
87.	1		1	1	1	1		
88.	1						1	
89.								
90.		0	0			0	0	0
91.		1	1	1		1	1	1
92.		1						
93.		0	0	0				0
94.								
95.		1	1	1				1

Note. 1 signifies an affirmative response, 0 a negative response.

determined as primarily a function of lack of information on these particular subjects. To investigate this possibility, the number of omissions for each Senator was counted. This distribution is given in Table 19. The major class of each Senator having more than eleven omissions is indicated in parentheses after each Senator's number. We find that all three of the last major classes (27, 28, and 30) consist of Senators having more than 21 omissions, and at least one member of every pair-sized major class is found to have more than eleven omissions. Thus it would appear reasonable that one determinant of these pairs was the large proportion of missing information.

Another method of studying the effect of omissions was to score each Senator on the key (pattern) obtained for each of the first eight classes. These scores are recorded in Table 20 as disagreement scores, where a disagreement on an issue is defined as a response in the opposite form from that of the key. Thus, failure to vote (omission) was no longer counted as a disagreement, whereas it had been when agreements were counted. This examination reveals that, of the 14 Senators in the pair-sized major classes, eleven have less than four disagreements with one or more of the eight classes. It follows that results would almost certainly have been more concise if Senators had always voted. Unfortunately, the way the omissions would have been voted if forced is unknown; thus no valid assumption as to the final structure under complete knowledge of position on issues can be made.

A further argument against the meaningfulness of these pair-sized classes is that, for classes 27, 28, and 30 the product is larger for the individual Senators than for the pairs. Thus, it would be consistent with the criterion of maximizing products to consider these

TABLE 19

NUMBER OF OMISSIONS FOR EACH SENATOR

Number of Omissions	Frequency	Senator Numbers
36	1	42 (27)*
31	1	4 (8)
29	1	5 (30)
26	1	62 (28)
25	1	9 (28)
24	2	1 (8); 49 (27)
23	1	32 (8)
22	1	3 (30)
21	2	11 (4); 35 (8)
19	3	22 (5); 66 (4); 86 (5)
18	2	54 (9); 65 (15)
17	1	75 (6)
15	1	41 (4)
14	1	20 (13)
13	1	80 (6)
12	1	27 (8)
11	2	36; 51
10	3	8; 39; 58
9	2	17; 25
8	8	14; 28; 29; 31; 34; 56; 57; 76
7	4	24; 46; 73; 87
6	8	12; 23; 37; 44; 63; 69; 82;85
5	4	45; 60; 64; 68
4	8	2; 13; 16; 33; 47; 70; 79; 88
3	8	7; 38; 50; 67; 71; 72; 78; 84
2	7	10; 26; 30; 59; 61; 74; 77
1	4	21; 40; 48; 83
0	9	6; 15; 18; 19; 43; 52; 53; 55; 81
Totals: 750 omissions for 88 senators		

* The number in parentheses indicates the obtained class of those senators having more than eleven omissions.

TABLE 20

DISAGREEMENT SCORE FOR EACH SENATOR ON EACH OF THE FIRST EIGHT CLASS PATTERNS

Senator Number	Major Class	1	2	3	4	5	6	7	8
1	8	8	8	1	4	6	13	17	0
2	8	11	11	7	11	7	12	25	0
3	30	6	15	8	16	3	13	22	3
4	8	10	6	4	6	6	8	13	0
5	30	10	13	8	13	8	10	17	4
6	3	11	3	0	8	8	10	16	0
7	3	8	7	0	13	8	15	15	0
8	2	19	0	7	3	15	15	8	3
9	28	16	5	12	4	12	14	13	3
10	2	17	0	7	4	12	13	13	3
11	4	18	1	9	0	12	14	11	1
12	2	10	0	10	7	13	10	1	6
13	7	14	4	15	9	15	15	0	5
14	2	22	0	14	1	18	14	7	5
15	2	25	0	18	1	18	8	12	4
16	6	4	10	12	13	6	0	18	8
17	6	0	12	10	18	3	0	16	7
18	1	0	14	14	22	2	0	17	8
19	1	0	17	14	25	0	3	23	11
20	13	2	14	16	21	5	2	17	12
21	1	0	17	17	23	3	2	18	13
22	5	0	16	12	17	0	7	21	8
23	5	5	17	15	18	0	8	25	9
24	5	1	22	15	26	0	7	25	12
25	5	1	20	12	24	0	6	29	9
26	1	0	22	15	25	1	5	27	10
27	8	16	8	8	9	13	20	23	0
28	15	9	5	8	7	6	16	13	3
29	9	6	11	6	13	10	8	15	3
30	8	17	7	10	11	11	17	22	0
31	8	20	7	11	4	13	19	21	0
32	8	10	4	2	5	10	7	14	0
33	3	9	11	0	12	5	10	23	0
34	2	21	0	11	2	19	15	9	5
35	8	18	2	5	2	14	13	13	0
36	10	21	7	18	6	13	21	21	6
37	4	24	3	15	0	19	18	13	2
38	7	11	3	11	7	13	11	0	6
39	7	11	4	12	9	14	9	0	7
40	2	25	0	12	2	19	20	11	5
41	4	24	3	17	0	19	15	12	5
42	27	4	6	7	7	5	1	10	3

TABLE 20 (Continued)

Senator Number	Major Class	1	2	3	4	5	6	7	8
43	1	0	10	11	20	3	1	17	7
44	1	0	14	12	22	2	1	17	9
45	1	0	15	15	23	0	2	23	9
46	1	0	13	15	20	4	0	16	10
47	1	0	15	15	22	3	0	15	12
48	1	0	18	14	25	0	5	23	11
49	27	6	17	15	17	1	7	28	7
50	1	0	21	13	25	0	5	24	9
51	1	0	18	14	23	0	5	24	10
52	5	3	19	17	22	0	10	26	11
53	3	5	9	0	15	8	7	11	3
54	9	7	8	1	8	6	8	19	2
55	3	16	7	0	10	11	16	20	4
56	4	21	2	15	0	16	18	11	3
57	8	16	5	11	8	14	21	14	0
58	2	10	0	4	7	10	9	7	2
59	2	21	0	16	2	17	16	12	5
60	2	22	0	14	2	15	17	14	2
61	2	25	0	17	0	19	20	12	5
62	28	15	2	13	2	16	13	11	7
63	2	22	0	14	0	16	15	9	5
64	4	19	6	16	0	16	15	13	3
65	15	9	3	5	6	10	9	11	3
66	4	20	0	13	0	14	11	9	5
67	2	24	0	17	1	18	18	15	4
68	13	11	9	13	11	9	5	18	9
69	5	3	14	18	17	0	3	25	10
70	1	0	16	15	20	0	3	20	9
71	1	0	16	13	22	2	4	21	11
72	1	0	18	14	22	4	0	21	11
73	1	0	18	17	23	4	1	17	13
74	6	3	16	17	21	6	0	21	10
75	6	0	17	14	21	1	0	16	8
76	1	0	18	13	23	1	1	18	9
77	1	0	19	13	25	1	3	20	12
78	1	0	14	15	21	4	0	16	11
79	1	0	14	10	21	2	0	17	9
80	6	2	9	16	15	6	0	13	10
81	1	0	14	16	20	6	3	14	10
82	1	0	12	14	19	3	0	15	10
83	1	0	15	15	21	4	1	17	10
84	5	3	21	16	23	0	12	29	11
85	1	0	18	12	23	0	3	24	7
86	5	2	17	13	18	0	6	24	8
87	10	0	14	14	17	3	8	24	9
88	5	4	22	18	23	0	6	28	9

Senators as forming six classes of size one. This would imply that these Senators were unique, with no outstanding similarity in voting behavior to any one larger class, or any other unique Senator.

Turning to the first eight classes, the effect of omissions was found to be rather limited. Again using the disagreement scores, we find that, if omissions had been voted in the most opportune manner, but using the obtained patterns, the only possible changes would have been the addition of two class six members to class one, and one class four member to class two. Thus it would appear that the presence of omissions has not sharply affected the membership of these obtained classes.

More generally, problems created by the presence of omissions in the response matrix are of two kinds. The first problem, that of increasing the number of classes, can be studied as was done here, by examining the disagreements of small class members with the patterns of the larger classes. The other problem, which is the reduction in the pattern size for each class, can be studied more closely by looking at the actual omissions for members of the same class. Each class has a theoretically possible pattern size of 95 items, but an omission by any class member eliminates that omitted item from consideration as a class characteristic. Thus the percentage of items defining any class is larger than our results indicate. These percentages of yes or no responses for all members of a class ranged from 65% to 79% for the pair-size classes, and from 47% to 66% for the first eight classes.

C. The Major Classes

Concentrating our attention on the first eight major classes as the most meaningful classifications of the Senate at this level, the problem now arises as to (a) the determinents of these classes, and (b) their differences. In general, the "definition" of a major class is given by the item responses making up the pattern of that class (see Table 18). Inspection of these patterns for the first eight classes will show that there are item responses which define each of these classes, but do not differentiate among any of them; others which define several classes, but not the remaining ones; and still others which absolutely differentiate one class from another, one voting affirmatively, the other negatively.

The "meaning" of a pattern is difficult to discuss when there are these several types of items. Two alternatives are available. If we wish to discuss the differences between two classes, we may consider only these responses on which the two classes do not agree; if we wish to talk of the uniqueness of each class, we consider only those responses which define one class and no other class on the same level.

In order to illustrate the first alternative responses characteristic of Classes 1 and 2 will be examined. Table 21 presents the number of "yes" and "no" responses to each issue for the members of Class 1 and Class 2. Issue 1 will be seen to be an Absolute-Absolute type, i.e., all members of class 2 respond "yes"--no one in Class 1 does so. (This issue is not in the Class 1 pattern because of two omissions) Issue 2 is of Absolute-Relative type, i.e., "yes" is the response of all Class 1 members, but only of approximately one-half of the Senators in Class 2. Issue 3 can be classified Relative-Relative,

TABLE 21

NUMBER OF SENATORS IN CLASS 1 AND CLASS 2 VOTING
FOR (1) OR AGAINST (0) EACH ISSUE

Issue Number	Class 1		Class 2		Issue Number	Class 1		Class 2		Issue Number	Class 1		Class 2	
	(1)	(0)	(1)	(0)		(1)	(0)	(1)	(0)		(1)	(0)	(1)	(0)
1	0	22*	13	0	33	23	1	8	3	65	0	24	13	0
2	23	0	6	7	34	5	15	6	4	66	0	24	12	1
3	9	15	7	5	35	1	21	10	0	67	24	0	0	13
4	0	23	12	1	36	0	21	10	0	68	24	0	4	9
5	8	14	0	13	37	3	19	1	10	69	14	10	9	4
6	9	12	3	9	38	2	21	7	2	70	23	0	13	0
7	0	21	11	0	39	0	22	9	2	71	24	0	9	4
8	6	18	0	13	40	7	15	9	2	72	7	16	2	10
9	22	2	13	0	41	0	24	1	11	73	19	5	12	0
10	0	21	9	2	42	1	23	12	1	74	12	7	1	10
11	6	17	3	10	43	0	24	13	0	75	23	1	2	11
12	17	7	12	1	44	24	0	3	9	76	0	24	11	2
13	24	0	13	0	45	24	0	11	0	77	0	24	11	2
14	18	0	9	2	46	0	24	10	0	78	7	17	0	13
15	24	0	4	9	47	0	22	13	0	79	0	24	10	3
16	23	0	0	13	48	4	18	6	5	80	0	24	4	9
17	14	10	0	12	49	22	0	12	0	81	0	24	13	0
18	14	10	4	8	50	24	0	2	9	82	24	0	13	0
19	17	7	3	9	51	24	0	0	13	83	24	0	13	0
20	24	0	7	6	52	19	4	13	0	84	24	0	4	9
21	1	20	10	1	53	0	24	7	4	85	1	23	13	0
22	19	4	0	13	54	0	24	8	3	86	24	0	13	0
23	14	9	13	0	55	0	24	6	6	87	24	0	12	0
24	0	24	9	4	56	0	20	5	7	88	24	0	4	9
25	10	14	2	11	57	0	22	13	0	89	0	21	8	4
26	22	1	12	0	58	1	21	12	1	90	4	17	0	13
27	2	21	0	13	59	22	0	13	0	91	21	2	13	0
28	18	6	13	0	60	24	0	0	13	92	22	0	13	0
29	21	1	1	11	61	0	23	13	0	93	6	18	0	13
30	0	24	0	13	62	24	0	0	13	94	17	5	12	1
31	0	24	11	2	63	23	0	0	11	95	13	10	13	0
32	23	1	12	1	64	0	24	7	6					

* The sum of the responses does not equal the class size in every case due to omissions on some issues.

i.e., "yes" is more often the vote of class 2 members (7 of 12) than of Class 1 members (9 of 24). We also find items, such as Issue 30, where the response "no" is characteristic of both classes. Thus, although an Absolute characteristic, it does not differentiate between these two classes.

Finally, we may look at the content of the issues which differentially define Classes 1 and 2. We find only seven Absolute-Absolute issues (numbers 43, 51, 60, 62, 65, 67, and 81) in Table 18. From Table 21, we find eight additional items (numbers 1, 7, 16, 46, 47, 57, 61, and 63) which fulfil this requirement except for omissions. This list could be extended even further by including issues where there is a statistically significant difference in response. However, it must be noted that most of these latter issues appear in the subclass patterns, and thus serve not only to differentiate Class 1 from Class 2, but also to differentiate one subclass from another within the same major class. For this reason the issue list is terminated at this point, so that issues claimed as characteristic and differentiating for Classes 1 and 2 will not be overly confounded with issues characteristic of their subclasses. These issues are listed in Table 22, divided into two groups; the issues Class 1 was for and class 2 against, and those Class 1 opposed and Class 2 supported.

There is an alternative way of differentiating each major class. Response patterns for the first eight classes show that each class is identified by at least two responses not given by any other class. The responses and issues uniquely defining each class are listed in Table 23.

TABLE 22

THE 15 ISSUES ABSOLUTELY DIFFERENTIATING CLASS 1 AND CLASS 2

a. Issues Supported by Class 1 Republicans, Opposed by Class 2 Democrats

Issue Number	
16	Ferguson amendment of the Bricker amendment to limit the President's treaty-making powers
51	Provide an additional $100 income tax exemption
60	Knowland motion supporting move authorizing AEC to contract for power for TVA
62	Table amendment authorizing president to set up atomic pool
63	Table amendment extending time for licensing patents
67	Table move to limit AEC payments for nuclear material

b. Issues Supported by Class 2 Democrats, Opposed by Class 1 Republicans

Issue Number	
1	Limit rubber plant sales
7	Limit special weapons planning
43	Increase school lunch funds
46	Bar salaries to certain persons not under the Hatch Act
47	Increase funds for Army personnel and operations
57	Preference for the sale of power to cooperatives
61	Johnson motion supporting move to authorize AEC to produce electrical power
65	Substitute striking out many provisions of atomic energy bill
81	Johnston motion supporting vote to prohibit limiting terms of county conservation committee members

TABLE 23

THE RESPONSES AND ISSUES UNIQUELY DEFINING MAJOR CLASSES

Major Class	Response	A Issue Number	Major Class	Response	A Issue Number
1	1	20	5	1	16
	0	31		1	17
	0	43		1	21
	0	65		1	72
	1	67		0	85
2	0	27	6	0	7
	0	60		0	35
	1	65		0	36
	1	92		0	47
				0	56
3	0	3		1	63
	1	8			
	1	33	7	0	11
	1	40		1	12
	0	74		0	18
				0	19
4	1	10		0	42
	1	31		1	75
	0	37			
	1	39	8	1	27
	0	68		0	28
	0	75			
	1	76			
	1	77			

While these few issues represent the unique aspect of each major class, they allow no simple interpretation of this uniqueness. While some issues for some classes can be easily discerned as highly related, there are many issues which are themselves unique in a particular class. On a strictly subjective basis, utilizing the discussions on these particular issues in the Congressional Record and elsewhere, some tentative labels have been attached to the major classes on the basis of both their membership and these unique issue responses. These labels and descriptions are not considered definative and are presented merely as a convenience.

Class 1. Pro-Eisenhower Republicans - support on farm policy and atomic energy bills.

Class 2. Liberal Democrats I - opposed to atomic energy bills, anti-Eisenhower

Class 3. Southern Democrats I (Conservative) - somewhat pro-Eisenhower, anti-liberal group.

Class 4. Southern Democrats II (Agriculture) - support rigid farm supports, especially dairy.

Class 5. Ultra-Conservative Republicans - anti-Eisenhower, support reduced foreign aid, and limiting executive and governmental powers.

Class 6. Progressive Republicans (Spenders) - pro-Eisenhower, support military and governmental expenditures.

Class 7. Liberal Democrats II (Seaway) - support St. Lawrence Seaway, other Democratic issues.

Class 8. Southern Democrats III (States Rights) - anti-statehood for Alaska and Hawaii, generally anti-Eisenhower.

Two additional points were studied in relation to the major classes. The first concerns the determination of the "distance" between the first eight classes, computed from the disagreement scores of Table 20 for each class in turn. Setting 10% average disagreement as the arbitrary cutting point between "close" and "distant" classes, the following results are obtained: for the Republican classes, class 1 is "close" to both class 5 and class 6, although 5 and 6 are not "close" to each other. For the Democrat classes, we find 2 and 4 "close" to each other, while class 3 is "close" to class 8, although class 8 is not "close" to class 3. Thus it would appear that class 1 represents "Republicanism," while classes 5 and 6 represent additional unique components within the party. The major factor in "Democratism" appears to be more limited, occurring primarily in classes 2 and 4. The remaining classes are all rather unique, none of them being mutually "close" to each other. These findings support the general view that Republicans are a fairly homogeneous group, while the Democrats are quite heterogeneous, representing many divergent interest groups.

Finally, we may ask whether the pair-size major classes "make sense" as separate classes. Both Classes 9 and 10 consist of Senators who are, according to the Congressional Quarterly, among the five lowest in terms of party voting support. Also, at least one member of each of the remaining pair-size classes is low in party support or high in omissions or both. Classes 9 and 10 probably represent "opposition" groups within their respective parties, while the remaining classes represent primarily unique individuals, either because of their special manner of responding or because of their lack of response.

D. The Subclasses

The major classes have been considered to represent broad groups of Senators which are relatively homogeneous internally, while heterogeneous in respect to one another. The theory of agreement analysis implies further differentiation of major classes. The obtained subclasses conform to this expectation. However, in this set of data, these subclasses may arise primarily from the way omissions were handled in the response matrix. Certainly there is no logical reason for denying the possibility that the presence of missing data alone would give a similar differentiation. Hence subclasses of Classes 1 and 2 have been examined in detail.

There were two reasons for selecting these two classes. First, they are the largest major classes of the two political parties and each has a large number of subclasses. Second, these classes have already been more intensively studied than the others.

If the subclasses of a major class are to be considered as clearly separated from one another, a strict requirement of difference should be used. Therefore the only issues accepted as contributors to the distinctiveness of a subclass were Absolute-Absolute ones. This restriction insures that issues accepted as differentiating were not based upon omissions.

There were 54 issues for Class 1 and 45 issues for Class 2 where all members of the class voted the same way. Thus 42 issues for Class 1 and 49 for Class 2 were available to differentiate subclasses. Table 24 presents the issues and responses which absolutely differentiate these first-level subclasses. The Class 1 subclasses have only six differential issues, and none is uniquely differential for class 11, the largest subclass. Classes 17 and 18 are well differentiated from each other. They disagree on three issues and fail to agree on any other. For example, Class 17 favors economic aid to foreign countries, admitting refugees and is opposed to the Bricker constitutional

TABLE 24

ISSUES UPON WHICH SUBCLASSES OF THE SAME MAJOR CLASS DISAGREE ABSOLUTELY

Issue Number	Subclass For	Subclass Against
Major Class 1		
6	18	17
8	18	17
11	18	11, 21
12	11, 21	18
17	11, 18, 21	17
18	21	17
Major Class 2		
2	25, 33	12
24	12, 24	33
31	12, 24, 25	33
33	33	25
44	33	24
53	12	33
55	12	24
68	25	12, 24
75	33	12, 24, 25
76	12, 24, 25	33
77	12, 24, 25	33
79	12, 25	33
80	25	12, 33
84	33	12, 25
88	33	12, 25

amendment, while Class 18 is of the opposite opinion. Class 17 is further opposed to the George substitute which Class 18 is undecided upon, while Class 18 is opposed to the St. Lawrence Seaway bills, which Class 17 is undecided upon. Class 21, while characterized by four of these issues, is uniquely identified only by its unanimous support for the George substitute.

Turning to the Class 2 subclasses, there are 15 uniquely identifying issues; each of the four subclasses is unique on at least two issues. Class 33 is the most clearly differentiated, being absolutely different from all three other classes on four issues, and absolutely different from at least one other class on seven more. Of these 15 issues, 12 are concerned with taxes and farm policy.

E. Prediction by Major Classes

Finally, the meaningfulness of the major classes will be explored by examining their ability as predictors. Class membership obviously cannot be predicted when we have no unused subjects. However, class voting behavior can be predicted on new issues. There remain 96 additional issues which have been voted upon by the Senate but not so far utilized. These are Fitch's Group B issues, numbers 33 to 128. If the classes derived in this study are meaningful in terms of predicting behavior, it should be possible to estimate, on the basis of class membership, the voting of the full Senate in respect to each of these issues. The most efficient method will be that requiring the least information in making the prediction, while the most accurate will utilize all possible information. Our prediction of how any Senator will vote on some issue may be made from knowledge of how other

Senators belonging to the same classes have voted on that issue, or how the new issue relates to others voted upon by that Senator and members of the classes to which he belongs, or preferably, knowledge of both of these. If, on the other hand, we simply wish to predict whether or not a new issue will receive a majority of the votes cast, with no knowledge of issue content and using minimal information, we might simply select a Senator who is thought to represent most accurately "majority opinion" over all issues and inquire as to his vote. What is usually done in prediction is to compromise between these two extremes, hoping to achieve accuracy and efficiency simultaneously.

In this study, the approach offering the better test of the representativeness of the obtained classes was to assume no knowledge of content of issues and rely solely on the assumption that any member of a class reflects the behavior of all members. Further assuming that the first eight major classes provide the most reliable Senate classification, the first member of each of these was chosen to represent the class.

The vote of each of these representatives on each Group B issue was multiplied by the class size, and these products summed to give the expected number of "yes" and "no" responses for the 74 Senators in these classes. Table 25 summarizes the results obtained through this procedure; some 84 of the predictions of outcome were successful. Surprisingly, the 12 incorrect predictions were not all cases where the issues were narrowly contested. In nearly half of these issues the margin of victory (or defeat) was 12 or more votes. Thus predictive accuracy seems to be primarily determined by the accuracy of the

TABLE 25

PREDICTED AND OBSERVED VOTING ON EACH OF 96 GROUP B ISSUES

Issue	Predicted	Observed	Issue	Predicted	Observed
1	42 - 29	40 - 31	49	65 - 0	65 - 3
2	25 - 43	31 - 49	50	51 - 23	57 - 27
3	36 - 38*	47 - 35	51	27 - 47	46 - 49
4	74 - 0	86 - 1	52	27 - 47	33 - 50
5	27 - 47	38 - 55	53	19 - 55	23 - 60
6	74 - 0	74 - 1	54	13 - 55	15 - 62
7	51 - 23*	29 - 62	55	55 - 19	63 - 9
8	18 - 56	35 - 53	56	38 - 36	44 - 41
9	18 - 56	32 - 52	57	3 - 51	13 - 54
10	18 - 56	33 - 49	58	38 - 36*	36 - 55
11	65 - 9	69 - 10	59	33 - 32	45 - 41
12	38 - 36	45 - 43	60	29 - 5	47 - 9
13	74 - 0	84 - 1	61	29 - 36*	41 - 37
14	23 - 51	34 - 55	62	47 - 27	44 - 42
15	38 - 22	58 - 25	63	27 - 47	30 - 56
16	65 - 9	81 - 6	64	26 - 48	37 - 40
17	65 - 9	72 - 16	65	21 - 53	23 - 54
18	38 - 36	45 - 42	66	55 - 19	57 - 28
19	36 - 38*	48 - 45	67	52 - 22	59 - 21
20	22 - 52	18 - 74	68	18 - 56	33 - 57
21	65 - 9	61 - 30	69	9 - 65	7 - 81
22	38 - 36	46 - 43	70	42 - 32*	32 - 58
23	14 - 50	36 - 53	71	27 - 47	31 - 48
24	0 - 74	1 - 84	72	19 - 46	19 - 55
25	13 - 61	25 - 63	73	39 - 35	45 - 41
26	31 - 43	27 - 61	74	0 - 74	12 - 81
27	68 - 6	76 - 8	75	36 - 38*	49 - 44
28	29 - 42	26 - 59	76	36 - 38*	49 - 43
29	47 - 27*	37 - 44	77	36 - 29	52 - 29
30	3 - 57	8 - 60	78	47 - 27	45 - 41
31	29 - 45	40 - 48	79	23 - 51	20 - 56
32	24 - 50	32 - 60	80	41 - 33	45 - 44
33	6 - 68	23 - 66	81	45 - 29	62 - 28
34	65 - 0	74 - 2	82	31 - 43	31 - 57
35	46 - 28*	15 - 51	83	74 - 0	85 - 1
36	36 - 38*	50 - 42	84	38 - 36*	41 - 48
37	55 - 19	58 - 19	85	45 - 29	41 - 34
38	65 - 9	73 - 3	86	52 - 22	62 - 19
39	74 - 0	69 - 6	87	38 - 36	43 - 39
40	19 - 55	14 - 58	88	27 - 38	21 - 56
41	56 - 18	34 - 24	89	46 - 28	47 - 30
42	13 - 33	12 - 48	90	0 - 65	16 - 55
43	57 - 12	51 - 20	91	0 - 62	2 - 76
44	36 - 33	43 - 39	92	9 - 62	20 - 68
45	19 - 50	22 - 61	93	9 - 62	21 - 66
46	9 - 65	18 - 59	94	33 - 38	33 - 55
47	27 - 47	32 - 45	95	62 - 9	64 - 24
48	74 - 0	71 - 3	96	3 - 71	5 - 82

* erroneous predictions

classification. Even using only eight classes, and the votes of only eight Senators, 87% correct prediction was yielded.

Theoretically, these predictions could have been improved by utilizing additional Senators to represent both the pair-size major classes and the first-level subclasses. However, this would have required additional knowledge of Senator voting records, reducing even further the unaccounted for (i.e., to-be-predicted) voting behavior. This use of one-eleventh of the Senators to predict the actual outcome appears to represent a reasonable compromise between accuracy and efficiency of prediction.

Summary

The investigation of the structure of the full Senate reported in this chapter was designed to illustrate the potential use of multiple agreement analysis as an objective classification technique. Results have been shown to possess meaning and predictive utility. It may be assumed that results would have been improved if there had been no missing data, or if omissions (failure to vote) had been included in the analysis as a defining characteristic.

The Senate was found to have essentially a fairly simple hierarchical structure, with no cross-classification realized in the first 44 classes, which accounted for 72% of the available information. The omissions possibly increase the number of classes by reducing the potential information for each. If earlier classes were larger and contained more defining characteristics, the total number of classes might be reduced, and at least the later classes, would be smaller in product size.

Generally, Republican party members appear to be more homogeneous that the Democratic members. There are several Senators who appear to vote quite differently from either major party, as well as from each other. The voting behavior of individual representatives of the major classes was shown to provide sufficient information to predict majority action of the full Senate on additional issues.

While the inclusion or exclusion of particular Senators in classes may appear inappropriate at times, it should be noted that these classes are differentially defined by rather small sets of issue responses. The tendency for classes to follow party and regional lines would appear realistic in terms of the demands of varied interest groups on these Senators. Thus a Senator's "philosophy" towards what is good and bad is tempered by the needs and demands of the people he represents, and on particular issues may lead to apparently contradictory behavior. Perhaps this only serves to illustrate the veracity of the old saying, "Politics makes strange bedfellows." However, the results presented here indicate that the voting behavior of Senators considered over many issues is quite consistent among members of a limited number of classes.

CHAPTER V

CONCLUSIONS AND DISCUSSION

The results reported in the last two chapters show that multiple agreement analysis, when used for analysis of voting response data, can produce classifications of subjects which are both reliable and meaningful. The classifications so obtained initially provide a descriptive basis for the subject set. Also, by utilization of class patterns, the method provides a means of comparison and prediction of both the behavior of subjects or classes on additional voting issues and the classification of new subjects.

The two groups used in these studies, the set of 20 selected Senators and the full 88 member Senate, show little similarity in their class structure. However, the 20 Senator group was selected on the basis of a predetermined structure in order to study the properties of the method. The full Senate was analyzed to study the meaningfulness of the classifications, assuming that the method had already been shown capable of yielding reliable results.

In the analysis of the full Senate, the large number of classes (15 major classes required to initially classify the 88 Senators) can be interpreted either as an indication of the complexity and diversity of the Senate or as an artifact due to the high number of no-response issues for many Senators. While practical considerations (especially the limited capacity of the computer) were the primary reasons for limiting the analysis to consideration of only the affirmative and negative response to each issue, post hoc interpretation would advise that such investigations either include all characteristics, including avoidance of response, or else take positive action to reduce missing responses to an absolute minimum. This issue could have been neatly avoided by following the example of the other investigators and filling in the missing data in either an arbitrary or random basis. This temptation was resisted primarily to avoid potential embarrassment if any occasion should arise where the inclusion of a Senator in a particular class would have to be defended on the basis of responses assigned by the investigator rather than actually given by the particular Senator.

While the evidence accumulated here is sufficient to warrant consideration of this method as a powerful objective technique for classification of objects on the basis of their common characteristics, the method as it stands is not considered to be in its final form. It is obvious that the method cannot fully meet the demands of the theoretical requirements. Several concessions to practicality, and limitations in the ability of both the investigator and the computer to meet the demands of the theory, have resulted in restriction of the method beyond that necessary or desirable in terms of the theory. These restrictions are:

1. The dependence of the obtained class upon its present size (number of subjects) when considering the inclusion of an additional person. Thus, if the class is of size 2, a third subject may be included if he agrees with only two-thirds of the common characteristics of the pair. For a person to be included as the twentieth member

of a class, however, he must agree on 95% of the common characteristics of the size-19 class. In general, for a subject to become the n-th member of a class of size n-1 defined by m characteristics, he must agree on at least n-1/n of the m responses to qualify (in terms of maintaining or increasing the product criterion) for membership.

This dependence of the product function upon the number of subjects is not detrimental to theoretical considerations for large classes, for it is reasonable to expect a stable structure in terms of defining responses. Thus it is reasonable to require a high degree of agreement before allowing an individual subject to join an already well-defined class. Rather, it is at the beginning of class formation, when a relatively low restriction on joining a class is in effect, that the dependency appears inadequate. If the first two or three members of a class are all representatives of a small true class, and these are all of the representatives of this class in the sample, we would expect that they would agree on a large proportion of the characteristics. But due to the relative ease of adding a new subject at this level, it would now be possible to add a subject not a representative of this true class simply because of his agreement on characteristics common to many classes. Continued buildup of this class could result in the obliteration of the small true class by elimination of its unique characteristics by the overpowering weight of a larger true class having many representatives in the sample and a reasonable number of characteristics common to both true classes.

Such results may be desirable or undesirable, depending upon the viewpoint of the investigator, but the undesirable aspect from any viewpoint is that the probability of such an occurrence depends upon when in the classification procedure the small class is formed. If it forms at the beginning of the analytic process when few other subjects have been classified, it is more probable that it will be "overcome" by another class than if it forms later when few subjects remain with all of their characteristics still available for classification purposes. Obviously this small class runs the danger of being overshadowed only when it is being formed; its unique set of defining responses should be sufficient to keep its members from being added to other classes which already include several members.

2. The requirement of invariance of response for all members of an obtained class. The only requirement set by the general theory is that the variance of members of a class on any characteristic be significantly less than the variance of classes of equivalent size composed of members of more than one class. It is this computational requirement of invariance which leads to the assumption that the obtained classes represent a lower limit, in terms of both subjects and defining responses. Such an assumption then implies that there is some error in every class realized, and classes realized later in the process may consist wholly of members improperly left out of an earlier class. This is not particularly harmful to the utility of the method; it merely implies that more classes are realized than is truly necessary. However, it can be harmful when only one or possibly two subjects are left out of each of their proper classes. This would mean that after the major classes have been formed, several individuals, each representing a different class, would remain in the matrix with their characteristics intact. Obviously, with only considerably reduced sets of data available for the already classified subjects,

these individuals would be forced to "pair up" with each other primarily on a chance basis. It is possible that this effect may have been the cause of the formation of the last five major classes realized in the full Senate results. Each of these classes consisted of only two Senators, and their number of common characteristics was quite low. However, these Senators also tended to have a considerable number of omissions, which also made it difficult to classify them with earlier classes. The lack of agreement as individuals with the first eight classes implies that certain of these Senators are quite unique. These results were a major reason for considering only the first eight classes as meaningful representatives of the major classifications of the Senate.

The fact that the full Senate analysis required 44 classes to account for 72% of the information may appear to be a detrimental factor in this approach. However, when it is considered that there are available 2^{95} or over 4 times 10^{28} theoretically possible response patterns (ignoring omissions) for each subject, it is rather encouraging to find so much information accounted for by so few classes.

Many other studies of patterns have suggested that there are many types of persons (McQuitty, 1957b), thus isolating 44 types from 88 persons is not an unexpected outcome. And, as the relations among these types is hierarchical, the usefulness of the typal concepts may be studied at any or all levels of classification.

Even in the results of the study of the small group of Senators we find rather remarkable results. For example, in the study on the A issues, double-entry, a class of size ten was obtained which included the ten Republican Senators. Such a result appears to be more than a chance effect when there are 184, 765 possible sets of size ten which could have been obtained, only one of which consists of ten Republicans. Thus, the results lead to the conclusion that the obtained classes do represent reliable and meaningful groupings of subjects who have more in common that just the responses defining their particular classes.

Granting the ability of the method to achieve meaningful classifications, what other questions should be asked of the method? The most important questions, not answered here, concern the relative ability of this method as compared with other methods for classifying and predicting behavior. These questions were avoided in this study for two reasons. First, it was believed that the first questions to be investigated concerned the "absolute" ability of the method, as reported here. Secondly, this data is not particularly well-suited for comparative investigations, as there are no clear objective criteria for evaluating the meaningfulness of the classes. Comparisons with other classification systems should ideally be made on data arising from populations with a well-defined structure. (Pickrel, 1958)

The method presented here is offered as a classification system, not as a measuring device. No assumptions have been made in the theory or in the computational procedure of any scales other than the nominal. In essence, the method is simply an objective counting device, assuming each characteristic (item response) to be either present or absent for each subject. The major assumptions of the method are that classes which contain the largest possible amount of information (subject - characteristic product) are more likely to be of interest; each characteristic is of equal importance; and the use of a characteristic for classification of a subject removes that

A slightly more complex modification could be made which would allow the investigator to set a predetermined subject size for each class. Thus one could sequentially determine the largest class or classes (in terms of number of defining characteristics) of size N, size N-1 and so on down to apir-size classes. Similarly, additional modification would also allow setting a minimum required number of characteristics for each class realized.

Under the requirements of the theory set forth here, there are additional modifications which suggest themselves. One is that a minimum proportion of agreement on common items must be attained before a subject joins a class. This would correct for the inequality of required proportion of agreement, depending upon when a subject is added to a class, mentioned earlier. However, such a restriction requires that "error" be considered to remain proportional or decrease, which implies then equal probability of error for all items.

Obviously much further investigation of the properties of this method and its theoretical assumptions remains necessary. The problems of when to stop classifying, the optimal number and kind of issues and subjects to use, and the significance of an obtained class remain as important areas of investigation. It is hoped that the results reported here will offer sufficient evidence of the potential usefulness of this method to generate interest in further exploration of this and other classification and pattern analytic methods.

characteristic from consideration in further classifications of that subject. The object of such a system is simply to obtain homogeneous sets, under the assumption that such sets will also show homogeneity of behavior in relation to other characteristics related to those defining the set.

The comparison of this method with methods based upon models requiring a different scale of measurement and dimensionality can only be made in terms of relative predictive value, again requiring an objective criterion. The value of any method as an explanatory device rests more upon the validity of the theoretical concepts involved than upon the value of obtained results in any given situation. Much further examination of comparative results would be required to determine what sorts of data and situations best lend themselves to increased comprehension under various techniques.

While the method has been presented in a theoretical framework which has set certain restrictions upon the procedure, such as the maximization of information and single use of individual responses, the computational procedure can be easily modified to handle other classification methods. For example, the alteration of one word in the computer program will allow only pair-size classes to form, in order of product size. By running such an analysis, then repeating the analysis of the results of the first run, and so forth, a complete hierarchical structure can be obtained, very similar to McQuitty's (1960) replacement version of hierarchical syndrome analysis. Such a technique effectively combines subjects into pairs, pairs into pairs of pairs (quadrads), these into octads, and so on.

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APPENDIX A

Senator Voting Records

Small Senate Sample A

Votes On Issues 1-32

Senators	1-			-32
1. Goldwater, Barry (R Ariz.)	10010001	00011000	10001110	11101011
2. Dworshak, Henry (R Idaho)	10010001	01010010	11001110	11011011
3. Welker, Herman (R Idaho)	10010001	01010000	11001110	11001011
4. Jenner, William (R Ind.)	10010001	01010000	11001110	11001111
5. Barrett, Frank A. (R Wyo.)	10110001	00010000	10001100	11000011
6. Knowland, William F. (R.Calif.)	10110001	01100111	10001110	00000010
7. Milliken, Eugene D. (R Colo.)	10110001	01110111	10001110	00000010
8. Smith, H. A. (R N.J.)	10110001	00100111	10001110	00100010
9. Duff, James H. (R Pa.)	10110001	00100010	10001100	00100010
10. Flanders, Ralph E.(R Vt.)	10110001	00100111	10001100	00000010
11. McClelland, John L. (D Ark.)	11100001	00111110	01110000	01101110
12. Smathers, George A. (D Ga.)	10110001	10011000	01110000	00101010
13. George, Walter F. (D Ga.)	10110001	00011110	01110000	00100010
14. Russell, Richard B. (D Ga.)	11110001	00011110	01110000	01101100
15. Johnson, Lyndon B. (D Tex.)	10110001	10001110	01110010	00100010
16. Humphrey, Hubert H. (D Minn.)	10101110	10001100	00110001	00110110
17. Mansfield, Mike (D Mont.)	10101110	00001000	01110001	00100111
18. Murry, James E. (D Mont.)	10101110	10001000	00110001	00110111
19. Monroney, A. S. Mike (D.Okla.)	10101110	10001000	00110000	00110010
20. Morse, Wayne (I Ore.)	01101110	10011000	00110000	00111110

Small Senate Sample B

Votes On Issues 1-32

Senators	1-			-32
1. Goldwater	01111100	00011000	01011001	10101111
2. Dworshak	01111100	00011010	01101101	10100011
3. Welker	11111100	00011000	01111101	10100011
4. Jenner	01111100	00011000	01001001	10100001
5. Barrett	01111100	00011010	01101001	10101111
6. Knowland	00011100	00011011	01101000	01001100
7. Milliken	01111100	00011011	01101001	01001110
8. Smith, H.A.	00011100	00001011	01101000	01001110
9. Duff	00001100	00000001	01111100	01011110
10. Flanders	00011100	00001011	01101000	01001111
11. McClelland	00011100	00011011	00100110	10111110
12. Smather	11011100	00000000	10100110	10011000
13. George	01111100	00011010	00100110	10011110
14. Russell	10011100	00011011	00100110	10111011
15. Johnson, L.	00011100	00000011	10100110	10011110
16. Humphrey	10001011	11100100	00000101	11010110
17. Mansfield	11101011	11100000	10000100	01011111
18. Murry	10000011	11100100	00000101	11010110
19. Monroney	10011111	11100100	00000100	11010101
20. Morse	11100011	11111100	00000101	00010110

Random 20 X 32 Response Matrix

Subject 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Random ΣX	Original ΣX
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20	19
0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	2	3
1	1	1	0	1	1	1	1	0	1	1	0	1	1	1	1	1	1	1	1	17	16
1	1	1	1	1	0	1	1	1	1	1	1	1	0	1	1	1	0	1	1	17	14
0	0	0	0	0	0	0	1	0	1	1	0	0	1	0	1	0	0	0	1	6	5
0	1	1	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	4	5
0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	5
0	0	0	1	1	0	1	1	1	1	0	1	1	1	1	0	1	1	1	1	14	15
0	0	0	0	1	0	0	1	0	0	0	1	0	0	0	0	0	0	1	1	5	6
0	0	1	0	0	0	0	1	1	1	0	1	0	0	0	0	0	0	0	0	5	6
0	0	0	0	0	0	0	1	0	1	0	1	0	1	0	1	1	1	0	0	7	6
1	0	0	0	1	1	1	0	1	1	1	0	1	1	1	1	1	1	0	0	13	11
0	1	0	1	1	0	0	1	0	1	1	0	0	1	1	0	1	1	1	1	12	11
1	1	0	1	1	1	1	0	1	0	0	0	1	0	0	0	1	0	1	0	10	9
1	1	1	1	0	0	1	1	1	0	1	0	1	1	0	1	0	0	0	1	12	10
1	0	1	0	0	0	0	0	0	0	0	1	1	0	0	0	1	0	0	0	5	4
1	1	0	1	0	0	0	0	0	1	0	0	1	1	1	1	1	1	1	1	12	10
0	0	1	0	0	0	1	1	0	1	0	1	1	1	0	1	1	1	0	1	11	9
0	0	0	0	1	0	0	1	1	1	1	1	1	1	1	1	0	1	1	0	12	10
1	1	0	0	1	0	0	1	1	1	0	0	0	0	1	1	1	1	0	1	11	10
1	0	0	1	0	0	1	0	1	1	0	0	0	0	0	1	0	0	0	1	7	10
1	0	0	0	0	1	1	0	0	0	0	1	0	1	1	1	0	1	0	0	8	10
1	0	1	0	0	0	1	0	0	1	0	0	1	1	1	0	0	0	0	0	7	8
0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	3	3
0	0	1	0	0	0	0	0	0	1	1	0	1	1	0	0	0	0	0	0	5	5
1	1	0	1	1	0	1	1	0	0	0	0	0	0	0	0	1	0	0	0	7	7
1	0	0	1	1	0	1	1	0	1	1	0	0	0	1	1	1	1	1	1	13	12
0	0	0	0	0	0	0	0	1	0	1	1	0	0	0	1	0	1	0	0	5	5
1	1	0	0	1	0	1	0	1	0	0	1	0	1	1	0	0	0	1	0	9	8
0	0	1	1	0	0	1	0	0	0	0	0	0	0	1	1	0	0	0	0	5	7
1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	18	19
1	0	0	0	1	0	0	1	1	0	1	0	1	1	0	0	0	1	0	0	8	7

Votes on A Issues 1-32*

1 McClellan, John L. (D Ark.)	1110	0001	0011	1110	0111	0000	0110	1110
2 Johnson, Edwin C. (D Colo.)	1100	1110	0000	0010	0011	0200	0100	1100
3 Byrd, Harry Flood (D Va.)	1011	2001	0002	0022	2100	0012	0102	2001
4 Eastland, James O. (D Miss.)	1111	0001	0122	0000	0011	0020	0010	1112
5 McCarran, Pat (D Nev.)	1101	0001	2222	2222	2011	0020	0111	1100
6 Johnson, Lyndon B. (D Tex.)	2011	0001	1000	1110	0111	0010	0010	0010
7 Smathers, George A. (D Fla.)	1011	0001	1001	1000	0111	0000	2212	1010
8 Symington, Stuart (D Mo.)	1010	2110	1000	1110	0111	0000	0010	1110
9 Chaves, Dennis (D N.M.)	2010	2110	1012	1111	0211	0002	2212	0210
10 Clements, Earle C. (D Ky.)	1011	0001	2000	1100	0111	0000	1010	0010
11 Sparkman, John J. (D Ala.)	1010	1010	1000	1010	0011	0001	0012	0100
12 Green, Theodore Francis (D R.I.)	1210	1110	1010	0010	0111	0000	0011	0010
13 Kennedy, John F. (D Mass.)	1010	1110	0001	0001	0100	0002	1012	2222
14 Humphrey, Hubert H. (D Minn.)	2010	1110	1000	1100	0211	0001	0012	0110
15 Jackson, Henry M. (D Wash.)	1010	1110	2000	000	0111	0001	1011	0110
16 Thye, Edward J. (R Minn.)	1011	0001	0010	0110	1011	1110	0000	0010
17 Kuchel, Thomas H. (R Calif.)	1011	0001	0101	0011	1000	1112	0100	0010
18 Payne, Frederick G. (R Maine)	1011	0001	0001	0010	1000	1110	0010	0010
19 Bennett, Wallace F. (R Utah)	1011	0001	0101	0111	1000	1100	0000	1010
20 Flanders, Ralph E. (R Vt.)	1011	0001	0010	0111	1000	1102	0002	0022
21 Knowland, William F. (R Calif.)	1011	0001	0110	0111	1000	1110	0000	0010
22 Bricker, John W. (R Ohio)	1011	0001	0101	0120	1000	1102	0100	1012
23 Mundt, Karl E. (R S.D.)	1011	0001	0001	0110	1211	1101	0100	0011
24 Goldwater, Barry (R Ariz.)	1001	0001	0101	1000	1000	1110	1100	2011
25 Welker, Herman (R Idaho)	1201	0001	0101	0022	2100	1110	1120	1211
26 Martin, Edward (R Pa.)	1011	0001	2101	0000	1100	1100	0100	0012
27 Russell, Richard B. (D Ga.)	1111	0001	2222	1110	2111	2000	0112	1100
28 Frear, J. Allen, Jr. (D Del.)	1010	0001	0000	1122	2100	0000	0120	1111
29 Robertson, A. Willis (D Va.)	1011	0001	0002	0021	0200	0020	0000	0001
30 Stennis, John C. D Miss.)	1111	0001	0001	1010	0211	0000	0110	2210
31 Johnston, Olin D. (D S.C.)	0111	0001	0010	1211	0011	0010	0111	1100
32 George, Walter F. (D Ga.)	1011	0001	0001	1110	0111	0002	0010	0010
33 Daniel, Price (D Tex.)	1011	0001	0001	1110	0111	0012	2212	2222
34 Hennings, Thomas C.,Jr. (D Mo.)	2010	1110	1010	1222	2111	0000	0012	0000
35 Kerr, Robert S. (D Okla.)	1012	2222	2220	1100	0111	0010	0010	0010
36 Langer, William (R N.D.)	1010	1110	1011	1120	2011	1011	1112	1110
37 Hill, Lister (D Ala.)	1110	1110	0010	1110	0011	0002	0011	0100
38 Pastore, John O. (D R.I.)	1010	1110	0000	0200	0100	0001	0012	0112
39 Hayden, Carl (D Ariz.)	1010	1110	1010	1111	0011	0000	0012	0010
40 Murray, James E. (D Mont.)	2010	1110	2020	1222	0211	0001	0011	0111
41 Lehman, Herbert H. (D N.Y.)	0010	1110	1000	0000	0122	0002	0011	0110
42 Wiley, Alexander (R Wis.)	1010	1000	2000	0111	1011	1100	0010	0020
43 Smith, Margaret Chase (R Maine)	1011	0001	0001	0010	1100	1110	0100	0010
44 Dirksen, Everett M. (R Ill.)	1011	0001	0122	0222	2200	1110	1100	1012

* A 'yes' vote is coded 1, a 'no' vote 0, and an absence 2.

Votes on A Issues 1-32

45 Watkins, Arthur V. (R Utah)	1011	0001	0101	0110	1000	1100	1100	1010
46 Saltonstall, Leverett (R Mass.)	1011	0001	0010	0111	2200	1100	0000	0010
47 Milliken, Eugene D. (R Colo.)	1011	0001	0111	0111	1000	1110	0002	0010
48 Barrett, Frank A. (R Wyo.)	1011	0001	0001	2020	2000	1100	1100	0011
49 McCarthy, Joseph R. (R Wis.)	1101	0001	1101	0222	2000	1102	0100	1112
50 Schoeppel, Andrew F. (R Kan.)	1001	0001	2102	0110	1000	1110	0110	1010
51 Jenner, William E. (R Ind.)	1021	0001	0101	0000	1100	1112	2200	1111
52 Dworshak, Henry C. (R Idaho)	1001	0001	0101	0010	1100	1110	1101	1011
53 Holland, Spessard L. (D Fla.)	1011	0001	0000	1000	0200	0000	0000	0010
54 Ellender, Allen J. (D La.)	1011	0001	0110	0111	0011	0000	0100	0010
55 Long, Russell B. (D La.)	1111	0001	1001	1002	0111	0000	1101	1110
56 Monroney, A.S. Mike (D Okla.)	2010	1110	1002	2000	0011	0000	0011	0010
57 Gore, Albert (D Tenn.)	1210	1110	0001	1010	0211	0020	0011	0011
58 Anderson, Clinton P. (D N.M.)	1010	1100	[illegible]	0222	2100	0000	0112	0110
59 Douglas, Paul H. (D Ill.)	1010	1110	0001	0000	0100	0001	1011	0110
60 Mansfield, Mike (D Mont.)	1010	1110	0000	1000	0111	0001	0010	0111
61 Morse, Wayne (I Ore.)	0110	1110	1001	1000	0011	0000	0011	1112
62 Kefauver, Estes (D Tenn.)	1010	1110	2000	0210	0111	0002	2010	0112
63 Neely, Matthew M. (D W. Va.)	0010	1110	1010	1000	0111	0002	0011	0112
64 Fullbright, J. William (D Ark.)	2110	1110	0000	1020	2111	0002	0012	2222
65 Gillette, Guy E. (D Iowa)	1110	1000	0022	1122	0111	0022	0101	2111
66 Kilgore, Harley M. (D W. Va.)	0110	1110	1010	1010	0011	0001	2212	2112
67 Magnuson, Warren G. (D Wash.)	0010	1110	0000	0221	0011	0001	1011	1110
68 Cooper, John Sherman (R Ky.)	1010	0100	2022	0110	1211	1100	0012	0011
69 Case, Francis (R S.D.)	1000	0100	0001	0210	1222	1100	1100	0010
70 Potter, Charles E. (R Mich.)	1011	0001	0101	0001	1000	1122	0000	0010
71 Beall, J. Glenn (R Md.)	1011	0001	0022	0120	2000	1110	0000	0011
72 Bush, Prescott (R Conn.)	1011	0001	0000	0020	2000	1112	0002	0002
73 Purtell, William A. (R Conn.)	1011	0001	0001	0020	2000	1100	0000	0011
74 Ives, Irving M. (R N.Y.)	1011	0001	0000	2222	2222	1222	2220	0010
75 Bridges, Styles (R N.H.)	1001	0001	0122	0111	2000	1122	0120	1020
76 Cordon, Guy (R Ore.)	1111	0001	0110	0112	1000	1102	0000	1010
77 Hickenlooper, Bourke B. (R Iowa)	1201	0001	0101	0111	1000	1110	0100	0110
78 Smith, H. Alexander (R N.J.)	1011	0001	0010	0211	1000	1110	0010	0010
79 Carlson, Frank (R Kan.)	1011	0001	0100	0110	1011	1110	[illegible]	0011
80 Duff, James H. (R Pa.)	1011	0001	0022	0010	1000	1102	2212	0010
81 Aiken, George D. (R Vt.)	1010	0100	1010	0110	1000	1100	0010	0010
82 Hendrickson, Robert C. (R N.J.)	1011	0001	0001	0111	1000	1110	1001	1010
83 Ferguson, Homer (R Mich.)	1011	0000	0101	0110	1000	1110	0000	0010
84 Williams, John J. (R Del.)	1011	0001	0101	0000	1100	1010	2001	1111
85 Butler, John Marshall (R Md.)	1011	0001	0101	0111	1000	1112	0000	1111
86 Capehart, Homer E. (R Ind.)	1011	0221	0002	2111	1022	1112	2200	2110
87 Young, Milton R. (R N.D.)	1010	0100	0011	0111	1200	1011	1100	1010
88 Malone, George W. (R Nev.)	1000	0020	0101	0111	1000	1112	1100	2110

Votes on A Issues 33-80

1	0101	1111	0010	1111	0111	2010	1210	0010	0011	2022	0111	1112
2	1101	0101	0100	1111	1111	0000	1110	0001	1002	0020	0111	1101
3	0200	1121	0010	2011	1111	0000	1010	0220	2212	0000	1001	1100
4	0101	1021	0101	1110	1111	0011	1110	1011	2222	1100	0111	2111
5	2201	1221	0010	1211	1112	2011	0110	0001	1222	2222	2222	2101
6	1101	0011	1010	1110	0111	0010	1110	0011	1011	1001	0111	1111
7	1101	0111	0011	1210	1111	0010	0110	1000	1111	0001	0111	1110
8	1101	0110	1001	1100	2222	1010	1101	0011	1022	0200	0110	1112
9	2201	1221	1101	1220	1112	2211	0101	1211	1211	2022	0100	2212
10	1111	0000	1001	1010	0111	1011	0101	0011	1011	0121	0111	2110
11	1101	0012	0101	1100	0112	2012	2222	2100	2222	0111	0111	1110
12	1111	0000	1201	1200	0002	2010	0101	0001	0011	0200	0011	1110
13	1011	1010	1001	1000	0000	1010	1111	1001	0111	0000	1010	1110
14	1011	0010	1101	1100	0000	2011	0101	0011	1211	2222	0110	1211
15	1011	0000	1101	1100	0100	1011	0101	0011	1111	0111	0110	1111
16	0100	0000	1001	1210	0001	0110	0101	1011	1100	0000	0121	2000
17	0100	0000	1001	1111	1111	0010	0101	1001	2200	0222	2221	1000
18	0110	0000	1001	1111	1111	0010	1101	1001	1100	0000	0001	1000
19	0100	0000	1001	1111	1111	0100	0101	1001	1000	0000	0001	1001
20	0110	2220	1010	1111	0101	1120	0101	1002	1100	0000	0001	1200
21	0100	0000	1001	1111	0011	0120	0101	1001	1000	0000	0001	1000
22	0102	1121	0000	1211	1112	0110	1100	1001	1000	2222	0001	1202
23	0100	1101	1001	1211	1111	1110	0111	1011	1010	1111	0101	1001
24	0100	1111	1001	1211	1111	0110	1100	2001	1100	1222	1001	1201
25	0100	1101	0010	1111	1112	0110	1100	0100	2100	1200	0001	1001
26	0110	1101	1010	1111	1111	0100	0120	1000	1000	2000	0001	1000
27	1101	2111	0011	1111	1111	2010	1010	0200	0012	0021	0110	1212
28	1101	1111	0010	1010	0110	1011	0101	0000	0001	0000	0011	1110
29	0100	0001	0010	1110	0111	0000	0110	0000	1010	0200	0001	1200
30	1101	1101	0010	1110	1111	0000	1110	1000	1000	0100	0111	0111
31	1001	1101	0110	1010	1110	0011	0110	0011	0011	1122	0111	2110
32	2221	2221	0010	1110	0111	0012	0110	2222	2202	2000	2111	1110
33	0101	1111	1010	1111	1111	0000	1010	0011	1011	1001	0111	2101
34	1101	0000	1101	1100	0002	1010	0201	0011	1111	0001	0110	2210
35	2201	2222	2011	1110	0112	2010	0210	0010	0012	2222	0111	2112
36	1000	1101	1101	2101	1111	1011	0001	0111	2210	0101	0110	1221
37	2001	0020	0101	1100	0100	1011	1010	0011	1111	0111	0111	1110
38	1111	1010	1101	1200	0000	2011	0101	0001	0011	0000	0011	1110
39	1001	0000	0001	2100	0001	1011	0111	1011	1012	2002	0001	1110
40	1021	0010	1101	1100	0000	1011	0101	0011	1111	1111	0110	1111
41	2211	2220	1101	1100	0000	2011	0101	0210	1111	0112	0110	1100
42	0102	0000	1001	1222	0001	1210	0222	1012	1120	0122	0111	1202
43	0100	0100	1001	1111	1111	0010	0101	1001	1000	0000	0001	1000
44	2100	0000	1001	1111	1111	0000	1001	10001	0000	2001	0001	1000

Votes on A Issues 33-80

45	0100	2220	1001	1211	1111	0110	0101	1001	1000	0100	0001	1001
46	2210	0000	1010	1211	0001	2110	0100	1001	1000	0022	0001	1020
47	0100	0000	1001	1212	0011	0110	0101	1001	1000	0000	0001	1000
48	0100	1101	1001	1111	1111	0110	1101	1001	1000	0000	0001	1001
49	0100	1101	1001	1221	1111	0110	0220	2112	0000	1100	0001	1002
50	0100	1221	1001	1111	1111	0110	1110	1001	1100	0001	0101	1001
51	0100	1101	0010	1211	1111	0110	0201	1001	1200	1000	0001	1002
52	1100	1101	0000	1111	1111	0110	1101	1100	1110	0000	0001	1001
53	1100	0001	0001	1010	0111	0000	1101	1001	1011	0001	0111	1100
54	1100	0101	0010	1110	1110	0000	0110	1010	1012	1020	0101	2200
55	1100	1111	0110	1110	1110	0000	0101	1011	1011	0001	0110	1100
56	1001	0010	1101	2100	0000	1010	1210	1010	1111	0211	2111	1110
57	1001	0011	0011	2110	0110	1010	1210	1000	0011	0122	0111	1110
58	1101	0110	1101	1010	0111	0010	1101	1001	0022	2222	0111	1211
59	1010	0010	1101	1110	0000	1011	0101	0010	0111	0011	1110	1110
60	1011	0010	1201	1110	0110	1011	0101	2011	2211	0111	0110	1111
61	1001	0100	1111	1100	0000	1011	0101	0011	1111	0111	2110	1112
62	1021	2010	1101	2200	0000	1010	0101	0011	2221	0111	0111	1210
63	1101	0010	1110	1100	0000	1011	0101	0011	2122	0111	0110	1110
64	1101	0000	1110	0200	0000	1010	0110	0010	0211	0010	0111	1210
65	0021	2220	1101	1110	0112	1010	0101	0011	1111	0002	0111	1101
66	2221	0000	1110	1000	0000	0011	1101	1211	0222	0211	2110	1210
67	1011	0100	1111	1200	0100	1011	0101	0011	1211	0111	0112	1111
68	0101	0000	1001	1200	0000	0000	1001	1011	1000	0102	0111	1210
69	0110	0000	1101	1111	1111	1100	1101	1011	1000	0000	0001	1001
70	0110	1100	1201	1211	1111	0110	0101	1001	1000	0000	0001	1000
71	0110	1101	1010	1111	1001	0110	1101	1001	1000	1022	0001	1000
72	0110	0000	1010	1111	0001	2100	1100	1001	1000	0201	0001	1000
73	0110	1000	1000	1111	001	0110	0101	1001	1200	0001	0001	1000
74	0110	0000	1010	1211	0001	0110	0100	2011	1100	0001	0000	1001
75	2222	0000	1210	1211	2222	0122	2120	1001	1200	0002	0001	1000
76	0102	2220	0001	1111	1111	0100	1101	1001	1100	0001	0001	1000
77	0100	1100	1001	1111	1111	0100	0101	1001	1022	0000	0001	1000
78	0100	0000	1201	1111	0000	0100	1101	1001	1200	0000	0001	1000
79	0100	0000	1001	1111	0111	2100	1101	1001	1022	0001	0001	1000
80	2210	0000	1000	1210	0001	0120	1101	1001	1200	2000	2011	1000
81	0110	0000	1001	1111	0001	1000	0101	0001	1110	0101	0001	1000
82	0100	0000	1221	1111	0011	0110	0101	2001	1200	0000	0001	1020
83	0110	0100	1001	1111	0001	0110	0100	1001	1102	0000	0001	1000
84	0100	1111	0010	1011	1111	2100	1001	0000	1120	0000	1001	1000
85	0100	0101	1010	1211	1111	0210	1110	2001	1000	1000	0001	1002
86	0110	1121	0222	2211	1112	0111	0101	1001	1202	0000	0221	1002
87	2200	1101	1101	1111	1111	0111	0101	1111	1110	0001	0101	2001
88	0100	1101	0200	1211	1111	0101	0110	1101	0000	0100	0001	1021

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1	1201	2222	2221	2222	2222	2211	1001	0001	1111	1110	0011	0011
2	1001	0010	1010	1120	0010	1111	0201	1001	1111	1110	0011	0011
3	1101	0011	0011	1120	0020	1211	2210	0100	1122	2222	2221	0111
4	1201	2222	2220	1221	1022	2222	2201	2222	1122	1111	2011	0111
5	1001	1110	0021	1022	2222	1110	1011	0220	1011	0111	2011	1000
6	1101	0000	1010	1000	1001	1111	1001	1000	1111	1110	0011	0111
7	1001	0001	1011	0020	1011	0111	1010	0001	1111	1111	0012	0011
8	1001	2000	1110	1000	1101	1110	1001	1011	1110	1110	2011	0111
9	2201	1112	1110	1021	1121	1100	1000	1122	2100	1112	1011	0111
10	1001	0000	1010	1000	1101	1111	1001	1011	1110	1110	0011	0111
11	1201	0011	1110	1001	1100	0120	1001	1222	1220	1110	2011	0111
12	1101	0020	1110	1000	1000	0110	1010	0000	1111	1111	1011	0111
13	1101	0001	1100	0000	1100	0110	1010	0000	1111	1111	1012	2222
14	1101	1101	1110	1021	1100	0100	1001	1010	1111	1110	1011	0111
15	1001	1110	1110	1001	1100	1110	1101	1010	1110	1110	0011	0111
16	1111	0000	2011	0110	0011	0110	1101	1000	1111	0110	0011	0111
17	1111	0000	0011	2110	0011	1110	1110	0000	0111	1111	0011	1100
18	1111	0000	0011	0110	0011	1110	1110	0000	0111	0111	0011	1111
19	1110	0000	0011	0110	0011	1111	0010	0000	0111	0111	0111	0111
20	1110	2000	0011	0112	2221	0100	1210	0000	0111	0011	2211	0111
21	1111	0000	0011	0110	0011	0110	1110	0000	0111	0111	0101	0100
22	1111	0000	2011	0112	2221	1211	0110	0000	0111	0111	0112	2020
23	1111	0100	0001	1122	2221	1111	1101	1000	0111	0110	0011	1000
24	1110	0002	0011	0110	0011	1111	0010	0100	0111	0111	0111	1000
25	1111	0000	0011	2120	0011	1111	0010	0100	0111	0111	2222	0100
26	1110	0000	0011	0110	0011	1110	1010	0100	0111	0111	0111	0000
27	1001	1210	1010	1020	0020	2111	0001	0111	1110	1100	2012	0011
28	1021	0001	1011	1001	0101	1111	0202	2222	2111	1111	1011	0011
29	1101	0010	0011	1020	0222	0110	1010	0001	1111	1102	2011	0111
30	1001	1010	0010	1001	1100	1111	1101	0001	1122	1111	0011	0111
31	1001	2220	1110	1021	1101	1011	0001	1111	1110	1110	2011	0111
32	1101	0000	1010	1020	1221	0110	1201	1001	1111	1112	2012	0011
33	1101	0000	2011	1020	0011	1111	1011	1000	1111	1110	2011	0111
34	2001	2212	1110	1001	1101	1100	1001	1011	1110	1110	1011	0111
35	1001	2220	2110	1000	1100	1110	1001	1011	1110	1110	1011	0111
36	0101	1100	1110	1021	1100	1011	0201	1010	1202	1112	2011	0000
37	1001	1020	1110	1021	1100	0100	1201	1011	1110	1110	2011	0111
38	1001	0000	2111	1000	0101	0110	1010	0000	1111	1111	1011	0111
39	1100	2000	1110	1022	1101	1110	1110	0020	1111	1121	2011	0111
40	1001	1111	1110	1001	1100	1110	1201	1010	1110	1110	1011	0111
41	1001	1120	1110	1021	1100	0100	1201	1222	1100	1112	1010	0111
42	2212	2222	2011	0210	2011	0110	1201	2000	1122	2222	2212	2222
43	1111	0000	0011	0110	0011	1110	1110	0000	0111	1111	0011	0111
44	1111	0002	0221	0110	0011	0110	1210	0000	0111	0111	0011	0100

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45	1111	0000	0011	0110	0011	1111	0210	0100	0111	0111	0011	0111
46	1111	0000	0011	0110	0011	0110	1110	0000	0111	0111	0011	0111
47	1111	0000	0011	0120	0011	1110	1010	0000	0111	0111	0112	1100
48	1111	0000	0021	0110	0011	1111	0010	0000	0111	0111	0011	1000
49	2112	2220	2011	0122	0011	2121	0201	1010	0111	0110	2212	2222
50	1111	0000	0011	0110	0011	1111	0210	0000	0111	0111	0001	1100
51	2112	0002	2011	0110	0011	1112	0010	0100	0111	0111	2211	0100
52	1111	0000	0011	1110	0010	1111	0111	0100	0111	0111	0011	1000
53	1101	0001	0011	0010	0011	0110	1010	0000	1111	1111	0011	0011
54	1201	0002	2221	2222	2221	0111	1001	1001	1111	1111	0212	0111
55	1000	0001	1010	1000	0001	0111	1001	1011	1111	1110	0011	0111
56	1201	1010	1110	1021	1100	0101	1001	1012	2110	1110	1011	0111
57	1001	1012	1100	1001	1000	0111	1010	0001	1110	1122	1012	0111
58	1001	0200	1110	1021	1101	1111	1010	0000	1111	1111	2011	0111
59	1201	0101	1110	1000	1100	0100	1001	1001	1110	1121	1011	0011
60	1201	1111	1110	1000	1100	0110	1001	1010	1110	1110	0011	0111
61	1001	1111	110	1001	1100	1110	1001	1010	1110	1110	1011	0111
62	1201	1022	2110	1222	2222	2122	2201	1011	1210	0010	1012	0111
63	1001	1100	1110	1001	1100	1112	2201	1010	1111	1111	1011	0111
64	1101	1011	1111	1020	0100	0100	1101	1011	1121	1110	1210	0011
65	1100	2120	1110	1022	2221	0112	0201	0020	1121	1111	2011	0011
66	1001	1120	1110	1001	1100	1212	2201	1022	2121	1110	1011	0111
67	1001	1110	1110	1000	1100	1100	1001	1010	1110	1110	1011	0111
68	1110	0100	0010	1112	0001	0100	1001	1000	0111	0110	2011	0111
69	1111	0000	0011	1122	2221	1111	0101	1100	0111	0111	0001	0121
70	1111	0000	0211	0110	0011	1111	1110	0100	0111	0111	0021	0111
71	1111	0002	0011	0110	0011	1111	1010	0000	0111	0111	0011	0111
72	1110	0000	0011	0110	0011	0110	1200	0100	0111	0111	0011	0011
73	1111	0002	0011	0110	0011	0210	1110	0100	0111	0111	2211	1200
74	1111	0000	0011	0110	0011	0100	1110	0100	0111	0111	0011	0111
75	1110	0000	0011	0110	0011	1110	1110	0100	0111	0111	2012	0000
76	1111	0000	0011	0110	0011	1110	1110	0000	0111	0111	2012	1220
77	1110	0000	0011	0110	0011	0110	1110	0000	0111	0111	0111	0100
78	1111	0000	0011	0110	0011	0110	1210	0000	0111	0111	0011	0111
79	1111	0000	0011	2110	0011	1110	1110	0000	0111	0111	0011	0011
80	1111	0000	0011	0210	2221	0100	1210	0100	0111	0111	0012	0111
81	1111	0000	0111	0110	0011	0110	1110	0000	0111	0111	0011	0111
82	1111	0000	2011	0110	0011	0110	1110	0000	0111	0111	0011	0111
83	1111	0000	0011	0110	0011	1110	1110	0000	0111	0111	0011	0111
84	1111	0011	0011	0110	0010	0111	1200	0100	0111	0111	0001	0001
85	2111	0000	0011	0110	0011	0111	1010	0100	0111	0111	0211	0000
86	2111	0000	2011	0110	0012	2211	0011	0100	0111	0111	2211	2100
87	2111	0000	0110	0110	2021	1111	0101	1000	1121	0110	2011	1000
88	2110	0000	0011	0110	0001	1111	0010	1100	0111	0111	0011	0000

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1 McClellan	0001	1100	0001	1011	0010	0110	1011	1110
2 Johnson, E.C.	1001	1011	1111	1100	1010	0100	1012	1110
3 Byrd	0111	1100	0001	1200	0211	0012	2012	2111
4 Eastland	1221	1200	0001	1000	1010	0211	1002	1112
5 McCarran	2221	1100	0002	2222	2220	0011	1012	0000
6 Johnson, L.	2001	1100	0000	0011	1010	0110	1001	1110
7 Smathers	1101	1100	0000	0000	1010	0110	1221	2000
8 Symington	1000	1012	2110	0012	1012	0100	1001	1110
9 Chavez	1002	1122	2111	2111	0010	0120	1221	2210
10 Clements	2001	1100	0000	0001	1000	0100	1001	1110
11 Sparkman	1001	1111	1110	0110	0000	0100	1001	2100
12 Green	2000	1011	1110	0220	1010	0100	1101	1100
13 Kennedy	2110	2011	1110	1002	00[illegible]1	0122	0111	2222
14 Humphrey	1000	1011	1110	0100	0000	0121	1101	2110
15 Jackson	1110	1011	1110	0100	0000	0100	1101	0110
16 Thye	0011	1100	0001	1011	0110	1000	0100	1110
17 Kuchel	0110	1100	0001	1010	0111	1002	1110	1100
18 Payne	0011	1100	0000	1000	0111	1001	1100	1110
19 Bennett	0111	1100	0001	1011	0111	1001	0100	1110
20 Flanders	0001	1200	0000	1011	2110	1002	0100	2122
21 Knowland	0001	1100	0001	1011	0110	1000	0100	1100
22 Bricker	0111	1100	0001	1001	0111	1002	0010	1012
23 Mundt	0111	1100	0001	1021	0110	1101	1110	1110
24 Goldwater	0111	1100	0001	1200	0101	1001	1010	1111
25 Welker	1111	1100	0001	1020	0111	1101	1010	0011
26 Martin	2111	1100	0001	1001	0111	1001	0110	1102
27 Russell	1221	1100	0002	2011	0010	2110	1011	2011
28 Frear	0111	1100	0001	0001	2221	0100	1012	1010
29 Robertson	0011	1100	0000	0000	0010	0020	1112	1111
30 Stennis	1011	1100	0001	0020	0010	0110	1011	2211
31 Johnston	1001	1100	0000	0022	1010	0110	1011	0011
32 George	2111	1100	0001	1020	0010	0112	1002	1120
33 Daniel	0211	1200	0001	0011	1010	0012	2222	2222
34 Hennings	2000	1011	1110	0022	2210	0100	1101	2110
35 Kerr	2221	1122	2222	2001	1000	0110	1001	1110
36 Langer	1001	1112	2110	0101	0110	1101	1011	2100
37 Hill	1001	1011	1110	0111	0010	0102	1001	2110
38 Pastore	1110	1211	1110	0022	0001	0101	0101	2112
39 Hayden	2001	2112	1110	0011	1010	0100	1101	2110
40 Murray	1020	0011	1110	0122	2020	0101	1101	0110
41 Lehman	1010	1011	1110	0100	0002	0100	2101	2110
42 Wiley	2001	1101	1110	1221	0110	1101	0100	1100
43 Smith, M.C.	0111	1100	0001	1001	0111	1101	0110	1100
44 Dirksen	0121	1100	0001	1022	0122	1001	0020	2000

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45 Watkins	0111	1100	0001	1011	0111	1001	0110	1110
46 Saltonstall	0001	1100	0000	1011	0111	1000	0100	1110
47 Millikin	0111	1100	0001	1011	0112	1001	0100	2110
48 Barrett	0111	1100	0001	1010	0110	1001	1010	2111
49 McCarthy	0111	1100	0001	1022	2120	1002	1010	1002
50 Schoeppel	2111	1100	0001	1001	0110	1001	0010	1000
51 Jenner	0111	1100	0001	1000	0100	1002	2220	0001
52 Dworshak	0111	1100	0001	1010	0110	1101	1010	0011
53 Holland	0001	1100	0000	0000	0010	0010	1100	1110
54 Ellender	0001	1100	0001	1011	1010	0010	1010	1110
55 Long	1011	1100	0001	0100	1000	0010	1011	0010
56 Monroney	1021	1111	1110	0100	0000	0100	1101	0101
57 Gore	1001	0111	1110	0010	0010	0120	1011	0111
58 Anderson	1220	1011	1112	0122	2221	0100	0011	2111
59 Douglas	1110	2011	1110	0100	0001	0100	0111	0110
60 Mansfield	1110	1011	1110	0000	1000	0100	0101	1111
61 Morse	1110	0011	1111	1100	0000	0101	0001	0112
62 Kefauver	1002	0111	1110	0112	1010	0102	1201	1112
63 Neely	1000	1011	1110	0100	1000	0100	1101	0112
64 Fullbright	1001	0011	1110	0100	1200	0122	2202	2222
65 Gillette	1221	1111	1110	0102	2220	0102	1000	0100
66 Kilgore	1000	0011	1110	0102	1010	0100	2201	2212
67 Magnuson	1000	1011	1110	0122	1020	0102	1101	0110
68 Cooper	0221	1000	0110	0011	1110	1101	0100	2110
69 Case	0011	1101	1001	1221	0112	1101	1111	011[illegible]
70 Potter	0111	1100	0001	1020	0101	1202	1110	1100
71 Beall	0121	1100	0000	1011	0111	1001	0100	1101
72 Bush	0001	1100	0000	1000	0121	1002	0100	2112
73 Purtell	0001	1100	0001	1010	0111	1000	0100	1111
74 Ives	0000	1101	1000	1222	2122	1222	2222	1110
75 Bridges	0221	1100	0001	1211	0111	1202	0112	1100
76 Cardon	0001	1100	0001	1111	0110	1001	0100	1110
77 Hickenlooper	0111	1100	0001	1021	0110	1001	0110	1100
78 Smith, H.A.	0001	1100	0000	1022	0110	1000	0100	1110
79 Carlson	0001	1100	0001	1011	0110	1000	0102	2111
80 Duff	0020	1100	0000	0002	0111	1102	2221	2110
81 Aiken	2011	1100	0111	0011	0110	1100	0101	1100
82 Hendrickson	0110	1100	0001	1001	0110	1101	0010	1110
83 Ferguson	0111	1100	0111	1011	0111	1000	0100	1100
84 Williams	0111	1100	0001	1000	0101	1000	0010	0011
85 Butler	0111	1200	0001	1011	0111	1000	0120	1001
86 Capehart	0121	1120	0220	0011	0112	1002	2220	1111
87 Young	1001	1101	1010	0211	0110	1101	1111	2100
88 Malone	1111	1110	0021	1001	1110	1012	1011	1000

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1	0111	1101	1110	1111	1010	0100	0111	1011	1101	1212	1211	0021
2	0111	0111	1110	1110	1010	1100	0111	1000	0101	1110	0001	0001
3	2011	0101	1102	1122	1110	0100	0001	0022	2221	1110	0200	0011
4	2011	1100	0111	1011	1110	0101	0111	1211	1221	2110	0211	0211
5	0020	1101	1220	1110	1020	2100	1111	1000	0121	1122	2222	2000
6	0011	1100	0010	1121	1010	1100	0011	1010	0101	1110	1211	0011
7	0111	1101	1110	1010	1010	1100	0011	0000	1101	1110	0001	2111
8	0111	1100	0010	1001	1022	2100	0111	1011	0101	1120	0111	1111
9	2221	1100	2220	1022	1010	1120	0110	1211	1121	0222	0001	0111
10	2211	1100	0010	1011	1010	1100	1110	1011	0101	0120	2011	0111
11	0111	1120	0010	1001	1011	0102	2222	1211	1221	2111	2011	1111
12	0111	1110	0010	2001	0010	1110	0010	0010	0101	0110	0120	1001
13	2111	1100	0010	1001	0011	1100	0012	0100	0111	1110	0201	0111
14	1111	1110	0010	1001	1011	1100	1010	1011	0121	0122	1111	1011
15	1111	1110	0010	1001	1011	1100	1110	1011	0111	0111	1111	1011
16	1001	0110	0011	1011	1100	1010	0010	1211	0100	1110	1222	2001
17	1001	0200	0011	1011	1100	0000	0010	0000	0220	1122	1012	2201
18	1001	0110	0011	1011	1100	1000	0010	0000	0110	1110	1010	0001
19	1001	0100	0111	1011	1100	1010	0010	1000	0100	1110	1010	0001
20	2001	0202	2221	1101	1100	1012	0010	0100	0100	1110	2010	2001
21	1001	0100	0011	1011	1100	1012	0010	0000	0100	1110	1000	0001
22	2001	0101	1101	1111	1100	1010	0010	0000	0100	1122	2210	0001
23	1011	0101	1110	1011	1100	0010	0010	0011	0100	1110	1011	0001
24	2001	0201	1101	1011	1100	0010	0010	1200	0100	1122	1000	0001
25	0001	0101	1101	1121	1100	0010	0111	1200	0200	1010	1210	0001
26	2001	0101	1111	1111	1100	0010	0012	0000	0100	1110	1000	0001
27	0011	1101	1110	1211	1010	0100	0001	1011	1121	0110	0201	0101
28	0111	1101	1110	1111	1010	0100	1111	0000	0101	1100	0100	0001
29	0011	0100	0011	1111	1110	0100	0011	2010	1101	0120	0000	0011
30	0111	1101	1110	1110	1010	0100	0011	1010	1101	1110	0211	0011
31	0111	1101	1100	1100	1010	1102	1111	1011	1111	0012	0011	1211
32	0221	1202	2222	1121	1010	1100	0211	2212	2221	1210	0011	2201
33	2011	1101	0111	1111	1010	1100	0001	1010	0101	1110	0011	0011
34	1111	1100	0010	1001	0011	1100	1010	1011	1111	0110	0221	1111
35	0221	1122	2212	1011	1010	1100	0011	1011	1101	0122	0211	2221
36	1111	0101	1100	1022	1010	1100	1101	1211	1221	1110	1211	1001
37	0211	1100	0010	1001	0011	1100	0001	1011	1111	0111	0211	1111
38	2111	1110	0010	1001	0011	1100	1011	0200	0001	0110	1221	0001
39	2111	1100	0010	1001	0011	1100	1111	0000	0101	0110	0001	0211
40	1111	1110	0010	2001	0011	2102	1110	1011	0111	0101	2211	1111
41	1221	1110	2210	1001	0011	1100	1010	0001	1111	0121	1111	1111
42	1001	0220	0012	1011	2101	1020	0012	1211	2100	1112	2011	1221
43	1001	0101	1010	1001	1100	1000	0010	0000	0100	1110	1010	0001
44	1001	0100	0011	1011	1100	1010	0000	0100	0100	1111	1000	0201

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45	1001	0100	2221	1011	1100	1010	0011	1000	0100	1110	1010	0001
46	1221	0110	0011	1111	1100	1010	0010	0000	0100	1112	1200	0001
47	1001	0200	0011	1011	2100	1010	0010	1000	0100	1110	1010	0001
48	1001	0110	1011	1011	1100	1011	0010	1000	0100	1110	1000	0001
49	2001	0201	1111	1011	1100	1010	0112	2211	0100	1010	2010	0022
50	1001	0101	1221	1011	1100	0010	0010	0000	0110	1110	1010	0001
51	0001	0101	1101	1111	1100	1010	0010	0200	0120	1110	2010	0001
52	1111	0101	1101	1011	1100	0010	0110	1000	0100	1110	1010	0001
53	0111	0100	0011	1011	1110	1000	0010	0000	0101	1110	0001	0011
54	0011	0101	1111	1111	1010	0100	0111	0011	1101	2110	0011	0011
55	0111	0101	1111	1100	0010	1000	0110	0011	1101	1101	0011	1111
56	0111	1100	0010	1002	0011	0100	0011	1010	1101	0121	0011	1111
57	0111	1101	0010	1002	0010	0100	0011	0000	1001	2112	0011	1111
58	0111	1101	0110	1001	1010	0100	0010	1000	0101	2222	2011	0111
59	1111	0110	0010	1001	1011	0100	1010	0011	1111	0101	1111	1211
60	0111	1110	0010	2001	1010	1100	1110	1211	0211	0111	1011	1011
61	2111	1211	1110	0001	0011	0110	1010	1011	2111	0111	1111	1211
62	2111	1110	0010	1001	2010	1100	1010	0011	1211	2211	1111	1211
63	1111	1110	0010	1101	1011	0100	1110	0011	1211	0111	1211	1101
64	2111	1110	0010	1101	0011	1100	0111	1011	1121	2110	0111	0011
65	2111	0202	2220	1011	1011	1100	0110	1100	1121	1112	0111	2011
66	1221	1010	0010	1101	0011	1100	1110	1011	0121	2111	1121	1101
67	0111	1110	0010	1011	1011	1100	1110	1011	0121	0111	1121	2111
68	1011	0110	0010	1011	0100	0000	0000	0010	0200	1112	1211	0201
69	1011	0100	0111	1011	1100	0010	0010	0011	0100	1110	1010	1001
70	1001	0100	0011	2011	1100	1010	1110	0100	0100	1110	1010	0201
71	1001	0100	0011	1111	1100	1010	0010	0000	0100	1112	1000	0001
72	2001	0110	0011	1111	1100	0010	0010	0000	0100	1120	1010	0001
73	1001	0110	0011	1111	1100	1010	0010	0000	0120	1110	1210	0001
74	1001	0110	0010	1111	1100	1010	0010	0000	0110	1110	1010	0001
75	2221	2100	0011	2112	1122	2012	2212	2000	0120	1110	2000	0001
76	1001	0102	2221	1011	1100	1000	0110	1000	0100	1110	2000	1001
77	1001	0100	1011	1011	1100	1010	0010	0000	0100	1110	1010	0001
78	1001	0110	0011	2011	1100	1000	0010	0000	0120	1120	1220	0001
79	1001	0100	0011	1011	1100	0010	0010	0100	0100	1110	1210	0001
80	1021	0210	0012	1111	1100	1002	0010	0100	0120	1110	1220	0001
81	1001	0100	0010	1001	1100	1000	0010	0100	0110	1110	1010	0001
82	1011	0110	0011	2011	1100	1010	0010	0100	0120	1120	1010	0001
83	1001	0110	0011	1011	1100	1010	1110	0100	0110	1110	1010	0001
84	1001	0101	1111	1111	1100	0010	0000	0000	0100	1100	1000	0001
85	1001	0101	1111	1111	1100	1120	0010	0000	0100	1110	1200	0201
86	0001	0101	1101	2221	1200	1012	1200	0200	0120	1120	1012	2001
87	1221	0101	1102	1011	1100	1010	0022	1011	0111	1110	1001	0200
88	0001	0101	1101	2110	1100	1112	1011	1000	0101	1110	0010	0000

Votes on B Issues 81-128

1	2211	2221	2022	2022	2122	2221	1000	1001	0010	1110	0000	0010
2	2000	0011	2112	0101	0111	0102	1000	1101	1110	1110	0000	0010
3	2000	0011	0012	2001	2101	2202	1011	1001	1011	1222	2200	0011
4	2211	2211	2110	2010	2022	2222	2000	2222	1210	2212	0000	0110
5	0011	0101	1012	2002	2020	0101	1010	1101	1010	0102	0001	1102
6	1011	0011	0110	0011	0110	0110	1000	0011	0010	1111	1000	0010
7	2011	0011	1002	0001	0110	0010	1011	1001	1010	1011	0020	0010
8	2011	0111	0112	0011	1020	0111	0000	0011	0110	1011	0000	0010
9	1011	1111	2112	0011	2010	0121	1100	0222	2110	1112	0000	0110
10	1011	0011	0110	0010	0000	2110	1000	0011	0110	1110	0000	0010
11	1211	1101	1112	0010	1000	0011	0000	0021	0220	2212	0000	0010
12	1110	0011	0112	0000	1000	0010	0011	1001	1110	1111	0000	0010
13	1011	0011	1102	0011	1100	0010	1011	1001	1110	1011	1022	2221
14	1111	1111	1110	0011	1000	0111	0100	0011	0110	0011	0000	0010
15	1111	1101	0112	0010	1000	0111	1000	0011	0110	1011	0000	0010
16	1100	0010	2001	1100	0110	0000	0000	0111	0011	0100	1000	0010
17	1100	0010	0021	1100	0110	0010	0011	1100	1011	0110	1000	1102
18	1100	0010	0001	1100	0110	0000	0011	1100	1011	0100	1000,	0110
19	1100	0010	0001	1100	0111	0000	1011	1100	1011	0100	1000	0010
20	1100	0010	0001	1222	2100	0002	1011	1100	1011	0102	1100	0010
21	1100	0010	0001	1100	0110	0000	0011	1100	1011	0100	1101	1100
22	1100	0010	2001	1122	2111	1000	1011	1100	1011	2100	1121	1120
23	1100	0010	0011	2222	2111	0100	1100	0110	1011	1100	1001	1100
24	1100	0010	2001	1101	0111	0000	1011	1100	1011	1101	1201	1100
25	1100	0010	0022	2101	0111	1100	1011	2100	1011	1102	1221	1100
26	1100	0010	0001	1100	0110	0000	0011	1100	1011	0100	1101	1100
27	2011	1101	0112	2001	2001	0111	1000	0011	0010	1111	1020	0010
28	1011	0011	0002	2011	0111	0002	1012	2222	2010	1110	1000	0111
29	1100	1211	0012	1002	2111	0020	0011	1001	1010	0110	1000	0010
30	1110	1011	0112	0001	0011	0112	1000	1001	1010	1010	1000	0010
31	1011	2211	0110	0010	1011	0111	1000	0001	0110	1111	0000	0010
32	1011	0011	0112	2202	2100	0002	0000	0001	1010	1110	1020	0010
33	1010	0011	0111	2001	0111	0010	1000	0011	0010	1111	2000	0010
34	1011	2211	2112	0011	1010	0111	0000	0011	0110	0011	0000	0010
35	2011	2201	0112	0010	0010	0110	1100	0001	0110	1110	0000	0010
36	1111	1011	0110	2011	1021	1111	1100	0011	0220	1010	0001	1100
37	1011	1201	2112	0010	1000	0111	0000	0001	0110	1011	0000	0010
38	1111	0011	0112	0000	0110	0010	0011	1001	1110	2111	0000	0010
39	1111	1011	2112	0010	1020	0021	0001	1101	1110	0112	1000	0010
40	1111	1111	1112	0010	1000	0111	1100	0011	0110	1011	0000	0010
41	1011	1121	1112	0011	1000	0112	0000	0011	0100	0010	0010	0010
42	2102	2210	2001	1100	0120	0002	0000	2011	1011	0222	2202	2220
43	1100	0010	0001	1100	0110	0000	0011	1100	1011	0110	1000	0010
44	1100	0010	2001	2100	0110	0222	0011	1100	1011	0100	1101	1100

Votes on B Issues 81-128

45	1100	0010	0001	1101	0111	0002	1011	1100	1011	1100	1100	0010
46	1100	0010	0001	1100	0100	0000	0011	1100	1011	0100	1100	0110
47	1100	0010	0001	1101	0110	0000	0011	1100	1011	0100	1120	1100
48	1100	0010	0001	1101	0111	0020	1011	1100	1011	1100	1001	1100
49	2102	2210	0001	2100	0121	1100	1100	0110	0011	0100	2022	2220
50	1100	0010	0001	1101	0111	0002	1011	1100	1011	1100	1001	1100
51	2100	0010	2001	1101	0111	1000	1011	1100	1011	1102	2201	1100
52	1100	0010	0011	1101	0111	0100	1011	1110	1010	1100	1001	0100
53	1000	0011	0001	0101	0110	0010	1011	1101	1010	1110	1000	0010
54	1211	0011	2022	2022	2121	0120	1001	0001	1010	1110	1220	0110
55	1111	0111	1010	0001	0111	0000	1000	0001	0110	1010	0000	0010
56	1011	1001	2110	0011	1010	0110	1000	0022	0110	1011	0000	0012
57	1011	1001	2112	0011	1010	0110	1001	1001	0110	1012	0020	0010
58	1011	1111	0112	0001	0110	0111	1011	1101	1110	1011	1000	0010
59	2011	1111	1112	0110	1000	0011	0000	1011	1110	0011	0000	0011
60	1111	1101	1112	0011	1000	0111	0100	0211	0110	1111	0000	0010
61	0111	1101	0112	0010	1000	0111	0100	2011	0110	0010	0000	0012
62	2211	1211	2112	2222	2000	2212	2000	2011	0220	2111	0020	0010
63	1011	1011	1112	0010	1010	1002	0000	0011	1110	1010	0000	0010
64	2011	1101	1012	0010	1100	0011	0000	0011	0111	0011	0010	0010
65	1111	2201	2112	0122	2010	0122	2100	0021	1110	2110	0000	0010
66	1011	1201	1110	0010	1000	0112	2000	0002	0110	2011	0000	0010
67	1111	1101	1112	0011	1011	0011	1100	0011	0110	1011	0000	0010
68	1100	0010	0112	1100	0010	0000	0000	1010	1110	0100	1000	0010
69	1100	0010	0011	1122	2111	0000	1000	0110	1011	1100	1100	0120
70	1100	0010	0001	1100	0111	0000	1011	1000	1011	1100	1200	0010
71	1100	0010	2001	1100	0120	0000	0011	1100	1011	0100	1001	0110
72	1100	0010	0001	1100	0110	0000	0011	1100	1011	0100	1100	0010
73	1100	0010	2001	1100	0110	0000	0011	1100	1011	0100	2201	2100
74	1100	0010	0001	2100	0100	0000	0011	1110	1111	0100	0000	0010
75	1100	0010	2001	1200	0110	2000	0011	1100	1011	0102	2121	1100
76	1100	0010	0001	1101	0110	0000	0010	1110	1011	2100	1122	1200
77	1100	0010	0001	1101	0110	0000	0011	1100	1011	0100	1101	1100
78	1100	0010	0001	1100	0120	0002	0011	1100	1011	0100	1100	0010
79	1100	0010	0001	1100	0110	0000	0011	1100	1011	0100	1000	0010
80	1100	0010	0001	2102	2110	0002	0011	1000	1011	0100	1120	0012
81	1100	0010	0001	1101	0110	0000	0011	1100	1011	0100	1000	0110
82	1100	0010	0001	1100	0110	0000	0011	1100	1011	0100	1100	0010
83	1100	0010	0001	1100	0110	0000	0011	1100	1011	0100	1100	0010
84	1100	0010	0001	1101	0101	0000	1011	1100	1011	1100	1100	0101
85	1100	0010	0001	1100	0111	0000	1011	1100	1011	0100	1201	1100
86	2100	0010	2021	1101	0111	2002	1010	1100	1011	2102	2201	1100
87	2111	0010	0111	2010	2021	1100	1100	0011	1010	1100	1001	1100
88	0100	0010	0001	1000	0111	1000	1011	1100	1010	1100	1001	1100

APPENDIX B

Summary of Issues

Identification of Small Sample A Votes

	Issue	Page	Vote	Date	Catagory*
1.	Wilson nomination	283	77-3	Jan. 26, 1953	6
2.	Allow a reorganization to be disapproved by simple majority	381	16-64	Feb. 6, 1953	7
3.	Bohlen nomination	256	74-13	March 27, 1953	4
4.	Table Anderson amendment killing offshore oil bill	457	56-35	April 27, 1953	9
5.	Limit state control to three miles	457	22-59	April 30, 1953	9
6.	Lehman amendment to give offshore rights to Federal Government	457	30-60	May 5, 1953	9
7.	Neely amendment to give offshore rights to Federal Government	457	27-64	May 5, 1953	9
8.	Committee amendment to offshore bill	462	56-32	May 5, 1953	9
9.	Increase funds for housing research	177	14-62	May 18, 1953	2
10.	Eliminate standby economic controls	463	26-61	May 19, 1953	9
11.	Increase funds for Public Building Service	177	19-56	May 20, 1953	2
12.	Decrease funds for housing	177	38-34	May 20, 1953	2
13.	Disapproval of Agriculture Department reorganization	381	29-46	May 27, 1953	7
14.	Appropriation for a census of business	187	41-38	June 2, 1953	2
15.	Reconsideration of vote by which amendment to acquire buildings was rejected	187	48-23	June 3, 1953	2

*Congressional Quarterly Catagories: 1. Agriculture, 2. Appropriations, 3. Education and Welfare, 4. Foreign Policy, 5. Labor, 6. Military and Veterans, 7. Misc. and Administration, 8. Special Senate Sessions on McCarthy Censure, 9. Taxes and Economic Policy

Identification of Small Sample A Votes

Issue	Page	Vote	Date	Catagory *
16. Authorization of shipbuilding funds	187	24-54	June 3, 1953	2
17. Suspension of rules to consider bill to ease discharging of employees	188	35-36	June 3, 1953	2
18. Reduction of postal funds	186	31-44	June 11, 1953	2
19. Increase funds for agriculture conservation	188	38-37	June 15, 1953	2
20. Williams amendment to increase funds for agriculture conservation	188	38-38	June 15, 1953	2
21. Take up conderence report on economic controls	463	39-39	June 18, 1953	9
22. Conference report for creation of Small Business Administration	463	42-47	June 22, 1953	9
23. Apply offshore lease revenue to national defense	462	37-42	June 24, k953	9
24. Make available surplus CCC commodities for famine relief	256	12-54	June 30, 1953	4
25. Administer Asia funds to encourage freedom	256	17-64	July 1, 1953	4
26. Reduce mutual security authorizations	256	34-48	July 1, 1953	4
27. Increase funds for hospitals	177	43-41	July 2, 1953	2
28. Send German treaty to committee	257	16-51	July 13, 1953	4
29. Give U.S. exclusive jurisdiction over offenses of citizens abroad	257	27-53	July 14, 1953	4
30. Exempt small corporations from excess profits tax	463	34-52	July 15, 1953	9
31. Adoption of an equal rights constitutional amendment	386	73-11	July 16, 1953	7
32. Increase employee pay	386	19-58	July 17, 1953	7

* op. cit.

Identification of Small Sample B Votes

Issue	Page	Vote	Date	Category*
1. Eliminate statistical analysis prohibition from Independent Offices Appropriation bill	177	20-45	May 18, 1953	2
2. Reduce by five per cent all amounts in Independent Offices Appropriation bill	177	35-43	May 20, 1953	2
3. Reduce funds for federal building repairs outside D.C.	177	39-36	May 20, 1953	2
4. Change debate rules	381	70-21	Jan. 7, 1953	7
5. Talbott nomination	283	76-6	Feb. 4, 1953	6
6. Cole nomination	205	64-18	March 9, 1953	3
7. Lay aside tidelands bill	457	21-61	April 23, 1953	9
8. Limit state ownership to three miles	457	26-68	April 28, 1953	9
9. Define limits of offshore boundaries	457	26-50	April 30, 1953	9
10. Establish study commission on submerged lands	457	32-59	May 5, 1953	9
11. Provide that 37.5 per cent of states' offshore revenues be used to reduce national debt	462	34-56	May 5, 1953	9
12. Amendment to economic controls bill	463	45-41	May 19, 1953	9
13. Prohibit president from making adjustments in ceilings	463	48-40	May 19, 1953	9
14. Change committee membership	381	19-56	May 25, 1953	7
15. Authorization for acquisition of buildings abroad with foreign credit	187	34-39	June 1, 1953	2
16. Table motion to reconsider census vote	187	39-35	June 2, 1953	2

* op. cit.

Identification of Small Sample B Votes

Issue	Page	Vote	Date	Category*
17. Increase airport aid	187	19-58	June 2, 1953	2
18. Suspend rules to permit considera-tion of provisions for appointment of deputy marshalls	188	35-36	June 3, 1953	2
19. Table motion to reconsider vote on building purchase abroad	187	64-16	June 4, 1953	2
20. Reduce funds for Agriculture Conservation Program	188	22-51	June 15, 1953	2
21. Table motion to reconsider vote on economic controls	463	41-41	June 18, 1953	9
22. Provide for use of outer shelf revenues for defense and education	462	45-37	June 24, 1953	9
23. Provide for committee to study submerged lands economics	462	18-61	June 25, 1953	9
24. Make Mutual Security funds avail-able for Asia Pacific countries	256	28-42	June 30, 1953	4
25. Make funds available for currency conversion program	256	49-35	July 1, 1953	4
26. Table motion to recommit Mutual Security bill	256	48-34	July 1, 1953	4
27. Motion to recommit Mutual Security bill	256	38-42	July 1, k953	4
28. Increase funds for TB control	177	39-38	July 7, 1953	2
29. Provide for payment of German debts to U.S. bondholders	257	46-16	July 13, 1953	4
30. Status of Forces Treaty	257	72-15	July 15, 1953	4
31. Amendment to equal rights for women Constitutional amendment	386	58-25	July 16, 1953	7
32. Refer legislative employees' re-tirement bill to committee	386	21-56	July 17, 1953	7

* op. cit.

Identification of Full Senate Sample A Votes

Issue	Page	Vote	Date	Category*
1. Limit rubber plant sales	464	34-45	July 21, 1953	9
2. Rubber plant disposal bill	464	65-16	July 21, 1953	9
3. Allow military funds to be used to correct economic dislocation	188	25-62	July 22, 1953	2
4. Increase pilot training	188	41-48	July 23, 1953	2
5. Suspension of rules to allow amendment to restrict trade with Communists	186	34-50	July 29, 1953	2
6. Reduce economic aid	186	37-45	July 29, 1953	2
7. Limit special weapons planning	186	23-55	July 29, 1953	2
8. Restrict entrance of refugees	257	40-49	July 29, 1953	4
9. Refugee Act of 1953	257	63-30	July 29, 1953	4
10. Committee assignment for Morse	452	26-59	Jan. 13, 1954	7
11. Financing St. Lawrence Seaway	565	34-55	Jan. 20, 1954	9
12. Seaway bill	565	51-33	Jan. 20, 1954	9
13. Funds for Government Operations Committee	454	85-1	Feb. 2, 1954	7
14. Discharge indebtedness of CCC	144	29-10	Feb. 9, 1954	1
15. Broadening of Bricker amendment	294	62-20	Feb. 15, 1954	4
16. Ferguson amendment of the Bricker amendment	294	44-43	Feb. 17, 1954	4
17. Bricker constitutional amendment	294	42-50	Feb. 25, 1954	4
18. George substitute for the constitutional a mendment	295	61-30	Feb. 26, 1954	4

* op. cit.

Sample A Votes

Issue	Page	Vote	Date	Category*
19. Constitutional amendment as amended	294	60-31	Feb. 26, 1954	4
20. Authorize recruitment of Mexican farm labor	144	59-22	March 3, 1954	1
21. Recommit bill to amend National Gas Act	566	25-52	March 15, 1954	9
22. Provide that the New Mexico vacancy be filled by an election	452	36-53	March 23, 1954	7
23. Reduce excose taxes on household items	567	64-23	March 24, 1954	9
24. Lower excise taxes on radios, etc.	567	23-64	March 25, 1954	9
25. Extend all excise taxes except on admissions	567	34-54	March 25, 1954	9
26. Conference excise bill	567	72-8	March 30, 1954	9
27. Status of commonwealths for Alaska and Hawaii	450	24-60	April 1, 1954	7
28. Statehood for Hawaii and Alaska	450	57-28	April 1, 1954	7
29. Lease-Purchase agreements	451	47-30	April 20, 1954	7
30. Establish tariff authority for wool	144	7-76	April 27, 1954	1
31. Set dairy supports at eighty-five per cent of parity	144	38-53	April 27, 1954	1
32. Wool supports bill	144	69-17	April 27, 1954	1
33. International Sugar Agreement	297	60-16	April 28, 1954	4
34. Modify D.C. tax structure	451	23-45	April 29, 1954	7
35. Recommit transportation rates bill	566	39-37	May 13, 1954	9

* op. cit

Sample A Votes

Issue	Page	Vote	Date	Category*
36. Reduce appropriations for Post Office Department	186	26-44	May 13, 1954	2
37. Permit individuals to bring fire-works into a state for own use	251	12-65	May 18, 1954	3
38. Increase appropriations for TVA	186	23-56	May 19, 1954	2
39. Grant jurisdiction of certain forest lands to Interior Department	452	18-52	May 20, 1954	7
40. Permit federal savings and loan institutions to have branches in certain states	569	31-39	May 30, 1954	9
41. Reduce flood and navigation funds	183	4-81	May 25, 1954	2
42. Increase REA loan authorization funds	183	42-40	June 2, 1954	2
43. Increase school lunch funds	183	39-43	June 2, 1954	2
44. Allow a maximum of 35,000 new starts annually in public housing	250	66-16	June 3, 1954	3
45. Constitutional amendment to allow filling of vacancies in an emergency	450	70-1	June 4, 1954	7
46. Bar salaries to certain persons not under Hatch Act	186	35-41	June 14, 1954	2
47. Increase funds for Army personnel and operations	183	38-50	June 17, 1954	2
48. Provide for investigation by the Tariff Commission of imports of farm products	296	23-52	June 24, 1954	4
49. Resolution on protecting Western Hemisphere from Communism	296	69-1	June 25, 1954	4
50. Table motion to reconsider vote by which Senate ratified Copyright Convention	297	52-23	June 29, 1954	4

* op. cit.

Sample A Votes

Issue	Page	Vote	Date	Category *
51. Provide an additional $100 income tax exemption	568	46-49	June 30, 1954	9
52. Delete provision allowing for tax credit	568	71-13	July 1, 1954	9
53. Delete accelerated tax depreciation plan for new plants	568	20-60	July 1, 1954	9
54. Plan for tax write off on farm equipment	568	15-65	July 2, 1954	9
55. Delete most provisions of tax bill	569	15-58	July 2, 1954	9
56. Reduce funds for building barracks	330	12-63	July 9, 1954	6
57. Preference for the sale of power to cooperatives	566	29-45	July 12, 1954	9
58. Establish national unemployment compensation standards	250	30-56	July 13, 1954	3
59. Unemployment security bill	250	78-3	July 13, 1954	3
60. Knowland motion supporting move authorizing AEC to contract for power for TVA	563	56-35	July 21, 1954	9
61. Johnson motion supporting move to authorize AEC to produce electrical power	563	46-42	July 22, 1954	9
62. Table amendment authorizing president to set up atomic pool	563	46-41	July 23, 1954	9
63. Table amendment extending time for licensing patents	564	43-24	July 24, 1954	9
64. Delete provisions on implementing international agreements	564	18-65	July 26, 1954	9
65. Substitue striking out many provisions of atomic energy bill	564	31-51	July 26, 1954	9

* op. cit.

Sample A Votes

Issue	Page	Vote	Date	Category*
66. Provide revenues to AEC to be used for education	564	25-55	July 26, 1954	9
67. Table move to limit AEC payments for nuclear material	565	43-34	July 26, 1954	9
68. Conference tax bill	569	61-26	July 29, 1954	9
69. Prohibit funds to stimulate production of strategic materials in other countries	295	49-40	July 30, 1954	4
70. Increase funds for technical programs in Latin America	295	8[illegible]-2	July 30, 1954	4
71. Refer McCarthy censure to select committee	454	75-12	Aug. 2, 1954	7
72. Reduce mutual security funds	295	38-48	Aug. 3, 1954	4
73. Mutual security bill	296	67-19	Aug. 3, 1954	4
74. Increase civil defense funds	186	29-44	Aug. 3, 1954	2
75. Support basic commodities from 82.5 to 90 per cent	142	49-44	Aug. 9, 1954	1
76. Support dairy prices from 80 to 90 per cent	142	44-48	Aug. 9, 1954	1
77. Support other grains	142	33-54	Aug. 10, 1954	1
78. Require states to pay for part of disaster relief	142	25-65	Aug. 10, 1954	1
79. Support live beef cattle prices	143	23-62	Aug. 10, 1954	1
80. Set a maximum support for wool	143	21-66	Aug. 10, 1954	1
81. Johnston's motion supporting vote to prohibit limiting terms of members of county conservation committees	143	46-63	Aug. 10, 1954	1

* op. cit

Sample A Votes

Issue	Page	Vote	Date	Category*
82. Establish the presumption that certain unions are not Communistic	453	87-1	Aug. 12, 1954	7
83. Lamont contempt citation	454	71-3	Aug. 16, 1954	7
84. Second atomic energy conference report	565	59-17	Aug. 16, 1954	9
85. Membership in Communist party a felony	453	41-39	Aug. 17, 1954	7
86. Adoption of house amendments to subversive activities bill	454	81-1	Aug. 17, 1954	7
87. Rivers and harbors bill	566	77-2	Aug. 17, 1954	9
88. Conference farm bill	143	44-28	Aug. 17, 1954	1
89. Delete exception to 160-acre limit	566	17-45	Aug. 18, 1954	9
90. Change salary base in railroad retirement bill	251	7-68	Aug. 19, 1954	3
91. Federal pay raise bill	451	69-4	Aug. 20, 1954	7
92. Adjourn until Nov. 29, 1954	472	76-2	Nov. 18, 1954	8
93. Mundt substitute for McCarthy censure	472	15-74	Dec. 1, 1954	8
94. Committee amendment of McCarthy censure	473	67-20	Dec. 1, 1954	8
95. Censure McCarthy for his charges against the committee recommending censure	473	64-23	Dec. 2, 1954	8

* op. cit.

Identification of Full Senate Sample B Votes

	Issue	Page	Vote	Date	Category*
1.	Recess for committee study of immigration bill	386	40-31	July 17, 1953	7
2.	Limit sale of rubber producing facilities	464	31-49	July 21, 1953	9
3.	Provide for Congressional disapproval of sale of rubber producing facilities	464	47-35	July 21, 1953	9
4.	Treaties of Friendship, Commerce and Navigation	258	86-1	July 21, 1953	4
5.	Increase funds for aircraft pruchase	188	38-55	July 23, 1953	2
6.	International Sugar Agreement extension	258	74-1	July 27, 1953	4
7.	Make visas available to Italian nationals	257	29-62	July 29, 1953	4
8.	Limit obligations of mutual security funds	186	35-53	July 29, 1953	2
9.	Reduce military assistance funds	186	32-52	July 29, 1953	2
10.	Limit mutual security expenditures in 1954	186	33-49	July 29, 1953	2
11.	Mutual Security Appropriation Bill	186	69-10	July 29, 1953	2
12.	Provide for U.S. jurisdiction over submerged lands of outer continental shelf	462	45-43	July 30, 1953	9
13.	Committee changes resolution	452	84-1	Jan. 13, 1954	7
14.	Recommit St. Lawrence Seaway bill	565	34-55	Jan. 20, 1954	9
15.	Lee nomination	569	58-25	Jan. 25, 1954	9

* op. cit.

Sample B Votes

Issue	Page	Vote	Date	Category*
16. Korea Mutual Defense Treaty	296	81-6	Jan. 26, 1954	4
17. Require roll call vote for treaty ratification	294	72-16	Feb. 16, 1954	4
18. Beeson nomination	309	45-42	Feb. 18, 1954	5
19. Motion to adjorn	294	48-45	Feb. 24, 1954	4
20. Recommit bill on Constitutional amendment limiting treaty powers	294	13-74	Feb. 25, 1954	4
21. Liberalize retirement benefits for legislative employees	451	61-30	Feb. 26, 1954	7
22. Include Alaska in Hawaiian statehood bill	452	46-43	March 11, 1954	7
23. New Mexico senatorial election	452	36-53	March 23, 1954	7
24. Motion to adjourn	567	1-84	March 24, 1954	9
25. Lower excise tax on vehicles	567	25-63	March 25, 1954	9
26. Earmark highway fuel tax revenues for road building	567	27-61	March 25, 1954	9
27. Excise tax reduction of $1 billion	567	76-8	March 25, 1954	9
28. Submit statehood bill to voters of Hawaii and Alaska	450	26-59	April 1, 1954	7
29. Maintain system on funds to states for highway construction	565	37-44	April 7, 1954	9
30. Provide for approval of Congress on lease-purchase agreement	451	8-60	April 9, 1954	7
31. Continue 90 per cent of parity supports	144	40-48	April 27, 1954	1
32. Support of dairy products	144	32-60	April 27, 1954	1

* op. cit.

Sample B Votes

Issue	Page	Vote	Date	Category*
33. Limit payments on shorn wool to 100 per cent of parity	144	23-66	April 27, 1954	1
34. Amendment to International Sugar Agreement must be ratified as was original agreement	297	74-2	April 28, 1954	4
35. Increase federal contribution to D.C. government	451	15-61	April 29, 1954	7
36. Recommit Taft-Hartley bill	309	50-42	May 9, 1954	5
37. Proposed Supreme Court amendment	450	58-19	May 11, 1954	7
38. Fireworks bill	251	73-3	May 18, 1954	3
39. Appropriations for FCC	186	69-6	May 19, 1954	2
40. Extension of savings and loan branch privileges	569	14-58	May 20, 1954	9
41. Proposed Constitutional amendment allowing eighteen-year-olds to vote	450	34-24	May 21, 1954	7
42. Affirm prior water right of U.S.	566	12-48	May 28, 1954	9
43. Increase funds for state agricultural experiment stations	183	51-20	June 1, 1954	2
44. Table motion to reconsider vote on rural electrification loans	183	43-39	June 2, 1954	2
45. Increase REA loan authorization	183	22-61	June 2, 1954	2
46. Recommit Hewitt appointment bill	452	18-59	June 8, 1954	7
47. Extend presidential authority on Reciprocal Trade Act	296	32-45	June 24, 1954	4
48. Reciprocal Trade Act Extension	296	71-3	June 24, 1954	4
49. Copyright Convention	297	65-3	June 25, 1954	4

* op. cit.

Sample B Votes

Issue	Page	Vote	Date	Category*
50. Indian health operations to PHS	452	57-27	June 29, 1954	7
51. Increase personal income tax exemptions	568	46-49	June 30, 1954	9
52. Grant each taxpayer $20 yearly tax credit	568	33-50	July 1, 1954	9
53. Delete certain estate tax exemptions	568	23-60	July 1, 1954	9
54. Recommit tax bill	568	15-62	July 2, 1954	9
55. Internal Revenue bill	569	63-9	July 2, 1954	9
56. Authorization of model rehabilitation center	251	44-41	July 7, 1954	3
57. Create civilian post to coordinate military findings	330	13-54	July 9, 1954	6
58. Limit AEC authority	563	36-55	July 21, 1954	9
59. Preference given to public bodies and cooperatives in use of excess AEC power	563	45-41	July 22, 1954	9
60. Table amendment to establish new division in AEC	563	47-9	July 22, 1954	9
61. Table amendment on licensing patents in atomic energy field	563	41-37	July 23, 1954	9
62. Limit AEC debate to amendments already submitted	564	44-42	July 1954	9
63. Create power advisory group	564	30-56	July 26, 1954	9
64. Use all AEC revenues to pay off principal on national debt	564	37-40	July 26, 1954	9
65. Licenses put under Federal Power Act	564	23-54	July 26, 1954	9

* op. cit.

Sample B Votes

Issue	Page	Vote	Date	Category*
66. Atomic energy bill	565	57-28	July 27, 1954	9
67. Housing redevelopment bill	250	59-21	July 28, 1954	3
68. Increase portion of mutual security funds available as loans	295	73-57	July 29, 1954	4
69. Authorize mutual security funds for aircraft construction	295	7-81	July 30, 1954	4
70. Amendment to encourage purchase of surphuses	295	32-58	July 30, 1954	4
71. Eliminate provision in employment security bill	250	31-48	July 13, 1954	3
72. Reduce Hoover Commission appropriation	186	19-55	Aug. 3, 1954	2
73. Reduce mutual security funds by $500,000,000	295	45-41	Aug. 3, 1954	4
74. Raise basic commodities supports to flexible 90 to 100 per cent of parity	142	12-81	Aug. 9, 1954	1
75. Raise basic commodities supports to flexable 82.5 per cent	142	49-44	Aug. 9, 1954	1
76. Continue dairy support at 75 to 90 per cent level	142	49-43	Aug. 9, 1954	1
77. Delete certain mandatory grain supports	142	52-29	Aug. 10, 1954	1
78. Encourage grazing land improvements	143	45-41	Aug. 10, 1954	1
79. Insert House language on certain dairy provisions	143	20-56	Aug. 10, 1954	1
80. Prohibit Secretary from limiting terms of county conservation committees	143	45-44	Aug. 10, 1954	1

* op. cit.

Sample B Votes

Issue	Page	Vote	Date	Category*
81. Omnibus farm bill	143	62-28	Aug. 10, 1954	1
82. Amendment to subversive activities bill to establish Committee on Security	453	31-57	Aug. 12, 1954	7
83. Retain existing language in subversive activities bill	453	85-1	Aug. 12, 1954	7
84. Atomic energy conference bill	565	41-48	Aug. 13, 1954	9
85. Reduce military aid funds	186	41-34	Aug. 14, 1954	2
86. Clarify certain definitions in subversive activities bill	453	62-19	Aug. 17, 1954	7
87. Table motion to reconsider vote on membership in Communist party	453	43-39	Aug. 17, 1954	7
88. Half of cost of Delaware River project to be borne locally	566	21-56	Aug. 17, 1954	9
89. Table amendment to attach federal pay bill as rider to Santa Maria River bill	566	47-30	Aug. 18, 1954	9
90. Tie postal rates increase in with federal pay raise	451	16-55	Aug. 20, 1954	7
91. Change reconvening date to Nov. 22	472	2-76	Nov. 18, 1954	8
92. Dismiss first count on McCarthy censure	472	21-66	Dec. 1, 1954	8
93. McCarthy not to be condemned for failure to appear before committee	472	20-68	Dec. 1, 1954	8
94. Table second count on McCarthy censure	473	33-55	Dec. 2, 1954	8
95. Amendment to McCarthy censure	473	64-24	Dec. 2, 1954	8
96. Reduce Army Civil Fuctions appropriation	183	5-82	May 25, 1954	2

* op. cit

APPENDIX C

Computer Program

TITLE
Multiple Agreement Analysis

TYPE
Complete

DESCRIPTION
This routine reduces a binary response matrix into a number of submatrices, each of which has identical columns (responses) for each subject (row) in the submatrix. These submatrices are formed iteratively, beginning with that pair of subjects with the maximum number of common (identical) responses. Each additional subject is then scored against these common responses, with that subject having the highest agreement score being the next member added to the group defining the scoring key. This procedure is repeated, with the new scoring key consisting of those responses common to all current members of the scoring key group, until noremaining subject agrees with the key on more than one response. At this point the group and its common responses which contains the maximum subject-response product (information) is printed out. The common responses of the subjects in this submatrix are then eliminated from the response matrix and the procedure is repeated, continuing until there remains no pair of subjects having as many common responses as required by a preset parameter.

The fundamental assumption of this technique is that subjects who are members of the same class will tend to possess identical characteristics; members of different classes will tend to possess dissimilar ones. In the more traditional statistical format, this is simply the equivalent of the statement that "within class" variance is less than the "between class" variance. The difference between this method and a standard analysis of variance is that in this method the data determines the classes, rather than assuming predetermined classes. Also, this method is designed primarily for unordered, or catagorical, data, such as items, characteristics, etc, For a fuller discussion of this method and its applications, see the unpublished doctoral thesis, "Multiple Agreement Analysis", by Peter W. Hemingway, Dept. of Psychology, MSU, 1961.

CAPACITY
The capacity of this program is given by the equation $DN + 2N + 2D + 5 - 703$, where N is the number of subjects to be classified and D is the number of locations required for the responses of each subject. That is, $D = p/39$ rounded up to the next integer, where p equals the number of subject responses.

TIME
Depends on number of subjects, number of items, and criterion. Two hours will usually give sufficient results. A spillout will allow more to be run if needed. Each class obtained takes an equal interval of time.

INPUT
1) Program Tape - make a copy of the appropriate form (tape or card input) of the program master tape in the computer laboratory library.
2) Parameters:
a) Card Input - punch in binary form in the rows and columns indicated the following six parameters.

Row Y;	Columns	29-40:	P_1 (the number of responses in the first word)
Row Y;	"	69-80:	P_r (number of responses in the last word)
Row X;	"	29-40:	D (number of words, p/39, per subject)
Row X;	"	69-80;	N (number of subjects
Row 0;	"	29-40:	C (criterion for terminating; see Note 1.)
Row 0:	"	69-80:	R (number of rows punched per subject)

See program K9-M for a more detailed description of the card format of parameter and data cards for the card input routine.

b) Tape input - Punch the following four parameters on tape.

```
00 4K
00 F   00 (Pr)F
00 F   00 ( D )F
00 F   00 (N) F
00 F   00 (C) F
24 999N
```

3) Data:
a) Card Input - follow the format given for program K9-M, substituting "subject" for "item". See Note 2 for explanation of response form.
b) Tape Input - punch all responses (see note 2) for each subject followed by an S at the end of each subject's responses. No other punches, other than fifth hole characters, may be permitted in the data tape.

Note 1. The determination of the criterion for stopping is at the discretion of the operator. The function of the criterion is to terminate the analysis when there remains no pair of subjects who agree on as many as C responses. Thus, if the criterion is large, relative to the nubber of responses, the analysis is terminated after fewer classifications than if the criterion is relatively small. It is recommended that the criterion never be set at less than 5% of the total responses,

Note 2. The responses utilized in the analysis are again entirely at the discretion of the investigator. If the data is in the form of items, such as true-false, or multiple-choice, the investigator may wish toclassify only on the basis of "right" responses (one per item), or on the basis of all responses (true and false, or right and wrongs).

Each response used must have a location; thus in the first case each item is punched (card or tape) as a "1" or a "0". In the second case, each item has more than one response, thus a "true" is punched as a 10 and a false as an 01. For a multiple-choice item with four alternatives, the data would be punched as 1000 for the first alternative, 0100 for the second, and so forth. The analysis is based on the number of responses, not the number of items. If the investigatėr desires, the analysis may be carried out separately on each response - one on the true responses, another on the false responses, for example. Such repeated analyses allow for the analysis of larger sets of items and/or subjects; but also increases the task of comprehending the combined results. However, if the two separate sets of responses are considered to be equivalent forms, such an analysismay be considered a form of split-half reliability.

OPERATION

1. Card Input: Place cards in hopper of IBM 528 (using Lingoes' plug board), Parameter card first, followed by data cards in order by subjects, termination cards (Y-punch - col. 1) and two blank cards. Put MAA program in reader; start with bootstrap, place Black Switch on Ignore (see note 3).

2. Tape Input: Put MAA in reader, bootstrap start. Stops on 24 999. Place data tape in reader, Black Switch. Stops on 24 999. Place Parameter tape in reader, Black Switch. Stops on 24 999. Replace MAA in reader, Black Switch, then place Black Switch on Ignore (see note 3.)

Note 3. A special spillout program is placed at the end of the regular MAA program. On analyses which require more than 1 hour of computer time, it is recommended that a spillout be obtained at the end of each 1 hour period, approximately. This provides a safety feature in case of machine failure, as the spillout can be reinserted as a data tape, without repeating the entire analysis. To use the spillout, the Black Switch is placed on Run after two hours. The machine stops on $34\ 024_{16}$ at the end of the next printout. The spillout routine is bootstrapped in without clearing memory. After the data is punched out, the machine stops on $34\ 024_{16}$. A Black Switch start, with Black Switch then placed on Ignore, returns control to the MAA routine for further computation. If machine failure occurs, the use of the last spillout before the failure as a tape input allows the completion of the analysis without repeating the earlier computations.

OUTPUT

The output is of the following form:

N = number of subjects in class (Product)
Subject Number 1 (Initial pair)
" " 2
.
.
.
.
" " i

KEY (the common class responses are 1's)

1_2 1 0 1 . . . 0 1 0_{39} (D rows)
0 1 0 0 0 . . . 1 1 0_{39}

STOPS

1. 00F 00 1023F in loc. 31. Data overflow of memory.
2. OFF L5 ( )F in loc. 175 End, by criterion test
3. 34 L 22 214 L in loc. 261 End of current class,

Black Switch on Ignore circumvents this stop. Use when spillout routine is to be used, by leaving B.S. on Run.

STORAGE

D.O.I.	0-2 and 998-1023
PARAMETERS	2-7 (by Card Input) 5-7 (by Tape Input)
CARD INPUT	22-60 (Temporary)
(TAPE INPUT)	20-43 and 50-53 (Temporary)
CONSTANTS	8-13
INITIALIZATION	22-35 (Temporary)
MAA	36-264
P-3	265-285
BINARY SWITCH	286-289
N = 2 ROUTINE	290-319
(DOI)	0-2 and 999-1023 (Reinput for Spillout)
SPILLOUT ROUTINE	950-969 (Temporary)
RESPONSE MATRIX	320 to 320 + DN
SUBJECT NUMBERS	320+DN+1 to 320+DN+N+1
SUBJECT NUMBERS	320+DN+N+2 to 320+DN+2N+2
SCORING KEY	320+DN+2N+3 to 320+DN+2N+ +3
SCORING KEY	320+DN+2N+ +4 to 320+DN+2N+2 +4

COMPUTING TIME: Approximately $\frac{N^{5/2}}{25}$ seconds per class; total time is a function of the number of classes obtained.

ORDERS

```
00 8K                     Set Constants

00    F  00    F          (0)
00    F  00   1F          (1)
00    F  00   2F          (2)
00   1F  00   1F          (1-1)
00    F  00  39F          (39)
00    F  00 320F          (FWA)

00 22K                    Initialization

51   5F  75   6F          L (D),  L (N)
S5    F  L4  13F          L (FWA)
40  14F  L4   9F          L (FWA+DN),  L (1)
40  15F  F4   6F          L (SNA), L (N)
40  16F  F4   6F          L (SNA), L (N)
40  17F  F4   5F          L (SKA), L (D)
40  18F  L4   5F          L (SKA), L (D)
40  19F  L0   9L          L (LWA+1), L (T1)
36   9L  26  10L          Test for Overflow
00    F  001023F          T1
L5   5F  L0   9F          L (D), L (1)
40  20F  L5  13F          L (D-1), L (FWA)
L4   5F  40  21F          L (D), L (FWA+D)
26 999F  00    F          Transfer to DOI
26  22N

00 36K                    Main Routine

41    F  41(22)F          by 1L
F5    L  40    L
L0  29L  32   3L          L (T2)
22    L  41   1F
L5  14F  42   5L          L (FWA+DN)
41   2F  41 ( )F          by 4L, 6L
F5   5L  40   5L
42    F  L5  19F          L (LWA+1)
L0    F  32   5L
41    F  L5  10F          L (2)
40  27F  40  34F          L (C6), L (n)
L5  15F  42  74L          L (SNA)
42  79L  42 106L
42 133L  42 157L
L4   9F  42  75L          L (1)
L5  16F  42 158L          L (SNA)
42 175L  42 198L
42 200L  51   8F          L (0)
L5  17F  00  20F          L (SKA)
L4  17F  42  83L          L (SKA)
46  90L  46 150L
42 170L  46 179L
```

```
L5  18F  42 151L      L (SKA)
42 169L  42 214L
51   8F  L5  13F      L (0), L (FWA)
00  20F  L4  13F      L (FWA)
46  31L  42  90L
L5  21F  42  31L      L (FWA+D)
26  31L  00    F
41    F  41  36F      T2
00    F  00  22F      Reset
51 ( )F  J0 ( )F      L (Si), L (Sj)
01   1F  L0   9F      L (1)
36  34L  26  35L
F5  22F  40  22F      L (C1)
F5  23F  40  23F      L (C2)
L5  12F  L0  23F      L (39), L (C2)
36  38L  26  39L
L5   8F  26  32L      L (0)
L5  22F  L4  28F      L (C1), L (AS)
40  28F  41  22F      L (AS), L (C1)
41  23F  F5  24F      L (C2), L (C3)
40  24F  L0   5F      L (C3), L (D)
32  45L  L5  31L
L4  11F  40  31L      L (1-1)
26  31L  L5  28F      L (AS)
L0  29F  32  47L      L (ASM)
22  53L  L5  28F      L (AS)
40  29F  L5  31L      L (ASM)
46  32F  42  33F      L (SiA), L (SjA)
L5  32F  10  20F      L (SiA)
L0  20F  40  32F      L (D-1), L (SiA)
L5  33F  L0  20F      L (SjA), L (D-1)
40  33F  51   8F      L (SjA), L (0)
L5  20F  00  20F      L (D-1)
40    F  L5  31L
46   1F  L5   1F
L0    F  46  31L
F5  31L  40  31L
42   2F  L5   2F
L0  14F  36  64L      L (FWA+DN)
41    F  41   1F      by 72L
41   2F  41  24F      L (C3)
41  28F  26  31L      L (AS)
F5  25F  40  25F      L (C4), L (C4)
51   5F  75  25F      L (D), L (C4)
55    F  L4  13F      L (FWA)
00  20F  46  31L
46   8F  L5   8F      L (0)', L (0)'
10  20F  L4   5F      L (D)
42  31L  L0  14F      L (FWA+DN)
32  72L  41   8F      L (0)
26  61L  41   8F      L (0)
41    F  41   1F
L5  32F  40 ( )F      L (SiA), L (SN1) by 11L
L5  33F  40 ( )F      L (SjA), L (SN2) by 14L
41   2F  41  24F      L (C3)
41  25F  L5  29F      L (C4), L (ASM)
L0   7F  32  79L      L (C)
```

```
OF    F  L5 ( )F     Final Stop, L (SN1) by 12L
00  20F  46  82L
L5  33F  42  82L     L (SjA)
51 ( )F  J0 ( )F     by 88L, by 145L
55    F  40 ( )F     L (SK) by 19L
L5  82L  L4  11F     L (1-1)
40  82L  F5  83L
40  83L  F5  22F     L(C1)
40  22F  L0   5F     L (C1), L (D)
36  89L  26  82L
41  22F  41  23F     L (C1), L (C2)
51 ( )F  J0 ( )F     L (SK) by 20L, L (SiData) by 26L
01   1F  L0   9F     L (1)
36  93L  26  94L
F5  22F  40  22F     L (C1)
F5  23F  40  23F     L (C2)
L0  12F  36  97L     L (39)
41    F  26  91L
L5  22F  L4  30F     L (C1), L (SAS)
40  30F  F5  24F     L (SAS), L (C3)
40  24F  L0   5F     L (C3), L (D)
32 103L  L5  90L
L4  11F  40  90L     L (1-1)
41  22F  41  23F     L (C1), L (C2)
26  90L  F5  90L
42    F  L5    F
L0   5F  40    F     L (D)
L5    F  L0 ( )F     by 112L, L (SNi) by 12L
36 108L  22 109L
L0   9F  32 109L     L (1)
26 113L  F5 106L
40 106L  F5  25F     L (C4)
40  25F  L0   6F     L (C4), L (N)
36 114L  26 106L
41  30F  26 114L     L(SAS), (waste)
41  24F  41  25F     L (C3), L (C4)
L5  17F  00  20F
46  90L  F5  90L
40  90L  L5  30F     L (SAS)
L0  31F  36 122L     L (SASM)
L5  90L  42   1F
L5   1F  L0  14F     L (FWA+DN)
36 128L  26 125L
L5  30F  40  31F     L (SAS), L (SASM)
L5    F  40  33F     L (SjA1)'
41   1F  26 119L
L5  15F  42 106L     L (SNA)
41  22F  41  23F
41  30F  26  90L
51  29F  75  34F     L (ASM), L (n)
55    F  40  35F     L (P)
F5  27F  40  27F     L (C6)
L5  15F  L4  27F     L (SNA), L (C6)
L0   9F  42 133L
```

```
L5  33F  40 ( )F        L (SjA)', L (SNi) by 132L
51  31F  75  27F        L (SASM), L (C6)
55    F  40  28F        L (AS)'
L0  35F  36 146L        L (P)
L5  33F  42  82L        L (SjA)'
L5  17F  42  83L        L (SKA)
00  20F  46  82L
L5  13F  42  90L        L (FWA)
L5  15F  42 106L        L (SNA)
41    F  41  22F        L (C1)
41  30F  L5   9F        L (SAS), L (1)
L0  31F  32 169L        L (SASM)
41  31F  26  82L        L (SASM)
L5  31F  40  29F        L (SASM), L (ASM)
L5  27F  40  34F        L (C6), L (n)
L5  28F  40  35F        L (AS)', L (P)
L5  33F  42 150L        L (SjA)'
51 ( )F  JC ( )F        L (SK), L (SjData)
55    F  40 ( )F        L (SK)
L5 150L  L4  11F        L (1-1)
40 150L  F5 151L
40 151L  F5  24F        L (C3)
40  24F  L0   5F        L (C3), L (D)
36 157L  26 150L
41  24F  L5 ( )F        L (C3), L (SN)
22 158L  40 ( )F        (waste), L (SN)
F5  24F  40  24F        L (C3)
L0   6F  32 163L        L (N)
F5 157L  40 157L
F5 158L  40 158L
22 157L  L5  17F        L (SKA)
00  20F  46 150L
L5  18F  42 151L        L (SKA)
L5  15F  42 157L        L (SNA)
L5  16F  42 158L        L (SNA)
41  23F  41  24F
26 137L  51 ( )F        L (SK)
K1    F  40 ( )F        L (SK)
F5  26F  40  26F        L (C5), L (C5)
L0   5F  32 175L        L (D)
F5 169L  40 169L
F5 170L  40 170L
22 169L  L5 ( )F        L (SN)
L0   9F  32 177L        L (1)
26 226L  L4   9F
42 179L  42 180L
51 ( )F  J0 ( )F        L (SK)', L (SNiData)
55    F  40 ( )F        L (SNiData)
F5  25F  40  25F        L (C4), L (C4)
L0   5F  36 186L        L (D)
L5 179L  L4  11F        L (1-1)
40 179L  F5 180L
40 180L  26 179L
F5 175L  40 175L
41  25F  L5  17F        L (C4), L (SKA)
00  20F  46 179L
22 175L  92 143F        (4CR+LF)
92 770F  92 579F        (N), (=)
```

```
92 967F   L5  34F     (2 spaces), L (n)
J0   4F   50 192L     to P-3
26 265F   92 975F     (4 spaces)
92 195F   L5  35F     ((), L (P)
J0   5F   50 195L     to P-3
26 265F   92 387F     ())
92 139F   41  24F     (3CR+LF), L (C3)
41  22F   L5 ( )F     L (C1), L(SN) by 16L
L0   9F   32 200L     L (1)
26 210L   L5 ( )F     L (SNi) by 17L
L0  13F   40  24F     L (FWA), L (C3)'
50  24F   01   1F     L (C3)'
66   5F   10   1F     L (D)
55    F   L4   9F     L (1)
J0   4F   50 205L     to P-3
26 265F   92 131F     (CR+LF)
92   3F   F5 198L     (Delay)
40 198L   F5 200L
40 200L   22 198L
41  24F   92 139F     L (C3), (3CR+LF)
92 259F   92 642F     (L.S.), K
92 194F   92 386F     Y
92 707F   92 135F     (n.s.), (2CR+LF)
41  22F   L5 ( )F     L (C1), L (SKi) by 23L
00   1F   40  23F     L (C2)'
32 217L   92  66F     (1)
26 218L   92   2F     (0)
92 963F   F5  24F     (space), L (C3)'
40  24F   L0  12F     L (C3)', L (39)
32 221L   L5  23F     L (C2)'
26 215L   92 135F     (2CR+LF)
41  24F   F5 214L     L (C3)
40 214L   F5  22F     L (C1)
40  22F   L0   5F     L (C1), L (D)
34    L   22 214L     STOP
L5  30L   42    L     L (T3)
L5  10F   L0  34F     L (2),  L (n)
36 286F   22 189L
```

<u>00 286K</u>   <u>Binary Switch</u> (n=2)

<u>00 290K</u>   <u>Reset Routine</u> (n=2)

<u>00950K</u>   <u>Spillout Routine</u>