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An Error-Dependent Model of Instrument-Scanning Behavior in Commercial Airline Pilots

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AN ERROR-DEPENDENT MODEL OF INSTRUMENT-SCANNING BEHAVIOR IN COMMERCIAL AIRLINE PILOTS

by

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Approved by:

Dr. Glynn D. Coates (Chairman)

DEDICATION

This work is dedicated to my wife, Caroline, who gave me consistent encouragement and support throughout these graduate years. You are magnificent.

ACKNOWLEDGMENTS

This work represents the fulfillment of a lifelong dream; a dream that began in the hearts and minds of my parents and was adopted by me while participating in a war I could never understand. I am grateful to my parents for their love and understanding and hope that this accomplishment atones for my dismissal from Lenoir County Community College in 1967.

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I would like to express my gratitude to the administrators, flight training personnel, and pilots from Piedmont Airlines for encouraging a novice, with a multitude of questions, to invade the privacy of their training programs. Their dedication to a better understanding of their profession must be the key ingredient to being "the up-and-coming airlines."

Finally, I am grateful to Ms. Jean Hopkins for her invaluable assistance in editing and typing this manuscript. Ms. Hopkins completed the manuscript in record time so I could participate in graduation ceremonies. Thanks, Jean.

ABSTRACT

AN ERROR-DEPENDENT MODEL OF INSTRUMENT-SCANNING BEHAVIOR IN COMMERCIAL AIRLINE PILOTS

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Since the work of Fitts and his colleagues, researchers have been using eye-movement data to evaluate various aspects of pilot instrument scanning behavior. Although Senders' work indicated that link values and transitional probabilities could be accurately predicted using a random sampling process, several investigators have recently suggested that pilot scanning behavior was deterministic. However, there has been no clear empirical evidence to support a deterministic hypothesis. The present research presents a new flexible model of pilot instrument scanning behavior which assumes that the pilot uses a set of deterministic scanning patterns on (1) the pilot's perception of error in the state of the aircraft, and (2) the pilot's knowledge of the interactive nature of the aircraft's systems. Statistical analyses revealed that a three-stage Markov process composed of the pilot's three predicted lookpoints, occurring 1/30, 2/30, and 3/30 of a second prior to each LP, accurately modelled the scanning behavior of 14 commercial airline pilots while flying steep turn maneuvers in a Boeing 737 flight simulator. Furthermore, the modelled scanning data

for each pilot were not statistically different from the observed scanning data in comparisons of mean dwell time, entropy, and entropy rate. These findings represent the first direct evidence that pilots are using deterministic scanning patterns during instrument flight. The results are interpreted as direct support for the error-dependent model and suggestions are made for further research that could allow for identification of the specific scanning patterns suggested by the model.

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Introduction

For over three decades scientists have been using eye-movement data to evaluate various aspects of human instrument-scanning behavior. One primary focus of this line of research has been the information gathering processes of pilots while "controlling an aircraft attitude, location, and rates of movement in three dimensional space" (Fitts, Jones, & Milton, 1950a, p. 24). Although much has been learned about instrument monitoring and sampling behavior, important questions remain about pilot instrument-scanning as an information gathering process.

Background

Instrument Panel Arrangements. The pioneering work in the area began with a series of reports by Fitts and his collegues for the U.S. Air Force (Jones, Milton, & Fitts, 1949; Milton, Jones, & Fitts, 1949; Fitts, Jones, & Milton, 1950b; Milton, McIntosh, & Cole, 1951; Milton & Wolfe, 1952). Using a 35 mm camera, these researchers recorded the eye-movements of 40 pilots flying a variety of maneuvers with different instrument panel arrangements. Their results were ultimately used to design the standard instrument panel arrangement used in most American and western European military and commercial aircraft (McCormick, 1976).

Fitts and his colleagues initially reduced the eye-movement data into three dependent variables: (1) the number of fixations per instrument, (2) the mean duration of fixations per instrument (i.e. mean dwell time), and (3) the number of transitions between each instrument and every other instrument. By summing the number of transitions between any two instruments (i.e. disregarding direction) and dividing by the total number of transitions the researchers developed a fourth dependent variable, link values. It was assumed that the link values provided the most important evaluation of the arrangement of instruments. The assumption was that instruments with high link values should be placed closely together on the instrument panel. For example, Fitts et al. (1950a) wrote:

> Eye movements in both directions between instruments have been combined. The "largest" link value, accounting for 29 percent of all eye movements, was between the cross pointer and the directional gyro. The longest important link was between the cross pointer and the gyro horizon. Placement of the most frequently used instrument, the cross pointer, at the extreme left, was obviously a poor arrangement for ILAS landings (p. 26).

Thus, link values became the primary dependent variable by which Fitts et al. evaluated the various instrument panel arrangements. They also seemed to assume that link values were indicative of overall scanning behavior. In their discussion of how the data were interpreted, Fitts et al. (1950a) wrote:

> It is reasonable to assume that the frequency of eye fixations on any given instrument is an indication of the relative importance of that instrument. The length of fixations, on the contrary, may be more properly considered as an indication of the relative difficulty of checking and interpreting particular instruments. The pattern of eye movements--i.e. the link values between the instruments--is a direct indication of the goodness of the different panel arrangements (p. 29).

The work by Fitts and his colleagues was instrumental in stimulating research into instrument-scanning behavior. They demonstrated clearly that the arrangement of instruments on the panel can influence the pattern of eye-movements and that the instruments can be arranged in a manner to facilitate optimal performance (see Seeberger & Wierwille, 1976). In fact, the instrument panel arrangements were found to be such a determining factor in instrument-scanning, Fitts et al. made no attempt to interpret scanning behavior as an information gathering process.

Sender's Visual Sampling Model. Senders (1955) was interested in the manner in which human operators processed information from complex displays. During his investigations (1964; 1966), he applied information metrics (Shannon & Weaver, 1948) to instrument monitoring behavior in an attempt (1) to determine whether the bandwidth of the signal from each instrument influenced fixational probabilities, and (2) to evaluate the amount of workload imposed on the operator by the instruments. An important assumption of Senders' (1966) model was that operators were aperiodic in their sampling of instruments, such that successive observations (i.e., transitions) were independent.

Senders assumed that the probability of a transition to instrument *i* was the product of the probability of a fixation and the dwell time on instrument *i* divided by the sum of the products of the probability of fixation and the mean dwell time for all instruments (X). Furthermore, it was assumed that the probability of a transition between two instruments (in one direction) was simply the product of the probabilities of fixating on each instrument. Therefore, link values were twice the probability of a transition between two instruments. However, since Senders assumed that a transition could be made from an instrument to itself, and these transitions could not be observed, a correction was added. He suggested that since the probability of a transition between instrument *i* and itself is P_i^2, the correct calculation of the link value between instrument *i* and instrument *j* was:

$$Pij = \frac{2PiPj}{1 - \Sigma P_{(X)}^2}$$

Senders tested his model using a monitoring task in the laboratory (1964) and with actual flight data (1966). In both cases he found that the model accurately predicted the transitional probabilities and link values between instruments. For example, Clement, Graham, & Best (1967) demonstrated the validity of Senders method using data from the work of Milton et al. (1951). Table 1 shows the approximate method used by Senders.

Table 1

Senders' Approximate Method for Computing Transitional Probabilities and Link Values (from Clement et al., 1967)

Inst.	Mean Frequency of Fixation Cycles/ Min.	$\frac{FFi}{\overline{FFi}}$ πi	Mean Dwell Time $\bar{T}di$	$\pi i\bar{T}di$	$\frac{\pi i\bar{T}di}{\overline{\pi i\bar{T}di}}$ Estimate of the Probability of a Ø order fixation Qi	Actual Pi	Qi^2
XP	29.6Ø	.279	.86	.240	.41Ø	.41	.17ØØ
AS	16.0Ø	.151	.38	.057	.10Ø	.10	.01ØØ
DG	28.0Ø	.249	.56	.148	.25Ø	.25	.0625
GH	16.9Ø	.159	.54	.086	.15Ø	.15	.0225
ALT	2.7Ø	.076	.38	.010	.017	.02	.0003
TE	.85	.008	.34	.003	.005	.01	.0000
VS	3.5Ø	.033	.39	.013	.022	.02	.0005
ENG	1.7Ø	.016	.71	.011	.019	.02	.0004
MISC	6.67	.063	.19	.015	.02Ø	.ØØ	.ØØØØ
	=106.ØØ	=1.034		.580	.995	.96	.2659

Examples of Predicting Link Value

1) XPT/AS $\quad \frac{2QiQj}{1 - \Sigma Q_i^2} = \frac{2(.41)\ (.10)}{1 - .2659} = \frac{.082}{.734} = \frac{.11}{.16}$ predicted / actual

2) XPT/D6 $\quad \frac{2QiQj}{1 - \Sigma Q_i^2} = \frac{2(.41)\ (.25)}{1 - .2659} = \frac{.205}{.734} = \frac{.28}{.29}$ predicted / actual

Senders' work was one of the first attempts to model the instrument-monitoring behavior both by subjects in a laboratory (1964) and by pilots (1966). The fact that a zero-order Markov process accurately modeled transitional probabilities and link values between the instruments suggested that the subjects were using random patterns to scan the instruments. However, Senders has argued that the visual sampling model probably does not reflect the actual scanning behavior of the pilot. Senders (1973) wrote:

> My model for the transition process treats the observer as if he drew at random from the set of displayed signals with the probabilities equal to the fixation probabilities each time a transition is made. Such an observation would make transitions between instruments without regard for any real or imagined relation between signals displayed. Although I do not contend that pilots in fact behave this way in aircraft, it is nonetheless true that the predictions of the model are in close enough accord with the actual link values measured in flight to have served as a basis for decisions on the layout of instrument panels (p. 111).

The significant limitation to Senders' model is that the model dealt specifically with monitoring behavior. The operator was assumed to be a passive observer who obtains information from the instrument panel randomly, applying equal weights to all the instruments. It is contended by the present author that one of the most important research questions has to be whether pilots are, in fact, randomly scanning the instruments patterns while controlling aircraft flight. It is also suggested that scanning patterns are not random, but are influenced by the pilots' decisions about tolerable error and their knowledge of the relationship

between control movements and other aircraft systems. Further, if similarities in scanning patterns exist, the information can be useful in training (see Braune & Trollip, 1981) and problem intervention (see Jones, Coates, & Kirby, 1983).

While Senders has continued his work on instrument-monitoring behavior (e.g. Senders & Posner, 1976), it was his work with Carbonell and the incorporation of an internal model (c.f. Smallwood, 1967; Braune, Kessel, & Wickers, 1978) that guided this line of research toward understanding the information processing aspects of pilot scanning behavior.

Carbonell's Queueing Model of Visual Sampling. Carbonell (1966), Carbonell, Ward, and Senders (1968), and Carbonell, Senders, & Ward (1969) proposed a queueing model of visual sampling that used information about each pilot's scanning strategy to predict the fraction of time spent on each instrument. The major assumptions of the model were:

1. The instruments compete for the pilot's attention; each time he looks at one instrument, he is postponing the observation of others;

2. The queue discipline stems from an intelligent decision made by the pilot at each time. We assume that he tries to minimize the total risk involved in not observing the other instruments;

3. This risk is given for each instrument by a unitary cost times the probability that the displayed value may, while not being observed, exceed a certain threshold that could lead to some catastrophic result;

4. The pilot's task in visually sampling his instruments is part of a feedback loop closed through his control actions;

5. If the pilot does not exert control, displayed values are not zero-mean Gaussian signals;... the mean will be given by the last reading of the instrument, while the variance monotonically increases with time. This increase is due to the signal autocorrelation which decreases with time, and also to a divergence term accounting for forgetting and fear of a sustained drift.

6. If the pilot exerts control, he will be concerned not with the absolute reading of each instrument, but rather with variations with the readings he has expected to obtain at that time. (Carbonell et al., 1968)

In addition, the authors assumed that the pilot looked at each instrument for a fixed amount of time (0.4 sec). Longer looks were accounted for as sequential selections of the same instrument in 0.4 second time periods.

Using an electro-oculographic technique (Kris, 1958), Carbonell collected eye-movement data and instrument data on three Air Force reserve pilots while flying selected maneuvers in a link trainer. Each run was divided into three phases: (1) beginning to descend, (2) turn, and (3) landing approach. Each total run produced 240 look points over a 96-second eye-movement data collection period. This is consistent with the researcher's assumption that fixation durations were at a constant rate of 0.4 sec.

Subsequent to simulator flight data collection, each pilot was given a questionnaire and asked to specify (1) the minimum deviation for each instrument he could perceive; (2) the deviations for each instrument he would like to stay within; and (3) the emergency action deviations for each

instrument. The pilots were also asked to rate the importance (i.e. cost) of each instrument and rate how their concern would grow as a function of time should individual instruments would become inoperative. This last rating (actually a graphical representation) was used as a means of predicting fixation as a function of the length of time since the last reading. These data were obtained for each phase of the simulation run.

The data for each pilot were submitted to a computer algorithm which calculated actual deviations for each instrument and predicted fixation durations for each pilot in each phase of the simulation run. The results indicated that (1) the statistical model accurately predicted the percentage of fixations on each instrument, and (2) there was a high correlation between the predicted and actual dwell times. Although Carbonell et al. (1968) suggested that "the model has shown itself capable of accurately representing the behavior of pilots visually sampling their instruments during an instrumented flight" (p. 87), there was no attempt to match actual transitional probabilities with those predicted by the model. These data would be extremely valuable, especially since Carbonell et al. (1968), as well as Senders (1973) report that individual differences between the pilots were small.

Aside from the obvious problem that Carbonell's queueing model has to be tuned to each pilot, using each pilot's individual estimates of costs, tolerances, action thresholds

and divergence functions (Sheridan & Ferrell, 1974), there are other problems in the assumptions of the model. As Greenstein and Rouse (1978) have pointed out, the model continues to emphasize instrument monitoring rather than overall scanning behavior. The differences are more than semantic. Greenstein et al. (1978) wrote:

> The models cited above emphasize the monitoring of displays, rather then the decisions or actions that result from the human operator's perception of the displayed values. The operator's motivation for monitoring the displays is the possibility that an event which requires his attention may occur (p. 32).

Furthermore, since Carbonell et al. (1968) only predicted duration of fixation on each instrument, it may be important to follow the reasoning of Allen, Clement, and Jex (1970) in differentiating instrument scanning and instrument sampling. They defined the differences as follows:

> Scanning is defined here as the process of selecting and fixating each instrument in an array of, or specific portions of, a complex display field. For the manual control tasks a "scanning traffic pattern" is involved, causing a given instrument to be sampled frequently. However, not all instruments are sampled at the same frequency.
>
> Sampling covers the perceptual acts of: focusing on a display; interpreting this as an appropriate command or error signal; and perceiving its displacement, rate (or direction), and, possibly, acceleration during a sequence of fixations. In the present context, the sampling does not have to be impulsive or periodic (p. 5).

Thus, the queueing model of Carbonell (1966; 1968) can best be viewed as a model of sampling behavior as defined by Allen et al. (1970). While the model focuses on the internal processes of the pilot, the statistical procedures did not

allow for making comparisons between the scanning patterns of the subjects.

Recent Research

Early research efforts into instrument scanning behavior were limited to a great extent by problems associated with eye-movement data collection techniques. In addition, most of the early research was aimed at the evaluation of instrument panel arrangements and human monitoring/sampling behavior.

From the early 1970's to the present, there has been a rapid growth and development of eye-movement recording devices (see Young & Sheena, 1975) and microcomputers to aid in data collection and analyses. Within this last decade, a great deal has been learned about specific aspects of pilot scanning and controlling behavior, but important questions remain about the processes used by the pilot to gather information from the instrument panel.

For example, in an extensive review of the literature, Braune (1981) found that a long line of recent research indicated that experienced pilots do not follow deterministic scan patterns when flying under instrument conditions (eg. Weir & Klein, 1970; Allen et al. 1970; Spady, 1978; Harris & Christhilf, 1980). In addition, most of these researchers have found that, although pilots tended to gather information from the same instruments, the patterns they used may be quite different.

However, in the last two years, several researchers have suggested that pilots do have regular scanning patterns (e.g. Tole, Stephens, Harris, & Ephrath, 1982; Ellis & Stark, 1981; Ellis, 1982) and point out that the recurring problem in this line of research has been to find a statistical method for making comparisons between transitional probability matrices. In fact, Ellis (1982) has argued that researchers cannot find determinism in scanning simply by making non-statistical comparisons of transition matrices. He wrote:

> In general, pilot scanning behavior has not been shown to exhibit gross determinism (i.e. a circulatory scanning pattern), despite pilots often reported impressions that they are indeed using a regular scanning technique to read their flight instruments. However, the presence of a partially deterministic scanning pattern that differs from the kind of pattern produced by stratified random sampling with replacement is difficult to informally recognize. It requires testing to demonstrate (p. 1006).

Ellis (1982) and Ellis and Stark (1981) have detailed a statistical method for making comparisons between transition matrices. They used a chi-square goodness-of-fit test to compare the obtained transitions with what would be expected if the transitions were simply random. Ellis et al. (1981) found that for some comparisons, their subjects deviated in a statistically significant way from what would be expected if the scanning behavior was random rather than deterministic. Ellis (1982) drew inferences from the scanning data after collapsing certain cells of the matrix into single cells and testing each cell using one degree of freedom.

A different and innovative technique has been suggested by Tole et al. (1982) who used the information theory measure, entropy, as an index of the orderliness within the scanning pattern. Tole et al. wrote:

> In the case of instrument scan, entropy has the units of bits/sequence and provides a measure of the randomness (or orderliness) of the scan path. The higher the entropy, the more disorder is present in the scan. The maximum possible entropy is constrained by the experimental conditions. The entropy measure used the same probabilities which are present in transition matrices, but it yields a single, more compact expression for the overall behavior of the probabilities, rather than presenting them each individually (p. 4).

The disadvantage of the entropy measure appears to be that it does not allow the researcher to make comparisons between pilots for similarity in scanning behavior. While two pilots may have the same level of non-randomness, they cannot be assumed to be scanning with similar scanning patterns.

In addition, Tole, Stephens, Harris, and Ephrath (1983) developed another data reduction technique which may be useful in evaluating scanning patterns. Tole et al. (1982) had collected eye-point-of-regard data on three pilots using the Honeywell oculometer (see Spady, 1978). In order to evaluate fixation sequences, the researchers chose to ignore dwell times in the data and compare the resulting ordered list of instrument fixations. Tole et al. (1982) wrote:

> As mentioned earlier, the oculometer provides an indication of instrument dwells as a function of time. If the dwell times are ignored, an ordered list of instrument fixations may be developed for

> each pilot under various loadings. These lists may be broken into smaller segments or sequences of various lengths for easier analysis. Each different sequence may be considered as a component of the overall scan pattern. One may hypothesize that those sequences most frequent during the maneuver are most important to the pilot, and indicate an ordered scan pattern (pp. 58-59).

By choosing the 10 most frequent sequences for each pilot as indicators of scan patterns, Tole et al. (1982) found that they could account for over 50 percent of the scan pattern of experienced pilots.

Another potentially important dependent measure developed by Tole et al. (1982) was entropy rate. This measure was also derived from information metrics in an attempt to quantify variations in dwell time under different levels of mental loading. Tole et al. found that entropy rate (expressed as bits/second) was related inversely to mental workload. Interestingly, their results indicated that the scanning patterns used by experienced pilots were less sensitive to disruption by increased task difficulty.

These findings are significant and suggest that (1) there is orderliness in instrument scanning behavior, (2) the amount of orderliness in instrument scanning may be an indication of the workload of the pilot, and (3) there may be statistical techniques that quantify scanning patterns within eye-movement data that have heretofore been overlooked.

Dick's Mini-Scan Model

The most recent attempt to model pilots' behavior was by Dick (1980). Dick reanalyzed data collected by Spady (1978) involving seven pilots flying ILS simulations in a Boeing 737

flight simulator. Dick's intention was to combine eye-movement data with control movement data and develop a model of pilot scanning behavior. He analyzed the pilots' eye-movements for various segments of the flights and used factor analytic techniques to reduce the data. The results indicated that 10 primary factors were present in the data: (1) monitoring airspeed; (2) horizontal and vertical situation; (3) lateral information; (4) glide slope tracking/vertical information; (5) altitude - "where he is and when"; (6) monitoring position; (7) monitoring technique; (8) glide slope tracking; (9) internal tracking; (10) roll.

Dick suggested that these components indicate that a pilot's instrument scanning strategy is related to aircraft parameters rather than the physical position of the instruments. That is, each component represents a "bundle of information" gained by various combinations of the instruments through the use of mini-scan patterns. He wrote:

> Essentially, what we are claiming with the information bundle idea is that each pilot has not a single scan pattern, but rather a series of information collection procedures (mini patterns) which are used flexibly in combination with controlling strategies (p. 38).

Dick used the various components in discriminant analysis and found that the analysis could successfully discriminate between segments and pilots. However, Dick's findings of individual differences between the pilots are not radically different from those findings reported in the review by Braune (1981). For example, Dick (1980) wrote:

> Individual differences among pilots exist in the way they collect information. The success of the discriminant analysis in distinguishing pilots is the result of differential weightings of the components. Some pilots apparently check one parameter at a time (e.g. components 3 and 4) while others may combine vertical and horizontal position into one (e.g. component 2). The similarity in mean dwell times (Spady, 1978) shows the pilots are using the instruments for the same amount of time, while the components show that the integration of the instrument in the scan may be different for different pilots; thus while individual scan patterns may differ, the emphasis on categories of information remains fairly stable and it is this emphasis on information which apparently gets translated through to control inputs. However, this does not necessarily imply that the basis for decision making about an individual control is the same for all pilots (p. 16).

Dick found support for his information bundle/mini-scan hypothesis by analyzing eye-movement data surrounding control inputs. He suggested that there were clear patterns of scanning surrounding controlling behavior and specific to each type of control mode. However specific data to support this hypothesis were not presented.

The concept of mini-scan patterns is a plausible explanation of pilot scanning behavior during instrument flight. As Carbonell (1966) pointed out, there can be no doubt that the instruments assume different weightings during various maneuvers or, for that matter, various segments of a specific maneuver. Furthermore, it is logical to assume that there is a relationship between controlling and scanning behavior. Dick's work suggests that the consistent finding of similarities between pilots' instrument-sampling behavior, but differences in instrument-scanning may reflect differences among the pilots in their application of weights to instruments when making control inputs.

It should be noted, however, that Dick's statistical analyses were limited to factor analytic techniques which may have served to maximize differences rather evaluate similarites between pilots. For example, an evaluation of transitional probability matrices (see page 30) surrounding control inputs would have been extremely instructive. Finally, Dick made no attempt to bring his theories together in a form that permits a test of the model in predicting scanning behavior.

Patterning Hypotheses

It should be mentioned that another line of reasoning exists concerning the scanning behavior of experienced pilots. Several researchers have indicated that pilots report that they were using regular scanning patterns (Ellis, 1982; Ellis & Stark, 1981; Spady, 1978). Indeed, many pilots suggested to this author that they were taught to follow a "spoke-and-wheel" pattern, a "T-shaped" pattern, or a "circulatory" pattern. Although documentation of these patterns was not found in the training or scientific literature, the belief of their existence seems so widespread among pilots and flight training personnel that this possibility cannot be ignored.

Essentially these patterns of scanning have one important aspect in common. The patterning hypothesis suggests that the spatial and temporal patterns used in obtaining information from the instrument panel do not interact with the information being obtained, but are the result of

techniques obtained during training. The patterning hypothesis can be differentiated from other hypotheses in that the former is stable and should be recognizable across maneuvers, while the latter are flexible and infer some interaction between the pilot, the instrument panel, and controlling behavior.

Purpose of Present Research

The purpose of the present research was to present a new, flexible model of pilot instrument-scanning behavior that emphasizes the interaction between the pilot and the information being obtained from the instrument panel. The model is intended to be simple enough to guide future researchers in areas such as training, problem-intervention, mental workload, and instrument panel design. However, in this initial research, the purpose was to model the instrument scanning behavior of commercial airline pilots flying two symmetrical segments of a steep turn maneuver.

Conceptual Presentation of the Model

The error-dependent model shown in Figure 1 is based on the following premises:

1. The performance of pilot P depends to a large extent on his/her piloting experience and knowledge of the inter-relatedness of the aircraft systems. Experience and knowledge of systems interact such that the pilot is aware of the amount of error within any system allowed by federal regulations and the flight training manual (Δ_M).

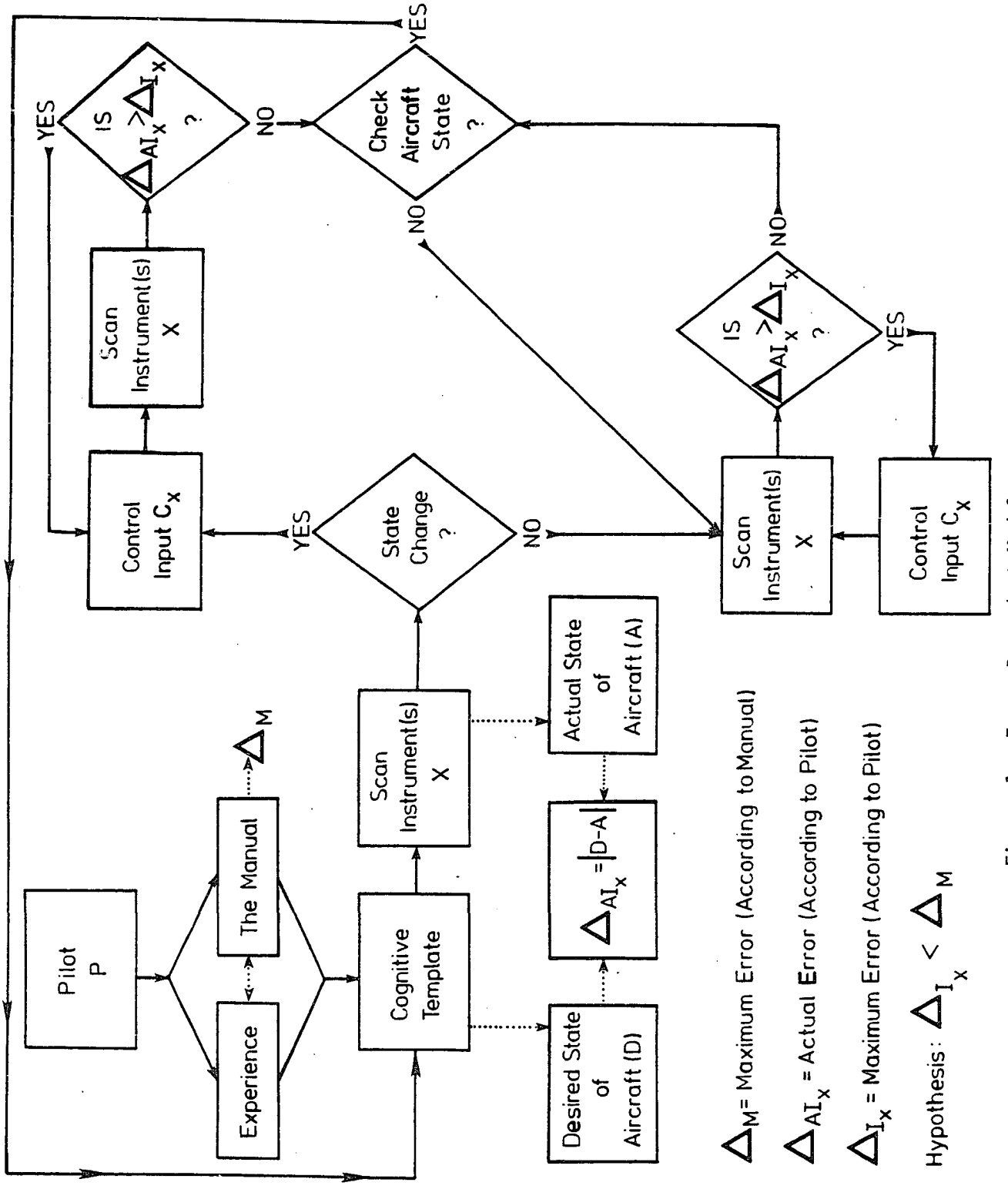

Figure 1. Error Dependent Model

2. Experience, knowledge of systems, and knowledge of allowable error form a cognitive template (mental picture) of the desired state of the aircraft which the pilot uses as a reference during flight.
3. By scanning the aircraft instruments, the pilot is seeking to obtain information about the actual state of the aircraft. During each visual fixation where information from the instruments is perceived, the pilot evaluates the difference between the actual state of the aircraft (A) and the desired state of the aircraft (D). This difference (ΔA_I) is then compared to the amount of tolerable error allowed by some internal criterion within the pilot (Δ_I).
4. Δ_I is a function of experience, environment, and/or personality traits, and may vary from instrument to instrument, maneuver to maneuver, or day to day. However, under normal circumstances, Δ_I will be less than Δ_M.
5. Instrument scanning patterns vary, to a large extent, with the information being obtained from the instrument panel. Under normal circumstances, the instrument scanning patterns conform to one of three possible states of the aircraft:

a. Error-Free--The instruments indicate that the aircraft is operating with all systems within acceptable error limits.

b. Error-State--This indicates that at least one of the aircraft instruments (x) exceeds $_{Ix}$ (i.e. $\Delta_{AIx} > \Delta_{Ix}$).

c. State-Change--This indicates that the aircraft is in the process of being repositioned by the pilot, such that one or more instruments are indicating a transient state.

6. Since the piloting task is a closed-loop system, instrument scanning behavior will be related to control movements.

7. There are basically two types of control movements:

a. State Control Movements--These control movements are executed in order to fly an aircraft from Point A to Point B. They are either executed because of instructions from ground control personnel, or are predetermined by the particular flight protocol. In either case, the pilot makes a control input to reposition the aircraft for reasons other than a response to error.

b. Error-Driven Control Movements--These control movements are executed in reaction to the pilot's decision that an error exists in one or more of the aircraft's systems ($\Delta_A > \Delta_I$).

8. A pilot will periodically decide if state control movements are necessary. This is especially true when the pilot is involved in timed maneuvers. The cognitive template is updated each time a state control movement is dictated.

The error-dependent model assumes that the pilot's scanning behavior is purposeful and deterministic. For each maneuver performed by the pilot, there is a subset of instruments relevant to its proper performance. The pilot will scan the subset of instruments using an "error-free" scanning pattern until an error is detected within an instrument. When the pilot detects an error, he/she will initiate an "error-driven" scanning pattern (1) to determine the cause of the error and (2) monitor the effects of the control input used to correct the error on related aircraft systems. In other words, the experienced pilot knows that the presence of an error in one instrument may indicate the potential for an error in another related system. A classic example would be airspeed and pitch attitude. A pilot perceiving an error while scanning the airspeed indicator knows it is possible that an improper pitch attitude could be

responsible. Furthermore the pilot is cognizant that a control input to correct an error in one aircraft system (e.g., pitch attitude) may also affect the relative position of other aircraft systems and their respective instrument(s) (e.g., airspeed). Indeed, it is suggested that the major difference between the experienced and novice pilot is this awareness of the inter-relatedness of the aircraft systems. Furthermore, it is the experienced pilot's knowledge of the ways in which the aircraft's systems interact which underlies the logic for assuming that the pilot uses deterministic scanning patterns.

In summary, the error-dependent model of instrument-scanning conceptualizes the scanning behavior of experienced pilots as being composed of a set of deterministic scanning patterns implemented to optimize performance and minimize the potential for error in the state of the aircraft. These scanning patterns include: (1) an "error-free" pattern, (2) "error-driven" pattern(s), and (3) patterns associated with systematic changes in the state of the aircraft.

The present investigation attempted to validate the error-dependent model using statistical techniques which allow for the comparison of actual and predicted instrument-scanning parameters. The major goal was to determine if individual and collective commercial airline pilots were using random, as opposed to deterministic, scanning patterns during instrument flight.

Method

Subjects

The subjects were four Boeing 737 instructor pilots (IPs), 12 experienced 737 pilots (Ps), one 737 pilot trainee (TP), and one 737 copilot trainee (TC). Data for two IPs (IP1 and IP2) and two experienced pilots (P04 and P12)) were eliminated due to a high percentage of invalid lookpoint (LP) data.

Data Collection and Reduction

The data were collected during the course of two studies (Jones, et al., 1983; Harris & Spady, 1982) at Piedmont Airlines Flight Training Center, Winston-Salem, NC. The experienced pilots were undergoing proficiency checks in the Boeing 737 flight simulator. The pilot and copilot trainees were participating in the flight training program consisting of five simulator sessions of four hours duration.

Eye-movement data were collected using the NASA/Langley oculometer system, described in detail elsewhere (Harris & Christhilf, 1980; Spady, 1978). The system used a corneal reflection technique that allowed for a cubic foot of head movement (Merchant, Morrissette, & Porterfield, 1974). As can be seen in Figure 2, an electro-optic head, through which an infrared light was emitted, was installed in the lower inside instrument panel of the pilot and copilot's station. The reflection from the cornea returned back through the

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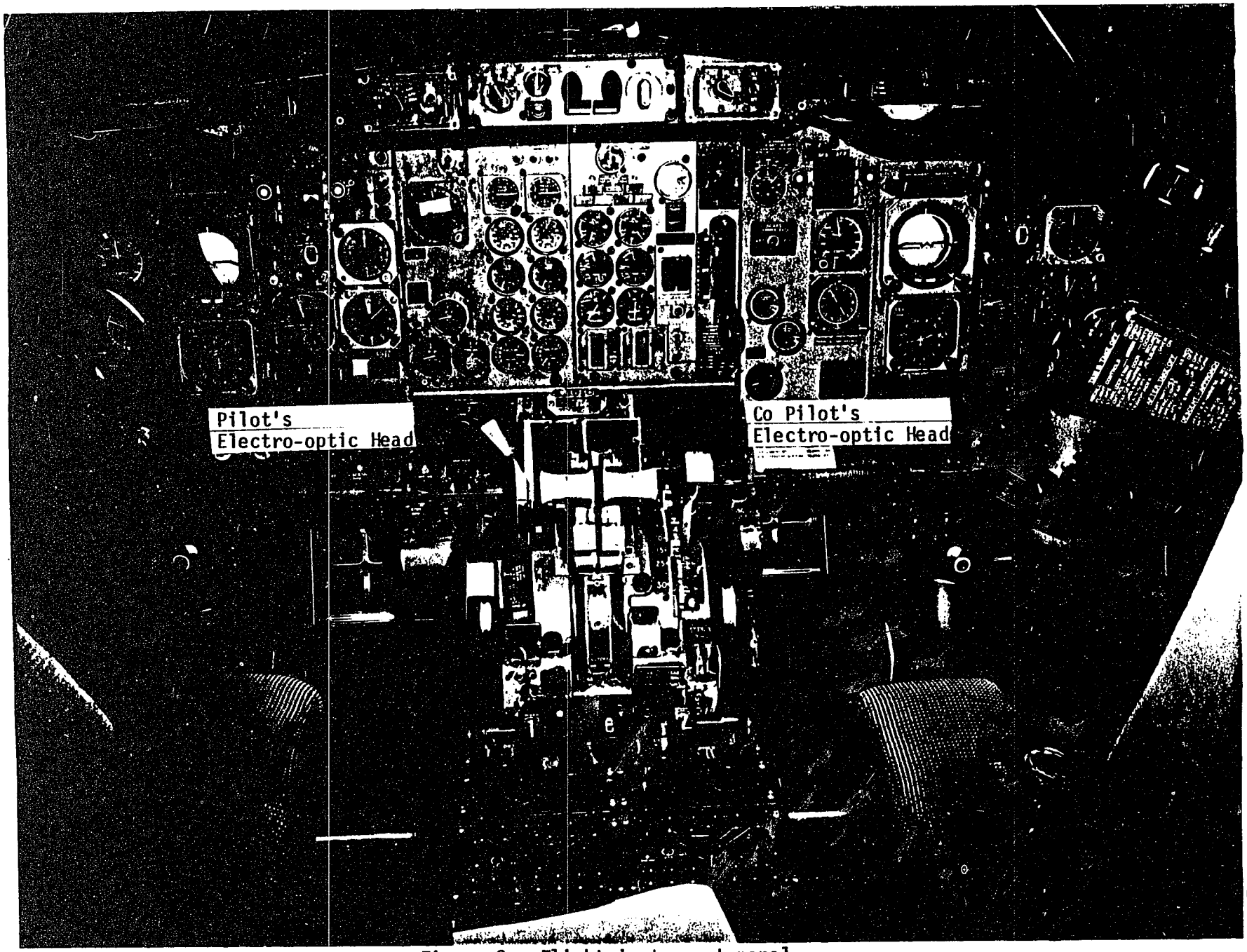

Figure 2. Flight instrument panel

electro-optic head providing a discrete voltage level which corresponded to the subject's LP. The system was calibrated to each subject prior to data collection so that voltage levels fell within fixed X-Y boundaries for both instrument panels. The system provided LP data at the rate of 30 per second.

In addition to the LP data, data were collected on stick, wheel, throttle and rudder deflection at the rate of 10 per second. Further, 20 measures of aircraft performance and instrument readings were also collected at the rate of one per second. The data were transferred via an A-D link from the simulator's computer to a microprocessing system which stored all the data on floppy disks.

The LP data were encoded to indicate the instrument being observed at each 30th of a second. Specific codes were recorded in those cases when the subject made a saccade between instruments, blinked, or was "out-of-track." The boundaries established for the instrument panels allowed for LP data on 26 different instrument locations; however, a preliminary analysis of these data revealed that over 95% of the subjects' lookpoints (LPs) were on nine flight instruments. These were: (1) Airspeed Indicator (AS), (2) Roll Attitude Indicator (ROLL), (3) Command Bars (CBARS), (4) Barometric Altimeter (ALT), (5) Automatic Direction Finder (ADF), (6) Horizontal Situation Indicator (HSI), (7) Instantaneous Vertical Speed Indicator (IVSI), (8) Engine Instruments, and (9) Nonspecific. Nonspecific LPs were included in the analyses for this study but "out of track"

(i.e. blinks) were not. The data for control movements, instrument readings, and aircraft performance were transformed to indicate position, and the metric appropriate for each instrument.

Subsequently, a series of computer algorithms were implemented to prepare the data for detailed analyses. Specifically, since the LP data, control movement data, aircraft performance, and instrument readings were sampled at differing points in time, and the goals of the present research required that control movements and LPs correspond in time, the data were submitted to a computer interpolation algorithm (see Program 1, Appendix C). The algorithm made linear interpolations between each pair of sequential data samples and output data files containing instrument number, stick position, wheel position, rudder position, throttle position, and instrument readings which corresponded in time for each 30th of a second. The maximum possible error in the time difference between the LP data and control position was 9/30s of one second; for instrument readings, 29/30s of one second.

The control position data were then submitted to a computer algorithm which evaluated control positions over one second intervals and determined whether a control movement had occurred. The criteria used for designation of the occurence of a control input were based on an empirical determination of the system by Harris (1983).

It should be noted that since the rudder pedal and throttle were not used for the selected segments of the steep

turn maneuver (see below) these data were not submitted for analysis.

Following the determination that a control movement had occurred, the algorithm determined (1) the exact point in the one second interval where the criterion was exceeded, (2) the direction of the control movement (i.e. nose up or nose down for stick; and left or right turn for wheel; and (3) the duration of the control movement. The algorithm converted the control position data to control status data indicating either no control movement, positive control movement, or negative control movement (see Program 2, Appendix C). Finally, since it was assumed that a pilot makes a decision about a control movement prior to the beginning of the movement, the algorithm encoded the three data points (1/10 sec.) prior to the beginning of each control movement indicating "control decision in progress." Therefore, for each type of control there were four possible control status designations: (1) no control movement, (2) control decision in progress, (3) positive control input, and (4) negative control input. The terms positive and negative are used generically and should be replaced by the directions of movement appropriate for each type of control.

Transition Matrices--The summary and analysis of the LP data focused on transition matrices and transitional probability matrices. A transition matrix presents the frequency with which the subject's LP was instrument Y at time, t, given that he/she was looking at instrument X at time, t-1.

Transition matrices are converted to transitional probability matrices in which the entries represent the probabilities that the subject's LP was instrument Y at time, t, given that the subject's LP was instrument X at time, t-1.

It should be noted that transition matrices and transitional probability matrices can be multi-dimensional. For example, transitional probabilities can be computed as the probabilities that a subject's LP was instrument Z at time, t, given that the subject's LP was instrument Y at time, t-1, and instrument X, at time, t-2. Although multi-dimensional matrices were employed in this investigation, the data were presented in the two-dimensional format (i.e. a From-To matrix) to facilitate the presentation of the data.

Steep Turn Maneuver

Data were collected for the subjects flying a variety of different maneuvers. Three major factors contributed to the decision to use the steep turn maneuver for this study. First, the steep turn maneuver is not a standard flight maneuver performed routinely by pilots flying commercial routes. Therefore the task itself is not overlearned, yet requires fundamental piloting skills. Second, most maneuvers, especially landing maneuvers, have variable error tolerances across time. Since the error-dependent model in Figure 1 suggests the pilot undergoes mental computations to make decisions about control movements, it was deemed necessary to select a maneuver with stable error tolerances.

Third, the steep turn maneuver requires the pilot to make two symmetrical turns at a 45° bank. Since there has been limited research on within-subject behavior in instrument-scanning, this maneuver provided a unique opportunity to evaluate similarities within pilots, as well as between pilots.

Figure 3 presents a graphic representation of the steep turn maneuver. The details of the steep turn maneuver as described in the Boeing 737 Pilot Training Manual (Boeing, 1975) can be found in Appendix A. Basically, the pilot is required to make two 180° turns at a 45° bank, maintaining a constant airspeed and altitude. The training manual also provides hints to the pilot for scanning the aircraft instruments.

The steep turn maneuver was originally divided into 5 segments: (1) preparation and roll-in, (2) maintain first turn, (3) roll-out of first turn and roll-in second turn, (4) maintain second turn, and (5) roll-out of second turn. However, during data reduction, it was found that, during the roll-in and roll-out portions of the maneuver, the yoke blocked the infrared light being emitted from the electro-optic head (see Figure 2). Therefore, Segment 2 and Segment 4 were used for the present study. The Segments were identified as follows: The data were submitted to a computer algorithm which stored data from the moment the aircraft exceeded a 39° bank angle (roll-in) until the bank angle was less than 39° (roll-out).

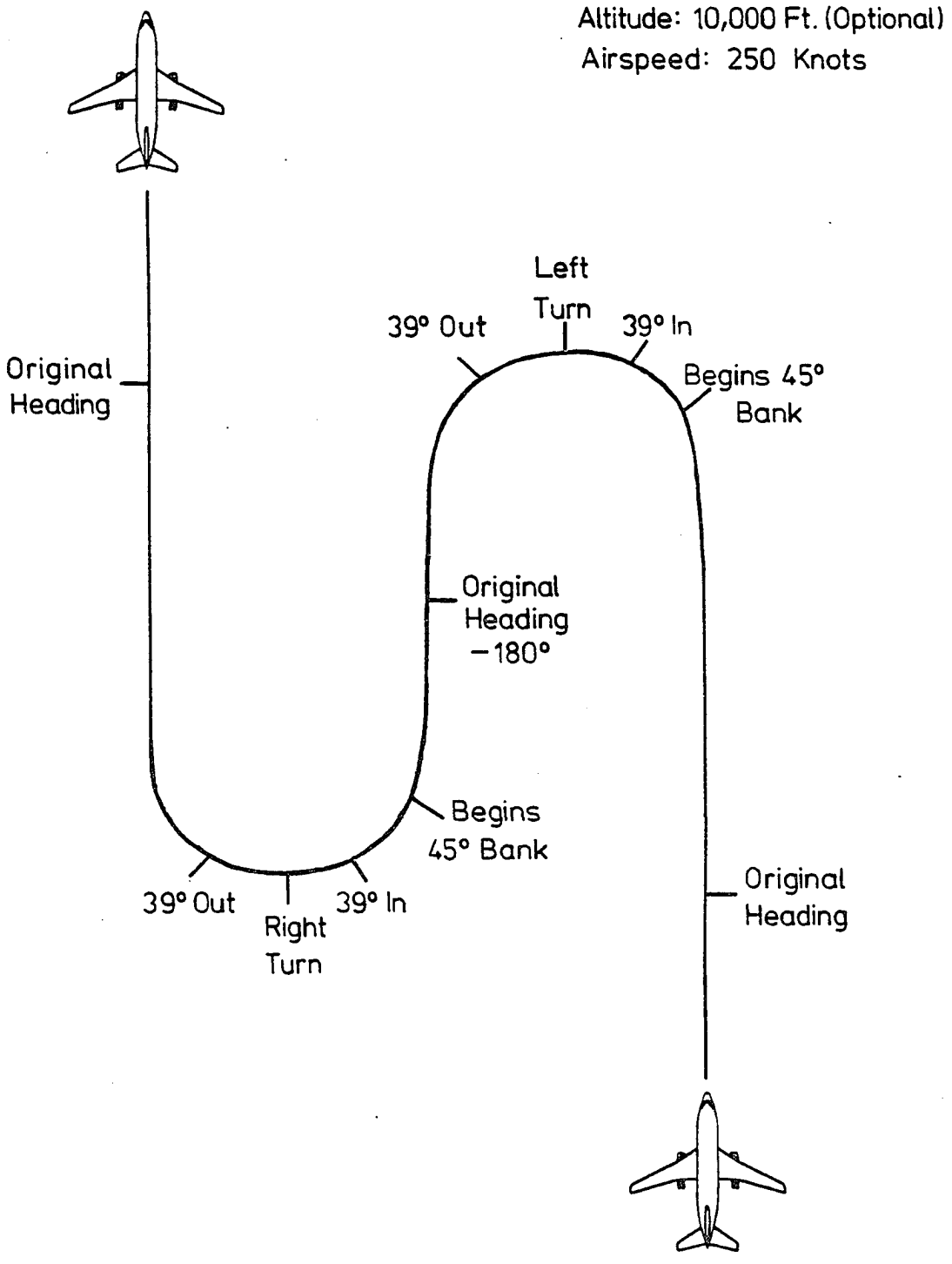

Figure 3. Steep Turn Maneuver

Since the pilots were variable in how quickly they banked the aircraft to 45°, there were differences between pilots and within each pilot in the number of transitions (i.e. length of time) in each segment of the steep turn maneuver. Table 2 shows the number of transitions (i.e. number of data points) and the amount of time in each segment by the subjects. It should be noted that data for the pilot and copilot trainees were analyzed for Session 1 and Session 5. The pilot trainee (TP) performed the left turn of the steep turn maneuver twice during Session 1. The data for the copilot trainee (TC) performing the right turn in Sessions 1 and 5 were eliminated due to an excessive amount of "out-of-track" time. Therefore, there were 31 separate data files for analysis in this study.

Development of the Mathematical Model

Ideally, this research would have been conducted by collecting instrument-scanning data on each subject (1) during an "error-free" state, (2) during the introduction of various types of instrument error (i.e. "error-driven" state), and (3) during various types of state changes. In this way, the transition matrices for each subject could be compared for similarities or differences in scanning patterns under the various experimental conditions. Furthermore, comparisons could be made of the amount of error within each instrument that each pilot considered excessive. It would also be possible to evaluate the relationship between error tolerances, reaction-time, and performance. From these data,

Table 2

Number of Transitions and Amount of Time for Each Segment of the Steep Turn Maneuver#

	Left Turn		Right Turn	
Subject	Transitions	Seconds	Transitions	Seconds
IP3	1104	36.80	1131	37.70
IP4	1141	38.03	1063	35.43
P01	1083	36.10	1104	36.80
P02	1124	37.47	1144	38.03
P03	1085	36.17	1239	41.30
P05	1303	43.43	1263	42.10
P06	1120	37.33	1199	39.97
P07	1064	35.47	900	30.00
P08	1046	34.87	1130	37.67
P09	1380	46.67	1122	37.40
P10	1010	33.67	920	30.67
P11	908	30.27	934	31.13
TP1(1)	1174	39.13	865	28.80
TP1(2)*	1437	47.80	----	-----
TP5	1339	44.63	1200	40.00
TC1	882	29.40	**	**
TC5	1000	33.33	**	**

*Second Left Turn
**Not Available

# IP = Instructor Pilot
P = Pilot
TPx = Trainee Pilot (Session #)
TCx = Trainee Copilot (Session #)

conclusions could be drawn about optimal scanning patterns for use in related research areas (e.g., training and problem-intervention).

The present experimental design was limited by a number of factors. Most importantly, time and economic constraints did not allow for the implementation of the complex experimental design described above. Furthermore, important instrument data, (airspeed indicator and barometric altimeter) were not available for all of the subjects. The mathematical model used to predict instrument-scanning behavior, as originally conceived, was to focus on previous LPs and the mean error tolerances specific to each instrument for each subject. Since the error tolerances for the airspeed and altimeter were not available for all the subjects, it was decided that control status (CS) measures would be used as an indicator of error tolerances (i.e Δ_Is) for each subject. According to the error-dependent model, control movements are the behavioral indication of the pilot's decision that there is an error in the state of the aircraft; therefore, scanning patterns that are "error-driven" or associated with state changes should be identifiable using CS measures. Scanning patterns associated with the "error-free" state would be identifiable when no control movements have occurred.

The goal of the mathematical model was to isolate statistically the transitional patterns exhibited by the pilots. Various combinations of LPs and CSs were used in

multi-stage Markov processes in an attempt to identify a configuration of parameters that would accurately model the scanning behavior of the subjects. This approach assumes that the pilots' scanning behavior will, in fact, exhibit some measure of determinism and that the deterministic scanning patterns are related to LPs and CSs.

Results and Discussion

Control Movements

Table 3 shows the number of stick and wheel movements made by each subject during each segment of the steep turn maneuver. The data indicate that (1) there were differences between pilots and within each pilot for the two segments, and (2) each pilot spent some portion of time within each segment in an "error-driven" state (as indicated by the number of CS measures).

Goodness-of-Fit Test

It was decided a-priori that the preliminary analyses of the data would be a chi-square goodness-of-fit test using the frequency counts from the transition matrix of the actual data as the expected frequencies and the output of the model as the observed frequencies. The model was represented by the average frequency counts from the transition matrices of 10 data files resulting from the implementation of the model. The goodness-of-fit test was suggested by Ellis & Stark (1981). The major difference was that Ellis & Stark used data computed from the model suggested by Senders (1964) as the expected frequencies and their data provided support for a deterministic hypothesis of instrument scanning when the expected and observed frequencies were statistically different. The analyses reported here support an hypothesis of determinism when the statistical hypothesis is accepted.

Table 3

Number of Control Movements for Each Segment of the Steep Turn Maneuver#

	Left Turn			Right Turn		
Subject	Stick	Wheel	Total	Stick	Wheel	Total
IP3	20	8	28	28	14	42
IP4	17	17	34	14	5	19
PO1	7	4	11	6	7	13
PO2	23	14	37	25	17	42
PO3	9	2	11	4	2	6
PO5	14	7	21	23	14	37
PO6	25	34	59	37	23	60
PO7	19	5	24	17	8	25
PO8	17	9	26	21	23	44
PO9	50	26	76	33	25	58
P10	22	9	31	33	13	46
P11	22	8	30	21	20	41
TP1(1)	31	10	41	17	5	22
TP2(2)*	42	11	53	--	--	--
TP5	29	13	42	28	14	42
TC1	23	9	32	**	**	**
TC5	24	8	32	**	**	**

*Second Left Turn
**Not Available

#IP = Instructor Pilot
P = Pilot
TPx = Trainee Pilot (Session #)
TCx = Trainee Copilot (Session #)

It should be noted that, although the mathematical models used in this research employed multi-dimensional transition matrices, the matrices were collapsed to two-dimensional matrices for purposes of this test.

Preliminary Analyses Using Three Stage Markov

In the previous sections, details were given of the data reduction procedures used to encode the LP and CS measures. By conceptualizing the LPs and CSs in time as a multi-stage Markov process, it was hoped that the pilot's scanning patterns would be congruent with this form of a mathematical model. Specifically, the transitional probabilities for each subject's actual data were submitted to the model's computer algorithm which utilized a three-stage Markov process augmented by a random number generator to produce 10 data files as models of that subject's LPs over time. The model was initiated in each case by using the first three LPs of the subject's actual data. As a result, the model produced a series of LPs that was three less than the number of LPs in the actual data.

The first attempt to model the pilots' scanning behavior used the subject's LP at time, t-1 (LP_{t-1}), the control status for the stick at time, t-1 (CSS_{t-1}) and the control status for the wheel at time, t-1 (CSW_{t-1}) to predict each LP at time, t(LP_t). A preliminary analysis of the data revealed that this configuration of parameters failed to model accurately the scanning behavior for a subsample of the subjects (N=6).

Subsequently, it was decided to combine the four CS measures for the stick and wheel into one composite measure containing 16 possible combinations (see Table 1, Appendix A), thus allowing another LP to be added to the mathematical model. This configuration of parameters, LP_{t-2}, LP_{t-1}, CS_{t-1}, also failed to model accurately the scanning behavior for the subsample of subjects. Similar results were found when the number of CS measures were reduced from 16 to nine (removing "control decision in progress" status) and also from nine to four (removing the distinction between positive and negative control movements).

Taken together, the preliminary analyses revealed that a three-stage Markov composed of LPs and multiple measures of control status (as indicators of Δ_I) failed to capture statistically the scanning patterns of the subjects. This would be expected if (1) the pilots were using a random scanning pattern for each segment of the maneuver, (2) the pilots were using scanning "patterns" that were not related to the information being obtained from the instrument panel, or (3) the "error-dependent" model is correct, but the CSs, as configured, were not accurate indicators of Δ_I.

Deterministic Scanning Patterns

To evaluate the possibility of random scanning patterns as an explanation for the model's attempts, the modeling approach was implemented to predict scanning behavior using a configuration of parameters composed of each pilot's three

previous LPs (i.e. LP_{t-3}, LP_{t-2}, LP_{t-1}) (see Program 3, appendix C). Table 4 shows the chi-square values from the goodness-of-fit test for each subject. In every case the transition matrix for the average of 10 data files was not statistically different from the transition matrix for the actual data. The goodness-of-fit matrices for all the subjects are presented in Tables 1-31 (Appendix B).

This finding represents the first clear, direct evidence in the literature that pilots are using deterministic, not random, scanning patterns during instument flight. In order to document this finding further, it was necessary to demonstrate that the modelled data were not statistically different from the actual data for measures of (1) mean dwell time, (2) entropy, and (3) entropy rate.

Fixations and Mean Dwell Time--Tables 5-13 present the actual and predicted number of fixations and mean dwell times for each instrument in each segment of the maneuver. Although the transition matrices for the goodness-of-fit tests contained diagonal entries which represented the total proportion of time spent on each instrument, this analysis allowed for the comparison of actual and predicted instrument sampling behavior.

A comparison of the predicted and actual mean dwell times using a multiple analysis of variance (MANOVA) revealed that there was no significant difference between the actual and model data sets ($F[9,22] = 1.1387$, $p > .05$). This finding supported the validity of a three-stage Markov

Table 4

Chi-Square Values from Goodness-of-Fit Tests
Comparing First Order Matrices of Actual Transitions
with Transitions* Predicted using Three Previous Lookpoints

	Left Turn	Right Turn
Subject	Chi-Square/df	Chi-Square/df
IP3	16.929/23	19.586/25
IP4	11.834/19	15.305/19
P01	6.712/14	13.767/18
P02	7.635/19	19.840/19
P03	11.220/21	7.330/17
P05	6.420/21	16.295/22
P06	15.635/24	12.309/22
P07	5.234/16	7.010/12
P08	9.448/17	10.643/17
P09	11.608/22	9.149/21
P10	10.937/17	5.513/17
P11	2.948/21	12.036/20
TP1(1)	7.165/15	1.138/14
TP1(2)**	5.876/21	---------
TP5	12.231/18	9.714/18
TC1	1.883/15	***
TC5	19.496/21	***

*Average of 10 Predictions
**Second Left Turn
***Not Available

Table 5
Number of Fixations and Mean Dwell Time on the Airspeed Indicator
During Each Segment of the Steep Turn Maneuver for Actual Data
and Data Predicted* Using Three Previous Lookpoints

	Left Turn						Right Turn					
	Actual			Predicted			Actual			Predicted		
Subject	# of Fixations	Mean Dwell Time	S.D.	# of Fixations	Mean Dwell Time	S.D.	# of Fixations	Mean Dwell Time	S.D.	# of Fixations	Mean Dwell Time	S.D.
IP3	9	.2667	.198	9.2	.2423	.200	10	.2833	.169	9.1	.3252	.281
IP4	5	.0733	.043	4.9	.0811	.045	7	.1143	.139	7.5	.0868	.106
P01	5	.5800	.146	4.3	.6486	.452	6	.6778	.209	5.3	.6559	.477
P02	3	.4556	.184	4.0	.4187	.295	3	.5000	.058	4.3	.5792	.305
P03	2	.2667	.047	2.1	.1700	.092	2	.6500	.024	2.0	.6881	.438
P05	7	.6571	.320	6.9	.6297	.489	4	.3333	.245	3.3	.3089	.348
P06	5	.0533	.045	5.6	.0568	.039	2	.1167	.118	2.1	.1200	.095
P07	0	.0000	.000	0.0	.0000	.000	0	.0000	.000	0.0	.0000	.000
P08	0	.0000	.000	0.0	.0000	.000	1	.0333	.000	1.2	.0233	.000
P09	2	.0667	.047	1.3	.0556	.008	2	.0667	.000	1.2	.0533	.000
P10	1	.0333	.000	.9	.0200	.000	5	.3000	.212	4.6	.2546	.145
P11	20	.2650	.199	20.9	.2493	.217	5	.4933	.089	4.8	.4474	.267
TP1(1)	1	.1667	.000	1.2	.1617	.015	2	.3000	.047	2.4	.2516	.114
TP1(2)**	7	.0667	.064	6.0	.0563	.042	-	------	----	---	-----	----
TP5	5	.3400	.223	5.7	.3673	.296	7	.2190	.168	7.2	.2125	.166
TC1	3	.9000	.567	2.7	.9861	.467	***	***	***	***	***	***
TC5	9	.3000	.271	9.0	.3175	.334	***	***	***	***	***	***

*Average of 10 Predictions
**Second Left Turn
***Not Available

Table 6
Number of Fixations and Mean Dwell Time on the Roll Indicator
During Each Segment of the Steep Turn Maneuver for Actual Data
and Data Predicted* Using Three Previous Lookpoints

	Left Turn						Right Turn					
	Actual			Predicted			Actual			Predicted		
Subject	# of Fixations	Mean Dwell Time	S.D.	# of Fixations	Mean Dwell Time	S.D.	# of Fixations	Mean Dwell Time	S.D.	# of Fixations	Mean Dwell Time	S.D.
IP3	23	.3913	.205	22.6	.4101	.345	26	.3526	.225	23.9	.3168	.273
IP4	16	.2458	.175	17.7	.2723	.217	13	.2795	.235	12.8	.2638	.216
P01	1	.0667	.000	0.0	.0000	.000	3	.2889	.150	2.7	.3628	.093
P02	11	.3121	.291	10.0	.3441	.282	11	.3333	.250	10.4	.3325	.227
P03	6	.3111	.233	6.9	.2995	.178	8	.1667	.067	8.9	.1589	.082
P05	31	.4688	.477	31.6	.4554	.501	42	.2706	.279	41.7	.3139	.318
P06	25	.4107	.313	27.4	.4276	.444	8	.2708	.376	7.0	.2910	.272
P07	17	.3039	.328	15.7	.3013	.428	5	.0600	.028	4.6	.0541	.024
P08	0	.0000	.000	0.0	.0000	.000	0	.0000	.000	0.0	.0000	.000
P09	3	.0889	.069	3.1	.1043	.074	12	.1833	.137	11.6	.1788	.115
P10	16	.3208	.334	16.0	.3787	.413	27	.6037	.492	26.4	.6147	.564
P11	0	.0000	.000	0.0	.0000	.000	1	.1667	.000	.8	.0783	.012
TP1(1)	2	.3000	.141	1.7	.2739	.094	3	.1667	.067	2.9	.1686	.048
TP1(2)**	10	.0900	.118	10.7	.0851	.081	-	-----	----	----	-----	----
TP5	6	.1278	.090	5.1	.1254	.051	4	.1083	.088	4.4	.1456	.112
TC1	5	.5133	.218	5.3	.5060	.293	***	***	***	***	***	***
TC5	9	.2778	.233	10.0	.2672	.187	***	***	***	***	***	***

*Average of 10 Predictions
**Second Left Turn
***Not Available

Table 7
Number of Fixations and Mean Dwell Time on the Command Bars
During Each Segment of the Steep Turn Maneuver for Actual Data
and Data Predicted* Using Three Previous Lookpoints

	Left Turn						Right Turn					
	Actual			Predicted			Actual			Predicted		
Subject	# of Fixations	Mean Dwell Time	S.D.	# of Fixations	Mean Dwell Time	S.D.	# of Fixations	Mean Dwell Time	S.D.	# of Fixations	Mean Dwell Time	S.D.
IP3	21	.4111	.285	19.9	.3761	.329	26	.3308	.406	25.2	.3862	.549
IP4	31	.5419	.404	33.1	.4986	.421	31	.5172	.490	29.3	.5005	.513
P01	20	1.2133	.586	21.5	1.0996	1.087	26	.4393	.335	26.6	.4380	.362
P02	23	.8725	.946	25.3	.8186	.897	22	1.0227	.659	21.8	1.0305	.972
P03	19	1.0070	1.030	19.7	.9126	.927	25	1.0707	.939	24.6	1.1022	1.012
P05	19	.3070	.259	20.4	.2992	.247	33	.3485	.305	30.6	.3472	.359
P06	27	.3259	.229	27.5	.3124	.230	30	.6011	.531	30.9	.6128	.589
P07	21	.9762	.719	21.1	1.0181	.885	9	2.6222	1.092	12.3	2.0550	1.806
P08	31	.5032	.356	30.6	.5076	.437	18	1.2667	1.138	19.3	1.2349	1.129
P09	31	.7742	.596	32.2	.7077	.614	30	.5322	.630	29.4	.5251	.553
P10	24	.5181	.437	23.7	.5392	.495	16	.3292	.345	15.5	.3706	.318
P11	25	.3600	.284	25.8	.3717	.295	26	.5436	.367	25.4	.5669	.509
TP1(1)	23	.7536	.502	23.8	.7831	.740	23	.6333	.351	22.8	.6409	.647
TP1(2)**	37	.7802	.526	37.0	.7566	.738	--	-----	----	----	-----	----
TP5	38	.4825	.265	37.7	.4858	.416	30	.5911	.390	31.9	.5989	.517
TC1	18	.8537	.597	16.8	.9079	.823	***	***	***	***	***	***
TC5	24	.3986	.452	24.3	.4033	.394	***	***	***	***	***	***

*Average of 10 Predictions
**Second Left Turn
***Not Available

Table 8
Number of Fixations and Mean Dwell Time on the Altimeter
During Each Segment of the Steep Turn Maneuver for Actual Data
and Data Predicted* Using Three Previous Lookpoints

	Left Turn						Right Turn					
	Actual			Predicted			Actual			Predicted		
Subject	# of Fixations	Mean Dwell Time	S.D.	# of Fixations	Mean Dwell Time	S.D.	# of Fixations	Mean Dwell Time	S.D.	# of Fixations	Mean Dwell Time	S.D.
IP3	18	.4537	.220	19.5	.5000	.418	19	.4246	.226	19.4	.4417	.338
IP4	24	.3611	.181	23.8	.3538	.275	28	.2262	.185	30.8	.2203	.179
P01	10	.1600	.150	11.1	.1515	.145	7	.4381	.133	7.2	.5236	.439
P02	14	.4571	.201	14.0	.4306	.343	7	.4952	.152	6.9	.4406	.286
P03	19	.3912	.170	20.4	.3700	.299	11	.5333	.210	10.5	.5564	.413
P05	14	.6667	.295	15.0	.6756	.540	23	.4478	.187	23.5	.4237	.317
P06	15	.4644	.198	14.1	.4643	.352	17	.4253	.215	15.9	.3971	.318
P07	6	.5000	.112	6.0	.4608	.343	6	.3500	.119	6.6	.3205	.152
P08	14	.3619	.193	13.0	.3321	.236	13	.3359	.169	13.4	.3397	.262
P09	21	.4381	.117	22.5	.4258	.317	18	.4093	.151	19.0	.3843	.332
P10	17	.3608	.262	15.4	.3509	.290	17	.3176	.136	18.0	.3007	.207
P11	7	.3476	.205	6.5	.3774	.249	17	.2412	.100	15.6	.2493	.144
TP1(1)	0	.0000	.000	0.0	.0000	.000	0	.0000	.000	0.0	.0000	.000
TP1(2)**	8	.0333	.000	9.0	.0333	.000	--	-----	----	----	-----	----
TP5	23	.4391	.104	24.3	.4211	.346	27	.2494	.157	24.6	.2426	.185
TC1	10	.4467	.117	10.0	.4934	.364	***	***	***	***	***	***
TC5	15	.6156	.235	13.9	.6074	.459	***	***	***	***	***	***

*Average of 10 Predictions
**Second Left Turn
***Not Available

Table 9

Number of Fixations and Mean Dwell Time on the Automatic Direction Finder (ADF) During Each Segment of the Steep Turn Maneuver for Actual Data and Data Predicted* Using Three Previous Lookpoints

	Left Turn						Right Turn					
	Actual			Predicted			Actual			Predicted		
Subject	# of Fixations	Mean Dwell Time	S.D.	# of Fixations	Mean Dwell Time	S.D.	# of Fixations	Mean Dwell Time	S.D.	# of Fixations	Mean Dwell Time	S.D.
IP3	5	.0800	.104	4.9	.0597	.056	2	.0333	.000	1.9	.0300	.000
IP4	0	.0000	.000	0.0	.0000	.000	0	.0000	.000	0.0	.0000	.000
P01	0	.0000	.000	0.0	.0000	.000	0	.0000	.000	0.0	.0000	.000
P02	0	.0000	.000	0.0	.0000	.000	0	.0000	.000	0.0	.0000	.000
P03	1	.2667	.000	1.2	.2028	.057	0	.0000	.000	0.0	.0000	.000
P05	0	.0000	.000	0.0	.0000	.000	0	.0000	.000	0.0	.0000	.000
P06	4	.2833	.191	5.0	.2116	.194	3	.3889	.126	3.3	.4103	.184
P07	2	.6500	.024	2.1	.6756	.271	0	.0000	.000	0.0	.0000	.000
P08	7	.3571	.230	6.2	.3588	.325	6	.4611	.125	5.8	.4226	.247
P09	3	.7000	.145	3.1	.7893	.432	6	.3278	.249	6.4	.4063	.333
P10	3	.2111	.069	2.3	.1842	.053	2	.1000	.047	1.6	.0911	.015
P11	6	.0889	.034	6.1	.0860	.031	1	.2000	.000	1.0	.0781	.012
TP1(1)	1	.0667	.000	.8	.0400	.000	1	.0333	.000	.9	.0233	.000
TP1(2)**	1	.0333	.000	1.0	.0200	.000	--	-----	----	----	-----	----
TP5	1	.1667	.000	1.5	.1017	.021	0	.0000	.000	0.0	.0000	.000
TC1	0	.0000	.000	0.0	.0000	.000	***	***	***	***	***	***
TC5	6	.1056	.124	5.3	.0982	.087	***	***	***	***	***	***

*Average of 10 Predictions

**Second Left Turn

***Not Available

Table 10
Number of Fixations and Mean Dwell Time on the Horizontal Situation Indicator (HSI)
During Each Segment of the Steep Turn Maneuver for Actual Data
and Data Predicted* Using Three Previous Lookpoints

	Left Turn						Right Turn					
	Actual			Predicted			Actual			Predicted		
Subject	# of Fixations	Mean Dwell Time	S.D.	# of Fixations	Mean Dwell Time	S.D.	# of Fixations	Mean Dwell Time	S.D.	# of Fixations	Mean Dwell Time	S.D.
IP3	11	.4182	.224	10.5	.4616	.378	10	.4067	.207	10.8	.3492	.235
IP4	2	.4333	.283	1.5	.3694	.209	6	.2611	.169	7.1	.2740	.222
P01	0	.0000	.000	0.0	.0000	.000	0	.0000	.000	0.0	.0000	.000
P02	5	.4333	.175	5.3	.3389	.214	4	.5000	.082	3.9	.4667	.307
P03	4	.2500	.263	3.4	.4007	.500	3	.4111	.327	3.5	.4150	.456
P05	5	.6467	.290	5.2	.7248	.424	1	.1000	.000	.5	.0400	.000
P06	8	.4042	.186	8.1	.3430	.298	8	.5083	.254	8.3	.4875	.381
P07	1	1.0333	.000	1.2	.5328	.112	2	.5000	.141	1.3	.8344	.367
Po8	4	.3333	.221	4.0	.4392	.384	5	.4867	.308	5.6	.4480	.381
P09	5	.6067	.305	5.1	.6812	.549	6	.6222	.337	6.7	.5152	.424
P10	0	.0000	.000	0.0	.0000	.000	0	.0000	.000	0.0	.0000	.000
P11	6	.3611	.114	6.0	.3689	.227	11	.4303	.129	11.2	.4167	.324
TP1(1)	25	.6933	.546	24.9	.6381	.556	21	.4968	.173	20.2	.5534	.517
TP1(2)**	30	.4200	.191	30.0	.4526	.341	--	-----	----	----	-----	----
TP5	13	.4000	.176	11.4	.3845	.288	10	.3967	.171	10.1	.3958	.324
TC1	2	.2667	.236	2.0	.1456	.093	***	***	***	***	***	***
TC5	7	.7667	.432	8.3	.7753	.591	***	***	***	***	***	***

*Average of 10 Predictions
**Second Left Turn
***Not Available

Table 11

Number of Fixations and Mean Dwell Time on the Instantaneous Vertical Speed Indicator (IVSI) During Each Segment of the Steep Turn Maneuver for Actual Data and Data Predicted* Using Three Previous Lookpoints

	Left Turn						Right Turn					
	Actual			Predicted			Actual			Predicted		
Subject	# of Fixations	Mean Dwell Time	S.D.	# of Fixations	Mean Dwell Time	S.D.	# of Fixations	Mean Dwell Time	S.D.	# of Fixations	Mean Dwell Time	S.D.
IP3	0	.0000	.000	0.0	.0000	.000	0	.0000	.000	0.0	.0000	.000
IP4	2	.2000	.141	1.6	.1825	.029	4	.2250	.110	4.8	.1974	.103
P01	3	.7222	.351	3.3	.8116	.555	2	1.9500	.872	2.4	1.4961	.664
P02	0	.0000	.000	0.0	.0000	.000	1	.0333	.000	1.2	.0300	.000
P03	6	.3222	.075	5.7	.3503	.256	7	.4238	.167	5.9	.4328	.362
P05	4	.4667	.072	3.8	.3758	.195	4	.3333	.122	3.8	.3364	.207
P06	7	.2905	.108	7.1	.2826	.179	6	.3667	.042	6.7	.3889	.306
P07	2	.4833	.118	2.3	.4683	.211	3	.6667	.145	3.3	.5889	.306
P08	6	.4722	.365	5.8	.6007	.541	4	.3917	.262	4.6	.4054	.344
P09	8	.3458	.246	8.4	.3603	.256	2	.3500	.118	2.3	.3389	.208
P10	0	.0000	.000	0.0	.0000	.000	0	.0000	.000	0.0	.0000	.000
P11	4	.1750	.204	2.9	.1889	.133	3	.2444	.217	3.5	.2648	.228
TP1(1)	0	.0000	.000	0.0	.0000	.000	0	.0000	.000	0.0	.0000	.000
TP1(2)**	0	.0000	.000	0.0	.0000	.000	--	-----	----	----	-----	----
TP5	0	.0000	.000	0.0	.0000	.000	0	.0000	.000	0.0	.0000	.000
TC1	0	.0000	.000	0.0	.0000	.000	***	***	***	***	***	***
TC5	1	.0667	.000	.6	.0200	.000	***	***	***	***	***	***

*Average of 10 Predictions

**Second Left Turn

***Not Available

Table 12
Number of Fixations and Mean Dwell Time on the Engine Instruments
During Each Segment of the Steep Turn Maneuver for Actual Data
and Data Predicted* Using Three Previous Lookpoints

	Left Turn						Right Turn					
	Actual			Predicted			Actual			Predicted		
Subject	# of Fixations	Mean Dwell Time	S.D.	# of Fixations	Mean Dwell Time	S.D.	# of Fixations	Mean Dwell Time	S.D.	# of Fixations	Mean Dwell Time	S.D.
IP3	0	.0000	.000	0.0	.0000	.000	0	.0000	.000	0.0	.0000	.000
IP4	0	.0000	.000	0.0	.0000	.000	0	.0000	.000	0.0	.0000	.000
P01	0	.0000	.000	0.0	.0000	.000	6	.3389	.249	5.7	.2958	.259
P02	0	.0000	.000	0.0	.0000	.000	2	.8167	.071	2.4	.6164	.401
P03	0	.0000	.000	0.0	.0000	.000	0	.0000	.000	0.0	.0000	.000
P05	0	.0000	.000	0.0	.0000	.000	0	.0000	.000	0.0	.0000	.000
P06	1	.5000	.000	.6	.2117	.021	0	.0000	.000	0.0	.0000	.000
P07	0	.0000	.000	0.0	.0000	.000	0	.0000	.000	0.0	.0000	.000
P08	0	.0000	.000	0.0	.0000	.000	1	.7667	.000	.5	.2967	.003
P09	1	.2667	.000	.7	.1100	.024	0	.0000	.000	0.0	.0000	.000
P10	0	.0000	.000	0.0	.0000	.000	0	.0000	.000	0.0	.0000	.000
P11	1	.4333	.000	.8	.3400	.005	1	.1333	.000	1.5	.0975	.022
TP1(1)	0	.0000	.000	0.0	.0000	.000	0	.0000	.000	0.0	.0000	.000
TP2(2)**	0	.0000	.000	0.0	.0000	.000	--	-----	----	----	-----	----
TP5	0	.0000	.000	0.0	.0000	.000	0	.0000	.000	0.0	.0000	.000
TC1	0	.0000	.000	0.0	.0000	.000	***	***	***	***	***	***
TC5	0	.0000	.000	0.0	.0000	.000	***	***	***	***	***	***

*Average of 10 Predictions
**Second Left Turn
***Not Available

Table 13
Number of Fixations and Mean Dwell Time for Nonspecific
During Each Segment of the Steep Turn Maneuver for Actual Data
and Data Predicted* Using Three Previous Lookpoints

	Left Turn						Right Turn					
	Actual			Predicted			Actual			Predicted		
Subject	# of Fixations	Mean Dwell Time	S.D.	# of Fixations	Mean Dwell Time	S.D.	# of Fixations	Mean Dwell Time	S.D.	# of Fixations	Mean Dwell Time	S.D.
IP3	44	.0818	.093	45.0	.0778	.081	40	.1225	.203	41.0	.1358	.169
IP4	50	.1400	.137	50.8	.1423	.143	50	.1233	.142	52.7	.1355	.158
P01	23	.2217	.193	24.9	.2237	.227	40	.2858	.341	39.9	.2929	.250
P02	36	.1120	.126	36.0	.1151	.152	32	.1042	.118	33.0	.1065	.104
P03	39	.1026	.095	40.4	.1056	.103	27	.0679	.052	27.2	.0712	.062
P05	41	.0984	.082	41.2	.0972	.075	54	.1142	.115	53.9	.1104	.112
P06	44	.0939	.092	44.9	.0949	.088	51	.0922	.127	51.8	.0857	.104
P07	22	.1591	.301	23.8	.1617	.276	15	.0667	.407	17.1	.0686	.044
P08	44	.1712	.164	44.2	.1736	.186	32	.0917	.096	35.5	.0900	.093
P09	60	.0706	.067	63.5	.0727	.076	43	.1240	.138	45.5	.1213	.122
P10	40	.2325	.254	38.0	.2374	.283	33	.0606	.049	35.0	.0662	.050
P11	48	.2021	.271	48.3	.1998	.218	53	.0843	.074	51.3	.0852	.081
TP1(1)	33	.1101	.131	34.7	.1108	.105	34	.0794	.046	33.3	.0801	.047
TP1(2)**	48	.0993	.115	48.0	.1023	.119	--	-----	----	----	-----	----
TP5	66	.1268	.119	68.8	.1276	.095	56	.1714	.209	57.0	.1593	.179
TC1	21	.1794	.264	20.1	.1930	.299	***	***	***	***	***	***
TC5	31	.1054	.237	32.9	.0925	.144	***	***	***	***	***	***

*Average of 10 Predictions
**Second Left Turn
***Not Available

process composed of three previous LPs as an accurate model of the scanning behavior of the pilots.

Entropy--The entropy measure was developed by Harris and his colleagues as an indication of the orderliness within a set of scanning data. The entropy measure combines the transitional probabilities into a single measure that increases linearly with the amount of "randomness" (see Program 4, Appendix C). Although this measure continues to be in the development stage (see Tole & Young, 1983), the measure provided another procedure for evaluating the goodness of fit of the model. Table 14 presents the actual and predicted entropy measures for each segment of the steep turn maneuver.

The correlation between the actual and predicted entropy measures was .995, df = 12, indicating a near perfect match for these measures.

Entropy Rate--Entropy rate, also developed by Harris and his colleagues, combines the transitional probability matrix with a dwell time matrix (see Program 5, Appendix C) to form a metric that Tole et al. (1982) demonstrated to be related inversely to mental workload for moderately skilled pilots. Since the transitional matrices and dwell time data were found not to be statistically different, it was expected that there would be a high correlation between predicted and actual entropy rates. Table 15 shows the entropy rate measures for each segment of the steep turn maneuver. As expected, the correlation between these two measures was .944, df = 12.

Table 14

Actual and Predicted* Entropy Measures for Each Segment of the Steep Turn Maneuver

	Left Turn		Right Turn	
Subject	Actual	Predicted	Actual	Predicted
IP3	3.18238	3.09981	3.16806	3.10968
IP4	2.67938	2.66388	2.92871	2.95477
P01	1.88317	1.89470	2.88705	2.75889
P02	2.47527	2.44793	2.43233	2.41074
P03	2.54962	2.58919	2.13995	2.08859
P05	3.08121	3.01573	2.97359	2.85922
Po6	3.34721	3.21779	2.90761	2.83646
P07	2.37861	2.26012	1.45221	1.44328
P08	2.73649	2.65569	2.34227	2.23563
P09	2.57905	2.61802	2.92742	2.89877
P10	2.60733	2.52581	2.45994	2.42770
P11	3.10377	2.99914	2.89414	2.80641
TP1(1)	1.91220	2.04101	2.08230	2.07837
TP1(2)**	1.88950	2.03764	-------	-------
TP5	2.75829	2.71839	2.66524	2.64434
TC1	2.42945	2.37615	***	***
TC5	3.09476	2.98906	***	***

*Average of 10 Predictions
**Second Left Turn
***Not Available

Table 15

Actual and Predicted* Entropy Rate Measures for Each Segment of the Steep Turn Maneuver

	Left Turn		Right Turn	
Subject	Actual	Predicted	Actual	Predicted
IP3	.99733	.99991	.94726	.94582
IP4	.98955	.89352	1.19761	.89352
P01	.40529	.31949	.72796	.61869
P02	.70377	.67422	.73431	.78097
P03	.90462	.95160	.54983	.50135
P05	.90010	.98526	1.06142	.89633
P06	1.27821	1.24256	.97447	.93041
P07	.39423	.40314	.47667	.22842
P08	.73652	.70655	.74923	.73847
P09	.77804	.64122	1.09196	1.00153
P10	.70815	.65279	1.10057	.85808
P11	1.15464	1.01925	1.14349	.95097
TP1(1)	.41764	.31617	.51796	.51303
TP1(2)**	.35013	.41217	-------	-------
TP5	.90985	.96766	.85930	.82567
TC1	.47867	.49079	***	***
TC5	1.01721	1.07515	***	***

*Average of 10 Predictions
**Second Left Turn
***Not Available

Discussion--These findings are clearly supportive of the hypothesis that pilots are using deterministic scanning patterns while obtaining information from the instrument panel. The results indicate that their scanning behavior can be accurately reproduced using the three predicted lookpoints occurring 1/30th, 2/30ths, and 3/30ths prior to each predicted LP. It can be argued that this configuration of parameters reflects a composite of the scanning patterns predicted by the error-dependent model. For example, these findings would be expected if the CS measures were not accurate indicators of Δ_I. However, these results would also be expected if each pilot were using stable patterns of scanning that were not influenced by the type of information obtained from the instruments. The following analysis attempted to evaluate these possibilities.

Patterning Versus Error-Dependent Patterns

As indicated above, many pilots and flight training personnel have suggested that they follow certain temporal and spatial patterns, learned during flight training, to scan the instruments. A "spoke and wheel" pattern, for example, suggests that the pilot uses one primary instrument as a central data source and obtains information from other relevant instruments by scanning a relevant instrument, returning to the primary instrument, scanning another relevant instrument, returning to the primary instrument, etc. In order to determine whether such stable patterns were used by the pilots in this research, the transitional

probabilities established for each pilot during the left turn of the maneuver were used in an attempt to model the pilot's scanning behavior during the right turn of the maneuver (see Program 6, Appendix C).

Table 16 shows the chi-square values from the goodness-of-fit tests comparing the actual data for the right segment of the steep turn maneuver with the data modelled using the transitional probabilities from the left turn. The goodness-of fit matrix for each subject is presented in Tables 32-45 (Appendix B). In every case, the transition matrices were statistically different, indicating that the pilots were not using similar scanning behaviors for each segment of the maneuver. Therefore, it was concluded that the pilots could not be using a stable pattern of scanning behavior, but a flexible strategy such as the one predicted by the error-dependent model. It is possible that stable scanning "patterns" (e.g., spoke and wheel) can accurately describe a pilot's scanning behavior during "error-free" states, but these findings do not support the patterning hypothesis as a general description of instrument scanning behavior.

Evaluating The Model Using A Four Stage Markov Process

Since the pilot's scanning behavior was accurately modelled using a configuration of parameters composed strictly of previous LPs, an attempt was made to model scanning behavior using three previous lookpoints and a composite control status measure containing four indices of

Table 16

Chi-Square Values from Goodness-of-Fit Tests Comparing First Order Matrices of Actual Transitions During Right Turn with Transitions* Predicted Using The Transitional Probabilities Calculated During Left Turn

Subject	Chi-Square/df
IP34	118.628/25#
IP4R	68.626/19#
P01R	783.701/18#
P02R	209.609/19#
D03R	254.517/17#
P05R	2679.874/22#
P06R	1293.917/22#
P07R	1841.437/12#
P08R	576.279/17#
P09R	210.063/21#
P10R	2076.423/17#
P11R	787.198/20#
TP1R	60.109/14#
TP5R	86.680/18#
TC**	

*Average of 10 Predictions
**Not Applicable

#$p < .05$

control status: (1) no control movements, (2) stick control movement, (3) wheel control movement, and (4) stick and wheel control movements. The Markov process using, LP_{t-3}, LP_{t-2}, LP_{t-1}, CS_{t-1}, was used to model the scanning behavior of each subject for each segment of the maneuver (see Program 7, Appendix C).

Table 17 presents the chi-square values from the goodness-of-fit tests for each segment of the steep turn maneuver. Of the 31 different tests, 12 were not statistically different from the actual data. The goodness-of-fit matrices are presented in Tables 46-76 (Appendix B).

A review of the individual matrices reveal that in many cases, the magnitude of the chi-square was largely influenced by one or two comparisons. There seemed to be a consistent pattern surrounding the failure of these four parameters to predict transitions involving the "non-specific" LP (e.g. see Table 55, Appendix B.) The conclusion from these analyses must be that this configuration of parameters was only marginally successful in modelling the scanning patterns of the pilots.

Discussion--One goal of this research was to use various configurations of each subject's previous LPs and CS measures to isolate the scanning patterns predicted by the error-dependent model. There are at least four possible explanations why the inclusion of the control status measure failed to provide a more consistent fit with the actual data.

Table 17

Chi-Square Values from Goodness-of-Fit Tests
Comparing First Order Matrices of Actual Transitions
with Transitions* Predicted Using
Three Previous Lookpoints and One Control Status

	Left Turn	Right Turn
Subject	Chi-Square/df	Chi-Square/df
IP3	8.064/23	153.265/25#
IP4	5.222/19	57.036/19#
P01	42.108/14#	10.592/18
P02	72.302/19#	94.755/19#
P03	20.427/21	33.574/17#
P05	28.874/21	18.405/22
P06	56.498/24#	50.611/22#
P07	119.815/16#	299.087/12#
P08	10.974/17	117.275/17#
P09	258.496/22#	136.160/21#
P10	27.942/17#	28.732/17#
P11	49.540/21#	14.289/20
TP1	16.121/15	6.152/14
TP1(2)**	33.027/21	----------
TP5	7.400/18	4.175/18
TC1	806.422/15#	***
TC5	223.437/21#	***

*Average of 10 Predictions
**Second Left Turn
***Not Available

#$p < .05$

First, the algorithm used to transform control position data into control status data identified the point in time when control movements began and identified each subsequent data point as "control movement in progress" until the movement ended. Therefore, the assumption was that "error-driven" scanning behavior was stable during the entire course of a control movement. It may well be that scanning patterns are influenced by temporal factors surrounding the detection of an error and the initiation of the control input. There is no a priori reason to believe that pilots use "error-driven" state scanning patterns during the entire duration of a control input. It should be noted that attempts were made to restructure the actual data files so that control status measures reflected arbitrary, equal time periods prior to and subsequent to the initiation of a control input. Preliminary analyses revealed these attempts to be unsuccessful in modelling scanning patterns accurately. However, this approach requires further consideration using systematic changes in temporal periods surrounding the initiation and termination of control inputs.

Second, it is possible that the presence of "non-specific" LPs within the data may have affected the ability of the mathematical models to be more consistent in modelling the actual scanning behavior. "Non-specific" LPs identified those cases when the subject was "in track" but not looking within specific X-Y boundaries. In most cases the non-specific measure indicated that the subject was making a

saccade between instruments. Since the non-specific designation cannot be associated with aircraft state, it may be unreasonable to assume that its occurrence is influenced by a configuration of parameters that include control status measures. In fact, it can be argued that the presence of the non-specific LP introduces a random segment into an essentially non-random process. Future researchers should consider various means of removing the influence of the non-specific designation from the data sets.

Third, it is possible that the separate instrument scanning patterns assumed by the error-dependent model cannot be isolated using the methodology described in this study. It is possible, for example, that combining the control status measures for stick and wheel into one composite measure made the CS parameter less sensitive to changes in scanning behavior. Although the present research attempted to evaluate various configurations of the parameters, there were many others that could have been tested, using the stick and wheel control status measures individually and in combination.

Finally, it is possible that pilots' instrument-scanning behavior is entirely situation specific and cannot be delineated using the error-dependent model. A pilot's scanning and sampling behavior may be highly individualistic and subject to extreme variations due to factors other than his/her perception of error in the aircraft state. For example, there is little or no information about the

relationship between magnitude of the error, type of error, and scanning behavior. Future research would benefit by an experimental design that collects eye-movement data on each subject while flying the aircraft in an error-free state (e.g. straight and level). By gradually and systematically introducing error into the aircraft state, it would be possible to evaluate gradual differences between "error-free" and "error-driven" scanning behavior.

Performance Measures

If instrument scanning patterns can be shown to be related to overall performance, this line of research can have a major impact in the training of pilots (Braune, 1981). Although the present research has provided important new information about pilot scanning behavior, specific inferences about the relationship with performance cannot yet be drawn. It is possible, however, to gain some insight into the relationship between the pilot's performance and the indices of scanning behavior used in the present research. Table 18 shows the mean pitch error, mean roll error and mean IVSI reading for each segment of the steep turn maneuver. These data were calculated using absolute values. A zero for each performance measure would indicate perfect performance.

The performance data were combined with the actual and predicted entropy and entropy rate measures, the total number of control movements, and the total number of fixations to produce the mean intercorrelation matrix presented in Table 19.

Table 18

Mean Pitch Error, Roll Error, and IVSI Reading During Each Segment of Steep Turn Maneuver with Standard Deviation ( )

	Left Turn			Right Turn		
Subject	Pitch	Roll	IVSI	Pitch	Roll	IVSI
IP3	.876	.753	311.367	1.038	2.002	270.943
	(.514)	(1.220)	(194.247)	(.583)	(1.141)	(164.131)
IP4	1.084	2.280	216.346	1.390	1.496	210.506
	(0.716)	(1.385)	(135.073)	(.752)	(1.289)	(127.287)
P01	.664	1.705	321.055	1.271	1.886	266.016
	(.608)	(1.149)	(161.189)	(.361)	(1.321)	(151.016)
P02	1.170	1.797	177.034	1.866	3.306	259.287
	(.650)	(.994)	(134.042)	(.575)	(2.118)	(262.286)
P03	.837	2.485	203.034	.643	4.613	194.944
	(.691)	(1.781)	(228.007)	(.412)	(.247)	(113.046)
P05	.493	3.358	139.704	1.733	2.498	342.822
	(.319)	(.930)	(92.096)	(1.011)	(1.564)	(212.399)
P06	.699	1.928	292.228	1.046	1.524	390.638
	(.568)	(1.285)	(221.629)	(.573)	(1.096)	(220.819)
P07	1.386	2.930	220.776	1.498	3.557	347.488
	(.606)	(1.297)	(128.068)	(.831)	(1.567)	(248.749)
P08	.640	2.031	272.818	1.738	1.866	381.231
	(.509)	(1.149)	(179.206)	(.723)	(1.433)	(337.950)
P09	.673	2.293	280.301	.977	2.931	290.155
	(.509)	(1.306)	(270.939)	(.845)	(1.063)	(288.689)
P10	.711	1.936	205.103	1.352	1.629	374.068
	(.359)	(1.252)	(121.064)	(1.076)	(1.066)	(273.488)
P11	.595	2.372	220.938	.889	2.930	337.311
	(.530)	(1.181)	(189.053)	(.663)	(1.491)	(178.021)
TP1(1)	.486	1.098	159.276	.551	3.558	222.606
	(.254)	(1.003)	(165.294)	(.466)	(1.044)	(123.578)
TP1(2)*	.874	1.010	302.136	----	-----	-------
	(.593)	(1.019)	(232.640)	----	-----	-------
TP5	.634	2.491	256.951	.514	1.844	175.648
	(.475)	(1.668)	(149.324)	(.309)	(1.637)	(86.720)
TC1	1.619	2.383	681.852	**	**	**
	(1.349)	(1.570)	(383.796)	**	**	**
TC5	.836	.905	260.734	**	**	**
	(.609)	(.9730	(155.907)	**	**	**

*Second Left Turn
**Not Available

Table 19

Mean Intercorrelation Matrix (N=31) for Variables in Each Segment of the Steep Turn Maneuver*

	AE	PE	AER	PER	CM	FIX	PE	RE	IVSI
AE	1.000	0.995#	0.824#	0.892#	0.215	0.682#	0.106	0.245	0.050
PE	-----	1.000	0.838#	0.908#	0.229	0.710#	0.127	0.248	0.072
AER	-----	-----	1.000	0.944#	0.270	0.637#	0.009	0.139	0.044
PER	-----	-----	-----	1.000	0.251	0.684#	0.0802	0.180	0.101
CM	-----	-----	-----	-----	1.000	0.450	0.030	0.280	0.221
FIX	-----	-----	-----	-----	-----	1.000	0.248	0.281	0.216
PE	-----	-----	-----	-----	-----	-----	1.000	0.061	0.493#
RE	-----	-----	-----	-----	-----	-----	-----	1.000	0.112
IVSI	-----	-----	-----	-----	-----	-----	-----	-----	1.000

AE = Actual Entropy Measure
PE = Predicted Entropy Measure
AER = Actual Entropy Rate
PER = Predicted Entropy Rate
CM = Number of Control Movements
FIX = Total Number of Fixations
PE = Mean Pitch Error
RE = Mean Roll Error
IVSI = Mean IVSI Reading

*df = 12
#$p < .05$

The data from the mean intercorrelation matrix reveal:

(1) There was a high positive correlation between the entropy and the entropy rate measures (r = .824, df = 12, p < .05). Since the entropy measure increases as the level of "randomness" in scanning behavior increases and since a high entropy rate measure has been found to be related inversely to mental workload (Tole et al., 1982), this finding suggests that the amount of randomness in a pilot's scan increases as mental workload decreases. This suggests the possibility that pilots may use non-deterministic patterns when the aircraft is in an error-free state.

(2) The entropy and entropy rate measures were positively correlated with the total number of fixations (r = .682, df = 12, p < .05; r = .637, df = 12, p < .05, respectively. This would be expected if the pilot increases his/her rate of scanning during periods of increased random scanning and during periods of low mental workload.

(3) Of the three performance measures, the only statistically significant correlation was between mean pitch error and mean IVSI reading (r = .493, df = 12, p < .05). This finding was expected given the systematic relationship between pitch attitude and vertical speed.

Summary and Conclusions

One of the most frequently cited examples of a "man-machine" interface is the piloting task. Since the work of Fitts and his colleagues, researchers have proposed various methods to evaluate the information gathering processes used by pilots during instrument flight. Fitts and his colleagues performed the pioneering work in this area and demonstrated the usefulness of eye-movement data in the evaluation of instrument panel arrangements. Their work demonstrated the importance of link values as a measure of the "goodness" of the placement of the instruments on the panel. Most importantly, their investigations stimulated a new line of research that sought to uncover various aspects of pilot information processing contained in the eye movement data.

The mathematical model used by Senders (1964; 1966a) was found to predict link values accurately and suggested the possibility that pilots used random patterns to scan aircraft instruments (Sheridan & Ferrell, 1974). Although Senders never contended that pilots do, in fact, scan the instruments randomly (Senders, 1973), the statistical evidence to support a deterministic pattern hypothesis has not proven to be easily obtained.

Senders work with Carbonell (Carbonell et al., 1968; Carbonell et al., 1969) and Smallwood (Senders et al., 1966b: Smallwood, 1967) demonstrated the importance of scanning behavior as an information gathering process and stressed the importance of an internal representation of the interaction between the pilot and the various instruments. Although these researchers found that mathematical procedures which emphasized an "internal-model" accurately predicted instrument sampling behavior, the procedures did not allow for evaluating whether the subjects used random or deterministic scanning patterns.

Recently there has been renewed interest in the question of whether pilots use deterministic or random scanning patterns during instrument flight. Harris and his colleagues (Harris et al., 1982; Tole et al., 1982; Tole et al., 1983) have developed new and potentially important metrics that allow for a single measure of "non-randomness" in scanning patterns and can be used to estimate the degree of mental workload being imposed on the pilot during instrument flight.

Similarly, Ellis (1982) and Ellis and Stark (1981) have begun to apply the metrics used in pattern recognition research (see Noton & Stark, 1971) to evaluate eye-movement patterns during simulated flight tasks. For example, Ellis (1982) provided evidence that subjects' scanning patterns were statistically different from what would be expected if they were scanning using the random pattern modelled by Senders (1964; 1966).

The present research has provided the first direct evidence that pilots use deterministic, not random, scanning patterns during instrument flight. The results indicated that a configuration of parameters, which combined the three previous predicted lookpoints, accurately modeled the scanning behavior of each subject, ranging in skill from copilot trainee (undergoing his/her first training session in a Boeing 737 simulator) to instructor pilots. Furthermore, the data modeled for each subject were not statistically different from the actual data in measures of mean dwell time, entropy, and entropy rate. Taken together, these findings provide conclusive evidence of the deterministic nature of scanning behavior used by commercial airline pilots, and indicate direct support for a model such as the error-dependent model depicted in Figure 1.

The error-dependent model represents a new, simplistic model of scanning behavior which assumes that a pilot uses a variety of deterministic scanning patterns during instrument flight. The various attempts to isolate the transition patterns using configurations of the parameters which included control status measures were only marginally successful. Several possible explanations for these findings were provided, and it is hoped that future research will be more successful in isolating the scanning patterns predicted by the error-dependent model.

The statistical analyses revealed that there was variability between pilots and within each pilot for the

symmetrical segments of the steep turn maneuver. It was also found that the pilots used statistically different scanning patterns during the symmetrical segments, thereby eliminating the possibility that the deterministic patterns were stable, temporal, or spatial patterns learned during flight training. This finding was interpreted as support for the error dependent model.

Finally, it should be noted that the error-dependent model does not propose to provide a definitive presentation of the processes surrounding the instrument-scanning behavior of pilots. The conceptual basis can be found repeatedly throughout the literature and the model may be remarkable only for its simplicity. In fact, the underlying premises of the model were also suggested by Rouse (1980) not as an explanation of scanning behavior, but as an explanation of human behavior in general. Rouse (1980) wrote:

> Thus, we propose that the human be viewed as an organism who receives input from the environment, compares the inputs to what was expected, processes these two types of information in a variety of ways, and then perhaps, but not necessarily, produces some action that may modify the environment. This process continually iterates, and thereby people walk, drive automobiles, repair airplane engines, manage insurance companies, and so on (p. 134).

Inevitably, an instrument scanning model must bring together the theoretical propositions from many disciplines, including estimation theory, control theory, queueing theory, and information processing theory, to be fully descriptive of all the complexities involved in the piloting task. In the meantime, it is hoped that the present research will arouse

the curiosity of other investigators and rekindle interest in understanding the processes involved in "controlling an aircraft attitude, location, and rates of movement in three dimensional space (Fitts et al., 1950a, p. 24).

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Appendix A

Description of the Steep Turn Maneuver
(Taken from 737 Pilot Training Manual, Boeing, 1975)

STEEP TURNS

Objective

The objective of the steep turn maneuver is to familiarize the pilot with the airplane handling characteristics, particularly elevator control. It is not intended that the pilot should bank greater than 30 degrees for normal, abnormal or emergency procedures.

Entry

Stabilize in trim at 250 knots on heading and altitude. Pitch trim is not used during the turn so that the pilot may experience the higher control forces required at bank angles greater than 30 degrees. Avoid abrupt aileron inputs. The steep turn entry is accomplished in the same manner as a normal turn entry. An increase in lift is required as the bank angle is increased at a constant airspeed and altitude to balance the increase in load factor (g). The additional lift is obtained by increasing the angle of attack (pitch attitude). The increased lift causes increased drag which requires an increase in thrust to maintain airspeed and altitude. As elevator pressure is applied to increase pitch attitude to maintain altitude, an increase in thrust will be required to maintain the airspeed constant.

During Turn

Pitch and thrust control are the same as for a normal turn; however, larger pitch adjustments will be required for a given altitude deviation. Varying the angle of bank while turning makes pitch control more difficult. Excursions from the entry conditions should be corrected by smooth, positive control inputs and/or thrust. If altitude loss becomes excessive, reduce the angle of bank as necessary to regain positive pitch control. A rapid instrument scan is required to detect deviations early enough to be corrected by small adjustments.

Instrument Characteristics

Attitude Director Indicator (ADI)

During steep turns it has cyclical precession in pitch. Although the actual airplane pitch attitude will remain constant in a perfect steep turn, the instrument indication of pitch attitude will slowly vary throughout the turn. Do not rely upon it for pitch attitude other than for small corrections based on short-period observations.

Tolerances

Satisfactory demonstration of proficiency in steep turns a turn of at least 180 degrees in each direction must be completed maintaining assigned altitude $\pm$ 100 ft at 250 kts $\pm$ 10 kts and roll out on assigned heading $\pm$ 10°.

Instantaneous Vertical Speed Indicator (IVSI)

This instrument interprets the change of acceleration and displays this as a change to vertical speed. Thus, a rapid increase in g forces as a steep turn is entered causes a transient display of approximately 200 FPM climb, even though the airplane is maintaining altitude perfectly, and conversely, a transient of approximately 200 FPM descent appears due to the reduction in g force during a fast rollout. Allow for this feature by relying on the IVSI for correct indications only during periods of steady g force.

Altimeter

The altimeter is accurate and useful during steep turns. Be alert to the direction and rate of altimeter needle movement, using smooth elevator control pressure changes for corrections.

Horizontal Situation Indicator (HSI)

During steep turns, each of the airplane's two compass systems usually displays a different indication on the Captain's and the First Officer's HSI's. This is caused by the individual response of each directional gyro, associated amplifier, and flux valve. Therefore, the HSI's may differ as much as 20° during the turn and for a short period rollout.

Airspeed

The airspeed is very slow to change due to the relatively small changes in thrust and drag. Anticipate the requirements for thrust changes and apply them at the first positive indication of change on the airspeed indicator. Normally a slight increase in thrust will be required. (Note: If the airspeed bug is rotated to 250 knots on the airspeed indicator, it will assist in the instrument scan.)

Rollout

Be alert to correct for the more than normal pitch attitude and power used during the turn. Roll out at the same rate as used with normal turns. Normally the desired heading should be led by 10-15 degrees; however, individual technique will determine the exact amount of lead.

Table 1

16 Original Control Status Measures*

Number	Control Status
1	No control movements
2	Stick decision being made
3	Positive stick input being made
4	Negative stick input being made
5	Wheel decision being made
6	Positive wheel input being made
7	Negative wheel input being made
8	Stick and wheel decisions being made
9	Positive stick input/wheel decision
10	Negative stick input/wheel decision
11	Stick decision/positive wheel input
12	Stick decision/negative wheel input
13	Positive stick input/positive wheel input
14	Positive stick input/negative wheel input
15	Negative stick input/positive wheel input
16	Negative stick input/negative wheel input

*The terms positive and negative are used generically to describe the direction of the control input. In actuality they represent:

Control	Positive	Negative
Stick	Nose up	Nose down
Wheel	Left turn	Right turn

Appendix B

TABLE 1

GOODNESS OF FIT MATRIX FOR IP3L
USING THREE PREVIOUS LOOKPOINTS
A=ACTUAL TRANSITIONS
P=PREDICTED TRANSITIONS *
C=CHI-SQUARE VALUES

	AS	ROLL	CBARS	ALT	ADF	HSI	IVSI	ENG	NON	ROW
A-	63.00	3.00	1.00	2.00	1.00	0.00	0.00	0.00	2.00	9.00
P-	57.10	3.60	1.20	1.60	1.00	0.00	0.00	0.00	1.80	9.20
C-	0.55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	1.00	247.00	9.00	1.00	0.00	0.00	0.00	0.00	12.00	2.00
P-	0.60	248.20	8.10	1.30	0.00	0.00	0.00	0.00	12.30	1.90
C-	0.00	0.01	0.09	0.00	0.00	0.00	0.00	0.00	0.01	0.00
A-	2.00	8.00	238.00	1.00	1.00	0.00	0.00	0.00	9.00	4.00
P-	1.80	8.00	199.60	1.30	0.80	0.00	0.00	0.00	7.70	3.90
C-	0.00	0.00	6.20	0.00	0.00	0.00	0.00	0.00	0.19	0.00
A-	2.00	1.00	1.00	227.00	0.00	0.00	0.00	0.00	14.00	4.00
P-	3.30	1.00	0.70	266.20	0.00	0.00	0.00	0.00	14.40	5.00
C-	0.00	0.00	0.00	6.77	0.00	0.00	0.00	0.00	0.01	0.00
A-	0.00	0.00	1.00	2.00	7.00	0.00	0.00	0.00	1.00	4.00
P-	0.00	0.00	1.30	2.50	4.10	0.00	0.00	0.00	1.00	4.80
C-	0.00	0.00	0.00	0.00	1.20	0.00	0.00	0.00	0.00	0.00
A-	0.00	3.00	0.00	0.00	2.00	127.00	0.00	0.00	6.00	5.00
P-	0.00	2.30	0.00	0.00	1.30	134.90	0.00	0.00	6.80	3.60
C-	0.00	0.00	0.00	0.00	0.00	0.49	0.00	0.00	0.11	0.39
A-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	4.00	8.00	8.00	12.00	1.00	11.00	0.00	0.00	64.00	5.00
P-	3.50	7.70	8.60	12.80	1.80	10.50	0.00	0.00	59.30	5.30
C-	0.00	0.01	0.05	0.05	0.00	0.02	0.00	0.00	0.35	0.02

NUMBER OF CELLS = 20
DEGREES OF FREEDOM = 19
CHI-SQUARE = 16.511

*- AVERAGE OF 10 PREDICTIONS

GOODNESS OF FIT MATRIX FOR IP3R
USING THREE PREVIOUS LOOKPOINTS
A=ACTUAL TRANSITIONS
P=PREDICTED TRANSITIONS *
C=CHI-SQUARE VALUES

	AS	ROLL	CBARS	ALT	ADF	HSI	IVSI	ENG	NON	ROW
A-	75.00	0.00	5.00	1.00	0.00	2.00	0.00	0.00	2.00	5.00
P-	75.90	0.00	4.20	0.50	0.00	2.10	0.00	0.00	2.30	4.90
C-	0.01	0.00	0.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	0.00	249.00	10.00	9.00	1.00	0.00	0.00	0.00	6.00	1.00
P-	0.00	199.60	9.00	8.10	1.20	0.00	0.00	0.00	5.50	1.20
C-	0.00	9.80	0.10	0.09	0.00	0.00	0.00	0.00	0.04	0.04
A-	2.00	15.00	232.00	0.00	0.00	1.00	0.00	0.00	8.00	3.00
P-	1.60	14.40	256.80	0.00	0.00	1.10	0.00	0.00	7.90	2.70
C-	0.00	0.02	2.65	0.00	0.00	0.00	0.00	0.00	0.00	0.03
A-	0.00	2.00	0.00	223.00	0.00	0.00	0.00	0.00	17.00	2.00
P-	0.00	2.00	0.00	238.00	0.00	0.00	0.00	0.00	17.20	2.00
C-	0.00	0.00	0.00	1.01	0.00	0.00	0.00	0.00	0.00	0.00
A-	1.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	2.00
P-	0.70	0.00	0.00	0.00	0.00	1.20	0.00	0.00	0.00	1.90
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	0.00	0.00	3.00	0.00	0.00	112.00	0.00	0.00	7.00	3.00
P-	0.00	0.00	3.40	0.00	0.00	99.60	0.00	0.00	7.10	3.40
C-	0.00	0.00	0.00	0.00	0.00	1.37	0.00	0.00	0.00	0.05
A-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	7.00	8.00	8.00	9.00	1.00	6.00	0.00	0.00	107.00	1.00
P-	6.80	7.50	8.60	10.80	0.70	6.40	0.00	0.00	126.80	0.70
C-	0.01	0.03	0.05	0.36	0.00	0.03	0.00	0.00	3.66	0.09

NUMBER OF CELLS = 26
DEGREES OF FREEDOM = 25
CHI-SQUARE = 19.586

*- AVERAGE OF 10 PREDICTIONS

TABLE 3

GOODNESS OF FIT MATRIX FOR IP4L
USING THREE PREVIOUS LOCKPOINTS
A=ACTUAL TRANSITIONS
P=PREDICTED TRANSITIONS *
C=CHI-SQUARE VALUES

	AS	ROLL	CBARS	ALT	ADF	HSI	IVSI	ENG	NON	ROW
A-	6.00	0.00	3.00	0.00	0.00	0.00	0.00	0.00	2.00	5.00
P-	7.70	0.00	2.50	0.00	0.00	0.00	0.00	0.00	2.40	4.90
C-	0.48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	0.00	102.00	8.00	0.00	0.00	0.00	0.00	0.00	7.00	0.00
P-	0.00	127.60	9.60	0.00	0.00	0.00	0.00	0.00	7.90	0.00
C-	0.00	6.43	0.32	0.00	0.00	0.00	0.00	0.00	0.12	0.00
A-	1.00	11.00	473.00	0.00	0.00	0.00	0.00	0.00	19.00	1.00
P-	1.40	13.10	455.00	0.00	0.00	0.00	0.00	0.00	18.20	1.40
C-	0.00	0.40	0.68	0.00	0.00	0.00	0.00	0.00	0.03	0.16
A-	0.00	3.00	1.00	236.00	0.00	0.00	0.00	0.00	20.00	4.00
P-	0.00	2.70	0.80	227.20	0.00	0.00	0.00	0.00	20.10	3.50
C-	0.00	0.00	0.00	0.33	0.00	0.00	0.00	0.00	0.00	0.06
A-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	0.00	0.00	1.00	0.00	0.00	24.00	0.00	0.00	1.00	2.00
P-	0.00	0.00	1.20	0.00	0.00	17.40	0.00	0.00	0.30	1.50
C-	0.00	0.00	0.00	0.00	0.00	1.81	0.00	0.00	0.00	0.13
A-	0.00	0.00	0.00	1.00	0.00	0.00	10.00	0.00	1.00	2.00
P-	0.00	0.00	0.00	0.70	0.00	0.00	8.20	0.00	0.90	1.60
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.32	0.00	0.00	0.08
A-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	4.00	2.00	17.00	23.00	0.00	2.00	2.00	0.00	160.00	10.00
P-	3.50	1.90	19.00	23.10	0.00	1.50	1.60	0.00	161.50	8.50
C-	0.00	0.00	0.24	0.00	0.00	0.00	0.00	0.00	0.01	0.22

NUMBER OF CELLS = 20
DEGREES OF FREEDOM = 19
CHI-SQUARE = 11.834

*- AVERAGE OF 10 PREDICTIONS

GOODNESS OF FIT MATRIX FOR IP4R
USING THREE PREVIOUS LOOKPOINTS
A=ACTUAL TRANSITIONS
P=PREDICTED TRANSITIONS *
C=CHI-SQUARE VALUES

	AS	ROLL	CBARS	ALT	ADF	HSI	IVSI	ENG	NON	ROW
A-	17.00	0.00	2.00	2.00	0.00	0.00	0.00	0.00	3.00	7.00
P-	11.80	0.00	2.30	2.50	0.00	0.00	0.00	0.00	2.60	7.40
C-	1.59	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02
A-	1.00	96.00	10.00	1.00	0.00	0.00	0.00	0.00	1.00	3.00
P-	0.90	88.60	9.50	0.80	0.00	0.00	0.00	0.00	1.40	3.10
C-	0.00	0.57	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	1.00	7.00	450.00	3.00	0.00	3.00	0.00	0.00	17.00	7.00
P-	1.00	6.10	407.60	2.60	0.00	3.50	0.00	0.00	15.60	7.10
C-	0.00	0.12	4.00	0.00	0.00	0.00	0.00	0.00	0.12	0.00
A-	1.00	2.00	2.00	162.00	0.00	1.00	2.00	0.00	20.00	8.00
P-	1.10	2.10	2.10	170.50	0.00	1.10	2.60	0.00	21.70	9.00
C-	0.00	0.00	0.00	0.45	0.00	0.00	0.00	0.00	0.14	0.13
A-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	0.00	0.00	0.00	0.00	0.00	41.00	0.00	0.00	6.00	0.00
P-	0.00	0.00	0.00	0.00	0.00	49.50	0.00	0.00	7.10	0.00
C-	0.00	0.00	0.00	0.00	0.00	1.76	0.00	0.00	0.20	0.00
A-	0.00	0.00	0.00	1.00	0.00	0.00	23.00	0.00	3.00	4.00
P-	0.00	0.00	0.00	1.40	0.00	0.00	25.50	0.00	3.30	4.70
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.27	0.00	0.00	0.12
A-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	4.00	4.00	16.00	21.00	0.00	2.00	2.00	0.00	135.00	12.00
P-	4.50	4.60	15.40	23.50	0.00	2.50	2.20	0.00	161.50	13.80
C-	0.00	0.00	0.02	0.30	0.00	0.00	0.00	0.00	5.20	0.27

NUMBER OF CELLS = 20
DEGREES OF FREEDOM = 19
CHI-SQUARE = 15.305

*- AVERAGE OF 10 PREDICTIONS

GOODNESS OF FIT MATRIX FOR POIL
USING THREE PREVIOUS LOOKPOINTS
A=ACTUAL TRANSITIONS
P=PREDICTED TRANSITIONS *
C=CHI-SQUARE VALUES

	AS	ROLL	CBARS	ALT	ADF	HSI	IVSI	ENG	NON	ROW
A-	82.00	0.00	4.00	0.00	0.00	0.00	0.00	0.00	1.00	5.00
P-	84.90	0.00	3.30	0.00	0.00	0.00	0.00	0.00	1.00	4.30
C-	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10
A-	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	2.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.00
A-	2.00	0.00	708.00	2.00	0.00	0.00	1.00	0.00	15.00	5.00
P-	1.60	0.00	677.40	2.50	0.00	0.00	0.90	0.00	15.60	5.00
C-	0.00	0.00	1.32	0.00	0.00	0.00	0.00	0.00	0.02	0.00
A-	0.00	0.00	2.00	38.00	0.00	0.00	1.00	0.00	6.00	3.00
P-	0.00	0.00	2.50	39.60	0.00	0.00	1.30	0.00	7.30	3.80
C-	0.00	0.00	0.00	0.07	0.00	0.00	0.00	0.00	0.28	0.21
A-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	0.00	0.00	0.00	3.00	0.00	0.00	62.00	0.00	0.00	3.00
P-	0.00	0.00	0.00	3.30	0.00	0.00	70.10	0.00	0.00	3.30
C-	0.00	0.00	0.00	0.00	0.00	0.00	1.06	0.00	0.00	0.03
A-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	3.00	0.00	14.00	5.00	0.00	0.00	1.00	0.00	130.00	4.00
P-	2.70	0.00	15.70	5.30	0.00	0.00	1.10	0.00	142.90	3.80
C-	0.00	0.00	0.21	0.02	0.00	0.00	0.00	0.00	1.28	0.01

NUMBER OF CELLS = 15
DEGREES OF FREEDOM = 14
CHI-SQUARE = 6.712

*- AVERAGE OF 10 PREDICTIONS

TABLE 6

GOODNESS OF FIT MATRIX FOR POLR
USING THREE PREVIOUS LOOKPOINTS
A=ACTUAL TRANSITIONS
P=PREDICTED TRANSITIONS *
C=CHI-SQUARE VALUES

	AS	ROLL	CBARS	ALT	ADF	HSI	IVSI	ENG	NON	ROW
A-	116.00	0.00	3.00	0.00	0.00	0.00	0.00	0.00	3.00	6.00
P-	96.50	0.00	3.60	0.00	0.00	0.00	0.00	0.00	1.70	5.30
C-	3.28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08
A-	0.00	23.00	1.00	0.00	0.00	0.00	0.00	0.00	2.00	3.00
P-	0.00	25.00	0.90	0.00	0.00	0.00	0.00	0.00	1.80	2.70
C-	0.00	0.17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03
A-	1.00	0.00	317.00	0.00	0.00	0.00	2.00	0.00	22.00	3.00
P-	1.00	0.00	317.00	0.00	0.00	0.00	2.40	0.00	22.60	3.40
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.05
A-	0.00	0.00	0.00	85.00	0.00	0.00	0.00	0.00	7.00	0.00
P-	0.00	0.00	0.00	111.50	0.00	0.00	0.00	0.00	7.20	0.00
C-	0.00	0.00	0.00	8.26	0.00	0.00	0.00	0.00	0.01	0.00
A-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	0.00	0.00	2.00	0.00	0.00	0.00	115.00	0.00	0.00	2.00
P-	0.00	0.00	2.10	0.00	0.00	0.00	108.10	0.00	0.00	2.10
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.41	0.00	0.00	0.00
A-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	55.00	6.00	0.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	46.90	5.70	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.19	0.02	0.00
A-	5.00	3.00	20.00	7.00	0.00	0.00	0.00	5.00	303.00	3.00
P-	4.30	2.70	20.00	7.20	0.00	0.00	0.00	5.60	306.20	2.70
C-	0.10	0.00	0.00	0.01	0.00	0.00	0.00	0.07	0.03	0.03

NUMBER OF CELLS = 19
DEGREES OF FREEDOM = 18
CHI-SQUARE = 13.767

*- AVERAGE OF 10 PREDICTIONS

GOODNESS OF FIT MATRIX FOR P02L
USING THREE PREVIOUS LOOKPOINTS
A=ACTUAL TRANSITIONS
P=PREDICTED TRANSITIONS *
C=CHI-SQUARE VALUES

	AS	ROLL	CBARS	ALT	ADF	HSI	IVSI	ENG	NON	ROW
A-	38.00	0.00	3.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00
P-	51.30	0.00	4.00	0.00	0.00	0.00	0.00	0.00	0.00	4.00
C-	4.66	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.33
A-	0.00	92.00	2.00	3.00	0.00	0.00	0.00	0.00	5.00	5.00
P-	0.00	94.70	2.30	3.10	0.00	0.00	0.00	0.00	4.60	5.40
C-	0.00	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.03
A-	2.00	5.00	578.00	1.00	0.00	0.00	0.00	0.00	16.00	3.00
P-	2.60	4.90	573.90	1.30	0.00	0.00	0.00	0.00	15.90	3.90
C-	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.27
A-	0.00	0.00	4.00	178.00	0.00	0.00	0.00	0.00	10.00	4.00
P-	0.00	0.00	4.40	165.80	0.00	0.00	0.00	0.00	9.40	4.40
C-	0.00	0.00	0.00	0.84	0.00	0.00	0.00	0.00	0.04	0.04
A-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	0.00	0.00	0.00	0.00	0.00	60.00	0.00	0.00	5.00	0.00
P-	0.00	0.00	0.00	0.00	0.00	52.90	0.00	0.00	5.10	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.84	0.00	0.00	0.00	0.00
A-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	1.00	6.00	14.00	10.00	0.00	5.00	0.00	0.00	85.00	1.00
P-	1.40	5.10	14.60	9.60	0.00	5.30	0.00	0.00	87.80	1.40
C-	0.00	0.13	0.03	0.02	0.00	0.02	0.00	0.00	0.09	0.16

NUMBER OF CELLS = 20
DEGREES OF FREEDOM = 19
CHI-SQUARE = 7.635

*- AVERAGE OF 10 PREDICTIONS

TABLE 8

GOODNESS OF FIT MATRIX FOR P02R
USING THREE PREVIOUS LOOKPOINTS
A=ACTUAL TRANSITIONS
P=PREDICTED TRANSITIONS *
C=CHI-SQUARE VALUES

	AS	ROLL	CBARS	ALT	ADF	HSI	IVSI	ENG	NON	ROW
A-	42.00	0.00	1.00	0.00	0.00	0.00	1.00	0.00	1.00	3.00
P-	66.60	0.00	1.00	0.00	0.00	0.00	1.20	0.00	2.10	4.30
C-	14.41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.56
A-	0.00	99.00	5.00	0.00	0.00	0.00	0.00	0.00	6.00	0.00
P-	0.00	94.80	4.30	0.00	0.00	0.00	0.00	0.00	5.90	0.00
C-	0.00	0.18	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	1.00	2.00	653.00	2.00	0.00	0.00	0.00	0.00	17.00	5.00
P-	1.20	1.80	634.70	1.90	0.00	0.00	0.00	0.00	16.40	4.90
C-	0.00	0.00	0.51	0.00	0.00	0.00	0.00	0.00	0.02	0.00
A-	0.00	0.00	3.00	97.00	0.00	0.00	0.00	0.00	4.00	7.00
P-	0.00	0.00	3.40	81.20	0.00	0.00	0.00	0.00	3.50	6.90
C-	0.00	0.00	0.00	2.57	0.00	0.00	0.00	0.00	0.00	0.00
A-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	0.00	1.00	0.00	0.00	0.00	56.00	0.00	0.00	3.00	4.00
P-	0.00	0.90	0.00	0.00	0.00	54.50	0.00	0.00	2.80	3.70
C-	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.02
A-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.20	0.00	1.20
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04
A-	0.00	0.00	1.00	0.00	0.00	0.00	0.00	47.00	1.00	2.00
P-	0.00	0.00	1.00	0.00	0.00	0.00	0.00	52.70	1.40	2.40
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.69	0.00	0.08
A-	2.00	8.00	11.00	5.00	0.00	4.00	0.00	1.00	68.00	7.00
P-	3.10	7.70	12.10	5.00	0.00	3.90	0.00	1.10	72.60	8.10
C-	0.00	0.01	0.11	0.00	0.00	0.00	0.00	0.00	0.31	0.17

NUMBER OF CELLS = 20
DEGREES OF FREEDOM = 19
CHI-SQUARE = 19.840

*- AVERAGE OF 10 PREDICTIONS

TABLE 9

GOODNESS OF FIT MATRIX FOR P03L
USING THREE PREVIOUS LOOKPOINTS
A=ACTUAL TRANSITIONS
P=PREDICTED TRANSITIONS *
C=CHI-SQUARE VALUES

	AS	ROLL	CBARS	ALT	ADF	HSI	IVSI	ENG	NON	ROW
A-	14.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	1.00	2.00
P-	12.30	0.00	0.00	0.00	1.20	0.00	0.00	0.00	0.90	2.10
C-	0.21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	0.00	50.00	0.00	1.00	0.00	0.00	0.00	0.00	5.00	1.00
P-	0.00	56.60	0.00	1.20	0.00	0.00	0.00	0.00	5.60	1.20
C-	0.00	0.87	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.04
A-	2.00	0.00	554.00	2.00	0.00	2.00	0.00	0.00	14.00	6.00
P-	2.10	0.00	518.40	1.80	0.00	1.80	0.00	0.00	13.60	5.70
C-	0.00	0.00	2.29	0.00	0.00	0.00	0.00	0.00	0.01	0.02
A-	0.00	2.00	4.00	204.00	0.00	0.00	1.00	0.00	12.00	7.00
P-	0.00	2.60	3.70	206.90	0.00	0.00	0.60	0.00	13.30	6.90
C-	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.14	0.00
A-	0.00	0.00	0.00	0.00	7.00	0.00	0.00	0.00	1.00	1.00
P-	0.00	0.00	0.00	0.00	9.80	0.00	0.00	0.00	1.20	1.20
C-	0.00	0.00	0.00	0.00	1.12	0.00	0.00	0.00	0.00	0.04
A-	0.00	0.00	1.00	0.00	0.00	26.00	0.00	0.00	2.00	3.00
P-	0.00	0.00	1.60	0.00	0.00	38.00	0.00	0.00	1.80	3.40
C-	0.00	0.00	0.00	0.00	0.00	5.54	0.00	0.00	0.00	0.05
A-	0.00	0.00	0.00	3.00	0.00	0.00	52.00	0.00	3.00	6.00
P-	0.00	0.00	0.00	2.60	0.00	0.00	53.20	0.00	3.00	5.60
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.03
A-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	0.00	4.00	15.00	13.00	0.00	2.00	5.00	0.00	81.00	6.00
P-	0.00	4.30	14.40	14.80	0.00	1.60	5.10	0.00	87.00	5.90
C-	0.00	0.00	0.02	0.25	0.00	0.00	0.00	0.00	0.44	0.00

NUMBER OF CELLS = 22
DEGREES OF FREEDOM = 21
CHI-SQUARE = 11.220

*- AVERAGE OF 10 PREDICTIONS

GOODNESS OF FIT MATRIX FOR P03R
USING THREE PREVIOUS LOOKPOINTS
A=ACTUAL TRANSITIONS
P=PREDICTED TRANSITIONS *
C=CHI-SQUARE VALUES

	AS	ROLL	CBARS	ALT	ADF	HSI	IVSI	ENG	NON	ROW
A-	37.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	1.00	2.00
P-	42.80	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.80	1.80
C-	0.91	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02
A-	0.00	32.00	8.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-	0.00	33.00	8.90	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.03	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	2.00	2.00	778.00	3.00	0.00	2.00	1.00	0.00	14.00	10.00
P-	2.00	2.00	774.90	3.00	0.00	2.20	0.90	0.00	13.90	10.10
C-	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	0.00	0.00	2.00	165.00	0.00	0.00	2.00	0.00	7.00	4.00
P-	0.00	0.00	2.70	161.80	0.00	0.00	1.30	0.00	6.40	4.00
C-	0.00	0.00	0.00	0.06	0.00	0.00	0.00	0.00	0.05	0.00
A-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	0.00	0.00	0.00	0.00	0.00	34.00	0.00	0.00	3.00	3.00
P-	0.00	0.00	0.00	0.00	0.00	43.20	0.00	0.00	3.40	3.40
C-	0.00	0.00	0.00	0.00	0.00	2.49	0.00	0.00	0.00	0.05
A-	0.00	0.00	1.00	4.00	0.00	0.00	82.00	0.00	2.00	7.00
P-	0.00	0.00	0.80	3.40	0.00	0.00	66.60	0.00	1.70	5.90
C-	0.00	0.00	0.00	0.00	0.00	0.00	2.89	0.00	0.00	0.17
A-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	0.00	6.00	12.00	4.00	0.00	1.00	4.00	0.00	28.00	9.00
P-	0.00	6.90	11.20	4.10	0.00	1.30	3.70	0.00	31.10	9.10
C-	0.00	0.13	0.05	0.00	0.00	0.00	0.00	0.00	0.34	0.00

NUMBER OF CELLS = 18
DEGREES OF FREEDOM = 17
CHI-SQUARE = 7.330

*- AVERAGE OF 10 PREDICTIONS

GOODNESS OF FIT MATRIX FOR P05L
USING THREE PREVIOUS LOOKPOINTS
A=ACTUAL TRANSITIONS
P=PREDICTED TRANSITIONS *
C=CHI-SQUARE VALUES

	AS	ROLL	CBARS	ALT	ADF	HSI	IVSI	ENG	NON	ROW
A-	131.00	4.00	1.00	1.00	0.00	0.00	0.00	0.00	1.00	7.00
P-	120.20	4.30	0.80	0.60	0.00	0.00	0.00	0.00	1.10	6.80
C-	0.89	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
A-	4.00	405.00	0.00	4.00	0.00	1.00	0.00	0.00	21.00	9.00
P-	4.30	398.90	0.00	5.00	0.00	1.00	0.00	0.00	21.00	10.30
C-	0.00	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.19
A-	0.00	12.00	156.00	0.00	0.00	1.00	0.00	0.00	6.00	1.00
P-	0.00	13.60	162.20	0.00	0.00	1.40	0.00	0.00	5.40	1.40
C-	0.00	0.21	0.25	0.00	0.00	0.00	0.00	0.00	0.06	0.16
A-	1.00	5.00	0.00	266.00	0.00	0.00	2.00	0.00	6.00	3.00
P-	1.20	5.20	0.00	279.30	0.00	0.00	2.10	0.00	6.30	3.30
C-	0.00	0.01	0.00	0.66	0.00	0.00	0.00	0.00	0.02	0.03
A-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	0.00	1.00	0.00	0.00	0.00	92.00	0.00	0.00	4.00	5.00
P-	0.00	0.90	0.00	0.00	0.00	97.40	0.00	0.00	4.10	5.00
C-	0.00	0.00	0.00	0.00	0.00	0.32	0.00	0.00	0.00	0.00
A-	0.00	0.00	0.00	1.00	0.00	0.00	52.00	0.00	3.00	4.00
P-	0.00	0.00	0.00	1.40	0.00	0.00	39.20	0.00	2.30	3.70
C-	0.00	0.00	0.00	0.00	0.00	0.00	3.15	0.00	0.00	0.02
A-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	2.00	8.00	18.00	8.00	0.00	3.00	2.00	0.00	80.00	7.00
P-	1.40	7.60	19.60	8.00	0.00	2.80	1.70	0.00	78.70	5.90
C-	0.00	0.02	0.14	0.00	0.00	0.00	0.00	0.00	0.02	0.17

NUMBER OF CELLS = 22
DEGREES OF FREEDOM = 21
CHI-SQUARE = 6.420

*- AVERAGE OF 10 PREDICTIONS

TABLE 12

GOODNESS OF FIT MATRIX FOR P05R
USING THREE PREVIOUS LOOKPOINTS
A=ACTUAL TRANSITIONS
P=PREDICTED TRANSITIONS *
C=CHI-SQUARE VALUES

	AS	ROLL	CBARS	ALT	ADF	HSI	IVSI	ENG	NON	ROW
A-	36.00	3.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	4.00
P-	26.40	2.70	0.00	0.50	0.00	0.00	0.00	0.00	0.00	3.20
C-	2.56	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.16
A-	1.00	299.00	8.00	10.00	0.00	0.00	0.00	0.00	22.00	1.00
P-	1.00	347.30	6.50	11.00	0.00	0.00	0.00	0.00	22.90	1.00
C-	0.00	7.80	0.28	0.10	0.00	0.00	0.00	0.00	0.04	0.00
A-	1.00	11.00	312.00	0.00	0.00	0.00	0.00	0.00	21.00	1.00
P-	0.30	12.50	288.20	0.00	0.00	0.00	0.00	0.00	17.60	0.30
C-	0.00	0.20	1.82	0.00	0.00	0.00	0.00	0.00	0.55	0.49
A-	1.00	13.00	0.00	286.00	0.00	0.00	1.00	0.00	8.00	2.00
P-	0.90	11.30	0.00	278.70	0.00	0.00	1.20	0.00	9.90	2.10
C-	0.00	0.22	0.00	0.19	0.00	0.00	0.00	0.00	0.45	0.00
A-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	0.00	0.00	0.00	0.00	0.00	2.00	0.00	0.00	1.00	3.00
P-	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.50	1.50
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.75
A-	0.00	0.00	0.00	2.00	0.00	0.00	36.00	0.00	2.00	4.00
P-	0.00	0.00	0.00	1.80	0.00	0.00	36.70	0.00	2.00	3.80
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.01
A-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	1.00	15.00	25.00	9.00	0.00	1.00	3.00	0.00	131.00	5.00
P-	1.10	15.20	24.10	10.20	0.00	0.50	2.60	0.00	124.40	4.20
C-	0.00	0.00	0.03	0.16	0.00	0.00	0.00	0.00	0.33	0.13

NUMBER OF CELLS = 23
DEGREES OF FREEDOM = 22
CHI-SQUARE = 16.295

*- AVERAGE OF 10 PREDICTIONS

GOODNESS OF FIT MATRIX FOR P06L
USING THREE PREVIOUS LOOKPOINTS
A=ACTUAL TRANSITIONS
P=PREDICTED TRANSITIONS *
C=CHI-SQUARE VALUES

	AS	ROLL	CBARS	ALT	ADF	HSI	IVSI	ENG	NON	ROW
A-	3.00	1.00	1.00	0.00	2.00	0.00	0.00	0.00	1.00	8.00
P-	4.30	1.20	0.80	0.00	2.30	0.00	0.00	0.00	1.30	9.90
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.45
A-	1.00	283.00	4.00	5.00	0.00	4.00	0.00	0.00	11.00	9.00
P-	1.30	319.50	4.00	5.00	0.00	5.50	0.00	0.00	11.30	10.80
C-	0.00	4.71	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.36
A-	1.00	7.00	237.00	0.00	0.00	0.00	0.00	0.00	18.00	1.00
P-	1.40	7.50	230.90	0.00	0.00	0.00	0.00	0.00	18.50	1.40
C-	0.00	0.04	0.16	0.00	0.00	0.00	0.00	0.00	0.01	0.16
A-	0.00	3.00	2.00	194.00	0.00	1.00	3.00	1.00	5.00	10.00
P-	0.00	4.00	1.80	177.70	0.00	0.30	2.70	0.60	4.20	9.40
C-	0.00	0.00	0.00	1.37	0.00	0.00	0.00	0.00	0.13	0.04
A-	0.00	0.00	2.00	0.00	30.00	0.00	0.00	0.00	2.00	4.00
P-	0.00	0.00	3.50	0.00	28.70	0.00	0.00	0.00	1.50	5.00
C-	0.00	0.00	0.00	0.00	0.06	0.00	0.00	0.00	0.00	0.25
A-	0.00	2.00	3.00	0.00	0.00	89.00	0.00	0.00	3.00	8.00
P-	0.00	2.10	2.20	0.00	0.00	71.40	0.00	0.00	3.70	8.00
C-	0.00	0.00	0.00	0.00	0.00	3.48	0.00	0.00	0.00	0.00
A-	0.00	0.00	1.00	2.00	1.00	0.00	54.00	0.00	3.00	7.00
P-	0.00	0.00	1.10	1.30	1.90	0.00	53.70	0.00	2.80	7.10
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	14.00	1.00	1.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.70	0.60	0.60
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.81	0.00	0.16
A-	3.00	11.00	14.00	8.00	1.00	3.00	4.00	0.00	80.00	11.00
P-	2.90	12.60	14.10	7.80	0.80	2.30	4.40	0.00	83.80	10.40
C-	0.00	0.23	0.00	0.00	0.00	0.00	0.00	0.00	0.18	0.03

NUMBER OF CELLS = 25
DEGREES OF FREEDOM = 24
CHI-SQUARE = 15.635

*- AVERAGE OF 10 PREDICTIONS

TABLE 14

GOODNESS OF FIT MATRIX FOR P06R
USING THREE PREVIOUS LOOKPOINTS
A=ACTUAL TRANSITIONS
P=PREDICTED TRANSITIONS *
C=CHI-SQUARE VALUES

	AS	ROLL	CBARS	ALT	ADF	HSI	IVSI	ENG	NON	ROW
A-	5.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	1.00	2.00
P-	6.10	0.00	0.00	0.00	1.00	0.00	0.00	0.00	1.10	2.10
C-	0.24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	0.00	57.00	3.00	2.00	0.00	0.00	0.00	0.00	3.00	3.00
P-	0.00	56.20	3.00	1.90	0.00	0.00	0.00	0.00	2.10	7.00
C-	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.12
A-	0.00	2.00	511.00	1.00	2.00	1.00	0.00	0.00	23.00	6.00
P-	0.00	1.50	532.60	1.10	2.30	0.90	0.00	0.00	24.50	5.80
C-	0.00	0.00	0.91	0.00	0.00	0.00	0.00	0.00	0.10	0.01
A-	0.00	1.00	1.00	205.00	0.00	1.00	2.00	0.00	12.00	5.00
P-	0.00	0.80	1.30	172.40	0.00	0.70	1.90	0.00	11.00	4.70
C-	0.00	0.00	0.00	5.18	0.00	0.00	0.00	0.00	0.08	0.02
A-	0.00	0.00	0.00	1.00	32.00	0.00	0.00	0.00	2.00	3.00
P-	0.00	0.00	0.00	1.00	41.20	0.00	0.00	0.00	2.20	3.20
C-	0.00	0.00	0.00	0.00	2.64	0.00	0.00	0.00	0.00	0.01
A-	1.00	0.00	1.00	0.00	0.00	114.00	0.00	0.00	6.00	2.00
P-	1.10	0.00	1.30	0.00	0.00	110.10	0.00	0.00	5.90	2.40
C-	0.00	0.00	0.00	0.00	0.00	0.13	0.00	0.00	0.00	0.08
A-	0.00	0.00	1.00	0.00	0.00	1.00	60.00	0.00	4.00	6.00
P-	0.00	0.00	1.40	0.00	0.00	1.30	70.00	0.00	4.00	6.70
C-	0.00	0.00	0.00	0.00	0.00	0.00	1.67	0.00	0.00	0.08
A-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	1.00	5.00	24.00	12.00	0.00	5.00	4.00	0.00	90.00	5.00
P-	1.00	4.70	23.90	11.90	0.00	5.40	4.80	0.00	81.40	5.80
C-	0.00	0.02	0.00	0.00	0.00	0.03	0.00	0.00	0.82	0.13

NUMBER OF CELLS = 23
DEGREES OF FREEDOM = 22
CHI-SQUARE = 12.309

*- AVERAGE OF 10 PREDICTIONS

TABLE 15

GOODNESS OF FIT MATRIX FOR P07L
USING THREE PREVIOUS LOOKPOINTS
A=ACTUAL TRANSITIONS
P=PREDICTED TRANSITIONS *
C=CHI-SQUARE VALUES

	AS	ROLL	CBARS	ALT	ADF	HSI	IVSI	ENG	NON	ROW
A-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	0.00	138.00	10.00	3.00	0.00	0.00	0.00	0.00	4.00	7.00
P-	0.00	126.30	9.20	2.30	0.00	0.00	0.00	0.00	4.00	6.30
C-	0.00	0.99	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.07
A-	0.00	11.00	593.00	0.00	0.00	0.00	0.00	0.00	10.00	0.00
P-	0.00	9.40	602.30	0.00	0.00	0.00	0.00	0.00	11.40	0.00
C-	0.00	0.23	0.15	0.00	0.00	0.00	0.00	0.00	0.20	0.00
A-	0.00	2.00	0.00	84.00	0.00	0.00	0.00	0.00	4.00	6.00
P-	0.00	2.30	0.00	77.20	0.00	0.00	0.00	0.00	3.60	5.90
C-	0.00	0.00	0.00	0.55	0.00	0.00	0.00	0.00	0.00	0.00
A-	0.00	0.00	0.00	0.00	37.00	0.00	0.00	0.00	2.00	2.00
P-	0.00	0.00	0.00	0.00	37.30	0.00	0.00	0.00	2.00	2.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	0.00	0.00	0.00	0.00	0.00	30.00	0.00	0.00	1.00	1.00
P-	0.00	0.00	0.00	0.00	0.00	23.60	0.00	0.00	1.10	1.10
C-	0.00	0.00	0.00	0.00	0.00	1.37	0.00	0.00	0.00	0.01
A-	0.00	1.00	0.00	0.00	0.00	0.00	27.00	0.00	1.00	2.00
P-	0.00	1.50	0.00	0.00	0.00	0.00	28.40	0.00	0.70	2.20
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.00	0.00	0.02
A-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	0.00	3.00	11.00	3.00	2.00	1.00	2.00	0.00	83.00	11.00
P-	0.00	2.50	11.90	3.70	2.10	1.20	2.30	0.00	93.70	11.80
C-	0.00	0.00	0.07	0.00	0.00	0.00	0.00	0.00	1.38	0.06

NUMBER OF CELLS = 17
DEGREES OF FREEDOM = 16
CHI-SQUARE = 5.234

*- AVERAGE OF 10 PREDICTIONS

TABLE 16

GOODNESS OF FIT MATRIX FOR P07R
USING THREE PREVIOUS LOCKPOINTS
A=ACTUAL TRANSITIONS
P=PREDICTED TRANSITIONS *
C=CHI-SQUARE VALUES

	AS	ROLL	CBARS	ALT	ADF	HSI	IVSI	ENG	NON	ROW
A-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	0.00	4.00	3.00	0.00	0.00	0.00	0.00	0.00	2.00	9.00
P-	0.00	3.20	3.20	0.00	0.00	0.00	0.00	0.00	1.40	7.80
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.16
A-	0.00	1.00	696.00	2.00	0.00	1.00	1.00	0.00	7.00	5.00
P-	0.00	0.90	671.50	2.00	0.00	0.40	0.80	0.00	7.40	4.10
C-	0.00	0.00	0.86	0.00	0.00	0.00	0.00	0.00	0.02	0.16
A-	0.00	4.00	0.00	57.00	0.00	0.00	0.00	0.00	2.00	6.00
P-	0.00	3.70	0.00	54.90	0.00	0.00	0.00	0.00	2.80	6.50
C-	0.00	0.00	0.00	0.08	0.00	0.00	0.00	0.00	0.00	0.04
A-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	0.00	0.00	0.00	0.00	0.00	28.00	0.00	0.00	1.00	1.00
P-	0.00	0.00	0.00	0.00	0.00	36.90	0.00	0.00	1.30	1.30
C-	0.00	0.00	0.00	0.00	0.00	2.83	0.00	0.00	0.00	0.09
A-	0.00	0.00	0.00	0.00	0.00	0.00	57.00	0.00	3.00	3.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	67.60	0.00	3.20	3.20
C-	0.00	0.00	0.00	0.00	0.00	0.00	1.97	0.00	0.00	0.01
A-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	0.00	0.00	8.00	4.00	0.00	1.00	2.00	0.00	15.00	7.00
P-	0.00	0.00	9.10	4.60	0.00	0.90	2.50	0.00	17.70	3.00
C-	0.00	0.00	0.15	0.00	0.00	0.00	0.00	0.00	0.49	0.14

NUMBER OF CELLS = 13
DEGREES OF FREEDOM = 12
CHI-SQUARE = 7.010

*- AVERAGE OF 10 PREDICTIONS

TABLE 17

GOODNESS OF FIT MATRIX FOR P08L
USING THREE PREVIOUS LOCKPOINTS
A=ACTUAL TRANSITIONS
P=PREDICTED TRANSITIONS *
C=CHI-SQUARE VALUES

	AS	ROLL	CBARS	ALT	ADF	HSI	IVSI	ENG	NON	ROW
A-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	0.00	0.00	437.00	3.00	3.00	2.00	0.00	0.00	22.00	8.00
P-	0.00	0.00	435.40	2.80	2.50	2.30	0.00	0.00	22.60	7.60
C-	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.02	0.02
A-	0.00	0.00	2.00	138.00	1.00	0.00	1.00	0.00	10.00	4.00
P-	0.00	0.00	1.90	116.50	0.90	0.00	0.70	0.00	9.40	3.50
C-	0.00	0.00	0.00	3.35	0.00	0.00	0.00	0.00	0.04	0.06
A-	0.00	0.00	0.00	0.00	68.00	0.00	1.00	0.00	6.00	1.00
P-	0.00	0.00	0.00	0.00	62.60	0.00	0.90	0.00	5.30	0.90
C-	0.00	0.00	0.00	0.00	0.43	0.00	0.00	0.00	0.08	0.01
A-	0.00	0.00	2.00	0.00	0.00	36.00	1.00	0.00	1.00	4.00
P-	0.00	0.00	2.00	0.00	0.00	44.90	0.80	0.00	1.20	4.00
C-	0.00	0.00	0.00	0.00	0.00	2.20	0.00	0.00	0.00	0.00
A-	0.00	0.00	0.00	1.00	0.00	0.00	79.00	0.00	5.00	1.00
P-	0.00	0.00	0.00	1.00	0.00	0.00	94.80	0.00	4.70	1.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	3.16	0.00	0.02	0.00
A-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	0.00	0.00	27.00	9.00	3.00	2.00	3.00	0.00	182.00	8.00
P-	0.00	0.00	26.70	9.20	2.80	1.70	3.40	0.00	185.00	7.90
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.00

NUMBER OF CELLS = 18
DEGREES OF FREEDOM = 17
CHI-SQUARE = 9.448

*- AVERAGE OF 10 PREDICTIONS

GOODNESS OF FIT MATRIX FOR P08R
USING THREE PREVIOUS LOOKPOINTS
A=ACTUAL TRANSITIONS
P=PREDICTED TRANSITIONS *
C=CHI-SQUARE VALUES

	AS	ROLL	CBARS	ALT	ADF	HSI	IVSI	ENG	NON	ROW
A-	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	1.00
P-	0.00	0.00	0.00	0.00	1.20	0.00	0.00	0.00	0.00	1.20
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04
A-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	1.00	0.00	665.00	4.00	1.00	1.00	0.00	0.00	11.00	7.00
P-	1.20	0.00	675.00	4.80	0.60	0.80	0.00	0.00	11.40	7.40
C-	0.00	0.00	0.15	0.00	0.00	0.00	0.00	0.00	0.01	0.02
A-	0.00	0.00	0.00	118.00	0.00	0.00	0.00	0.00	13.00	0.00
P-	0.00	0.00	0.00	120.60	0.00	0.00	0.00	0.00	13.20	0.00
C-	0.00	0.00	0.00	0.06	0.00	0.00	0.00	0.00	0.00	0.00
A-	0.00	0.00	2.00	0.00	77.00	1.00	0.00	1.00	2.00	6.00
P-	0.00	0.00	1.90	0.00	65.00	1.30	0.00	0.50	2.00	5.70
C-	0.00	0.00	0.00	0.00	1.87	0.00	0.00	0.00	0.00	0.01
A-	0.00	0.00	1.00	0.00	0.00	68.00	1.00	0.00	3.00	5.00
P-	0.00	0.00	0.90	0.00	0.00	60.00	0.60	0.00	4.10	5.60
C-	0.00	0.00	0.00	0.00	0.00	0.94	0.00	0.00	0.00	0.07
A-	0.00	0.00	0.00	1.00	0.00	0.00	43.00	0.00	3.00	4.00
P-	0.00	0.00	0.00	0.70	0.00	0.00	50.00	0.00	3.80	4.50
C-	0.00	0.00	0.00	0.00	0.00	0.00	1.14	0.00	0.00	0.06
A-	0.00	0.00	0.00	1.00	0.00	0.00	0.00	22.00	0.00	1.00
P-	0.00	0.00	0.00	0.50	0.00	0.00	0.00	11.10	0.00	0.50
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.40	0.00	0.25
A-	0.00	0.00	15.00	7.00	4.00	3.00	3.00	0.00	56.00	10.00
P-	0.00	0.00	16.50	7.40	4.00	3.50	4.00	0.00	59.40	11.50
C-	0.00	0.00	0.15	0.02	0.00	0.00	0.00	0.00	0.21	0.22

NUMBER OF CELLS = 18
DEGREES OF FREEDOM = 17
CHI-SQUARE = 10.643

*- AVERAGE OF 10 PREDICTIONS

TABLE 19

GOODNESS OF FIT MATRIX FOR P09L
USING THREE PREVIOUS LOOKPOINTS
A=ACTUAL TRANSITIONS
P=PREDICTED TRANSITIONS *
C=CHI-SQUARE VALUES

	AS	ROLL	CBARS	ALT	ADF	HSI	IVSI	ENG	NON	ROW
A-	2.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.00	4.00
P-	1.40	0.00	0.00	0.00	0.00	0.00	0.00	0.70	0.60	2.70
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.42
A-	0.00	5.00	3.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00
P-	0.00	7.10	3.10	0.00	0.00	0.00	0.00	0.00	0.00	3.10
C-	0.00	0.88	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	1.00	0.00	689.00	0.00	0.00	0.00	0.00	0.00	30.00	1.00
P-	0.60	0.00	644.70	0.00	0.00	0.00	0.00	0.00	31.00	0.60
C-	0.00	0.00	2.85	0.00	0.00	0.00	0.00	0.00	0.03	0.16
A-	0.00	0.00	2.00	255.00	0.00	0.00	1.00	0.00	18.00	3.00
P-	0.00	0.00	1.90	257.70	0.00	0.00	0.90	0.00	19.60	2.80
C-	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.14	0.01
A-	0.00	0.00	0.00	0.00	60.00	0.00	0.00	0.00	3.00	3.00
P-	0.00	0.00	0.00	0.00	63.80	0.00	0.00	0.00	3.10	3.10
C-	0.00	0.00	0.00	0.00	0.24	0.00	0.00	0.00	0.00	0.00
A-	0.00	1.00	1.00	0.00	0.00	86.00	0.00	0.00	2.00	4.00
P-	0.00	1.20	1.30	0.00	0.00	103.80	0.00	0.00	2.60	5.10
C-	0.00	0.00	0.00	0.00	0.00	3.68	0.00	0.00	0.00	0.30
A-	0.00	0.00	0.00	1.00	0.00	2.00	75.00	0.00	5.00	3.00
P-	0.00	0.00	0.00	1.20	0.00	2.10	80.50	0.00	4.90	3.30
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.40	0.00	0.00	0.03
A-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.00	1.00	1.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.00	0.70	0.70
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.29	0.00	0.09
A-	1.00	2.00	24.00	20.00	3.00	3.00	7.00	0.00	67.00	9.00
P-	0.70	1.90	25.90	21.30	3.10	3.00	7.50	0.00	74.10	8.70
C-	0.00	0.00	0.15	0.08	0.00	0.00	0.04	0.00	0.75	0.01

NUMBER OF CELLS = 23
DEGREES OF FREEDOM = 22
CHI-SQUARE = 11.608

*- AVERAGE OF 10 PREDICTIONS

TABLE 20

GOODNESS OF FIT MATRIX FOR P09R
USING THREE PREVIOUS LOOKPOINTS
A=ACTUAL TRANSITIONS
P=PREDICTED TRANSITIONS *
C=CHI-SQUARE VALUES

	AS	ROLL	CBARS	ALT	ADF	HSI	IVSI	ENG	NON	ROW
A-	2.00	0.00	0.00	0.00	2.00	0.00	0.00	0.00	0.00	4.00
P-	1.20	0.00	0.00	0.00	1.20	0.00	0.00	0.00	0.00	2.40
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.64
A-	0.00	54.00	8.00	0.00	0.00	0.00	0.00	0.00	4.00	4.00
P-	0.00	51.90	7.60	0.00	0.00	0.00	0.00	0.00	4.00	4.00
C-	0.00	0.08	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	0.00	7.00	449.00	1.00	1.00	0.00	0.00	0.00	20.00	2.00
P-	0.00	7.50	430.50	0.80	0.90	0.00	0.00	0.00	19.90	1.70
C-	0.00	0.04	0.76	0.00	0.00	0.00	0.00	0.00	0.00	0.04
A-	0.00	0.00	8.00	203.00	0.00	1.00	0.00	0.00	9.00	1.00
P-	0.00	0.00	7.00	202.40	0.00	1.80	0.00	0.00	9.80	1.80
C-	0.00	0.00	0.13	0.00	0.00	0.00	0.00	0.00	0.07	0.64
A-	0.00	0.00	0.00	1.00	53.00	1.00	0.00	0.00	4.00	6.00
P-	0.00	0.00	0.00	1.30	67.60	0.90	0.00	0.00	4.00	6.20
C-	0.00	0.00	0.00	0.00	4.02	0.00	0.00	0.00	0.00	0.01
A-	0.00	2.00	0.00	0.00	0.00	106.00	0.00	0.00	4.00	6.00
P-	0.00	2.20	0.00	0.00	0.00	97.70	0.00	0.00	4.50	6.70
C-	0.00	0.00	0.00	0.00	0.00	0.65	0.00	0.00	0.00	0.08
A-	0.00	0.00	0.00	0.00	0.00	0.00	19.00	0.00	2.00	2.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	24.60	0.00	2.30	2.30
C-	0.00	0.00	0.00	0.00	0.00	0.00	1.65	0.00	0.00	0.09
A-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	2.00	2.00	14.00	16.00	3.00	4.00	2.00	0.00	117.00	13.00
P-	1.20	1.90	14.80	16.90	4.30	4.00	2.30	0.00	121.00	13.70
C-	0.00	0.00	0.05	0.05	0.00	0.00	0.00	0.00	0.14	0.04

NUMBER OF CELLS = 22
DEGREES OF FREEDOM = 21
CHI-SQUARE = 9.149

*- AVERAGE OF 10 PREDICTIONS

TABLE 21

GOODNESS OF FIT MATRIX FOR P1OL
USING THREE PREVIOUS LOOKPOINTS
A=ACTUAL TRANSITIONS
P=PREDICTED TRANSITIONS *
C=CHI-SQUARE VALUES

	AS	ROLL	CBARS	ALT	ADF	HSI	IVSI	ENG	NON	ROW
A-	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
P-	0.00	0.00	0.90	0.00	0.00	0.00	0.00	0.00	0.00	0.90
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
A-	0.00	138.00	3.00	3.00	0.00	0.00	0.00	0.00	9.00	6.00
P-	0.00	164.90	3.80	2.80	0.00	0.00	0.00	0.00	9.10	6.60
C-	0.00	5.24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06
A-	0.00	5.00	349.00	1.00	0.00	0.00	0.00	0.00	18.00	1.00
P-	0.00	6.00	357.60	1.30	0.00	0.00	0.00	0.00	16.10	1.30
C-	0.00	0.20	0.21	0.00	0.00	0.00	0.00	0.00	0.20	0.09
A-	0.00	5.00	0.00	167.00	0.00	0.00	0.00	0.00	12.00	0.00
P-	0.00	4.20	0.00	144.70	0.00	0.00	0.00	0.00	10.90	0.00
C-	0.00	0.13	0.00	2.98	0.00	0.00	0.00	0.00	0.10	0.00
A-	1.00	0.00	1.00	0.00	16.00	0.00	0.00	0.00	1.00	3.00
P-	0.90	0.00	0.50	0.00	11.80	0.00	0.00	0.00	0.90	2.30
C-	0.00	0.00	0.00	0.00	1.10	0.00	0.00	0.00	0.00	0.16
A-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	0.00	6.00	19.00	12.00	3.00	0.00	0.00	0.00	239.00	3.00
P-	0.00	5.80	18.50	11.30	2.30	0.00	0.00	0.00	231.70	2.30
C-	0.00	0.01	0.01	0.04	0.00	0.00	0.00	0.00	0.22	0.16

NUMBER OF CELLS = 18
DEGREES OF FREEDOM = 17
CHI-SQUARE = 10.937

*- AVERAGE OF 10 PREDICTIONS

TABLE 22

GOODNESS OF FIT MATRIX FOR P1OR
USING THREE PREVIOUS LOOKPOINTS
A=ACTUAL TRANSITIONS
P=PREDICTED TRANSITIONS *
C=CHI-SQUARE VALUES

	AS	ROLL	CBARS	ALT	ADF	HSI	IVSI	ENG	NON	ROW
A-	40.00	0.00	1.00	1.00	1.00	0.00	0.00	0.00	2.00	5.00
P-	32.50	0.00	0.60	1.00	0.90	0.00	0.00	0.00	2.10	4.60
C-	1.41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03
A-	0.00	462.00	3.00	7.00	0.00	0.00	0.00	0.00	16.00	3.00
P-	0.00	446.60	2.70	6.30	0.00	0.00	0.00	0.00	16.60	2.70
C-	0.00	0.51	0.00	0.07	0.00	0.00	0.00	0.00	0.02	0.03
A-	1.00	3.00	142.00	0.00	0.00	0.00	0.00	0.00	12.00	4.00
P-	0.70	2.70	155.30	0.00	0.00	0.00	0.00	0.00	11.90	3.40
C-	0.00	0.00	1.25	0.00	0.00	0.00	0.00	0.00	0.00	0.09
A-	0.00	13.00	1.00	145.00	0.00	0.00	0.00	0.00	3.00	4.00
P-	0.00	13.80	0.80	144.30	0.00	0.00	0.00	0.00	3.40	4.20
C-	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
A-	1.00	0.00	1.00	0.00	4.00	0.00	0.00	0.00	0.00	6.00
P-	0.90	0.00	0.70	0.00	3.70	0.00	0.00	0.00	0.00	5.30
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08
A-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	3.00	10.00	10.00	9.00	1.00	0.00	0.00	0.00	27.00	4.00
P-	3.00	9.90	10.70	10.70	0.70	0.00	0.00	0.00	33.50	3.70
C-	0.00	0.00	0.05	0.32	0.00	0.00	0.00	0.00	1.56	0.02

NUMBER OF CELLS = 18
DEGREES OF FREEDOM = 17
CHI-SQUARE = 5.513

*- AVERAGE OF 10 PREDICTIONS

GOODNESS OF FIT MATRIX FOR P11L
USING THREE PREVIOUS LOOKPOINTS
A=ACTUAL TRANSITIONS
P=PREDICTED TRANSITIONS *
C=CHI-SQUARE VALUES

	AS	ROLL	CBARS	ALT	ADF	HSI	IVSI	ENG	NON	ROW
A-	139.00	0.00	4.00	0.00	4.00	0.00	0.00	1.00	11.00	9.00
P-	134.80	0.00	4.50	0.00	4.10	0.00	0.00	0.80	11.20	9.40
C-	0.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02
A-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	4.00	0.00	245.00	0.00	0.00	2.00	0.00	0.00	18.00	6.00
P-	4.40	0.00	256.80	0.00	0.00	1.70	0.00	0.00	19.70	6.10
C-	0.00	0.00	0.57	0.00	0.00	0.00	0.00	0.00	0.16	0.00
A-	0.00	0.00	0.00	66.00	0.00	0.00	0.00	0.00	7.00	0.00
P-	0.00	0.00	0.00	62.60	0.00	0.00	0.00	0.00	6.30	0.00
C-	0.00	0.00	0.00	0.18	0.00	0.00	0.00	0.00	0.07	0.00
A-	1.00	0.00	0.00	0.00	10.00	0.00	0.00	0.00	5.00	1.00
P-	1.20	0.00	0.00	0.00	9.60	0.00	0.00	0.00	4.90	1.20
C-	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.04
A-	0.00	0.00	2.00	0.00	1.00	59.00	0.00	0.00	3.00	6.00
P-	0.00	0.00	1.50	0.00	1.20	59.20	0.00	0.00	3.10	5.80
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
A-	1.00	0.00	0.00	1.00	0.00	0.00	17.00	0.00	2.00	4.00
P-	0.50	0.00	0.00	1.10	0.00	0.00	12.90	0.00	1.30	2.90
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.99	0.00	0.00	0.30
A-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	12.00	1.00	1.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.60	0.80	0.80
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.16	0.00	0.04
A-	14.00	0.00	19.00	6.00	1.00	4.00	4.00	0.00	243.00	9.00
P-	14.80	0.00	19.80	5.40	0.80	4.30	2.90	0.00	241.20	8.00
C-	0.05	0.00	0.03	0.06	0.00	0.00	0.00	0.00	0.01	0.11

NUMBER OF CELLS = 22
DEGREES OF FREEDOM = 21
CHI-SQUARE = 2.948

*- AVERAGE OF 10 PREDICTIONS

GOODNESS OF FIT MATRIX FOR P11R
USING THREE PREVIOUS LOOKPOINTS
A=ACTUAL TRANSITIONS
P=PREDICTED TRANSITIONS *
C=CHI-SQUARE VALUES

	AS	ROLL	CBARS	ALT	ADF	HSI	IVSI	ENG	NON	ROW
A-	69.00	0.00	2.00	0.00	1.00	0.00	0.00	0.00	2.00	5.00
P-	59.50	0.00	2.00	0.00	1.00	0.00	0.00	0.00	1.80	4.80
C-	1.31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
A-	0.00	4.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	5.00
P-	0.00	2.40	0.00	0.00	0.00	0.00	0.00	0.00	0.80	3.20
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.65
A-	1.00	1.00	398.00	1.00	0.00	2.00	0.00	0.00	20.00	5.00
P-	1.00	0.80	406.20	1.40	0.00	3.00	0.00	0.00	18.80	6.20
C-	0.00	0.00	0.17	0.00	0.00	0.00	0.00	0.00	0.07	0.29
A-	0.00	0.00	0.00	106.00	0.00	0.00	0.00	0.00	17.00	0.00
P-	0.00	0.00	0.00	99.50	0.00	0.00	0.00	0.00	15.60	0.00
C-	0.00	0.00	0.00	0.40	0.00	0.00	0.00	0.00	0.12	0.00
A-	0.00	0.00	0.00	0.00	5.00	0.00	0.00	0.00	1.00	1.00
P-	0.00	0.00	0.00	0.00	3.70	0.00	0.00	0.00	1.00	1.00
C-	0.00	0.00	0.00	0.00	0.34	0.00	0.00	0.00	0.00	0.00
A-	0.00	0.00	0.00	0.00	0.00	131.00	1.00	0.00	10.00	1.00
P-	0.00	0.00	0.00	0.00	0.00	129.50	1.00	0.00	10.00	1.00
C-	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00
A-	0.00	0.00	0.00	1.00	0.00	1.00	19.00	0.00	1.00	3.00
P-	0.00	0.00	0.00	1.00	0.00	1.30	30.90	0.00	1.10	3.40
C-	0.00	0.00	0.00	0.00	0.00	0.00	7.45	0.00	0.00	0.05
A-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00	1.00	4.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.40	1.50	5.90
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.90
A-	4.00	0.00	24.00	14.00	0.00	8.00	2.00	1.00	81.00	7.00
P-	3.80	0.00	23.40	13.20	0.00	6.90	2.50	1.20	79.80	7.50
C-	0.00	0.00	0.01	0.05	0.00	0.15	0.00	0.00	0.02	0.04

NUMBER OF CELLS = 21
DEGREES OF FREEDOM = 20
CHI-SQUARE = 12.036

*- AVERAGE OF 10 PREDICTIONS

GOODNESS OF FIT MATRIX FOR TP1L
USING THREE PREVIOUS LOCKPOINTS
A=ACTUAL TRANSITIONS
P=PREDICTED TRANSITIONS *
C=CHI-SQUARE VALUES

	AS	ROLL	CBARS	ALT	ADF	HSI	IVSI	ENG	NON	ROW
A-	4.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	5.00
P-	5.10	0.00	1.20	0.00	0.00	0.00	0.00	0.00	0.00	6.30
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.34
A-	0.00	16.00	1.00	0.00	0.00	0.00	0.00	0.00	1.00	2.00
P-	0.00	15.30	0.70	0.00	0.00	0.00	0.00	0.00	1.00	1.70
C-	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04
A-	1.00	1.00	497.00	0.00	0.00	6.00	0.00	0.00	15.00	2.00
P-	1.20	1.00	530.30	0.00	0.00	5.50	0.00	0.00	15.60	2.20
C-	0.00	0.00	2.23	0.00	0.00	0.04	0.00	0.00	0.02	0.02
A-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	0.00	0.00	0.00	0.00	1.00	1.00	0.00	0.00	0.00	2.00
P-	0.00	0.00	0.00	0.00	0.80	0.80	0.00	0.00	0.00	1.60
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08
A-	0.00	1.00	6.00	0.00	0.00	495.00	0.00	0.00	17.00	1.00
P-	0.00	0.70	6.70	0.00	0.00	451.90	0.00	0.00	17.10	0.70
C-	0.00	0.00	0.08	0.00	0.00	3.75	0.00	0.00	0.00	0.09
A-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	0.00	0.00	14.00	0.00	1.00	18.00	0.00	0.00	76.00	1.00
P-	0.00	0.00	15.20	0.00	0.80	18.60	0.00	0.00	80.50	0.80
C-	0.00	0.00	0.10	0.00	0.00	0.02	0.00	0.00	0.27	0.04

NUMBER OF CELLS = 16
DEGREES OF FREEDOM = 15
CHI-SQUARE = 7.165

*- AVERAGE OF 10 PREDICTIONS

GOODNESS OF FIT MATRIX FOR TP1X
USING THREE PREVIOUS LOOKPOINTS
A=ACTUAL TRANSITIONS
P=PREDICTED TRANSITIONS *
C=CHI-SQUARE VALUES

	AS	ROLL	CBARS	ALT	ADF	HSI	IVSI	ENG	NON	ROW
A-	7.00	0.00	2.00	0.00	0.00	2.00	0.00	0.00	3.00	7.00
P-	4.20	0.00	2.40	0.00	0.00	1.30	0.00	0.00	2.30	6.00
C-	1.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.14
A-	0.00	17.00	5.00	0.00	0.00	2.00	0.00	0.00	3.00	5.00
P-	0.00	16.40	5.40	0.00	0.00	1.70	0.00	0.00	3.60	5.30
C-	0.00	0.02	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.02
A-	1.00	2.00	829.00	3.00	0.00	6.00	0.00	0.00	24.00	6.00
P-	0.60	2.30	796.40	3.20	0.00	5.30	0.00	0.00	25.20	6.10
C-	0.00	0.00	1.28	0.00	0.00	0.08	0.00	0.00	0.06	0.00
A-	0.00	0.00	2.00	0.00	0.00	5.00	0.00	0.00	1.00	3.00
P-	0.00	0.00	2.50	0.00	0.00	5.90	0.00	0.00	0.60	3.10
C-	0.00	0.00	0.00	0.00	0.00	0.16	0.00	0.00	0.00	0.00
A-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	1.00	0.00	10.00	3.00	1.00	348.00	0.00	0.00	15.00	5.00
P-	0.90	0.00	10.30	3.10	1.00	375.40	0.00	0.00	14.30	5.00
C-	0.00	0.00	0.01	0.00	0.00	2.16	0.00	0.00	0.03	0.00
A-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	5.00	8.00	18.00	2.00	0.00	15.00	0.00	0.00	95.00	2.00
P-	4.50	8.40	16.40	2.70	0.00	15.80	0.00	0.00	99.90	2.70
C-	0.05	0.02	0.14	0.00	0.00	0.04	0.00	0.00	0.25	0.24

NUMBER OF CELLS = 22
DEGREES OF FREEDOM = 21
CHI-SQUARE = 5.876

*- AVERAGE OF 10 PREDICTIONS

TABLE 27

GOODNESS OF FIT MATRIX FOR TP1R
USING THREE PREVIOUS LOOKPOINTS
A=ACTUAL TRANSITIONS
P=PREDICTED TRANSITIONS *
C=CHI-SQUARE VALUES

	AS	ROLL	CBARS	ALT	ADF	HSI	IVSI	ENG	NON	ROW
A-	16.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.00	2.00
P-	17.70	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.30	2.30
C-	0.18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05
A-	0.00	12.00	2.00	0.00	0.00	0.00	0.00	0.00	1.00	3.00
P-	0.00	11.50	1.90	0.00	0.00	0.00	0.00	0.00	1.00	2.90
C-	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	1.00	1.00	414.00	0.00	0.00	3.00	0.00	0.00	17.00	5.00
P-	1.80	0.70	403.50	0.00	0.00	3.70	0.00	0.00	16.00	6.20
C-	0.00	0.00	0.27	0.00	0.00	0.00	0.00	0.00	0.06	0.29
A-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	1.00
P-	0.00	0.00	0.00	0.00	0.00	0.90	0.00	0.00	0.00	0.90
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
A-	0.00	0.00	7.00	0.00	0.00	292.00	0.00	0.00	14.00	0.00
P-	0.00	0.00	6.60	0.00	0.00	299.10	0.00	0.00	13.60	0.00
C-	0.00	0.00	0.02	0.00	0.00	0.17	0.00	0.00	0.01	0.00
A-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	1.00	2.00	14.00	0.00	1.00	16.00	0.00	0.00	47.00	4.00
P-	0.50	2.20	13.90	0.00	0.90	15.50	0.00	0.00	46.70	3.60
C-	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.04

NUMBER OF CELLS = 15
DEGREES OF FREEDOM = 14
CHI-SQUARE = 1.138

*- AVERAGE OF 10 PREDICTIONS

GOODNESS OF FIT MATRIX FOR TP5L
USING THREE PREVIOUS LOCKPOINTS
A=ACTUAL TRANSITIONS
P=PREDICTED TRANSITIONS *
C=CHI-SQUARE VALUES

	AS	ROLL	CBARS	ALT	ADF	HSI	IVSI	ENG	NON	ROW
A-	46.00	0.00	2.00	1.00	0.00	0.00	0.00	0.00	2.00	5.00
P-	60.40	0.00	2.00	0.90	0.00	0.00	0.00	0.00	2.80	5.70
C-	4.51	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10
A-	0.00	17.00	2.00	1.00	0.00	0.00	0.00	0.00	3.00	6.00
P-	0.00	12.70	1.50	1.00	0.00	0.00	0.00	0.00	2.60	5.10
C-	0.00	1.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.13
A-	2.00	1.00	512.00	0.00	1.00	6.00	0.00	0.00	27.00	4.00
P-	2.00	0.90	504.00	0.00	1.50	5.00	0.00	0.00	27.90	4.40
C-	0.00	0.00	0.13	0.00	0.00	0.17	0.00	0.00	0.03	0.04
A-	0.00	0.00	0.00	280.00	0.00	0.00	0.00	0.00	23.00	0.00
P-	0.00	0.00	0.00	284.90	0.00	0.00	0.00	0.00	24.20	0.00
C-	0.00	0.00	0.00	0.09	0.00	0.00	0.00	0.00	0.06	0.00
A-	0.00	0.00	0.00	0.00	4.00	0.00	0.00	0.00	1.00	5.00
P-	0.00	0.00	0.00	0.00	5.40	0.00	0.00	0.00	1.50	6.90
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.72
A-	0.00	1.00	1.00	1.00	0.00	143.00	0.00	0.00	10.00	3.00
P-	0.00	0.90	1.00	0.70	0.00	118.70	0.00	0.00	8.80	2.60
C-	0.00	0.00	0.00	0.00	0.00	4.13	0.00	0.00	0.14	0.05
A-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	3.00	4.00	32.00	20.00	0.00	7.00	0.00	0.00	185.00	7.00
P-	3.70	3.30	33.20	21.70	0.00	6.40	0.00	0.00	195.40	7.00
C-	0.00	0.00	0.04	0.14	0.00	0.05	0.00	0.00	0.58	0.00

NUMBER OF CELLS = 19
DEGREES OF FREEDOM = 18
CHI-SQUARE = 12.213

*- AVERAGE OF 10 PREDICTIONS

TABLE 29

GOODNESS OF FIT MATRIX FOR TP5R
USING THREE PREVIOUS LOOKPOINTS
A=ACTUAL TRANSITIONS
P=PREDICTED TRANSITIONS *
C=CHI-SQUARE VALUES

	AS	ROLL	CBARS	ALT	ADF	HSI	IVSI	ENG	NON	ROW
A-	39.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	6.00	1.00
P-	38.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	6.20	1.00
C-	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00
A-	0.00	9.00	1.00	2.00	0.00	0.00	0.00	0.00	1.00	4.00
P-	0.00	14.10	1.60	1.90	0.00	0.00	0.00	0.00	0.90	4.40
C-	0.00	2.89	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04
A-	2.00	2.00	502.00	2.00	0.00	2.00	0.00	0.00	22.00	8.00
P-	2.50	2.50	536.60	1.10	0.00	2.40	0.00	0.00	23.00	8.50
C-	0.00	0.00	2.38	0.00	0.00	0.00	0.00	0.00	0.05	0.03
A-	2.00	0.00	1.00	175.00	0.00	2.00	0.00	0.00	21.00	5.00
P-	1.70	0.00	1.30	154.70	0.00	1.00	0.00	0.00	20.30	4.00
C-	0.00	0.00	0.00	2.35	0.00	0.00	0.00	0.00	0.02	0.20
A-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	0.00	0.00	2.00	2.00	0.00	109.00	0.00	0.00	6.00	4.00
P-	0.00	0.00	2.40	2.10	0.00	102.80	0.00	0.00	5.60	4.50
C-	0.00	0.00	0.00	0.00	0.00	0.35	0.00	0.00	0.03	0.06
A-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	3.00	2.00	25.00	20.00	0.00	6.00	0.00	0.00	232.00	5.00
P-	3.00	1.90	25.60	19.50	0.00	6.70	0.00	0.00	215.60	4.90
C-	0.00	0.00	0.01	0.01	0.00	0.08	0.00	0.00	1.16	0.00

NUMBER OF CELLS = 19
DEGREES OF FREEDOM = 18
CHI-SQUARE = 9.714

*- AVERAGE OF 10 PREDICTIONS

GOODNESS OF FIT MATRIX FOR TC1L
USING THREE PREVIOUS LOOKPOINTS
A=ACTUAL TRANSITIONS
P=PREDICTED TRANSITIONS *
C=CHI-SQUARE VALUES

	AS	ROLL	CBARS	ALT	ADF	HSI	IVSI	ENG	NON	ROW
A-	78.00	0.00	3.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00
P-	75.30	0.00	2.70	0.00	0.00	0.00	0.00	0.00	0.00	2.70
C-	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03
A-	0.00	72.00	3.00	1.00	0.00	0.00	0.00	0.00	1.00	5.00
P-	0.00	68.50	2.80	1.30	0.00	0.00	0.00	0.00	1.00	5.10
C-	0.00	0.17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	1.00	4.00	443.00	4.00	0.00	0.00	0.00	0.00	8.00	9.00
P-	0.70	3.70	435.90	4.50	0.00	0.00	0.00	0.00	7.60	8.90
C-	0.00	0.00	0.11	0.00	0.00	0.00	0.00	0.00	0.02	0.00
A-	0.00	0.00	1.00	124.00	0.00	0.00	0.00	0.00	9.00	1.00
P-	0.00	0.00	1.30	133.00	0.00	0.00	0.00	0.00	8.50	1.30
C-	0.00	0.00	0.00	0.65	0.00	0.00	0.00	0.00	0.03	0.09
A-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	0.00	0.00	0.00	0.00	0.00	14.00	0.00	0.00	2.00	2.00
P-	0.00	0.00	0.00	0.00	0.00	12.60	0.00	0.00	2.00	2.00
C-	0.00	0.00	0.00	0.00	0.00	0.14	0.00	0.00	0.00	0.00
A-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	2.00	1.00	11.00	5.00	0.00	2.00	0.00	0.00	92.00	5.00
P-	2.00	1.60	10.00	4.20	0.00	2.00	0.00	0.00	96.80	5.60
C-	0.00	0.00	0.09	0.13	0.00	0.00	0.00	0.00	0.25	0.07

NUMBER OF CELLS = 16
DEGREES OF FREEDOM = 15
CHI-SQUARE = 1.883

*- AVERAGE OF 10 PREDICTIONS

TABLE 31

GOODNESS OF FIT MATRIX FOR TC5L
USING THREE PREVIOUS LOOKPOINTS
A=ACTUAL TRANSITIONS
P=PREDICTED TRANSITIONS *
C=CHI-SQUARE VALUES

	AS	ROLL	CBARS	ALT	ADF	HSI	IVSI	ENG	NON	ROW
A-	72.00	0.00	2.00	1.00	3.00	0.00	0.00	0.00	3.00	9.00
P-	60.10	0.00	2.20	1.00	3.50	0.00	0.00	0.00	2.10	8.80
C-	1.97	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	0.00	66.00	5.00	0.00	0.00	0.00	0.00	0.00	4.00	4.00
P-	0.00	62.40	4.80	0.00	0.00	0.00	0.00	0.00	4.10	4.10
C-	0.00	0.20	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	1.00	9.00	263.00	3.00	1.00	1.00	0.00	0.00	8.00	6.00
P-	1.10	9.10	266.20	2.50	0.90	0.70	0.00	0.00	8.80	5.20
C-	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.08	0.11
A-	2.00	0.00	4.00	262.00	0.00	1.00	1.00	0.00	7.00	8.00
P-	1.10	0.00	4.00	281.90	0.00	0.70	1.30	0.00	8.80	7.10
C-	0.00	0.00	0.00	1.51	0.00	0.00	0.00	0.00	0.46	0.10
A-	1.00	0.00	0.00	0.00	13.00	1.00	0.00	0.00	4.00	6.00
P-	1.10	0.00	0.00	0.00	13.30	0.70	0.00	0.00	4.50	6.30
C-	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.02
A-	0.00	0.00	2.00	0.00	1.00	154.00	0.00	0.00	4.00	7.00
P-	0.00	0.00	1.50	0.00	0.80	118.90	0.00	0.00	3.70	6.00
C-	0.00	0.00	0.00	0.00	0.00	8.00	0.00	0.00	0.00	0.14
A-	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00	2.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	1.30	0.00	1.30	2.60
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.18
A-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	5.00	0.00	10.00	11.00	1.00	4.00	0.00	0.00	67.00	5.00
P-	5.60	0.00	10.80	12.70	1.10	3.90	0.00	0.00	87.50	5.00
C-	0.07	0.00	0.06	0.26	0.00	0.00	0.00	0.00	6.27	0.00

NUMBER OF CELLS = 22
DEGREES OF FREEDOM = 21
CHI-SQUARE = 19.496

*- AVERAGE OF 10 PREDICTIONS

GOODNESS OF FIT MATRIX FOR IP3R
USING THE CONDITIONAL PROBABILITIES
FROM THE SUBJECT S LEFT ROLL.
RA=ACTUAL TRANSITIONS IN RIGHT ROLL
RP=PREDICTED TRANSITIONS *
C=CHI-SQUARE VALUES

	AS	ROLL	CBARS	ALT	ADF	HSI	IVSI	ENG	NON	ROW
RA-	75.00	0.00	5.00	1.00	0.00	2.00	0.00	0.00	2.00	5.00
RP-	57.10	3.20	1.00	2.10	1.00	0.00	0.00	0.00	2.40	8.70
C-	4.27	0.00	3.20	0.00	0.00	0.00	0.00	0.00	0.00	2.74
RA-	0.00	249.00	10.00	9.00	1.00	0.00	0.00	0.00	6.00	1.00
RP-	0.80	250.60	9.50	0.50	0.00	0.00	0.00	0.00	12.00	0.80
C-	0.00	0.01	0.02	8.03	0.00	0.00	0.00	0.00	6.00	0.04
RA-	2.00	15.00	232.00	0.00	0.00	1.00	0.00	0.00	8.00	3.00
RP-	2.10	8.20	240.60	1.00	1.20	0.00	0.00	0.00	9.70	4.30
C-	0.00	3.08	0.32	0.00	0.00	0.00	0.00	0.00	0.36	0.56
RA-	0.00	2.00	0.00	223.00	0.00	0.00	0.00	0.00	17.00	2.00
RP-	3.10	0.90	0.50	220.70	0.00	0.00	0.00	0.00	14.30	4.50
C-	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.43	3.13
RA-	1.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	2.00
RP-	0.00	0.00	2.40	3.10	6.20	0.00	0.00	0.00	1.00	12.70
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	57.25
RA-	0.00	0.00	3.00	0.00	0.00	112.00	0.00	0.00	7.00	3.00
RP-	0.00	2.90	0.00	0.00	2.40	138.00	0.00	0.00	7.50	5.30
C-	0.00	0.00	0.00	0.00	0.00	6.04	0.00	0.00	0.04	1.76
RA-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RP-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RA-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RP-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RA-	7.00	8.00	8.00	9.00	1.00	6.00	0.00	0.00	107.00	1.00
RP-	3.90	7.00	9.00	12.20	1.90	12.80	0.00	0.00	74.20	1.90
C-	1.37	0.13	0.13	1.14	0.00	7.71	0.00	0.00	10.05	0.81

NUMBER OF CELLS = 26
DEGREES OF FREEDOM = 25
CHI-SQUARE = 118.628

*- AVERAGE OF 10 PREDICTIONS

TABLE 33

GOODNESS OF FIT MATRIX FOR IP4R
USING THE CONDITIONAL PROBABILITIES
FROM THE SUBJECT S LEFT ROLL.
RA=ACTUAL TRANSITIONS IN RIGHT ROLL
RP=PREDICTED TRANSITIONS *
C=CHI-SQUARE VALUES

	AS	ROLL	CBARS	ALT	ADF	HSI	IVSI	ENG	NON	ROW
RA-	17.00	0.00	2.00	2.00	0.00	0.00	0.00	0.00	3.00	7.00
RP-	4.60	0.00	3.30	0.00	0.00	0.00	0.00	0.00	1.40	4.70
C-	9.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.76
RA-	1.00	96.00	10.00	1.00	0.00	0.00	0.00	0.00	1.00	3.00
RP-	0.00	110.60	9.90	0.00	0.00	0.00	0.00	0.00	7.30	7.30
C-	0.00	2.22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.16
RA-	1.00	7.00	450.00	3.00	0.00	3.00	0.00	0.00	17.00	7.00
RP-	0.50	12.30	410.60	0.00	0.00	0.00	0.00	0.00	20.30	0.50
C-	0.00	4.01	3.45	0.00	0.00	0.00	0.00	0.00	0.64	6.04
RA-	1.00	2.00	2.00	162.00	0.00	1.00	2.00	0.00	20.00	8.00
RP-	0.00	3.20	0.60	212.30	0.00	0.00	0.00	0.00	19.30	3.80
C-	0.00	0.00	0.00	15.62	0.00	0.00	0.00	0.00	0.02	2.21
RA-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RP-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RA-	0.00	0.00	0.00	0.00	0.00	41.00	0.00	0.00	6.00	0.00
RP-	0.00	0.00	0.90	0.00	0.00	29.20	0.00	0.00	1.10	0.90
C-	0.00	0.00	0.00	0.00	0.00	3.40	0.00	0.00	4.00	0.00
RA-	0.00	0.00	0.00	1.00	0.00	0.00	23.00	0.00	3.00	4.00
RP-	0.00	0.00	0.00	1.30	0.00	0.00	9.80	0.00	0.50	1.80
C-	0.00	0.00	0.00	0.00	0.00	0.00	7.58	0.00	0.00	1.21
RA-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RP-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RA-	4.00	4.00	16.00	21.00	0.00	2.00	2.00	0.00	135.00	12.00
RP-	4.20	1.80	17.80	22.20	0.00	2.10	1.90	0.00	150.00	10.00
C-	0.00	0.00	0.20	0.07	0.00	0.00	0.00	0.00	1.67	0.33

NUMBER OF CELLS = 20
DEGREES OF FREEDOM = 19
CHI-SQUARE = 68.626

*- AVERAGE OF 10 PREDICTIONS

GOODNESS OF FIT MATRIX FOR P01R
USING THE CONDITIONAL PROBABILITIES
FROM THE SUBJECT S LEFT ROLL.
RA=ACTUAL TRANSITIONS IN RIGHT ROLL
RP=PREDICTED TRANSITIONS *
C=CHI-SQUARE VALUES

	AS	ROLL	CBARS	ALT	ADF	HSI	IVSI	ENG	NON	ROW
RA-	116.00	0.00	3.00	0.00	0.00	0.00	0.00	0.00	3.00	6.00
RP-	71.50	0.00	3.40	0.00	0.00	0.00	0.00	0.00	0.60	4.00
C-	17.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.67
RA-	0.00	23.00	1.00	0.00	0.00	0.00	0.00	0.00	2.00	3.00
RP-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	23.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00
RA-	1.00	0.00	317.00	0.00	0.00	0.00	2.00	0.00	22.00	3.00
RP-	1.70	0.00	721.40	1.60	0.00	0.00	1.70	0.00	14.50	5.00
C-	0.00	0.00	515.90	0.00	0.00	0.00	0.00	0.00	2.56	1.33
RA-	0.00	0.00	0.00	85.00	0.00	0.00	0.00	0.00	7.00	0.00
RP-	0.00	0.00	2.40	32.30	0.00	0.00	1.30	0.00	6.40	3.70
C-	0.00	0.00	0.00	32.67	0.00	0.00	0.00	0.00	0.05	0.00
RA-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RP-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RA-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RP-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RA-	0.00	0.00	2.00	0.00	0.00	0.00	115.00	0.00	0.00	2.00
RP-	0.00	0.00	0.00	4.10	0.00	0.00	95.00	0.00	0.00	4.10
C-	0.00	0.00	0.00	0.00	0.00	0.00	3.48	0.00	0.00	2.21
RA-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	55.00	6.00	0.00
RP-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	55.00	6.00	0.00
RA-	5.00	3.00	20.00	7.00	0.00	0.00	0.00	5.00	303.00	3.00
RP-	2.60	0.00	14.20	4.40	0.00	0.00	1.20	0.00	119.70	1.20
C-	1.15	0.00	1.68	0.97	0.00	0.00	0.00	5.00	110.89	1.08

NUMBER OF CELLS = 19
DEGREES OF FREEDOM = 18
CHI-SQUARE = 783.701

*- AVERAGE OF 10 PREDICTIONS

GOODNESS OF FIT MATRIX FOR P02R
USING THE CONDITIONAL PROBABILITIES
FROM THE SUBJECT S LEFT ROLL.
RA=ACTUAL TRANSITIONS IN RIGHT ROLL
RP=PREDICTED TRANSITIONS *
C=CHI-SQUARE VALUES

	AS	ROLL	CBARS	ALT	ADF	HSI	IVSI	ENG	NON	ROW
RA-	42.00	0.00	1.00	0.00	0.00	0.00	1.00	0.00	1.00	3.00
RP-	40.00	0.00	3.20	0.00	0.00	0.00	0.00	0.00	0.00	3.20
C-	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
RA-	0.00	99.00	5.00	0.00	0.00	0.00	0.00	0.00	6.00	0.00
RP-	0.00	103.30	1.70	2.80	0.00	0.00	0.00	0.00	6.00	2.80
C-	0.00	0.19	2.18	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RA-	1.00	2.00	653.00	2.00	0.00	0.00	0.00	0.00	17.00	5.00
RP-	1.90	5.00	544.70	0.80	0.00	0.00	0.00	0.00	16.10	7.70
C-	0.00	0.00	17.96	0.00	0.00	0.00	0.00	0.00	0.05	1.46
RA-	0.00	0.00	3.00	97.00	0.00	0.00	0.00	0.00	4.00	7.00
RP-	0.00	0.00	3.80	202.10	0.00	0.00	0.00	0.00	10.30	14.10
C-	0.00	0.00	0.00	113.88	0.00	0.00	0.00	0.00	0.00	7.20
RA-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RP-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RA-	0.00	1.00	0.00	0.00	0.00	56.00	0.00	0.00	3.00	4.00
RP-	0.00	0.00	0.00	0.00	0.00	68.80	0.00	0.00	5.70	5.70
C-	0.00	0.00	0.00	0.00	0.00	2.93	0.00	0.00	0.00	0.72
RA-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00
RP-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
RA-	0.00	0.00	1.00	0.00	0.00	0.00	0.00	47.00	1.00	2.00
RP-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	47.00	0.00	2.00
RA-	2.00	8.00	11.00	5.00	0.00	4.00	0.00	1.00	68.00	7.00
RP-	1.20	5.80	14.60	10.70	0.00	5.70	0.00	0.00	85.80	6.90
C-	0.00	0.60	1.18	6.50	0.00	0.00	0.00	0.00	4.66	0.00

NUMBER OF CELLS = 20
DEGREES OF FREEDOM = 19
CHI-SQUARE = 209.609

*- AVERAGE OF 10 PREDICTIONS

TABLE 36

GOODNESS OF FIT MATRIX FOR P03R
USING THE CONDITIONAL PROBABILITIES
FROM THE SUBJECT S LEFT ROLL.
RA=ACTUAL TRANSITIONS IN RIGHT ROLL
RP=PREDICTED TRANSITIONS *
C=CHI-SQUARE VALUES

	AS	ROLL	CBARS	ALT	ADF	HSI	IVSI	ENG	NON	ROW
RA-	37.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	1.00	2.00
RP-	17.50	0.00	0.00	0.00	1.50	0.00	0.00	0.00	1.10	2.60
C-	10.28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.18
RA-	0.00	32.00	8.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RP-	0.00	51.60	0.00	0.80	0.00	0.00	0.00	0.00	5.50	6.30
C-	0.00	12.00	8.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RA-	2.00	2.00	778.00	3.00	0.00	2.00	1.00	0.00	14.00	10.00
RP-	2.60	0.00	634.40	2.20	0.00	2.10	0.00	0.00	17.00	6.90
C-	0.00	0.00	26.51	0.00	0.00	0.00	0.00	0.00	0.64	0.96
RA-	0.00	0.00	2.00	165.00	0.00	0.00	2.00	0.00	7.00	4.00
RP-	0.00	1.00	4.80	213.10	0.00	0.00	1.50	0.00	12.60	7.30
C-	0.00	0.00	0.00	14.02	0.00	0.00	0.00	0.00	4.48	2.72
RA-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RP-	0.00	0.00	0.00	0.00	11.50	0.00	0.00	0.00	1.50	13.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RA-	0.00	0.00	0.00	0.00	0.00	34.00	0.00	0.00	3.00	3.00
RP-	0.00	0.00	2.40	0.00	0.00	46.00	0.00	0.00	2.10	4.50
C-	0.00	0.00	0.00	0.00	0.00	4.24	0.00	0.00	0.00	0.75
RA-	0.00	0.00	1.00	4.00	0.00	0.00	82.00	0.00	2.00	7.00
RP-	0.00	0.00	0.00	3.30	0.00	0.00	59.20	0.00	4.40	7.70
C-	0.00	0.00	0.00	0.00	0.00	0.00	6.34	0.00	0.00	0.07
RA-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RP-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RA-	0.00	6.00	12.00	4.00	0.00	1.00	4.00	0.00	28.00	9.00
RP-	0.00	5.30	16.70	13.60	0.00	2.50	6.20	0.00	91.00	22.30
C-	0.00	0.08	1.84	0.00	0.00	0.00	0.00	0.00	141.75	19.65

NUMBER OF CELLS = 18
DEGREES OF FREEDOM = 17
CHI-SQUARE = 254.517

*- AVERAGE OF 10 PREDICTIONS

GOODNESS OF FIT MATRIX FOR P05R
USING THE CONDITIONAL PROBABILITIES
FROM THE SUBJECT S LEFT ROLL.
RA=ACTUAL TRANSITIONS IN RIGHT ROLL
RP=PREDICTED TRANSITIONS *
C=CHI-SQUARE VALUES

	AS	ROLL	CBARS	ALT	ADF	HSI	IVSI	ENG	NON	ROW
RA-	36.00	3.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	4.00
RP-	119.70	3.70	0.70	1.50	0.00	0.00	0.00	0.00	1.30	7.20
C-	194.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.56
RA-	1.00	299.00	8.00	10.00	0.00	0.00	0.00	0.00	22.00	1.00
RP-	4.90	387.40	0.00	3.20	0.00	1.00	0.00	0.00	18.60	5.90
C-	0.00	26.14	8.00	4.62	0.00	0.00	0.00	0.00	0.53	24.01
RA-	1.00	11.00	312.00	0.00	0.00	0.00	0.00	0.00	21.00	1.00
RP-	0.00	11.20	165.60	0.00	0.00	0.70	0.00	0.00	6.20	0.70
C-	0.00	0.00	68.70	0.00	0.00	0.00	0.00	0.00	10.43	0.09
RA-	1.00	13.00	0.00	286.00	0.00	0.00	1.00	0.00	8.00	2.00
RP-	1.00	4.50	0.00	265.60	0.00	0.00	2.20	0.00	5.70	3.20
C-	0.00	5.56	0.00	1.46	0.00	0.00	0.00	0.00	0.66	0.72
RA-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RP-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RA-	0.00	0.00	0.00	0.00	0.00	2.00	0.00	0.00	1.00	3.00
RP-	0.00	1.40	0.00	0.00	0.00	81.00	0.00	0.00	3.60	86.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2296.33
RA-	0.00	0.00	0.00	2.00	0.00	0.00	36.00	0.00	2.00	4.00
RP-	0.00	0.00	0.00	1.10	0.00	0.00	49.40	0.00	3.00	4.10
C-	0.00	0.00	0.00	0.00	0.00	0.00	4.99	0.00	0.00	0.00
RA-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RP-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RA-	1.00	15.00	25.00	9.00	0.00	1.00	3.00	0.00	131.00	5.00
RP-	1.40	7.30	17.60	7.80	0.00	3.40	1.90	0.00	75.40	6.70
C-	0.00	3.95	2.19	0.16	0.00	0.00	0.00	0.00	23.60	0.58

NUMBER OF CELLS = 23
DEGREES OF FREEDOM = 22
CHI-SQUARE = 2679.874

*- AVERAGE OF 10 PREDICTIONS

GOODNESS OF FIT MATRIX FOR P06R
USING THE CONDITIONAL PROBABILITIES
FROM THE SUBJECT S LEFT ROLL.
RA=ACTUAL TRANSITIONS IN RIGHT ROLL
RP=PREDICTED TRANSITIONS *
C=CHI-SQUARE VALUES

	AS	ROLL	CBARS	ALT	ADF	HSI	IVSI	ENG	NON	ROW
RA-	5.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	1.00	2.00
RP-	2.70	1.20	1.40	0.00	2.00	0.00	0.00	0.00	0.80	5.40
C-	1.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.78
RA-	0.00	57.00	3.00	2.00	0.00	0.00	0.00	0.00	3.00	8.00
RP-	0.80	300.20	3.40	6.10	0.00	4.00	0.00	0.00	13.20	27.50
C-	0.00	2296.33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	47.53
RA-	0.00	2.00	511.00	1.00	2.00	1.00	0.00	0.00	23.00	6.00
RP-	0.90	8.70	238.10	0.00	0.00	0.00	0.00	0.00	18.40	9.60
C-	0.00	0.00	145.74	0.00	0.00	0.00	0.00	0.00	0.92	2.16
RA-	0.00	1.00	1.00	205.00	0.00	1.00	2.00	0.00	12.00	5.00
RP-	0.00	2.80	3.20	230.80	0.00	1.20	3.00	1.40	5.60	11.60
C-	0.00	0.00	0.00	3.25	0.00	0.00	0.00	0.00	3.41	8.71
RA-	0.00	0.00	0.00	1.00	32.00	0.00	0.00	0.00	2.00	3.00
RP-	0.00	0.00	2.20	0.00	37.20	0.00	0.00	0.00	2.00	4.20
C-	0.00	0.00	0.00	0.00	0.84	0.00	0.00	0.00	0.00	0.48
RA-	1.00	0.00	1.00	0.00	0.00	114.00	0.00	0.00	6.00	2.00
RP-	0.00	2.10	3.60	0.00	0.00	106.30	0.00	0.00	3.10	5.70
C-	0.00	0.00	0.00	0.00	0.00	0.52	0.00	0.00	1.40	6.84
RA-	0.00	0.00	1.00	0.00	0.00	1.00	60.00	0.00	4.00	6.00
RP-	0.00	0.00	0.80	1.40	1.00	0.00	39.70	0.00	2.60	5.80
C-	0.00	0.00	0.00	0.00	0.00	0.00	6.87	0.00	0.00	0.01
RA-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RP-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	15.70	1.30	17.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RA-	1.00	5.00	24.00	12.00	0.00	5.00	4.00	0.00	90.00	5.00
RP-	3.70	12.80	13.70	9.00	1.40	3.60	2.80	0.00	79.10	7.90
C-	0.00	12.17	4.42	0.75	0.00	0.39	0.00	0.00	1.32	1.68

NUMBER OF CELLS = 23
DEGREES OF FREEDOM = 22
CHI-SQUARE = 1293.917

*- AVERAGE OF 10 PREDICTIONS

GOODNESS OF FIT MATRIX FOR P07R
USING THE CONDITIONAL PROBABILITIES
FROM THE SUBJECT S LEFT ROLL.
RA=ACTUAL TRANSITIONS IN RIGHT ROLL
RP=PREDICTED TRANSITIONS *
C=CHI-SQUARE VALUES

	AS	ROLL	CBARS	ALT	ADF	HSI	IVSI	ENG	NON	ROW
RA-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RP-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RA-	0.00	4.00	3.00	0.00	0.00	0.00	0.00	0.00	2.00	9.00
RP-	0.00	113.60	8.20	2.60	0.00	0.00	0.00	0.00	3.80	128.20
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1578.74
RA-	0.00	1.00	696.00	2.00	0.00	1.00	1.00	0.00	7.00	5.00
RP-	0.00	10.00	507.80	0.00	0.00	0.00	0.00	0.00	7.80	10.00
C-	0.00	0.00	50.89	0.00	0.00	0.00	0.00	0.00	0.09	5.00
RA-	0.00	4.00	0.00	57.00	0.00	0.00	0.00	0.00	2.00	6.00
RP-	0.00	1.90	0.00	59.10	0.00	0.00	0.00	0.00	2.60	4.50
C-	0.00	0.00	0.00	0.08	0.00	0.00	0.00	0.00	0.00	0.38
RA-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RP-	0.00	0.00	0.00	0.00	46.10	0.00	0.00	0.00	2.40	48.50
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RA-	0.00	0.00	0.00	0.00	0.00	28.00	0.00	0.00	1.00	1.00
RP-	0.00	0.00	0.00	0.00	0.00	17.00	0.00	0.00	0.50	0.50
C-	0.00	0.00	0.00	0.00	0.00	4.32	0.00	0.00	0.00	0.25
RA-	0.00	0.00	0.00	0.00	0.00	0.00	57.00	0.00	3.00	3.00
RP-	0.00	1.00	0.00	0.00	0.00	0.00	25.30	0.00	0.90	1.90
C-	0.00	0.00	0.00	0.00	0.00	0.00	17.63	0.00	0.00	0.40
RA-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RP-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RA-	0.00	0.00	8.00	4.00	0.00	1.00	2.00	0.00	15.00	7.00
RP-	0.00	1.80	9.40	1.90	2.40	0.50	2.00	0.00	67.40	8.60
C-	0.00	0.00	0.24	0.00	0.00	0.00	0.00	0.00	183.05	0.37

NUMBER OF CELLS = 13
DEGREES OF FREEDOM = 12
CHI-SQUARE = 1841.437

*- AVERAGE OF 10 PREDICTIONS

TABLE 40

GOODNESS OF FIT MATRIX FOR P08R
USING THE CONDITIONAL PROBABILITIES
FROM THE SUBJECT S LEFT ROLL.
RA=ACTUAL TRANSITIONS IN RIGHT ROLL
RP=PREDICTED TRANSITIONS *
C=CHI-SQUARE VALUES

	AS	ROLL	CBARS	ALT	ADF	HSI	IVSI	ENG	NON	ROW
RA-	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	1.00
RP-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
RA-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RP-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RA-	1.00	0.00	665.00	4.00	1.00	1.00	0.00	0.00	11.00	7.00
RP-	0.00	0.00	486.20	3.70	3.70	1.50	0.00	0.00	24.80	8.90
C-	0.00	0.00	48.07	0.00	0.00	0.00	0.00	0.00	17.31	0.52
RA-	0.00	0.00	0.00	118.00	0.00	0.00	0.00	0.00	13.00	0.00
RP-	0.00	0.00	2.20	151.90	0.50	0.00	1.50	0.00	10.20	4.20
C-	0.00	0.00	0.00	9.74	0.00	0.00	0.00	0.00	0.60	0.00
RA-	0.00	0.00	2.00	0.00	77.00	1.00	0.00	1.00	2.00	6.00
RP-	0.00	0.00	0.00	0.00	58.80	0.00	1.10	0.00	5.40	6.50
C-	0.00	0.00	0.00	0.00	4.30	0.00	0.00	0.00	0.00	0.04
RA-	0.00	0.00	1.00	0.00	0.00	68.00	1.00	0.00	3.00	5.00
RP-	0.00	0.00	2.00	0.00	0.00	26.70	0.30	0.00	0.70	3.00
C-	0.00	0.00	0.00	0.00	0.00	25.08	0.00	0.00	0.00	0.80
RA-	0.00	0.00	0.00	1.00	0.00	0.00	43.00	0.00	3.00	4.00
RP-	0.00	0.00	0.00	0.90	0.00	0.00	89.50	0.00	5.90	6.80
C-	0.00	0.00	0.00	0.00	0.00	0.00	50.28	0.00	0.00	1.96
RA-	0.00	0.00	0.00	1.00	0.00	0.00	0.00	22.00	0.00	1.00
RP-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	22.00	0.00	1.00
RA-	0.00	0.00	15.00	7.00	4.00	3.00	3.00	0.00	56.00	10.00
RP-	0.00	0.00	28.90	9.90	2.30	1.50	4.20	0.00	201.70	8.00
C-	0.00	0.00	12.88	1.20	0.00	0.00	0.00	0.00	379.08	0.40

NUMBER OF CELLS = 18
DEGREES OF FREEDOM = 17
CHI-SQUARE = 576.279

*- AVERAGE OF 10 PREDICTIONS

GOODNESS OF FIT MATRIX FOR P09R
USING THE CONDITIONAL PROBABILITIES
FROM THE SUBJECT S LEFT ROLL.
RA=ACTUAL TRANSITIONS IN RIGHT ROLL
RP=PREDICTED TRANSITIONS *
C=CHI-SQUARE VALUES

	AS	ROLL	CBARS	ALT	ADF	HSI	IVSI	ENG	NON	ROW
RA-	2.00	0.00	0.00	0.00	2.00	0.00	0.00	0.00	0.00	4.00
RP-	1.40	0.00	0.00	0.00	0.00	0.00	0.00	0.70	0.50	2.60
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.49
RA-	0.00	54.00	8.00	0.00	0.00	0.00	0.00	0.00	4.00	4.00
RP-	0.00	4.20	3.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	45.93	3.13	0.00	0.00	0.00	0.00	0.00	0.00	4.00
RA-	0.00	7.00	449.00	1.00	1.00	0.00	0.00	0.00	20.00	2.00
RP-	0.50	0.00	541.90	0.00	0.00	0.00	0.00	0.00	25.10	0.50
C-	0.00	7.00	19.22	0.00	0.00	0.00	0.00	0.00	1.30	1.13
RA-	0.00	0.00	8.00	203.00	0.00	1.00	0.00	0.00	9.00	1.00
RP-	0.00	0.00	1.30	200.40	0.00	0.00	0.60	0.00	14.00	0.60
C-	0.00	0.00	5.61	0.03	0.00	0.00	0.00	0.00	2.78	0.16
RA-	0.00	0.00	0.00	1.00	53.00	1.00	0.00	0.00	4.00	6.00
RP-	0.00	0.00	0.00	0.00	42.80	0.00	0.00	0.00	2.10	2.10
C-	0.00	0.00	0.00	0.00	1.96	0.00	0.00	0.00	0.00	2.53
RA-	0.00	2.00	0.00	0.00	0.00	106.00	0.00	0.00	4.00	6.00
RP-	0.00	1.10	1.20	0.00	0.00	100.50	0.00	0.00	1.90	4.20
C-	0.00	0.00	0.00	0.00	0.00	0.29	0.00	0.00	0.00	0.54
RA-	0.00	0.00	0.00	0.00	0.00	0.00	19.00	0.00	2.00	2.00
RP-	0.00	0.00	0.00	0.40	0.00	1.40	56.00	0.00	4.60	6.40
C-	0.00	0.00	0.00	0.00	0.00	0.00	72.05	0.00	0.00	9.68
RA-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RP-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.10	0.70	5.80
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RA-	2.00	2.00	14.00	16.00	3.00	4.00	2.00	0.00	117.00	13.00
RP-	0.70	1.90	19.50	15.90	2.10	3.00	5.80	0.00	57.70	13.50
C-	0.00	0.00	2.16	0.00	0.00	0.00	0.00	0.00	30.06	0.02

NUMBER OF CELLS = 22
DEGREES OF FREEDOM = 21
CHI-SQUARE = 210.063

*- AVERAGE OF 10 PREDICTIONS

TABLE 42

GOODNESS OF FIT MATRIX FOR P10R
USING THE CONDITIONAL PROBABILITIES
FROM THE SUBJECT S LEFT ROLL.
RA=ACTUAL TRANSITIONS IN RIGHT ROLL
RP=PREDICTED TRANSITIONS *
C=CHI-SQUARE VALUES

	AS	ROLL	CBARS	ALT	ADF	HSI	IVSI	ENG	NON	ROW
RA-	40.00	0.00	1.00	1.00	1.00	0.00	0.00	0.00	2.00	5.00
RP-	0.00	0.00	0.40	0.00	0.00	0.00	0.00	0.00	0.00	0.40
C-	40.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.23
RA-	0.00	462.00	3.00	7.00	0.00	0.00	0.00	0.00	16.00	3.00
RP-	0.00	122.20	2.60	3.00	0.00	0.00	0.00	0.00	8.40	2.60
C-	0.00	249.92	0.00	2.29	0.00	0.00	0.00	0.00	3.61	0.05
RA-	1.00	3.00	142.00	0.00	0.00	0.00	0.00	0.00	12.00	4.00
RP-	0.00	5.10	320.80	0.90	0.00	0.00	0.00	0.00	16.30	6.00
C-	0.00	0.00	225.14	0.00	0.00	0.00	0.00	0.00	1.54	1.00
RA-	0.00	13.00	1.00	145.00	0.00	0.00	0.00	0.00	3.00	4.00
RP-	0.00	4.10	0.00	145.20	0.00	0.00	0.00	0.00	11.40	11.40
C-	0.00	6.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	13.69
RA-	1.00	0.00	1.00	0.00	4.00	0.00	0.00	0.00	0.00	6.00
RP-	0.40	0.00	0.80	0.00	8.00	0.00	0.00	0.00	0.70	9.90
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.54
RA-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RP-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RA-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RP-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RA-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RP-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RA-	3.00	10.00	10.00	9.00	1.00	0.00	0.00	0.00	27.00	4.00
RP-	0.00	3.90	18.80	12.00	1.90	0.00	0.00	0.00	229.10	1.90
C-	0.00	3.72	7.74	1.00	0.00	0.00	0.00	0.00	1512.76	1.10

NUMBER OF CELLS = 18
DEGREES OF FREEDOM = 17
CHI-SQUARE = 2076.423

*- AVERAGE OF 10 PREDICTIONS

TABLE 43

GOODNESS OF FIT MATRIX FOR P11R
USING THE CONDITIONAL PROBABILITIES
FROM THE SUBJECT S LEFT ROLL.
RA=ACTUAL TRANSITIONS IN RIGHT ROLL
RP=PREDICTED TRANSITIONS *
C=CHI-SQUARE VALUES

	AS	ROLL	CBARS	ALT	ADF	HSI	IVSI	ENG	NON	ROW
RA-	69.00	0.00	2.00	0.00	1.00	0.00	0.00	0.00	2.00	5.00
RP-	130.20	0.00	3.40	0.00	4.60	0.00	0.00	1.00	10.90	19.90
C-	54.28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	44.40
RA-	0.00	4.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	5.00
RP-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.00
RA-	1.00	1.00	398.00	1.00	0.00	2.00	0.00	0.00	20.00	5.00
RP-	3.00	0.00	232.90	0.00	0.00	2.90	0.00	0.00	18.00	5.90
C-	0.00	0.00	68.49	0.00	0.00	0.00	0.00	0.00	0.20	0.16
RA-	0.00	0.00	0.00	106.00	0.00	0.00	0.00	0.00	17.00	0.00
RP-	0.00	0.00	0.00	86.40	0.00	0.00	0.00	0.00	8.80	0.00
C-	0.00	0.00	0.00	3.62	0.00	0.00	0.00	0.00	3.96	0.00
RA-	0.00	0.00	0.00	0.00	5.00	0.00	0.00	0.00	1.00	1.00
RP-	1.10	0.00	0.00	0.00	11.60	0.00	0.00	0.00	5.30	6.40
C-	0.00	0.00	0.00	0.00	8.71	0.00	0.00	0.00	0.00	29.16
RA-	0.00	0.00	0.00	0.00	0.00	131.00	1.00	0.00	10.00	1.00
RP-	0.00	0.00	2.50	0.00	1.10	53.70	0.00	0.00	2.90	3.60
C-	0.00	0.00	0.00	0.00	0.00	45.61	0.00	0.00	5.04	6.76
RA-	0.00	0.00	0.00	1.00	0.00	1.00	19.00	0.00	1.00	3.00
RP-	0.90	0.00	0.00	1.50	0.00	0.00	14.90	0.00	2.10	4.50
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.88	0.00	0.00	0.75
RA-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00	1.00	4.00
RP-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	21.50	1.00	22.50
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	85.56
RA-	4.00	0.00	24.00	14.00	0.00	8.00	2.00	1.00	81.00	7.00
RP-	14.90	0.00	18.30	6.40	0.90	3.70	4.60	0.00	259.00	20.40
C-	0.00	0.00	1.35	4.13	0.00	2.31	0.00	0.00	391.16	25.65

NUMBER OF CELLS = 21
DEGREES OF FREEDOM = 20
CHI-SQUARE = 787.198

*- AVERAGE OF 10 PREDICTIONS

TABLE 44

GOODNESS OF FIT MATRIX FOR TP1R
USING THE CONDITIONAL PROBABILITIES
FROM THE SUBJECT S LEFT ROLL.
RA=ACTUAL TRANSITIONS IN RIGHT ROLL
RP=PREDICTED TRANSITIONS *
C=CHI-SQUARE VALUES

	AS	ROLL	CBARS	ALT	ADF	HSI	IVSI	ENG	NON	ROW
RA-	16.00	0.00	C.00	0.00	0.00	0.00	0.00	0.00	2.00	2.00
RP-	1.20	0.00	0.40	0.00	0.00	0.00	C.00	0.00	0.00	0.40
C-	13.69	0.00	C.00	0.00	0.00	0.00	C.00	0.00	0.00	1.28
RA-	0.00	12.00	2.00	0.00	0.00	0.00	C.00	0.00	1.00	3.00
RP-	0.00	18.50	1.10	C.00	0.00	0.00	C.00	0.00	0.70	1.80
C-	0.00	3.52	C.00	C.00	0.00	0.00	0.00	0.00	0.00	0.48
RA-	1.00	1.00	414.00	0.00	0.00	3.00	C.00	0.00	17.00	5.00
RP-	0.50	1.10	359.00	C.00	0.00	4.30	C.00	C.00	9.30	5.90
C-	0.00	0.00	7.31	0.00	0.00	0.00	C.00	0.00	3.49	0.16
RA-	0.00	0.00	0.00	0.00	0.00	0.00	C.00	0.00	0.00	0.00
RP-	0.00	0.00	0.00	C.00	0.00	0.00	C.00	0.00	0.00	0.00
C-	0.00	0.00	C.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RA-	0.00	0.00	0.00	0.00	0.00	1.00	C.00	0.00	0.00	1.00
RP-	0.00	0.00	0.00	0.00	0.20	0.20	C.00	0.00	0.00	0.40
C-	0.00	0.00	0.00	C.00	0.00	0.00	C.00	0.00	0.00	0.36
RA-	0.00	0.00	7.00	0.00	0.00	292.00	C.00	0.00	14.00	0.00
RP-	0.00	0.70	4.00	0.00	0.00	373.10	0.00	0.00	12.40	0.70
C-	0.00	0.00	1.29	C.00	0.00	22.52	C.00	C.00	0.18	0.00
RA-	0.00	0.00	0.00	0.00	0.00	0.00	C.00	0.00	0.00	0.00
RP-	0.00	0.00	0.00	0.00	0.00	0.00	C.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	C.00	0.00	0.00	0.00
RA-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RP-	0.00	0.00	C.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RA-	1.00	2.00	14.00	0.00	1.00	16.00	C.00	0.00	47.00	4.00
RP-	0.00	0.00	10.20	0.00	0.30	11.90	0.00	0.00	50.90	0.30
C-	0.00	0.00	1.03	0.00	0.00	1.05	0.00	0.00	0.32	3.42

NUMBER OF CELLS = 15
DEGREES OF FREEDOM = 14
CHI-SQUARE = 60.109

*- AVERAGE OF 10 PREDICTIONS

TABLE 45

GOODNESS OF FIT MATRIX FOR TP5R
USING THE CONDITIONAL PROBABILITIES
FROM THE SUBJECT S LEFT ROLL.
RA=ACTUAL TRANSITIONS IN RIGHT ROLL
RP=PREDICTED TRANSITIONS *
C=CHI-SQUARE VALUES

	AS	ROLL	CBARS	ALT	ADF	HSI	IVSI	ENG	NON	ROW
RA-	39.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	6.00	1.00
RP-	39.90	0.00	2.40	0.70	0.00	0.00	0.00	0.00	1.40	3.10
C-	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.53	4.41
RA-	0.00	9.00	1.00	2.00	0.00	0.00	0.00	0.00	1.00	4.00
RP-	0.00	19.40	1.90	0.70	0.00	0.00	0.00	0.00	3.40	6.00
C-	0.00	12.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
RA-	2.00	2.00	502.00	2.00	0.00	2.00	0.00	0.00	22.00	8.00
RP-	2.30	0.70	465.10	0.00	1.20	5.60	0.00	0.00	24.00	9.80
C-	0.00	0.00	2.71	0.00	0.00	0.00	0.00	0.00	0.18	0.41
RA-	2.00	0.00	1.00	175.00	0.00	2.00	0.00	0.00	21.00	5.00
RP-	0.00	0.00	0.00	216.50	0.00	0.00	0.00	0.00	18.40	0.00
C-	0.00	0.00	0.00	9.84	0.00	0.00	0.00	0.00	0.32	5.00
RA-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RP-	0.00	0.00	0.00	0.00	5.00	0.00	0.00	0.00	1.10	6.10
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RA-	0.00	0.00	2.00	2.00	0.00	109.00	0.00	0.00	6.00	4.00
RP-	0.00	1.00	0.90	1.00	0.00	156.00	0.00	0.00	9.60	2.90
C-	0.00	0.00	0.00	0.00	0.00	20.27	0.00	0.00	2.16	0.30
RA-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RP-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RA-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RP-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RA-	3.00	2.00	25.00	20.00	0.00	6.00	0.00	0.00	232.00	5.00
RP-	2.20	4.30	28.60	16.20	0.00	7.00	0.00	0.00	159.50	6.50
C-	0.00	0.00	0.52	0.72	0.00	0.17	0.00	0.00	22.66	0.45

NUMBER OF CELLS = 19
DEGREES OF FREEDOM = 18
CHI-SQUARE = 86.680

*- AVERAGE OF 10 PREDICTIONS

TABLE 46

GOODNESS OF FIT MATRIX FOR IP3L
USING THREE PREVIOUS LOOKPOINTS
AND ONE CONTROL STATUS.
A=ACTUAL TRANSITIONS
P=PREDICTED TRANSITIONS *
C=CHI-SQUARE VALUES

	AS	ROLL	CBARS	ALT	ADF	HSI	IVSI	ENG	NON	ROW
A-	63.00	3.00	1.00	2.00	1.00	0.00	0.00	0.00	2.00	9.00
P-	61.10	2.60	0.50	1.40	0.60	0.00	0.00	0.00	3.60	8.70
C-	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
A-	1.00	247.00	9.00	1.00	0.00	0.00	0.00	0.00	12.00	2.00
P-	0.90	251.70	10.60	0.50	0.00	0.00	0.00	0.00	12.20	1.40
C-	0.00	0.09	0.28	0.00	0.00	0.00	0.00	0.00	0.00	0.18
A-	2.00	8.00	238.00	1.00	1.00	0.00	0.00	0.00	9.00	4.00
P-	2.20	8.00	242.30	0.70	1.30	0.00	0.00	0.00	10.10	4.20
C-	0.00	0.00	0.08	0.00	0.00	0.00	0.00	0.00	0.13	0.01
A-	2.00	1.00	1.00	227.00	0.00	0.00	0.00	0.00	14.00	4.00
P-	2.60	1.50	0.80	199.60	0.00	0.00	0.00	0.00	12.90	4.90
C-	0.00	0.00	0.00	3.31	0.00	0.00	0.00	0.00	0.09	0.20
A-	0.00	0.00	1.00	2.00	7.00	0.00	0.00	0.00	1.00	4.00
P-	0.00	0.00	0.80	2.60	8.40	0.00	0.00	0.00	1.10	4.50
C-	0.00	0.00	0.00	0.00	0.28	0.00	0.00	0.00	0.00	0.06
A-	0.00	3.00	0.00	0.00	2.00	127.00	0.00	0.00	6.00	5.00
P-	0.00	3.80	0.00	0.00	1.00	123.60	0.00	0.00	7.70	4.80
C-	0.00	0.00	0.00	0.00	0.00	0.09	0.00	0.00	0.48	0.01
A-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	4.00	8.00	8.00	12.00	1.00	11.00	0.00	0.00	64.00	5.00
P-	3.00	8.50	8.90	12.60	1.60	13.10	0.00	0.00	75.60	4.60
C-	0.00	0.03	0.10	0.03	0.00	0.40	0.00	0.00	2.10	0.03

NUMBER OF CELLS = 24
DEGREES OF FREEDOM = 23
CHI-SQUARE = 8.064

*- AVERAGE OF 10 PREDICTIONS

TABLE 47

GOODNESS OF FIT MATRIX FOR IP3R
USING THREE PREVIOUS LOCKPOINTS
AND ONE CONTROL STATUS.
A=ACTUAL TRANSITIONS
P=PREDICTED TRANSITIONS *
C=CHI-SQUARE VALUES

	AS	ROLL	CBARS	ALT	ADF	HSI	IVSI	ENG	NON	ROW
A-	75.00	0.00	5.00	1.00	0.00	2.00	0.00	0.00	2.00	5.00
P-	56.10	0.00	3.20	0.40	0.00	2.40	0.00	0.00	2.40	5.20
C-	4.76	0.00	0.65	0.00	0.00	0.00	0.00	0.00	0.00	0.01
A-	0.00	249.00	10.00	9.00	1.00	0.00	0.00	0.00	6.00	1.00
P-	0.00	188.20	8.40	13.50	1.00	0.00	0.00	0.00	12.40	1.00
C-	0.00	14.85	0.26	2.25	0.00	0.00	0.00	0.00	6.83	0.00
A-	2.00	15.00	232.00	0.00	0.00	1.00	0.00	0.00	8.00	3.00
P-	2.40	10.70	171.60	0.00	0.00	0.00	0.00	0.00	9.40	2.40
C-	0.00	1.23	15.72	0.00	0.00	0.00	0.00	0.00	0.24	0.12
A-	0.00	2.00	0.00	223.00	0.00	0.00	0.00	0.00	17.00	2.00
P-	0.00	1.50	0.00	318.40	0.00	0.00	0.00	0.00	20.70	1.50
C-	0.00	0.00	0.00	40.81	0.00	0.00	0.00	0.00	0.81	0.13
A-	1.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	2.00
P-	0.00	0.00	0.00	0.00	0.00	0.90	0.00	0.00	0.10	1.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.50
A-	0.00	0.00	3.00	0.00	0.00	112.00	0.00	0.00	7.00	3.00
P-	0.00	0.00	3.30	0.00	0.00	82.00	0.00	0.00	5.70	3.30
C-	0.00	0.00	0.00	0.00	0.00	8.04	0.00	0.00	0.24	0.03
A-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	7.00	8.00	8.00	9.00	1.00	6.00	0.00	0.00	107.00	1.00
P-	6.00	22.60	7.70	8.60	0.00	5.70	0.00	0.00	161.70	0.00
C-	0.14	26.64	0.01	0.02	0.00	0.02	0.00	0.00	27.96	1.00

NUMBER OF CELLS = 26
DEGREES OF FREEDOM = 25
CHI-SQUARE = 153.265

*- AVERAGE OF 10 PREDICTIONS

GOODNESS OF FIT MATRIX FOR IP4L
USING THREE PREVIOUS LOOKPOINTS
AND ONE CONTROL STATUS.
A=ACTUAL TRANSITIONS
P=PREDICTED TRANSITIONS *
C=CHI-SQUARE VALUES

	AS	ROLL	CBARS	ALT	ADF	HSI	IVSI	ENG	NON	ROW
A-	6.00	0.00	3.00	0.00	0.00	0.00	0.00	0.00	2.00	5.00
P-	4.40	0.00	3.90	0.00	0.00	0.00	0.00	0.00	1.60	5.50
C-	0.43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05
A-	0.00	102.00	8.00	0.00	0.00	0.00	0.00	0.00	7.00	0.00
P-	0.00	96.20	8.00	0.00	0.00	0.00	0.00	0.00	7.90	0.00
C-	0.00	0.33	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.00
A-	1.00	11.00	473.00	0.00	0.00	0.00	0.00	0.00	19.00	1.00
P-	0.80	10.30	477.20	0.00	0.00	0.00	0.00	0.00	20.50	0.80
C-	0.00	0.04	0.04	0.00	0.00	0.00	0.00	0.00	0.12	0.04
A-	0.00	3.00	1.00	236.00	0.00	0.00	0.00	0.00	20.00	4.00
P-	0.00	2.70	0.90	216.30	0.00	0.00	0.00	0.00	19.40	3.60
C-	0.00	0.00	0.00	1.64	0.00	0.00	0.00	0.00	0.02	0.04
A-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	0.00	0.00	1.00	0.00	0.00	24.00	0.00	0.00	1.00	2.00
P-	0.00	0.00	0.10	0.00	0.00	24.40	0.00	0.00	1.80	1.90
C-	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.01
A-	0.00	0.00	0.00	1.00	0.00	0.00	10.00	0.00	1.00	2.00
P-	0.00	0.00	0.00	1.10	0.00	0.00	9.00	0.00	1.10	2.20
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.00	0.00	0.02
A-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	4.00	2.00	17.00	23.00	0.00	2.00	2.00	0.00	160.00	10.00
P-	4.70	2.80	18.30	22.30	0.00	1.90	2.20	0.00	177.20	11.60
C-	0.00	0.00	0.10	0.02	0.00	0.00	0.00	0.00	1.85	0.26

NUMBER OF CELLS = 20
DEGREES OF FREEDOM = 19
CHI-SQUARE = 5.222

*- AVERAGE OF 10 PREDICTIONS

GOODNESS OF FIT MATRIX FOR IP4R
USING THREE PREVIOUS LOOKPOINTS
AND ONE CONTROL STATUS.
A=ACTUAL TRANSITIONS
P=PREDICTED TRANSITIONS *
C=CHI-SQUARE VALUES

	AS	ROLL	CBARS	ALT	ADF	HSI	IVSI	ENG	NON	ROW
A-	17.00	0.00	2.00	2.00	0.00	0.00	0.00	0.00	3.00	7.00
P-	15.60	0.00	1.50	2.20	0.00	0.00	0.00	0.00	3.30	7.00
C-	0.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	1.00	96.00	10.00	1.00	0.00	0.00	0.00	0.00	1.00	3.00
P-	0.70	71.70	8.70	0.80	0.00	0.00	0.00	0.00	1.10	2.60
C-	0.00	6.15	0.17	0.00	0.00	0.00	0.00	0.00	0.00	0.05
A-	1.00	7.00	450.00	3.00	0.00	3.00	0.00	0.00	17.00	7.00
P-	0.80	6.20	417.70	2.20	0.00	3.20	0.00	0.00	17.20	6.20
C-	0.00	0.09	2.32	0.00	0.00	0.00	0.00	0.00	0.00	0.09
A-	1.00	2.00	2.00	162.00	0.00	1.00	2.00	0.00	20.00	8.00
P-	0.90	2.10	2.50	151.10	0.00	1.20	2.30	0.00	18.10	9.00
C-	0.00	0.00	0.00	0.73	0.00	0.00	0.00	0.00	0.18	0.13
A-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	0.00	0.00	0.00	0.00	0.00	41.00	0.00	0.00	6.00	0.00
P-	0.00	0.00	0.00	0.00	0.00	47.10	0.00	0.00	6.60	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.91	0.00	0.00	0.06	0.00
A-	0.00	0.00	0.00	1.00	0.00	0.00	23.00	0.00	3.00	4.00
P-	0.00	0.00	0.00	1.70	0.00	0.00	50.00	0.00	7.60	9.30
C-	0.00	0.00	0.00	0.00	0.00	0.00	31.70	0.00	0.00	7.02
A-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	4.00	4.00	16.00	21.00	0.00	2.00	2.00	0.00	135.00	12.00
P-	4.60	3.00	16.20	20.40	0.00	2.20	7.40	0.00	161.10	17.20
C-	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	5.05	2.25

NUMBER OF CELLS = 20
DEGREES OF FREEDOM = 19
CHI-SQUARE = 57.036

*- AVERAGE OF 10 PREDICTIONS

TABLE 50

GOODNESS OF FIT MATRIX FOR POIL
USING THREE PREVIOUS LOOKPOINTS
AND ONE CONTROL STATUS.
A=ACTUAL TRANSITIONS
P=PREDICTED TRANSITIONS *
C=CHI-SQUARE VALUES

	AS	ROLL	CBARS	ALT	ADF	HSI	IVSI	ENG	NON	ROW
A-	82.00	0.00	4.00	0.00	0.00	0.00	0.00	0.00	1.00	5.00
P-	93.30	0.00	3.50	0.00	0.00	0.00	0.00	0.00	0.40	3.90
C-	1.56	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.24
A-	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	2.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.00
A-	2.00	0.00	708.00	2.00	0.00	0.00	1.00	0.00	15.00	5.00
P-	1.30	0.00	659.20	2.80	0.00	0.00	0.90	0.00	12.60	5.00
C-	0.00	0.00	3.36	0.00	0.00	0.00	0.00	0.00	0.38	0.00
A-	0.00	0.00	2.00	38.00	0.00	0.00	1.00	0.00	6.00	3.00
P-	0.00	0.00	1.10	42.80	0.00	0.00	1.10	0.00	12.80	2.20
C-	0.00	0.00	0.00	0.61	0.00	0.00	0.00	0.00	7.71	0.21
A-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	0.00	0.00	0.00	3.00	0.00	0.00	62.00	0.00	0.00	3.00
P-	0.00	0.00	0.00	1.70	0.00	0.00	43.10	0.00	1.60	3.30
C-	0.00	0.00	0.00	0.00	0.00	0.00	5.76	0.00	0.00	0.03
A-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	3.00	0.00	14.00	5.00	0.00	0.00	1.00	0.00	130.00	4.00
P-	2.60	0.00	13.60	10.60	0.00	0.00	1.40	0.00	172.60	4.00
C-	0.00	0.00	0.01	6.27	0.00	0.00	0.00	0.00	13.96	0.00

NUMBER OF CELLS = 15
DEGREES OF FREEDOM = 14
CHI-SQUARE = 42.108

*- AVERAGE OF 10 PREDICTIONS

GOODNESS OF FIT MATRIX FOR P01R
USING THREE PREVIOUS LOOKPOINTS
AND ONE CONTROL STATUS.
A=ACTUAL TRANSITIONS
P=PREDICTED TRANSITIONS *
C=CHI-SQUARE VALUES

	AS	ROLL	CBARS	ALT	ADF	HSI	IVSI	ENG	NON	ROW
A-	116.00	0.00	3.00	0.00	0.00	0.00	0.00	0.00	3.00	6.00
P-	93.80	0.00	3.30	0.00	0.00	0.00	0.00	0.00	3.20	6.50
C-	4.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04
A-	0.00	23.00	1.00	0.00	0.00	0.00	0.00	0.00	2.00	3.00
P-	0.00	19.50	0.50	0.00	0.00	0.00	0.00	0.00	2.50	3.00
C-	0.00	0.53	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	1.00	0.00	317.00	0.00	0.00	0.00	2.00	0.00	22.00	3.00
P-	1.90	0.00	335.80	0.00	0.00	0.00	1.80	0.00	22.00	3.70
C-	0.00	0.00	1.11	0.00	0.00	0.00	0.00	0.00	0.00	0.16
A-	0.00	0.00	0.00	85.00	0.00	0.00	0.00	0.00	7.00	0.00
P-	0.00	0.00	0.00	96.10	0.00	0.00	0.00	0.00	8.30	0.00
C-	0.00	0.00	0.00	1.45	0.00	0.00	0.00	0.00	0.24	0.00
A-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	0.00	0.00	2.00	0.00	0.00	0.00	115.00	0.00	0.00	2.00
P-	0.00	0.00	1.20	0.00	0.00	0.00	106.50	0.00	0.60	1.80
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.63	0.00	0.00	0.02
A-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	55.00	6.00	0.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	45.80	5.50	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.54	0.04	0.00
A-	5.00	3.00	20.00	7.00	0.00	0.00	0.00	5.00	303.00	3.00
P-	4.60	3.00	21.70	8.30	0.00	0.00	0.00	4.70	309.40	3.00
C-	0.03	0.00	0.14	0.24	0.00	0.00	0.00	0.02	0.14	0.00

NUMBER OF CELLS = 19
DEGREES OF FREEDOM = 18
CHI-SQUARE = 10.592

*- AVERAGE OF 10 PREDICTIONS

GOODNESS OF FIT MATRIX FOR P02L
USING THREE PREVIOUS LOOKPOINTS
AND ONE CONTROL STATUS.
A=ACTUAL TRANSITIONS
P=PREDICTED TRANSITIONS *
C=CHI-SQUARE VALUES

	AS	ROLL	CBARS	ALT	ADF	HSI	IVSI	ENG	NON	ROW
A-	38.00	0.00	3.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00
P-	24.00	0.00	2.00	0.00	0.00	0.00	0.00	0.00	0.80	2.80
C-	5.16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
A-	0.00	92.00	2.00	3.00	0.00	0.00	0.00	0.00	5.00	5.00
P-	0.00	104.20	2.60	2.50	0.00	0.00	0.00	0.00	7.90	5.10
C-	0.00	1.62	0.00	0.00	0.00	0.00	0.00	0.00	1.68	0.00
A-	2.00	5.00	578.00	1.00	0.00	0.00	0.00	0.00	16.00	3.00
P-	1.40	4.90	521.40	1.30	0.00	0.00	0.00	0.00	15.80	2.70
C-	0.00	0.00	5.54	0.00	0.00	0.00	0.00	0.00	0.00	0.03
A-	0.00	0.00	4.00	178.00	0.00	0.00	0.00	0.00	10.00	4.00
P-	0.00	0.00	3.30	158.70	0.00	0.00	0.00	0.00	13.20	3.30
C-	0.00	0.00	0.00	2.09	0.00	0.00	0.00	0.00	1.02	0.12
A-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	0.00	0.00	0.00	0.00	0.00	60.00	0.00	0.00	5.00	0.00
P-	0.00	0.00	0.00	0.00	0.00	57.10	0.00	0.00	4.60	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.14	0.00	0.00	0.03	0.00
A-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	1.00	6.00	14.00	10.00	0.00	5.00	0.00	0.00	85.00	1.00
P-	1.40	8.10	15.20	12.90	0.00	4.60	0.00	0.00	152.10	1.40
C-	0.00	0.74	0.10	0.84	0.00	0.03	0.00	0.00	52.97	0.16

NUMBER OF CELLS = 20
DEGREES OF FREEDOM = 19
CHI-SQUARE = 72.302

*- AVERAGE OF 10 PREDICTIONS

GOODNESS OF FIT MATRIX FOR P02R
USING THREE PREVIOUS LOOKPOINTS
AND ONE CONTROL STATUS.
A=ACTUAL TRANSITIONS
P=PREDICTED TRANSITIONS *
C=CHI-SQUARE VALUES

	AS	ROLL	CBARS	ALT	ADF	HSI	IVSI	ENG	NON	ROW
A-	42.00	0.00	1.00	0.00	0.00	0.00	1.00	0.00	1.00	3.00
P-	33.30	0.00	0.50	0.00	0.00	0.00	0.20	0.00	2.70	3.40
C-	1.80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05
A-	0.00	99.00	5.00	0.00	0.00	0.00	0.00	0.00	6.00	0.00
P-	0.00	100.00	3.70	0.00	0.00	0.00	0.00	0.00	8.10	0.00
C-	0.00	0.01	0.34	0.00	0.00	0.00	0.00	0.00	0.74	0.00
A-	1.00	2.00	653.00	2.00	0.00	0.00	0.00	0.00	17.00	5.00
P-	0.90	1.80	597.60	2.80	0.00	0.00	0.00	0.00	16.60	5.50
C-	0.00	0.00	4.70	0.00	0.00	0.00	0.00	0.00	0.01	0.05
A-	0.00	0.00	3.00	97.00	0.00	0.00	0.00	0.00	4.00	7.00
P-	0.00	0.00	2.80	87.50	0.00	0.00	0.00	0.00	4.90	7.70
C-	0.00	0.00	0.00	0.93	0.00	0.00	0.00	0.00	0.00	0.07
A-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	0.00	1.00	0.00	0.00	0.00	56.00	0.00	0.00	3.00	4.00
P-	0.00	1.00	0.00	0.00	0.00	106.80	0.00	0.00	5.20	6.20
C-	0.00	0.00	0.00	0.00	0.00	46.08	0.00	0.00	0.00	1.21
A-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.00	0.20
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.64
A-	0.00	0.00	1.00	0.00	0.00	0.00	0.00	47.00	1.00	2.00
P-	0.00	0.00	0.70	0.00	0.00	0.00	0.00	19.70	0.50	1.20
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	15.86	0.00	0.32
A-	2.00	8.00	11.00	5.00	0.00	4.00	0.00	1.00	68.00	7.00
P-	3.00	9.00	13.90	4.90	0.00	6.20	0.00	1.00	104.50	10.20
C-	0.00	0.13	0.76	0.00	0.00	0.00	0.00	0.00	19.59	1.46

NUMBER OF CELLS = 20
DEGREES OF FREEDOM = 19
CHI-SQUARE = 94.755

*- AVERAGE OF 10 PREDICTIONS

GOODNESS OF FIT MATRIX FOR P03L
USING THREE PREVIOUS LOCKPOINTS
AND ONE CONTROL STATUS.
A=ACTUAL TRANSITIONS
P=PREDICTED TRANSITIONS *
C=CHI-SQUARE VALUES

	AS	ROLL	CBARS	ALT	ADF	HSI	IVSI	ENG	NON	ROW
A-	14.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	1.00	2.00
P-	8.50	0.00	0.00	0.00	0.80	0.00	0.00	0.00	0.70	1.50
C-	2.16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.13
A-	0.00	50.00	0.00	1.00	0.00	0.00	0.00	0.00	5.00	1.00
P-	0.00	46.80	0.00	0.20	0.00	0.00	0.00	0.00	6.20	0.20
C-	0.00	0.20	0.00	0.00	0.00	0.00	0.00	0.00	0.29	0.64
A-	2.00	0.00	554.00	2.00	0.00	2.00	0.00	0.00	14.00	6.00
P-	1.50	0.00	559.60	1.90	0.00	1.70	0.00	0.00	16.80	5.10
C-	0.00	0.00	0.06	0.00	0.00	0.00	0.00	0.00	0.56	0.13
A-	0.00	2.00	4.00	204.00	0.00	0.00	1.00	0.00	12.00	7.00
P-	0.00	1.40	3.70	190.60	0.00	0.00	0.70	0.00	11.60	5.80
C-	0.00	0.00	0.00	0.88	0.00	0.00	0.00	0.00	0.01	0.21
A-	0.00	0.00	0.00	0.00	7.00	0.00	0.00	0.00	1.00	1.00
P-	0.00	0.00	0.00	0.00	4.20	0.00	0.00	0.00	0.80	0.80
C-	0.00	0.00	0.00	0.00	1.12	0.00	0.00	0.00	0.00	0.04
A-	0.00	0.00	1.00	0.00	0.00	26.00	0.00	0.00	2.00	3.00
P-	0.00	0.00	1.80	0.00	0.00	38.80	0.00	0.00	2.00	3.80
C-	0.00	0.00	0.00	0.00	0.00	6.30	0.00	0.00	0.00	0.21
A-	0.00	0.00	0.00	3.00	0.00	0.00	52.00	0.00	3.00	6.00
P-	0.00	0.00	0.00	2.70	0.00	0.00	37.50	0.00	2.80	5.50
C-	0.00	0.00	0.00	0.00	0.00	0.00	4.04	0.00	0.00	0.04
A-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	0.00	4.00	15.00	13.00	0.00	2.00	5.00	0.00	81.00	6.00
P-	**0.00**	**5.00**	**16.00**	**12.90**	**0.00**	**2.20**	**4.80**	**0.00**	**96.80**	**7.20**
C-	**0.00**	**0.00**	**0.07**	**0.00**	**0.00**	**0.00**	**0.01**	**0.00**	**3.08**	**0.24**

NUMBER OF CELLS = 22
DEGREES OF FREEDOM = 21
CHI-SQUARE = 20.427

*- AVERAGE OF 10 PREDICTIONS

GOODNESS OF FIT MATRIX FOR P03R
USING THREE PREVIOUS LOOKPOINTS
AND ONE CONTROL STATUS.
A=ACTUAL TRANSITIONS
P=PREDICTED TRANSITIONS *
C=CHI-SQUARE VALUES

	AS	ROLL	CBARS	ALT	ADF	HSI	IVSI	ENG	NON	ROW
A-	37.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	1.00	2.00
P-	35.00	0.00	0.70	0.00	0.00	0.00	0.00	0.00	1.10	1.80
C-	0.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02
A-	0.00	32.00	8.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-	0.00	35.90	8.60	0.00	0.00	0.00	0.00	0.00	0.10	0.10
C-	0.00	0.48	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	2.00	2.00	778.00	3.00	0.00	2.00	1.00	0.00	14.00	10.00
P-	1.80	1.80	769.00	2.70	0.00	1.40	0.60	0.00	15.10	8.30
C-	0.00	0.00	0.10	0.00	0.00	0.00	0.00	0.00	0.09	0.29
A-	0.00	0.00	2.00	165.00	0.00	0.00	2.00	0.00	7.00	4.00
P-	0.00	0.00	2.30	145.80	0.00	0.00	1.50	0.00	5.20	3.80
C-	0.00	0.00	0.00	2.23	0.00	0.00	0.00	0.00	0.46	0.01
A-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	0.00	0.00	0.00	0.00	0.00	34.00	0.00	0.00	3.00	3.00
P-	0.00	0.00	0.00	0.00	0.00	52.30	0.00	0.00	2.60	2.60
C-	0.00	0.00	0.00	0.00	0.00	9.85	0.00	0.00	0.00	0.05
A-	0.00	0.00	1.00	4.00	0.00	0.00	82.00	0.00	2.00	7.00
P-	0.00	0.00	1.10	2.70	0.00	0.00	68.50	0.00	2.60	6.40
C-	0.00	0.00	0.00	0.00	0.00	0.00	2.22	0.00	0.00	0.05
A-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	0.00	6.00	12.00	4.00	0.00	1.00	4.00	0.00	28.00	9.00
P-	0.00	6.90	10.70	3.50	0.00	1.20	4.30	0.00	50.00	9.00
C-	0.00	0.13	0.14	0.00	0.00	0.00	0.00	0.00	17.29	0.00

NUMBER OF CELLS = 18
DEGREES OF FREEDOM = 17
CHI-SQUARE = 33.574

*- AVERAGE OF 10 PREDICTIONS

TABLE 56

GOODNESS OF FIT MATRIX FOR P05L
USING THREE PREVIOUS LOOKPOINTS
AND ONE CONTROL STATUS.
A=ACTUAL TRANSITIONS
P=PREDICTED TRANSITIONS *
C=CHI-SQUARE VALUES

	AS	ROLL	CBARS	ALT	ADF	HSI	IVSI	ENG	NON	ROW
A-	131.00	4.00	1.00	1.00	0.00	0.00	0.00	0.00	1.00	7.00
P-	129.90	3.10	0.70	1.70	0.00	0.00	0.00	0.00	2.80	8.30
C-	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.24
A-	4.00	405.00	0.00	4.00	0.00	1.00	0.00	0.00	21.00	9.00
P-	5.40	403.00	0.00	3.80	0.00	1.30	0.00	0.00	19.30	10.50
C-	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.14	0.25
A-	0.00	12.00	156.00	0.00	0.00	1.00	0.00	0.00	6.00	1.00
P-	0.00	11.30	158.90	0.00	0.00	1.40	0.00	0.00	7.30	1.40
C-	0.00	0.04	0.05	0.00	0.00	0.00	0.00	0.00	0.28	0.16
A-	1.00	5.00	0.00	266.00	0.00	0.00	2.00	0.00	6.00	3.00
P-	0.80	4.80	0.00	207.70	0.00	0.00	1.70	0.00	6.40	2.50
C-	0.00	0.01	0.00	12.78	0.00	0.00	0.00	0.00	0.03	0.08
A-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	0.00	1.00	0.00	0.00	0.00	92.00	0.00	0.00	4.00	5.00
P-	0.00	1.50	0.00	0.00	0.00	124.90	0.00	0.00	4.30	5.80
C-	0.00	0.00	0.00	0.00	0.00	11.77	0.00	0.00	0.00	0.13
A-	0.00	0.00	0.00	1.00	0.00	0.00	52.00	0.00	3.00	4.00
P-	0.00	0.00	0.00	0.40	0.00	0.00	55.00	0.00	3.90	4.30
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.17	0.00	0.00	0.02
A-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	2.00	8.00	18.00	8.00	0.00	3.00	2.00	0.00	80.00	7.00
P-	2.10	8.70	19.70	7.70	0.00	3.10	2.60	0.00	93.80	7.80
C-	0.00	0.06	0.16	0.01	0.00	0.00	0.00	0.00	2.38	0.09

NUMBER OF CELLS = 22
DEGREES OF FREEDOM = 21
CHI-SQUARE = 28.874

*- AVERAGE OF 10 PREDICTIONS

TABLE 57

GOODNESS OF FIT MATRIX FOR P05R
USING THREE PREVIOUS LOOKPOINTS
AND ONE CONTROL STATUS.
A=ACTUAL TRANSITIONS
P=PREDICTED TRANSITIONS *
C=CHI-SQUARE VALUES

	AS	ROLL	CBARS	ALT	ADF	HSI	IVSI	ENG	NON	ROW
A-	36.00	3.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	4.00
P-	28.90	2.80	0.00	0.90	0.00	0.00	0.00	0.00	0.80	4.50
C-	1.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06
A-	1.00	299.00	8.00	10.00	0.00	0.00	0.00	0.00	22.00	1.00
P-	1.20	289.40	6.00	9.50	0.00	0.00	0.00	0.00	24.70	1.20
C-	0.00	0.31	0.50	0.02	0.00	0.00	0.00	0.00	0.33	0.04
A-	1.00	11.00	312.00	0.00	0.00	0.00	0.00	0.00	21.00	1.00
P-	1.60	9.60	287.40	0.00	0.00	0.00	0.00	0.00	21.20	1.60
C-	0.00	0.18	1.94	0.00	0.00	0.00	0.00	0.00	0.00	0.36
A-	1.00	13.00	0.00	286.00	0.00	0.00	1.00	0.00	8.00	2.00
P-	0.90	12.90	0.00	274.90	0.00	0.00	0.70	0.00	7.90	1.60
C-	0.00	0.00	0.00	0.43	0.00	0.00	0.00	0.00	0.00	0.08
A-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	0.00	0.00	0.00	0.00	0.00	2.00	0.00	0.00	1.00	3.00
P-	0.00	0.00	0.00	0.00	0.00	2.10	0.00	0.00	1.10	3.20
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
A-	0.00	0.00	0.00	2.00	0.00	0.00	36.00	0.00	2.00	4.00
P-	0.00	0.00	0.00	2.50	0.00	0.00	47.50	0.00	2.50	5.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	3.67	0.00	0.00	0.25
A-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	1.00	15.00	25.00	9.00	0.00	1.00	3.00	0.00	131.00	5.00
P-	0.80	16.30	25.50	10.10	0.00	1.10	4.30	0.00	163.90	6.20
C-	0.00	0.11	0.01	0.13	0.00	0.00	0.00	0.00	8.26	0.29

NUMBER OF CELLS = 23
DEGREES OF FREEDOM = 22
CHI-SQUARE = 18.405

*- AVERAGE OF 10 PREDICTIONS

GOODNESS OF FIT MATRIX FOR P06L
USING THREE PREVIOUS LOOKPOINTS
AND ONE CONTROL STATUS.
A=ACTUAL TRANSITIONS
P=PREDICTED TRANSITIONS *
C=CHI-SQUARE VALUES

	AS	ROLL	CBARS	ALT	ADF	HSI	IVSI	ENG	NON	ROW
A-	3.00	1.00	1.00	0.00	2.00	0.00	0.00	0.00	1.00	8.00
P-	0.20	0.90	0.40	0.00	1.60	0.00	0.00	0.00	1.20	4.30
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.71
A-	1.00	283.00	4.00	5.00	0.00	4.00	0.00	0.00	11.00	9.00
P-	1.00	241.40	3.30	3.80	0.00	4.10	0.00	0.00	12.20	8.40
C-	0.00	6.12	0.00	0.29	0.00	0.00	0.00	0.00	0.13	0.04
A-	1.00	7.00	237.00	0.00	0.00	0.00	0.00	0.00	18.00	1.00
P-	0.60	3.70	197.80	0.00	0.00	0.00	0.00	0.00	23.90	0.60
C-	0.00	1.56	6.48	0.00	0.00	0.00	0.00	0.00	1.93	0.16
A-	0.00	3.00	2.00	194.00	0.00	1.00	3.00	1.00	5.00	10.00
P-	0.00	3.30	1.50	179.90	0.00	1.70	2.10	0.90	5.50	9.50
C-	0.00	0.00	0.00	1.02	0.00	0.00	0.00	0.00	0.05	0.02
A-	0.00	0.00	2.00	0.00	30.00	0.00	0.00	0.00	2.00	4.00
P-	0.00	0.00	1.40	0.00	33.20	0.00	0.00	0.00	3.90	5.30
C-	0.00	0.00	0.00	0.00	0.34	0.00	0.00	0.00	0.00	0.42
A-	0.00	2.00	3.00	0.00	0.00	89.00	0.00	0.00	3.00	8.00
P-	0.00	2.90	1.70	0.00	0.00	117.20	0.00	0.00	4.00	8.60
C-	0.00	0.00	0.00	0.00	0.00	8.94	0.00	0.00	0.00	0.05
A-	0.00	0.00	1.00	2.00	1.00	0.00	54.00	0.00	3.00	7.00
P-	0.00	0.00	0.40	1.60	0.30	0.00	61.50	0.00	5.90	8.20
C-	0.00	0.00	0.00	0.00	0.00	0.00	1.04	0.00	0.00	0.21
A-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	14.00	1.00	1.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	11.60	0.90	0.90
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.41	0.00	0.01
A-	3.00	11.00	14.00	8.00	1.00	3.00	4.00	0.00	80.00	11.00
P-	2.60	13.00	19.80	9.80	3.40	2.80	6.10	0.00	121.00	14.90
C-	0.00	0.36	2.40	0.40	0.00	0.00	0.00	0.00	21.01	1.38

NUMBER OF CELLS = 25
DEGREES OF FREEDOM = 24
CHI-SQUARE = 56.498

*- AVERAGE OF 10 PREDICTIONS

TABLE 59

GOODNESS OF FIT MATRIX FOR P06R
USING THREE PREVIOUS LOOKPOINTS
AND ONE CONTROL STATUS.
A=ACTUAL TRANSITIONS
P=PREDICTED TRANSITIONS *
C=CHI-SQUARE VALUES

	AS	ROLL	CBARS	ALT	ADF	HSI	IVSI	ENG	NON	ROW
A-	5.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	1.00	2.00
P-	2.00	0.00	0.00	0.00	0.50	0.00	0.00	0.00	1.00	1.50
C-	1.80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.13
A-	0.00	57.00	3.00	2.00	0.00	0.00	0.00	0.00	3.00	8.00
P-	0.00	33.00	1.10	1.20	0.00	0.00	0.00	0.00	3.50	5.80
C-	0.00	10.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.60
A-	0.00	2.00	511.00	1.00	2.00	1.00	0.00	0.00	23.00	6.00
P-	0.00	1.90	486.00	0.80	2.70	1.40	0.00	0.00	23.40	6.80
C-	0.00	0.00	1.22	0.00	0.00	0.00	0.00	0.00	0.01	0.11
A-	0.00	1.00	1.00	205.00	0.00	1.00	2.00	0.00	12.00	5.00
P-	0.00	0.40	3.70	194.20	0.00	1.20	1.10	0.00	12.70	6.40
C-	0.00	0.00	0.00	0.57	0.00	0.00	0.00	0.00	0.04	0.39
A-	0.00	0.00	0.00	1.00	32.00	0.00	0.00	0.00	2.00	3.00
P-	0.00	0.00	0.00	0.30	28.40	0.00	0.00	0.00	2.90	3.20
C-	0.00	0.00	0.00	0.00	0.40	0.00	0.00	0.00	0.00	0.01
A-	1.00	0.00	1.00	0.00	0.00	114.00	0.00	0.00	6.00	2.00
P-	0.90	0.00	1.30	0.00	0.00	168.50	0.00	0.00	8.00	2.20
C-	0.00	0.00	0.00	0.00	0.00	26.05	0.00	0.00	0.67	0.02
A-	0.00	0.00	1.00	0.00	0.00	1.00	60.00	0.00	4.00	6.00
P-	0.00	0.00	0.30	0.00	0.00	0.70	45.60	0.00	5.00	6.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	3.46	0.00	0.00	0.00
A-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	1.00	5.00	24.00	12.00	0.00	5.00	4.00	0.00	90.00	5.00
P-	0.60	3.50	24.50	16.00	0.00	6.90	5.00	0.00	104.80	5.60
C-	0.00	0.45	0.01	1.33	0.00	0.72	0.00	0.00	2.43	0.07

NUMBER OF CELLS = 23
DEGREES OF FREEDOM = 22
CHI-SQUARE = 50.611

*- AVERAGE OF 10 PREDICTIONS

GOODNESS OF FIT MATRIX FOR P07L
USING THREE PREVIOUS LOOKPOINTS
AND ONE CONTROL STATUS.
A=ACTUAL TRANSITIONS
P=PREDICTED TRANSITIONS *
C=CHI-SQUARE VALUES

	AS	ROLL	CBARS	ALT	ADF	HSI	IVSI	ENG	NON	ROW
A-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	0.00	138.00	10.00	3.00	0.00	0.00	0.00	0.00	4.00	7.00
P-	0.00	111.90	6.60	1.80	0.00	0.00	0.00	0.00	3.80	5.60
C-	0.00	4.94	1.16	0.00	0.00	0.00	0.00	0.00	0.00	0.28
A-	0.00	11.00	593.00	0.00	0.00	0.00	0.00	0.00	10.00	0.00
P-	0.00	8.30	525.10	0.00	0.00	0.00	0.00	0.00	9.90	0.00
C-	0.00	0.66	7.77	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	0.00	2.00	0.00	84.00	0.00	0.00	0.00	0.00	4.00	6.00
P-	0.00	0.70	0.00	82.70	0.00	0.00	0.00	0.00	4.20	4.90
C-	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.20
A-	0.00	0.00	0.00	0.00	37.00	0.00	0.00	0.00	2.00	2.00
P-	0.00	0.00	0.00	0.00	36.30	0.00	0.00	0.00	1.80	1.80
C-	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.02
A-	0.00	0.00	0.00	0.00	0.00	30.00	0.00	0.00	1.00	1.00
P-	0.00	0.00	0.00	0.00	0.00	22.90	0.00	0.00	1.60	1.60
C-	0.00	0.00	0.00	0.00	0.00	1.68	0.00	0.00	0.00	0.36
A-	0.00	1.00	0.00	0.00	0.00	0.00	27.00	0.00	1.00	2.00
P-	0.00	0.60	0.00	0.00	0.00	0.00	53.20	0.00	2.30	2.90
C-	0.00	0.00	0.00	0.00	0.00	0.00	25.42	0.00	0.00	0.41
A-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	0.00	3.00	11.00	3.00	2.00	1.00	2.00	0.00	83.00	11.00
P-	0.00	2.80	11.20	3.20	1.80	1.60	2.90	0.00	162.80	12.30
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	76.72	0.15

NUMBER OF CELLS = 17
DEGREES OF FREEDOM = 16
CHI-SQUARE = 119.815

*- AVERAGE OF 10 PREDICTIONS

TABLE 61

GOODNESS OF FIT MATRIX FOR P07R
USING THREE PREVIOUS LOOKPOINTS
AND ONE CONTROL STATUS.
A=ACTUAL TRANSITIONS
P=PREDICTED TRANSITIONS *
C=CHI-SQUARE VALUES

	AS	ROLL	CBARS	ALT	ADF	HSI	IVSI	ENG	NON	ROW
A-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	0.00	4.00	3.00	0.00	0.00	0.00	0.00	0.00	2.00	9.00
P-	0.00	1.90	3.50	0.00	0.00	0.00	0.00	0.00	1.30	6.70
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.59
A-	0.00	1.00	696.00	2.00	0.00	1.00	1.00	0.00	7.00	5.00
P-	0.00	0.50	594.80	1.30	0.00	1.00	0.90	0.00	7.20	3.70
C-	0.00	0.00	14.71	0.00	0.00	0.00	0.00	0.00	0.01	0.34
A-	0.00	4.00	0.00	57.00	0.00	0.00	0.00	0.00	2.00	6.00
P-	0.00	4.30	0.00	61.60	0.00	0.00	0.00	0.00	1.80	6.10
C-	0.00	0.00	0.00	0.37	0.00	0.00	0.00	0.00	0.00	0.00
A-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	0.00	0.00	0.00	0.00	0.00	28.00	0.00	0.00	1.00	1.00
P-	0.00	0.00	0.00	0.00	0.00	89.90	0.00	0.00	4.70	4.70
C-	0.00	0.00	0.00	0.00	0.00	136.84	0.00	0.00	0.00	13.69
A-	0.00	0.00	0.00	0.00	0.00	0.00	57.00	0.00	3.00	3.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	41.70	0.00	3.10	3.10
C-	0.00	0.00	0.00	0.00	0.00	0.00	4.11	0.00	0.00	0.00
A-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	0.00	0.00	8.00	4.00	0.00	1.00	2.00	0.00	15.00	7.00
P-	0.00	0.00	7.10	4.90	0.00	3.70	2.30	0.00	58.50	10.90
C-	0.00	0.00	0.10	0.00	0.00	0.00	0.00	0.00	126.15	2.17

NUMBER OF CELLS = 13
DEGREES OF FREEDOM = 12
CHI-SQUARE = 299.087

*- AVERAGE OF 10 PREDICTIONS

TABLE 62

GOODNESS OF FIT MATRIX FOR P08L
USING THREE PREVIOUS LOCKPOINTS
AND ONE CONTROL STATUS.
A=ACTUAL TRANSITIONS
P=PREDICTED TRANSITIONS *
C=CHI-SQUARE VALUES

	AS	ROLL	CBARS	ALT	ADF	HSI	IVSI	ENG	NON	ROW
A-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	0.00	0.00	437.00	3.00	3.00	2.00	0.00	0.00	22.00	8.00
P-	0.00	0.00	468.50	3.30	2.40	2.10	0.00	0.00	20.70	7.80
C-	0.00	0.00	2.27	0.00	0.00	0.00	0.00	0.00	0.08	0.00
A-	0.00	0.00	2.00	138.00	1.00	0.00	1.00	0.00	10.00	4.00
P-	0.00	0.00	1.30	132.30	1.10	0.00	1.10	0.00	10.50	3.50
C-	0.00	0.00	0.00	0.24	0.00	0.00	0.00	0.00	0.02	0.06
A-	0.00	0.00	0.00	0.00	68.00	0.00	1.00	0.00	6.00	1.00
P-	0.00	0.00	0.00	0.00	54.90	0.00	1.10	0.00	5.90	1.10
C-	0.00	0.00	0.00	0.00	2.52	0.00	0.00	0.00	0.00	0.01
A-	0.00	0.00	2.00	0.00	0.00	36.00	1.00	0.00	1.00	4.00
P-	0.00	0.00	0.40	0.00	0.00	23.30	1.20	0.00	2.80	4.40
C-	0.00	0.00	0.00	0.00	0.00	4.48	0.00	0.00	0.00	0.04
A-	0.00	0.00	0.00	1.00	0.00	0.00	79.00	0.00	5.00	1.00
P-	0.00	0.00	0.00	1.10	0.00	0.00	71.50	0.00	5.90	1.10
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.71	0.00	0.16	0.01
A-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	0.00	0.00	27.00	9.00	3.00	2.00	3.00	0.00	182.00	8.00
P-	0.00	0.00	27.60	8.60	3.50	2.40	3.60	0.00	184.90	9.50
C-	0.00	0.00	0.01	0.02	0.00	0.00	0.00	0.00	0.05	0.28

NUMBER OF CELLS = 18
DEGREES OF FREEDOM = 17
CHI-SQUARE = 10.974

*- AVERAGE OF 10 PREDICTIONS

TABLE 63

GOODNESS OF FIT MATRIX FOR P08R
USING THREE PREVIOUS LOOKPOINTS
AND ONE CONTROL STATUS.
A=ACTUAL TRANSITIONS
P=PREDICTED TRANSITIONS *
C=CHI-SQUARE VALUES

	AS	ROLL	CBARS	ALT	ADF	HSI	IVSI	ENG	NON	ROW
A-	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	1.00
P-	0.00	0.00	0.00	0.00	0.80	0.00	0.00	0.00	0.10	0.90
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
A-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	1.00	0.00	665.00	4.00	1.00	1.00	0.00	0.00	11.00	7.00
P-	0.90	0.00	690.60	4.10	0.70	1.50	0.00	0.00	11.80	7.20
C-	0.00	0.00	0.99	0.00	0.00	0.00	0.00	0.00	0.06	0.01
A-	0.00	0.00	0.00	118.00	0.00	0.00	0.00	0.00	13.00	0.00
P-	0.00	0.00	0.00	86.90	0.00	0.00	0.00	0.00	11.70	0.00
C-	0.00	0.00	0.00	8.20	0.00	0.00	0.00	0.00	0.13	0.00
A-	0.00	0.00	2.00	0.00	77.00	1.00	0.00	1.00	2.00	6.00
P-	0.00	0.00	1.90	0.00	59.10	0.50	0.00	0.40	1.50	4.30
C-	0.00	0.00	0.00	0.00	4.16	0.00	0.00	0.00	0.00	0.48
A-	0.00	0.00	1.00	0.00	0.00	68.00	1.00	0.00	3.00	5.00
P-	0.00	0.00	0.90	0.00	0.00	91.10	0.60	0.00	3.10	4.60
C-	0.00	0.00	0.00	0.00	0.00	7.85	0.00	0.00	0.00	0.03
A-	0.00	0.00	0.00	1.00	0.00	0.00	43.00	0.00	3.00	4.00
P-	0.00	0.00	0.00	0.30	0.00	0.00	11.80	0.00	1.40	1.70
C-	0.00	0.00	0.00	0.00	0.00	0.00	22.64	0.00	0.00	1.32
A-	0.00	0.00	0.00	1.00	0.00	0.00	0.00	22.00	0.00	1.00
P-	0.00	0.00	0.00	0.20	0.00	0.00	0.00	3.30	0.20	0.40
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	15.90	0.00	0.36
A-	0.00	0.00	15.00	7.00	4.00	3.00	3.00	0.00	56.00	10.00
P-	0.00	0.00	15.80	7.10	2.90	2.70	1.10	0.00	111.00	6.70
C-	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	54.02	1.09

NUMBER OF CELLS = 18
DEGREES OF FREEDOM = 17
CHI-SQUARE = 117.275

*- AVERAGE OF 10 PREDICTIONS

TABLE 64

GOODNESS OF FIT MATRIX FOR P09L
USING THREE PREVIOUS LOOKPOINTS
AND ONE CONTROL STATUS.
A=ACTUAL TRANSITIONS
P=PREDICTED TRANSITIONS *
C=CHI-SQUARE VALUES

	AS	ROLL	CBARS	ALT	ADF	HSI	IVSI	ENG	NON	ROW
A-	2.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.00	4.00
P-	1.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.10	4.60
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.09
A-	0.00	5.00	3.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00
P-	0.00	9.00	2.40	0.00	0.00	0.00	0.00	0.00	0.50	2.90
C-	0.00	3.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	1.00	0.00	689.00	0.00	0.00	0.00	0.00	0.00	30.00	1.00
P-	1.60	0.00	620.80	0.00	0.00	0.00	0.00	0.00	26.60	1.60
C-	0.00	0.00	6.75	0.00	0.00	0.00	0.00	0.00	0.39	0.36
A-	0.00	0.00	2.00	255.00	0.00	0.00	1.00	0.00	18.00	3.00
P-	0.00	0.00	0.90	203.40	0.00	0.00	0.60	0.00	16.70	1.50
C-	0.00	0.00	0.00	10.44	0.00	0.00	0.00	0.00	0.09	0.75
A-	0.00	0.00	0.00	0.00	60.00	0.00	0.00	0.00	3.00	3.00
P-	0.00	0.00	0.00	0.00	63.40	0.00	0.00	0.00	3.70	3.70
C-	0.00	0.00	0.00	0.00	0.19	0.00	0.00	0.00	0.00	0.16
A-	0.00	1.00	1.00	0.00	0.00	86.00	0.00	0.00	2.00	4.00
P-	0.00	1.00	1.10	0.00	0.00	101.00	0.00	0.00	1.80	3.90
C-	0.00	0.00	0.00	0.00	0.00	2.62	0.00	0.00	0.00	0.00
A-	0.00	0.00	0.00	1.00	0.00	2.00	75.00	0.00	5.00	3.00
P-	0.00	0.00	0.00	0.40	0.00	1.60	61.10	0.00	6.40	2.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	2.58	0.00	0.39	0.33
A-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.00	1.00	1.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.00	0.00	1.00
A-	1.00	2.00	24.00	20.00	3.00	3.00	7.00	0.00	67.00	9.00
P-	1.50	1.90	23.30	17.90	3.70	2.40	7.80	0.00	188.90	9.50
C-	0.00	0.00	0.02	0.22	0.00	0.00	0.09	0.00	221.79	0.03

NUMBER OF CELLS = 23
DEGREES OF FREEDOM = 22
CHI-SQUARE = 258.496

*- AVERAGE OF 10 PREDICTIONS

GOODNESS OF FIT MATRIX FOR P09R
USING THREE PREVIOUS LOOKPOINTS
AND ONE CONTROL STATUS.
A=ACTUAL TRANSITIONS
P=PREDICTED TRANSITIONS *
C=CHI-SQUARE VALUES

	AS	ROLL	CBARS	ALT	ADF	HSI	IVSI	ENG	NON	ROW
A-	2.00	0.00	0.00	0.00	2.00	0.00	0.00	0.00	0.00	4.00
P-	2.80	0.00	0.00	0.00	2.60	0.00	0.00	0.00	0.30	5.70
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.72
A-	0.00	54.00	8.00	0.00	0.00	0.00	0.00	0.00	4.00	4.00
P-	0.00	31.80	4.20	0.00	0.00	0.00	0.00	0.00	5.60	5.60
C-	0.00	9.13	1.81	0.00	0.00	0.00	0.00	0.00	0.00	0.64
A-	0.00	7.00	449.00	1.00	1.00	0.00	0.00	0.00	20.00	2.00
P-	0.00	6.10	380.20	1.10	0.70	0.00	0.00	0.00	18.40	1.80
C-	0.00	0.12	10.54	0.00	0.00	0.00	0.00	0.00	0.13	0.02
A-	0.00	0.00	8.00	203.00	0.00	1.00	0.00	0.00	9.00	1.00
P-	0.00	0.00	6.50	208.30	0.00	1.80	0.00	0.00	10.90	1.80
C-	0.00	0.00	0.28	0.14	0.00	0.00	0.00	0.00	0.40	0.64
A-	0.00	0.00	0.00	1.00	53.00	1.00	0.00	0.00	4.00	6.00
P-	0.00	0.00	0.00	0.50	103.50	0.60	0.00	0.00	4.60	5.70
C-	0.00	0.00	0.00	0.00	48.12	0.00	0.00	0.00	0.00	0.01
A-	0.00	2.00	0.00	0.00	0.00	106.00	0.00	0.00	4.00	6.00
P-	0.00	0.40	0.00	0.00	0.00	61.00	0.00	0.00	6.40	6.80
C-	0.00	0.00	0.00	0.00	0.00	19.10	0.00	0.00	0.00	0.11
A-	0.00	0.00	0.00	0.00	0.00	0.00	19.00	0.00	2.00	2.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	37.30	0.00	4.40	4.40
C-	0.00	0.00	0.00	0.00	0.00	0.00	17.63	0.00	0.00	2.88
A-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	2.00	2.00	14.00	16.00	3.00	4.00	2.00	0.00	117.00	13.00
P-	2.90	3.30	15.10	17.70	2.70	4.50	4.40	0.00	167.40	17.80
C-	0.00	0.00	0.09	0.18	0.00	0.00	0.00	0.00	21.71	1.77

NUMBER OF CELLS = 22
DEGREES OF FREEDOM = 21
CHI-SQUARE = 136.160

*- AVERAGE OF 10 PREDICTIONS

TABLE 66

GOODNESS OF FIT MATRIX FOR P10L
USING THREE PREVIOUS LOOKPOINTS
AND ONE CONTROL STATUS.
A=ACTUAL TRANSITIONS
P=PREDICTED TRANSITIONS *
C=CHI-SQUARE VALUES

	AS	ROLL	CBARS	ALT	ADF	HSI	IVSI	ENG	NON	ROW
A-	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
P-	0.00	0.00	1.30	0.00	0.00	0.00	0.00	0.00	0.00	1.30
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.09
A-	0.00	138.00	3.00	3.00	0.00	0.00	0.00	0.00	9.00	6.00
P-	0.00	136.60	3.80	3.60	0.00	0.00	0.00	0.00	8.10	7.40
C-	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.09	0.33
A-	0.00	5.00	349.00	1.00	0.00	0.00	0.00	0.00	18.00	1.00
P-	0.00	5.40	341.00	1.20	0.00	0.00	0.00	0.00	17.70	1.20
C-	0.00	0.03	0.18	0.00	0.00	0.00	0.00	0.00	0.00	0.04
A-	0.00	5.00	0.00	167.00	0.00	0.00	0.00	0.00	12.00	0.00
P-	0.00	4.30	0.00	149.90	0.00	0.00	0.00	0.00	12.40	0.00
C-	0.00	0.10	0.00	1.75	0.00	0.00	0.00	0.00	0.01	0.00
A-	1.00	0.00	1.00	0.00	16.00	0.00	0.00	0.00	1.00	3.00
P-	1.30	0.00	2.20	0.00	35.90	0.00	0.00	0.00	0.00	3.50
C-	0.00	0.00	0.00	0.00	24.75	0.00	0.00	0.00	0.00	0.08
A-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	0.00	6.00	19.00	12.00	3.00	0.00	0.00	0.00	239.00	3.00
P-	0.00	6.60	17.20	11.00	3.50	0.00	0.00	0.00	243.00	3.50
C-	0.00	0.06	0.17	0.08	0.00	0.00	0.00	0.00	0.07	0.08

NUMBER OF CELLS = 18
DEGREES OF FREEDOM = 17
CHI-SQUARE = 27.942

*- AVERAGE OF 10 PREDICTIONS

TABLE 67

GOODNESS OF FIT MATRIX FOR P1OR
USING THREE PREVIOUS LOOKPOINTS
AND ONE CONTROL STATUS.
A=ACTUAL TRANSITIONS
P=PREDICTED TRANSITIONS *
C=CHI-SQUARE VALUES

	AS	ROLL	CBARS	ALT	ADF	HSI	IVSI	ENG	NON	ROW
A-	40.00	0.00	1.00	1.00	1.00	0.00	0.00	0.00	2.00	5.00
P-	25.80	0.00	0.70	0.20	0.60	0.00	0.00	0.00	2.60	4.10
C-	5.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.16
A-	0.00	462.00	3.00	7.00	0.00	0.00	0.00	0.00	16.00	3.00
P-	0.00	435.60	2.90	5.70	0.00	0.00	0.00	0.00	18.00	2.90
C-	0.00	1.51	0.00	0.24	0.00	0.00	0.00	0.00	0.25	0.00
A-	1.00	3.00	142.00	0.00	0.00	0.00	0.00	0.00	12.00	4.00
P-	1.50	4.40	165.80	0.00	0.00	0.00	0.00	0.00	12.50	5.90
C-	0.00	0.00	3.99	0.00	0.00	0.00	0.00	0.00	0.02	0.90
A-	0.00	13.00	1.00	145.00	0.00	0.00	0.00	0.00	3.00	4.00
P-	0.00	10.70	1.00	137.30	0.00	0.00	0.00	0.00	4.10	5.10
C-	0.00	0.41	0.00	0.41	0.00	0.00	0.00	0.00	0.00	0.30
A-	1.00	0.00	1.00	0.00	4.00	0.00	0.00	0.00	0.00	6.00
P-	0.40	0.00	0.50	0.00	2.00	0.00	0.00	0.00	0.50	3.40
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.13
A-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	3.00	10.00	10.00	9.00	1.00	0.00	0.00	0.00	27.00	4.00
P-	2.20	11.40	13.40	9.90	0.80	0.00	0.00	0.00	45.50	3.00
C-	0.00	0.20	1.16	0.09	0.00	0.00	0.00	0.00	12.68	0.25

NUMBER OF CELLS = 18
DEGREES OF FREEDOM = 17
CHI-SQUARE = 28.732

*- AVERAGE OF 10 PREDICTIONS

TABLE 68

GOODNESS OF FIT MATRIX FOR P11L
USING THREE PREVIOUS LOOKPOINTS
AND ONE CONTROL STATUS.
A=ACTUAL TRANSITIONS
P=PREDICTED TRANSITIONS *
C=CHI-SQUARE VALUES

	AS	ROLL	CBARS	ALT	ADF	HSI	IVSI	ENG	NON	ROW
A-	139.00	0.00	4.00	0.00	4.00	0.00	0.00	1.00	11.00	9.00
P-	153.10	0.00	3.50	0.00	3.80	0.00	0.00	1.20	11.30	8.50
C-	1.43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.03
A-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	4.00	0.00	245.00	0.00	0.00	2.00	0.00	0.00	18.00	6.00
P-	4.20	0.00	178.70	0.00	0.00	2.00	0.00	0.00	16.30	6.20
C-	0.00	0.00	17.94	0.00	0.00	0.00	0.00	0.00	0.16	0.01
A-	0.00	0.00	0.00	66.00	0.00	0.00	0.00	0.00	7.00	0.00
P-	0.00	0.00	0.00	55.50	0.00	0.00	0.00	0.00	6.60	0.00
C-	0.00	0.00	0.00	1.67	0.00	0.00	0.00	0.00	0.02	0.00
A-	1.00	0.00	0.00	0.00	10.00	0.00	0.00	0.00	5.00	1.00
P-	0.70	0.00	0.00	0.00	9.40	0.00	0.00	0.00	4.90	0.70
C-	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.09
A-	0.00	0.00	2.00	0.00	1.00	59.00	0.00	0.00	3.00	6.00
P-	0.00	0.00	1.40	0.00	0.80	47.20	0.00	0.00	3.30	5.50
C-	0.00	0.00	0.00	0.00	0.00	2.36	0.00	0.00	0.00	0.04
A-	1.00	0.00	0.00	1.00	0.00	0.00	17.00	0.00	2.00	4.00
P-	1.30	0.00	0.00	2.60	0.00	0.00	25.60	0.00	1.40	5.30
C-	0.00	0.00	0.00	0.00	0.00	0.00	4.35	0.00	0.00	0.42
A-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	12.00	1.00	1.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.40	1.20	1.20
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.21	0.00	0.04
A-	14.00	0.00	19.00	6.00	1.00	4.00	4.00	0.00	243.00	9.00
P-	13.60	0.00	17.70	4.00	1.00	3.50	5.30	0.00	312.50	9.80
C-	0.01	0.00	0.09	0.67	0.00	0.00	0.00	0.00	19.88	0.07

NUMBER OF CELLS = 22
DEGREES OF FREEDOM = 21
CHI-SQUARE = 49.540

*- AVERAGE OF 10 PREDICTIONS

GOODNESS OF FIT MATRIX FOR P11R
USING THREE PREVIOUS LOOKPOINTS
AND ONE CONTROL STATUS.
A=ACTUAL TRANSITIONS
P=PREDICTED TRANSITIONS *
C=CHI-SQUARE VALUES

	AS	ROLL	CBARS	ALT	ADF	HSI	IVSI	ENG	NON	ROW
A-	69.00	0.00	2.00	0.00	1.00	0.00	0.00	0.00	2.00	5.00
P-	73.50	0.00	0.90	0.00	0.80	0.00	0.00	0.00	2.60	4.30
C-	0.29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10
A-	0.00	4.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	5.00
P-	0.00	4.90	0.00	0.00	0.00	0.00	0.00	0.00	1.30	6.20
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.29
A-	1.00	1.00	398.00	1.00	0.00	2.00	0.00	0.00	20.00	5.00
P-	0.80	1.30	406.20	1.40	0.00	1.80	0.00	0.00	18.10	5.30
C-	0.00	0.00	0.17	0.00	0.00	0.00	0.00	0.00	0.18	0.02
A-	0.00	0.00	0.00	106.00	0.00	0.00	0.00	0.00	17.00	0.00
P-	0.00	0.00	0.00	95.50	0.00	0.00	0.00	0.00	16.50	0.00
C-	0.00	0.00	0.00	1.04	0.00	0.00	0.00	0.00	0.01	0.00
A-	0.00	0.00	0.00	0.00	5.00	0.00	0.00	0.00	1.00	1.00
P-	0.00	0.00	0.00	0.00	3.00	0.00	0.00	0.00	0.80	0.80
C-	0.00	0.00	0.00	0.00	0.80	0.00	0.00	0.00	0.00	0.04
A-	0.00	0.00	0.00	0.00	0.00	131.00	1.00	0.00	10.00	1.00
P-	0.00	0.00	0.00	0.00	0.00	119.40	1.30	0.00	7.40	1.30
C-	0.00	0.00	0.00	0.00	0.00	1.03	0.00	0.00	0.68	0.09
A-	0.00	0.00	0.00	1.00	0.00	1.00	19.00	0.00	1.00	3.00
P-	0.00	0.00	0.00	0.10	0.00	1.10	11.60	0.00	2.30	3.50
C-	0.00	0.00	0.00	0.00	0.00	0.00	2.88	0.00	0.00	0.08
A-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00	1.00	4.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.70	1.80	6.50
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.56
A-	4.00	0.00	24.00	14.00	0.00	8.00	2.00	1.00	81.00	7.00
P-	3.50	0.00	23.20	14.60	0.00	5.80	2.30	1.80	99.70	7.60
C-	0.00	0.00	0.03	0.03	0.00	0.60	0.00	0.00	4.32	0.05

NUMBER OF CELLS = 21
DEGREES OF FREEDOM = 20
CHI-SQUARE = 14.289

*- AVERAGE OF 10 PREDICTIONS

TABLE 70

GOODNESS OF FIT MATRIX FOR TP1L
USING THREE PREVIOUS LOCKPOINTS
AND ONE CONTROL STATUS.
A=ACTUAL TRANSITIONS
P=PREDICTED TRANSITIONS *
C=CHI-SQUARE VALUES

	AS	ROLL	CBARS	ALT	ADF	HSI	IVSI	ENG	NON	ROW
A-	4.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	5.00
P-	3.70	0.00	0.80	0.00	0.00	0.00	0.00	0.00	0.10	4.60
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03
A-	0.00	16.00	1.00	0.00	0.00	0.00	0.00	0.00	1.00	2.00
P-	0.00	11.10	1.20	0.00	0.00	0.00	0.00	0.00	1.40	2.60
C-	0.00	1.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.18
A-	1.00	1.00	497.00	0.00	0.00	6.00	0.00	0.00	15.00	2.00
P-	0.90	1.00	493.60	0.00	0.00	5.80	0.00	0.00	17.50	1.90
C-	0.00	0.00	0.02	0.00	0.00	0.01	0.00	0.00	0.42	0.00
A-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	0.00	0.00	0.00	0.00	1.00	1.00	0.00	0.00	0.00	2.00
P-	0.00	0.00	0.00	0.00	0.90	0.90	0.00	0.00	0.30	2.10
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	0.00	1.00	6.00	0.00	0.00	495.00	0.00	0.00	17.00	1.00
P-	0.00	1.60	6.90	0.00	0.00	462.50	0.00	0.00	18.00	1.60
C-	0.00	0.00	0.13	0.00	0.00	2.13	0.00	0.00	0.06	0.36
A-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	0.00	0.00	14.00	0.00	1.00	18.00	0.00	0.00	76.00	1.00
P-	0.00	0.00	15.50	0.00	1.20	20.60	0.00	0.00	104.50	1.20
C-	0.00	0.00	0.16	0.00	0.00	0.38	0.00	0.00	10.69	0.04

NUMBER OF CELLS = 16
DEGREES OF FREEDOM = 15
CHI-SQUARE = 16.121

*- AVERAGE OF 10 PREDICTIONS

TABLE 71

GOODNESS OF FIT MATRIX FOR TP1X
USING THREE PREVIOUS LOOKPOINTS
AND ONE CONTROL STATUS.
A=ACTUAL TRANSITIONS
P=PREDICTED TRANSITIONS *
C=CHI-SQUARE VALUES

	AS	ROLL	CBARS	ALT	ADF	HSI	IVSI	ENG	NON	ROW
A-	7.00	0.00	2.00	0.00	0.00	2.00	0.00	0.00	3.00	7.00
P-	11.40	0.00	1.40	0.00	0.00	1.80	0.00	0.00	3.30	6.50
C-	2.77	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04
A-	0.00	17.00	5.00	0.00	0.00	2.00	0.00	0.00	3.00	5.00
P-	0.00	28.80	5.20	0.00	0.00	1.60	0.00	0.00	4.40	6.00
C-	0.00	8.19	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.20
A-	1.00	2.00	829.00	3.00	0.00	6.00	0.00	0.00	24.00	6.00
P-	1.10	2.50	792.40	2.60	0.00	7.00	0.00	0.00	24.00	6.20
C-	0.00	0.00	1.62	0.00	0.00	0.17	0.00	0.00	0.00	0.01
A-	0.00	0.00	2.00	0.00	0.00	5.00	0.00	0.00	1.00	3.00
P-	0.00	0.00	1.60	0.00	0.00	3.80	0.00	0.00	0.80	2.40
C-	0.00	0.00	0.00	0.00	0.00	0.29	0.00	0.00	0.00	0.12
A-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.70	0.70
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.09
A-	1.00	0.00	10.00	3.00	1.00	348.00	0.00	0.00	15.00	5.00
P-	1.20	0.00	10.10	2.20	0.70	323.00	0.00	0.00	16.70	4.10
C-	0.00	0.00	0.00	0.00	0.00	1.80	0.00	0.00	0.19	0.16
A-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	5.00	8.00	18.00	2.00	0.00	15.00	0.00	0.00	95.00	2.00
P-	4.20	8.70	18.60	1.40	0.00	16.90	0.00	0.00	134.90	1.40
C-	0.13	0.06	0.02	0.00	0.00	0.24	0.00	0.00	16.76	0.18

NUMBER OF CELLS = 22
DEGREES OF FREEDOM = 21
CHI-SQUARE = 33.027

*- AVERAGE OF 10 PREDICTIONS

GOODNESS OF FIT MATRIX FOR TP1R
USING THREE PREVIOUS LOOKPOINTS
AND ONE CONTROL STATUS.
A=ACTUAL TRANSITIONS
P=PREDICTED TRANSITIONS *
C=CHI-SQUARE VALUES

	AS	ROLL	CBARS	ALT	ADF	HSI	IVSI	ENG	NON	ROW
A-	16.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.00	2.00
P-	10.80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.70	1.70
C-	1.69	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04
A-	0.00	12.00	2.00	0.00	0.00	0.00	0.00	0.00	1.00	3.00
P-	0.00	13.90	2.20	0.00	0.00	0.00	0.00	0.00	1.60	3.80
C-	0.00	0.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.21
A-	1.00	1.00	414.00	0.00	0.00	3.00	0.00	0.00	17.00	5.00
P-	1.00	1.30	429.70	0.00	0.00	3.50	0.00	0.00	17.80	5.80
C-	0.00	0.00	0.60	0.00	0.00	0.00	0.00	0.00	0.04	0.13
A-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	1.00
P-	0.00	0.00	0.00	0.00	0.00	1.10	0.00	0.00	0.20	1.30
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.09
A-	0.00	0.00	7.00	0.00	0.00	292.00	0.00	0.00	14.00	0.00
P-	0.00	0.00	7.50	0.00	0.00	267.30	0.00	0.00	13.00	0.00
C-	0.00	0.00	0.04	0.00	0.00	2.09	0.00	0.00	0.07	0.00
A-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	1.00	2.00	14.00	0.00	1.00	16.00	0.00	0.00	47.00	4.00
P-	0.70	2.50	13.90	0.00	1.30	15.90	0.00	0.00	53.10	4.50
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.79	0.06

NUMBER OF CELLS = 15
DEGREES OF FREEDOM = 14
CHI-SQUARE = 6.152

*- AVERAGE OF 10 PREDICTIONS

GOODNESS OF FIT MATRIX FOR TP5L
USING THREE PREVIOUS LOOKPOINTS
AND ONE CONTROL STATUS.
A=ACTUAL TRANSITIONS
P=PREDICTED TRANSITIONS *
C=CHI-SQUARE VALUES

	AS	ROLL	CBARS	ALT	ADF	HSI	IVSI	ENG	NON	ROW
A-	46.00	0.00	2.00	1.00	0.00	0.00	0.00	0.00	2.00	5.00
P-	34.80	0.00	1.70	0.80	0.00	0.00	0.00	0.00	2.70	5.20
C-	2.73	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
A-	0.00	17.00	2.00	1.00	0.00	0.00	0.00	0.00	3.00	6.00
P-	0.00	11.90	1.00	0.80	0.00	0.00	0.00	0.00	3.50	5.30
C-	0.00	1.53	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08
A-	2.00	1.00	512.00	0.00	1.00	6.00	0.00	0.00	27.00	4.00
P-	2.10	0.90	512.50	0.00	0.90	5.70	0.00	0.00	30.00	3.90
C-	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.33	0.00
A-	0.00	0.00	0.00	280.00	0.00	0.00	0.00	0.00	23.00	0.00
P-	0.00	0.00	0.00	278.60	0.00	0.00	0.00	0.00	22.10	0.00
C-	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.04	0.00
A-	0.00	0.00	0.00	0.00	4.00	0.00	0.00	0.00	1.00	5.00
P-	0.00	0.00	0.00	0.00	3.80	0.00	0.00	0.00	0.90	4.70
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02
A-	0.00	1.00	1.00	1.00	0.00	143.00	0.00	0.00	10.00	3.00
P-	0.00	1.30	1.20	1.60	0.00	137.20	0.00	0.00	9.60	4.10
C-	0.00	0.00	0.00	0.00	0.00	0.24	0.00	0.00	0.02	0.40
A-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	3.00	4.00	32.00	20.00	0.00	7.00	0.00	0.00	185.00	7.00
P-	3.10	3.10	35.10	19.10	0.00	8.20	0.00	0.00	200.80	6.20
C-	0.00	0.00	0.30	0.04	0.00	0.21	0.00	0.00	1.35	0.09

NUMBER OF CELLS = 19
DEGREES OF FREEDOM = 18
CHI-SQUARE = 7.400

*- AVERAGE OF 10 PREDICTIONS

GOODNESS OF FIT MATRIX FOR TP5R
USING THREE PREVIOUS LOOKPOINTS
AND ONE CONTROL STATUS.
A=ACTUAL TRANSITIONS
P=PREDICTED TRANSITIONS *
C=CHI-SQUARE VALUES

	AS	ROLL	CBARS	ALT	ADF	HSI	IVSI	ENG	NON	ROW
A-	39.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	6.00	1.00
P-	39.70	0.00	1.10	0.00	0.00	0.00	0.00	0.00	6.50	1.10
C-	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.01
A-	0.00	9.00	1.00	2.00	0.00	0.00	0.00	0.00	1.00	4.00
P-	0.00	6.60	0.80	2.50	0.00	0.00	0.00	0.00	1.30	4.60
C-	0.00	0.64	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.09
A-	2.00	2.00	502.00	2.00	0.00	2.00	0.00	0.00	22.00	8.00
P-	1.60	1.90	501.00	2.30	0.00	2.50	0.00	0.00	21.80	8.30
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
A-	2.00	0.00	1.00	175.00	0.00	2.00	0.00	0.00	21.00	5.00
P-	2.40	0.00	0.40	184.40	0.00	2.30	0.00	0.00	20.80	5.10
C-	0.00	0.00	0.00	0.50	0.00	0.00	0.00	0.00	0.00	0.00
A-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	0.00	0.00	2.00	2.00	0.00	109.00	0.00	0.00	6.00	4.00
P-	0.00	0.00	2.00	1.40	0.00	93.60	0.00	0.00	7.00	3.40
C-	0.00	0.00	0.00	0.00	0.00	2.18	0.00	0.00	0.17	0.09
A-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	3.00	2.00	25.00	20.00	0.00	6.00	0.00	0.00	232.00	5.00
P-	3.60	2.70	26.10	19.80	0.00	5.70	0.00	0.00	234.20	6.30
C-	0.00	0.00	0.05	0.00	0.00	0.02	0.00	0.00	0.02	0.34

NUMBER OF CELLS = 19
DEGREES OF FREEDOM = 18
CHI-SQUARE = 4.175

*- AVERAGE OF 10 PREDICTIONS

GOODNESS OF FIT MATRIX FOR TC1L
USING THREE PREVIOUS LOOKPOINTS
AND ONE CONTROL STATUS.
A=ACTUAL TRANSITIONS
P=PREDICTED TRANSITIONS *
C=CHI-SQUARE VALUES

	AS	ROLL	CBARS	ALT	ADF	HSI	IVSI	ENG	NON	ROW
A-	78.00	0.00	3.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00
P-	30.70	0.00	0.80	0.00	0.00	0.00	0.00	0.00	6.70	7.50
C-	28.68	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.75
A-	0.00	72.00	3.00	1.00	0.00	0.00	0.00	0.00	1.00	5.00
P-	0.00	121.10	1.00	0.30	0.00	0.00	0.00	0.00	0.70	2.00
C-	0.00	33.48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.80
A-	1.00	4.00	443.00	4.00	0.00	0.00	0.00	0.00	8.00	9.00
P-	0.30	2.30	248.90	2.10	0.00	0.00	0.00	0.00	13.70	4.70
C-	0.00	0.00	85.04	0.00	0.00	0.00	0.00	0.00	4.06	2.05
A-	0.00	0.00	1.00	124.00	0.00	0.00	0.00	0.00	9.00	1.00
P-	0.00	0.00	0.70	68.00	0.00	0.00	0.00	0.00	5.90	0.70
C-	0.00	0.00	0.00	25.29	0.00	0.00	0.00	0.00	1.07	0.09
A-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	0.00	0.00	0.00	0.00	0.00	14.00	0.00	0.00	2.00	2.00
P-	0.00	0.00	0.00	0.00	0.00	9.10	0.00	0.00	7.90	7.90
C-	0.00	0.00	0.00	0.00	0.00	1.71	0.00	0.00	0.00	17.40
A-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	2.00	1.00	11.00	5.00	0.00	2.00	0.00	0.00	92.00	5.00
P-	7.20	0.20	16.00	4.40	0.00	8.00	0.00	0.00	322.00	15.40
C-	0.00	0.00	2.27	0.07	0.00	0.00	0.00	0.00	575.00	21.63

NUMBER OF CELLS = 16
DEGREES OF FREEDOM = 15
CHI-SQUARE = 806.422

*- AVERAGE OF 10 PREDICTIONS

TABLE 76

GOODNESS OF FIT MATRIX FOR TC5L
USING THREE PREVIOUS LOOKPOINTS
AND ONE CONTROL STATUS.
A=ACTUAL TRANSITIONS
P=PREDICTED TRANSITIONS *
C=CHI-SQUARE VALUES

	AS	ROLL	CBARS	ALT	ADF	HSI	IVSI	ENG	NON	ROW
A-	72.00	0.00	2.00	1.00	3.00	0.00	0.00	0.00	3.00	9.00
P-	45.00	0.00	1.10	0.90	2.00	0.00	0.00	0.00	13.10	17.10
C-	10.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.29
A-	0.00	66.00	5.00	0.00	0.00	0.00	0.00	0.00	4.00	4.00
P-	0.00	63.30	5.70	0.00	0.00	0.00	0.00	0.00	3.50	3.50
C-	0.00	0.11	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.06
A-	1.00	9.00	263.00	3.00	1.00	1.00	0.00	0.00	8.00	6.00
P-	0.20	9.20	188.70	1.00	0.60	0.00	0.00	0.00	9.60	1.80
C-	0.00	0.00	20.99	0.00	0.00	0.00	0.00	0.00	0.32	2.94
A-	2.00	0.00	4.00	262.00	0.00	1.00	1.00	0.00	7.00	8.00
P-	2.20	0.00	3.60	246.10	0.00	0.80	0.80	0.00	6.90	7.40
C-	0.00	0.00	0.00	0.96	0.00	0.00	0.00	0.00	0.00	0.04
A-	1.00	0.00	0.00	0.00	13.00	1.00	0.00	0.00	4.00	6.00
P-	1.60	0.00	0.00	0.00	1.90	1.20	0.00	0.00	2.00	4.80
C-	0.00	0.00	0.00	0.00	9.48	0.00	0.00	0.00	0.00	0.24
A-	0.00	0.00	2.00	0.00	1.00	154.00	0.00	0.00	4.00	7.00
P-	0.00	0.00	1.20	0.00	0.40	171.80	0.00	0.00	3.20	4.80
C-	0.00	0.00	0.00	0.00	0.00	2.06	0.00	0.00	0.00	0.69
A-	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00	2.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.60	0.00	0.80	1.40
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.18
A-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-	5.00	0.00	10.00	11.00	1.00	4.00	0.00	0.00	67.00	5.00
P-	13.20	0.00	8.10	12.60	1.80	2.80	0.00	0.00	168.50	4.60
C-	13.45	0.00	0.36	0.23	0.00	0.00	0.00	0.00	153.76	0.03

NUMBER OF CELLS = 22
DEGREES OF FREEDOM = 21
CHI-SQUARE = 223.437

*- AVERAGE OF 10 PREDICTIONS

Appendix C

Program 1

Fortran Program to Perform Linear Interpolations for Control Position, Aircraft Position, and Instrument Readings

```
      DIMENSION XO(3,10,3),E(3,10,12),A(3,10,12),R(3,10,12),T(3,10,12)
     1,F1(3,10),F2(3,10),PIT(3,10,12),ROLL(3,10,12),HEAD(3,10,12)
     2,ALT(3,10,12),AS(3,10,12),XIVS(3,10,12),NO(3,10,3),XGS(3,10,12)
     3,XLO(3,10,12),NA(8),NMN(15)
      COMMON H(4,3)
      I1=27
      I2=19
      I3=31
      WRITE(2,99)I1,I2,I1,I3
   99 FORMAT(4A1)
  777 WRITE(1,992)
  992 FORMAT(20X,' STATUS OF SUBJECT? ',/,20X,' 1= PILOT '
     1,/,20X,' 2= COPILOT',/,20X,' 3= IP ',///,25X,'>')
      READ(1,993) NSTAT
  993 FORMAT(I1)
      RX=66.
      RY=132.
      IF(NSTAT.EQ.2)RX=60.
      IF(NSTAT.EQ.2)RY=120.
      IF(NSTAT.GT.3)GO TO 777
      WRITE(1,990)
  990 FORMAT(20X,' WHAT IS THE FILE NAME ? ',/,
     120X,' EXAMPLE : >IP1ECT  DAT<CR> ',///,25X,'>')
  991 FORMAT(8A2)
      READ(1,991) NA
      CALL OPEN(9,NA,2)
      WRITE(1,888)
  888 FORMAT(//,20X,' WHICH MANEUVER IS BEING SAMPLED ? ',///,25X,'>')
      READ(1,889)NMN
  889 FORMAT(15A2)
  778 WRITE(1,994)
  994 FORMAT(20X,' HOW OFTEN DO YOU WANT THE DATA SAMPLED ? '
     1,/,20X,' 1= 1 SAMPLE PER SECOND ',/,20X,' 2= 10 SAMPLES PER
     2SECOND ',/,20X,' 3= 30 SAMPLES PER SECOND ',///,25X,'>')
      READ(1,993) NCNT
      IF(NCNT.EQ.1)NNCT=1
      IF(NCNT.EQ.2)NNCT=10
      IF(NCNT.EQ.3)NNCT=30
      IF(NCNT.GT.3)GO TO 778
      JE=1
      LE=1
      JX=1
      LX=1
      IF(NCNT.EQ.2)JE=10
      IF(NCNT.EQ.2)JX=1
      IF(NCNT.EQ.2)LE=1
      IF(NCNT.EQ.3)JE=10
      IF(NCNT.EQ.3)LE=3
      WRITE(1,145)
  145 FORMAT(///,5X,' FROM WHICH SECOND WOULD YOU LIKE THE SAMPLING ',
     1'TO BEGIN ? ',/,5X,' (USE I3 FORMAT! E.G. "015") ',/////,25X,'>')
      READ(1,333)NSB
  333 FORMAT(I3)
  779 WRITE(1,148)
  148 FORMAT(1X,///,' IS THERE A SPECIFIC SECOND WITHIN THE DATA ',
```

```
   1'WHERE YOU WANT THE SAMPLING TO END ? ',///,28X,' 1= YES
   2 2= NO ',///,35X,'>')
    READ(1,993)NSQ                                              157
    IF(NSQ.EQ.1)GO TO 153
    IF(NSQ.EQ.2)NSE=999
    IF(NSQ.NE.2)GO TO 779
    GO TO 775
153 WRITE(1,160)
160 FORMAT(///,15X,' AT WHICH SECOND WOULD YOU LIKE THE SAMPLING
   1 TO END? ',/,15X,' (USE I3 FORMAT! E.G. "065") ',/////,25X,'>')
    READ(1,333)NSE
775 WRITE(1,611)
611 FORMAT(///,5X,' WOULD YOU LIKE THE NAME OF THE INSTRUMENT',
   1' FOR EACH OCULOMETER NUMBER? ',///,28X,' 1= YES 2= NO ',///,
   235X,'>')
    READ(1,993)INST
    IF(INST.EQ.2)GO TO 175
    IF(INST.GT.2)GO TO 775
    WRITE(2,613)
613 FORMAT(31X,' OCULOMETER NUMBER ',15X,' INSTRUMENT NAME ',/,
   131X,19('-'),15X,19('-'),//,41X,' 0 ',22X,' NON-SPECIFIC TRACK ',
   2/,41X,' 1 ',22X,' OUT OF TRACK ',/,41X,' 2 ',22X,' WINDSCREEN ',
   3/,41X,' 3 ',22X,' AIRSPEED ',/,41X,' 4 ',22X,' ROLL INDICATOR ',
   4/,41X,' 5 ',22X,' COMMAND BARS ',/,41X,' 6 ',22X,' GLIDE SLOPE ',
   5/,41X,' 7 ',22X,' LOCALIZER ',/,41X,' 8 ',22X,' LFT ALTIMETER ',
   6/,41X,' 9 ',22X,' RT ALTIMETER ',/,41X,' 10 '21X,' RAD',
   7' ALTIMETER ',/,41X,' 11 ',21X,' ADF ',/,41X,' 12 ',21X,' HSI ',
   8/,41X,' 13 ',21X,' IVSI ',/,41X,' 14 ',21X,' BACKUP ATTITUDE ',
   8/,41X,' 15 ',21X,' FUEL QUANTITY ',/,38X,
   8' 16 - 24 ',19X,' ENGINE INSTRUMENTS ',/,38X,' 25 & 26 ',19X,
   9,' FUEL FLOW ',////////)
175 WRITE (1,8)
  8 FORMAT(/////,25X, ' THE FILE IS OPEN ')
    WRITE (2,17)NA,NNCT,NMN
 17 FORMAT (54X,' FILE : ',8A2,/,54X,' DATA ARE AT ',I2,' PER SECOND '
   1,/,54X,' MANEUVER : ',15A2)
    WRITE (2,18)
 18 FORMAT (/,3X,'T',1X,'OCU',5X,'STICK',5X,'WHEEL',5X,'RUD P',5X,
   1'THR',6X,'PITCH',6X,'ROLL',6X,'HEAD',6X,'ALT',5X,'SPEED',7X,'IVSI'
   2,5X,'GLIDE',5X,'LOCAL')
    XM=0.
    IT=0
    ACNT=0
    NCAL=10
    NT=0.
    DO 51 I=1,3
    DO 52 J=1,10
    DO 53 K=1,12
    E(I,J,K)=0.
    A(I,J,K)=0.
    R(I,J,K)=0.
    T(I,J,K)=0
    XO(I,J,1)=0.
    XO(I,J,2)=0.
    XO(I,J,3)=0.
    F1(I,J)=0.
    F2(I,J)=0.
    PIT(I,J,K)=0.
    ROLL(I,J,K)=0.
    HEAD(I,J,K)=0.
```

```
      ALT(I,J,K)=0.
      AS(I,J,K)=0.
      XIVS(I,J,K)=0.
      XGS(I,J,K)=0.
      XLO(I,J,K)=0.
   53 CONTINUE
   52 CONTINUE
   51 CONTINUE
  101 ACNT=ACNT+1
      IF(ACNT.EQ.1.)M=1
      IF(ACNT.GT.1.)M=3
      DO 2 I=M,3
      DO 3 J=1,10
      READ( 9,41,ERR=200,END=548) XO(I,J,1),E(I,J,2),A(I,J,3),R(I,J,4)
     1,XO(I,J,2),T(I,J,6),F1(I,J),F2(I,J),XO(I,J,3)
   41 FORMAT(9F5.0)
    3 CONTINUE
    2 CONTINUE
      CALL CINTP(E,2)
      CALL CINTP(A,3)
      CALL CINTP(R,4)
      CALL CINTP(T,6)
      DO 70 I=1,3
      IH=0
      DO 71 J=1,10
      IF(F2(I,J).EQ.-2048.)GO TO 106
      IH=IH+1
   71 CONTINUE
  106 DO 500 M=1,4
      MM=IH-4+M
      IF(MM.LT.1)MM=MM+10
      H(M,I)=MM
  500 CONTINUE
      IH4=H(1,I)
      IH5=H(2,I)
      IH6=H(3,I)
      IH7=H(4,I)
      PIT(I,IH4,7)=F1(I,IH4)
      ROLL(I,IH4,8)=F2(I,IH4)
      IF(I.LT.3)GO TO 790
      XM=F1(I,IH5) - F1(I-1,IH5)
      IF(ABS(XM).GT.2048)GO TO 689
      GO TO 790
  689 IF(F1(I,IH5).GT.F1(I-1,IH5))GO TO 891
  890 F1(I,IH5)=F1(I,IH5)+4096.
      GO TO 790
  891 F1(I,IH5)=F1(I,IH5)-4096.
  790 HEAD(I,IH5,7)=F1(I,IH5)
      ALT(I,IH5,8)=F2(I,IH5)
      AS(I,IH6,7)=F1(I,IH6)
      XIVS(I,IH6,8)=F2(I,IH6)
      XGS(I,IH7,7)=F1(I,IH7)
      XLO(I,IH7,8)=F2(I,IH7)
   70 CONTINUE
      CALL SINTP(PIT,7)
      CALL SINTP(ROLL,8)
      CALL SINTP(HEAD,7)
      CALL SINTP(ALT,8)
      CALL SINTP(AS,7)
      CALL SINTP(XIVS,8)
```

```
      CALL SINTP(XGS,7)
      CALL SINTP(XLO,8)
      I=2
      DO 44 J=1,10
      DO 44 K=1,12
      PIT(I,J,K)=PIT(I,J,K)/40.96
      ROLL(I,J,K)=ROLL(I,J,K)/40.96
      HEAD(I,J,K)=(HEAD(I,J,K)+2048)/11.38
      ALT(I,J,K)=(ALT(I,J,K)+2048)/.4096
      AS(I,J,K)=(AS(I,J,K)+2048)/16.38
      XIVS(I,J,K)=(XIVS(I,J,K)/(-20.48))*60
      XGS(I,J,K)=XGS(I,J,K)/1024
      XLO(I,J,K)=XLO(I,J,K)/1024
      T(I,J,K)=((T(I,J,K)+499.)/1358.)*100.
      E(I,J,K)=(E(I,J,K)*0.00601)+1.0576
      A(I,J,K)=(A(I,J,K)*0.0566)
      R(I,J,K)=(R(I,J,K)*0.00267)+.0855
   44 CONTINUE
      I=2
      DO 45 J=1,10
      DO 45 L=1,3
      NO(I,J,L)=(XO(I,J,L)+RX)/RY
   45 CONTINUE
      I=2
      NT=NT+1
      IF(NT.LT.NSB)GO TO 147
      IF(NT.GT.NSE)GO TO 548
      DO 73 J=1,JE,JX
      DO 74 L=1,LE,LX
      IF(L.EQ.1)K=1
      IF(L.EQ.2)K=5
      IF(L.EQ.3)K=9
      WRITE(2,5)NT,NO(I,J,L),E(I,J,K),A(I,J,K),R(I,J,K),T(I,J,K)
     1,PIT(I,J,K),ROLL(I,J,K),HEAD(I,J,K),ALT(I,J,K),AS(I,J,K)
     2,XIVS(I,J,K),XGS(I,J,K),XLO(I,J,K)
    5 FORMAT(1X,I3,1X,I3,12(1X,F9.3))
   74 CONTINUE
   73 CONTINUE
  147 CONTINUE
      I=2
      DO 641 J=1,10
      E(I,J,2)=(E(I,J,2)-1.0576)/.00601
      A(I,J,3)=A(I,J,3)/.0566
      R(I,J,4)=(R(I,J,4)-.0855)/.00267
      T(I,J,6)=((T(I,J,6)/100.)*1358.)-499
  641 CONTINUE
      DO 75 I=1,2
      DO 76 J=1,10
      XO(I,J,1)=XO(I+1,J,1)
      E(I,J,2)=E(I+1,J,2)
      A(I,J,3)=A(I+1,J,3)
      R(I,J,4)=R(I+1,J,4)
      XO(I,J,2)=XO(I+1,J,2)
      T(I,J,6)=T(I+1,J,6)
      F1(I,J)=F1(I+1,J)
      F2(I,J)=F2(I+1,J)
      XO(I,J,3)=XO(I+1,J,3)
   76 CONTINUE
   75 CONTINUE
      GO TO 101
```

```
200 WRITE(1,77)
 77 FORMAT( ' READ ERROR ')
    GO TO 202
548 IF(NSE.EQ.999)NSE=NT
    WRITE(1,162)NSE
162 FORMAT(//,20X,' THE SAMPLING ENDED AT SECOND #',I3,/)
    WRITE(1,78)
 78 FORMAT(///,25X,' END OF FILE ',//,25X)
202 STOP
    END
    SUBROUTINE CINTP(X,L)
    DIMENSION X(3,10,12)
    I=2
    DX=0
    DO 24 J=1,10
    DO 24 K=1,12
    KK=K-L
    IF(KK)21,22,23
 21 IF(J.NE.1)GO TO 212
211 DX=X(I,J,L)-X(I-1,10,L)
    GO TO 22
212 DX=X(I,J,L)-X(I,J-1,L)
    GO TO 22
 23 IF(J.NE.10)GO TO 232
231 DX=X(I+1,1,L)-X(I,J,L)
    GO TO 22
232 DX=X(I,J+1,L)-X(I,J,L)
 22 XKK=KK
 24 X(I,J,K)=X(I,J,L)+(XKK*DX/12.)
    RETURN
    END
    SUBROUTINE SINTP(X,L)
    DIMENSION X(3,10,12)
    COMMON H(4,3)
    DATA NC/0/
    NC=NC+1
    IF(NC.GT.8)NC=1
    M=(NC+1)/2
    I=2
    LT=H(M,I+1)
    LM=H(M,I)
    LB=H(M,I-1)
    DX=0
    DO 55 J=1,10
    DO 55 K=1,12
    KK=((J-1)*12+K)-((LM-1)*12+L)
    IF(KK)21,51,23
 21 DX=X(I,LM,L)-X(I-1,LB,L)
    X(I,J,K)=X(I,LM,L)+(FLOAT(KK)*DX)/(120.+((LM-LB)*12.))
    GO TO 55
 23 DX=X(I+1,LT,L)-X(I,LM,L)
 51 X(I,J,K)=X(I,LM,L)+(FLOAT(KK)*DX)/(120.+((LT-LM)*12.))
 55 CONTINUE
    RETURN
    END
```

Program 2

Fortran Program to Detect and Encode Control Movements for Stick, Wheel, Throttle, and Rudder

```
C THIS PROGRAM IS DESIGNED TO TRANSFORM CONTROL POSITION
C DATA INTO CONTROL MOVEMENT DATA,WHERE:
C           0 = NO CONTROL MOVEMENTS
C           1 = CONTROL DECISION IN PROGRESS(.1 SEC PRIOR TO CM)
C          +2 = POSITIVE CONTROL MOVEMENT
C                  STICK- + = NOSE UP
C                  WHEEL- + = RIGHT TURN
C               THROTTLE- + = INCREASE POWER
C          -2 = NEGATIVE CONTROL MOVEMENT
      DIMENSION OCU(1600),S(1600),W(1600),T(1600),P(1600),R(1600)
     1,XH(1600),ALT(1600),AS(1600),VSI(1600),LS(1600),LW(1600)
     2,LT(1600),NID(1)
      COMMON NCT
      OPEN(ACCESS='SEQINOUT',UNIT=11,DEVICE='TTY')
      OPEN(ACCESS='SEQIN',UNIT=21,FILE='WHAT.DAT',DEVICE='DSK')
      OPEN(ACCESS='SEQOUT',UNIT=22,FILE='TEST.',DEVICE='DSK')
      OPEN(ACCESS='APPEND',UNIT=23,FILE='CMS.',DEVICE='DSK')
      NCT=0
      DO 10 I=1,1500
      OCU(I)=0
      S(I)=0.
      W(I)=0.
      T(I)=0.
      P(I)=0.
      R(I)=0.
      XH(I)=0.
      ALT(I)=0.
      VSI(I)=0.
      AS(I)=0.
      LS(I)=0
      LW(I)=0
      LT(I)=0
   10 CONTINUE
      I=0
  100 I=I+1
      READ(21,80,END=200)OCU(I),S(I),W(I),T(I),P(I),R(I),XH(I)
     1,ALT(I),AS(I),VSI(I)
   80 FORMAT(I4,8(F9.3),F10.3)
      NCT=NCT+1
      GO TO 100
  200 CONTINUE
      CALL CNTRL(S,.301,LS,LSEV)
      CALL CNTRL(W,3.0,LW,LWEV)
      CALL CNTRL(T,1.5,LT,LTEV)
      DO 25 I=1,NCT
      WRITE(22,90)OCU(I),LS(I),LW(I),LT(I),P(I),R(I),XH(I)
     1,ALT(I),AS(I),VSI(I)
   90 FORMAT(4(1X,I3),5(1X,F8.3),1X F9.3)
   25 CONTINUE
      WRITE(11,516)
  516 FORMAT(20X,' SUBJECT ID ')
      READ(11,517)NID
  517 FORMAT(1A5)
      WRITE(23,91)NID,LSEV,LWEV,LTEV
   91 FORMAT(10X,1A5,10X,I4,10X,I4,10X,I4)
      STOP
      END
      SUBROUTINE CNTRL(X,CRIT,LX,NEVENT)
      DIMENSION X(1500),LX(1500)
      COMMON NCT
```

```
      LOGICAL SGNTST,ONEPAS
      NEVENT=0
      PCNT=.05
      SGNTST=.TRUE.
      ONEPAS=.TRUE.
      ISFLGS=0
      DO 1 I=31,NCT
      CALL AVGY(Y1AVGY,X(I-30))
      CALL AVGY(Y2AVGY,X(I-14))
      IF(ABS(Y2AVGY-Y1AVGY).LT.(PCNT*CRIT))SGNTST=.FALSE.
      VALUE=(X(I)-X(I-30))
      IF(ABS(VALUE).GE.CRIT)GO TO 110
      IF((ABS(X(I)-X(I-15)).GT.CRIT).AND.SGNTST)LX(I)=2*ISGN
      IF(.NOT.ONEPAS)GO TO 1
      ONEPAS=.FALSE.
      CALL CORNER(X(I-30),JMAX,-1.)
      DO 99 K=JMAX,31
      LX(I+K-31)=0
   99 CONTINUE
      GO TO 1
  110 ISGN=+1
      IF(VALUE.LT.0.)ISGN=-1
      LX(I)=2*ISGN
      IF(.NOT.SGNTST)GO TO 120
      IF(ISGN.NE.ISFLGS) GO TO 120
      IF(ONEPAS)GO TO 1
      ONEPAS=.TRUE.
      DO 91 J=1,50
      IF(LX(I-J).NE.0)GO TO 1
   91 LX(I-J)=LX(I)
      GO TO 1
  120 ISFLGS=ISGN
      SGNTST=.TRUE.
      ONEPAS=.TRUE.
      NEVENT=NEVENT+1
      CALL CORNER(X(I-30),JMAX,+1.)
      LX(I+JMAX-32)=1
      LX(I+JMAX-33)=1
      LX(I+JMAX-34)=1
      DO 3 K=JMAX,31
      LX(I+K-31)=2*ISGN
    3 CONTINUE
    1 CONTINUE
      RETURN
      END
      SUBROUTINE AVGY(X,XX)
      DIMENSION XX(15)
      X=0.
      DO 1 I=1,15
      X=X+XX(I)
    1 CONTINUE
      X=X/15
      RETURN
      END
      SUBROUTINE CORNER(Y,JMAX,SS)
      DIMENSION Y(31)
      JMAX=0
      XDEL=0.
      DEL=(Y(31)-Y(1))/30.
      IF(DEL.LT.0.)REL=-1.
```

```
      IF(DEL.EQ.0.)REL=0.
      IF(DEL.GT.0.)REL=+1.
      DO 2 J=2,30
      TDEL=(Y(1)+(J-1)*DEL-Y(J))*REL*SS
      IF(TDEL.LT.XDEL)GO TO 2
      XDEL=TDEL
      JMAX=J
    2 CONTINUE
      RETURN
      END
```

Program 3

Fortran Program to Predict Each Pilot's Lookpoint (LP)
at Time, $\underline{t}$, Using 3 Previous Lookpoints
(LP_{t-3}, LP_{t-2}, LP_{t-1}), where $\underline{t}$ = 1/30 of A Second

```
C THIS PROGRAM USES THREE PREVIOUS LPS TO PREDICT THE
C FOURTH.
      DIMENSION LP(1600),X(9,9,9,9),XN(9,9,9)
      OPEN(ACCESS='SEQINOUT',UNIT=11,DEVICE='TTY')
      OPEN(ACCESS='SEQIN',UNIT=21,FILE='PC11L2.RED',DEVICE='DSK')
      OPEN(ACCESS='SEQOUT',UNIT=22,FILE='PC11L.PRE',DEVICE='DSK')
      OPEN(ACCESS='SEQOUT',UNIT=23,FILE='PC11L.PRB',DEVICE='DSK')
      CALL TIME(I,J)
      IM=(J/4096)
      CALL SETRAN(IM)
      DO 55 I=1,1600
      LP(I)=0
   55 CONTINUE
      DO 56 I=1,9
      DO 56 J=1,9
      DO 56 K=1,9
      XN(I,J,K)=0.
      DO 56 L=1,9
      X(I,J,K,L)=0.
   56 CONTINUE
      TN=0.
      NCT=0
      I=0
  100 I=I+1
      READ(21,80,END=200)LP(I)
   80 FORMAT(1(2X,I2))
      NCT=NCT+1
      GO TO 100
  200 CONTINUE
      DO 1 I=4,NCT
      M=LP(I)
      L=LP(I-1)
      K=LP(I-2)
      J=LP(I-3)
      X(J,K,L,M)=X(J,K,L,M)+1.
      XN(J,K,L)=XN(J,K,L)+1.
    1 TN=TN+1.
      DO 2 J=1,9
      DO 2 K=1,9
      DO 2 L=1,9
      IF(XN(J,K,L).EQ.0.)GO TO 2
      XN(J,K,L)=XN(J,K,L)/TN
    2 CONTINUE
      DO 3 J=1,9
      DO 3 K=1,9
      DO 3 L=1,9
      DO 3 M=1,9
      IF(X(J,K,L,M).EQ.0.)GO TO 3
      X(J,K,L,M)=X(J,K,L,M)/TN
      X(J,K,L,M)=X(J,K,L,M)/XN(J,K,L)
    3 CONTINUE
      DO 5 J=1,9
      DO 5 K=1,9
      DO 5 L=1,9
      DO 5 M=2,9
    5 X(J,K,L,M)=X(J,K,L,M)+X(J,K,L,M-1)
      DO 666 I=1,9
      DO 666 J=1,9
      DO 666 K=1,9
      DO 666 L=1,9
```

```
      WRITE(23,6666)X(I,J,K,L)
 6666 FORMAT(2X,F8.6)
  666 CONTINUE
      DO 9999 II=1,10
      J=0
      K=0
      L=0
      DO 999 I=4,NCT
      IF(I.EQ.3)J=LP(I-3)
      IF(I.EQ.3)K=LP(I-2)
      IF(I.EQ.3)L=LP(I-1)
      IF(I.GT.3)J=K
      IF(I.GT.3)K=L
      IF(I.GT.3)L=IP
      P=RAN(XX)
      DO 6 M=1,9
      IF(P.LE.X(J,K,L,M))GO TO 7
    6 CONTINUE
    7 IP=M
      WRITE(22,81)IP
   81 FORMAT(1(I6))
  999 CONTINUE
 9999 CONTINUE
      STOP
      END
```

Program 4

Fortran Program to Compute Entropy

```
      DIMENSION SUM(10,10),PER(10,10),NN(1)
     1,SUMC(10),SUMR(10),SUMPC(10),SUMPR(10),UNC(8)
      NNS=0
      SUMP=0.
      OPEN(ACCESS='SEQINOUT',UNIT=11,DEVICE='TTY')
      OPEN(ACCESS='SEQIN',UNIT=21,FILE='WHAT.DAT',DEVICE='DSK')
      OPEN(ACCESS='APPEND',UNIT=22,FILE='ENTD.ALL',DEVICE='DSK')
      ENT=0.
      TC=0.
      TSR=0.
      TSC=0.
      TPR=0.
      TPC=0.
      NT=0
      DO 99 I=1,10
      DO 99 J=1,10
      SUM(I,J)=0.
      PER(I,J)=0.
   99 CONTINUE
      WRITE(11,81)
   81 FORMAT(10X,' SUBJECT ID ')
      READ(11,82)NN
   82 FORMAT(1A5)
      NT=1
      IF(NT.EQ.1)NNT=30
      IF(NT.EQ.2)NNT=15
      IF(NT.EQ.3)NNT=10
      IF(NT.EQ.4)NNT=6
      IF(NT.EQ.5)NNT=5
      IF(NT.EQ.6)NNT=3
      IF(NT.EQ.7)NNT=2
      IF(NT.EQ.8)NNT=1
      IF(NT.EQ.1)NC=1
      IF(NT.EQ.2)NC=2
      IF(NT.EQ.3)NC=3
      IF(NT.EQ.4) NC=4
      IF(NT.EQ.5)NC=5
      IF(NT.EQ.6)NC=9
      IF(NT.EQ.7)NC=14
      IF(NT.EQ.8)NC=29
      READ(21,85)I
   85 FORMAT(I4)
  100 M=1
      IF(NC.EQ.2)M=2
      IF(NC.EQ.3)M=2
      DO 55 K=M,NC
      IF(NC.EQ.1)GO TO 55
      READ(21,38,END=200)LM
   38 FORMAT(I1)
   55 CONTINUE
      READ(21,85,END=200)J
      SUM(I,J)=SUM(I,J)+1.
      I=J
      TC=TC+1.
      GO TO 100
  200 CONTINUE
      DO 30 I=1,10
      DO 30 J=1,10
      IF(SUM(I,J).EQ.0.)GO TO 30
      PER(I,J)=PER(I,J)+(SUM(I,J)/TC)
```

```
 30 CONTINUE
    SUMP=0.
    DO 900 I=1,10                                                    170
    DO 900 J=1,10
    IF(PER(I,J).EQ.0.00)GO TO 900
    SUMP=SUMP+PER(I,J)*(ALOG10(PER(I,J))/(ALOG10(2.)))
900 CONTINUE
    ENT=ENT+(-SUMP)
    WRITE(22,666)NN,ENT
666 FORMAT(10X,I5,10X,F7.5)
    STOP
    END
```

Program 5

Fortran Program to Computer Entropy Rate

```
C THIS PROGRAM IS DESIGNED TO COMPUTE ENTROPY RATE.FOUR
C MATRICES ARE NEEDED:
C       1.MATRIX INDICATING THE NUMBER OF TRANSITIONS
C         BETWEEN EACH PAIR OF INSTRUMENTS(0 DIAGONAL
C         ENTRIES)
C       2.MATRIX INDICATING THE TRANSITIONAL PROBABILITIES
C         BETWEEN EACH PAIR OF INSTRUMENTS.
C       3.MATRIX INDICATING THE SUM OF DWELL COUNTS
C         BETWEEN EACH PAIR OF INSTRUMENTS.
C       4.MATRIX INDICATING AVERAGE DWELL TIME FOR EACH
C         PAIR OF INSTRUMENTS:
C            DT(I,J)=  N OF DWELLS FOR I&J/N OF TRANS FOR I&J/30
C ENTROPY RATE=  -SUM OF P(I,J)*LOG2 P(I,J)/DT(I,J)
      DIMENSION LP(1600),NT(10,10),NR(10),NC(10),PT(10,10)
     1,SCP(10),SRP(10),T(10,10),ND(10,10),NRD(10),NCD(10)
     2,NN(1),PD(10,10),SRPD(10),SCPD(10),XND(10,10)
      COMMON NCT,NTT,TP,TPD,SUM,ENT
      OPEN(ACCESS='SEQINOUT',UNIT=11,DEVICE='TTY')
      OPEN(ACCESS='SEQIN',UNIT=21,FILE='TC15LC.NEW',DEVICE='DSK')
      OPEN(ACCESS='SEQOUT',UNIT=22,FILE='TC15LC.ENTR',DEVICE='DSK')
      OPEN(ACCESS='APPEND',UNIT=23,FILE='ENTR.ALL',DEVICE='DSK')
      NCT=0
      I=0
      TP=0.
      NTT=0
      XTT=0.
      TP=0.0
      NTD=0
      ENT=0.
      SUM=0.
      DO 1 I=1,1600
    1 LP(I)=0
      DO 2 I=1,10
      DO 2 J=1,10
      NT(I,J)=0
      PT(I,J)=0.
      T(I,J)=0.
      ND(I,J)=0
      PD(I,J)=0.
      XND(I,J)=0.
    2 CONTINUE
      DO 3 I=1,10
      NR(I)=0
      NC(I)=0
      SCP(I)=0.
      SRP(I)=0.
      NCD(I)=0
      NRD(I)=0
      SRPD(I)=0.
      SCPD(I)=0.
    3 CONTINUE
      I=0
  100 I=I+1
      READ(21,80,END=200)LP(I)
   80 FORMAT(I4)
      NCT=NCT+1
      GO TO 100
  200 CONTINUE
      WRITE(11,81)
   81 FORMAT(10X,' SUBJECT ID ')
```

```
      READ(11,82)NN
   82 FORMAT(1A5)
      CALL NTRANS(LP,NT,NR,NC,NTT,ND,NRD,NCD,NTD)
      WRITE(22,83)NN
   83 FORMAT(//,10X,'TRANSITION MATRIX FOR SUBJECT ',1A5)
      WRITE(22,84)
   84 FORMAT(/,3X,'AS',2X,'ROLL',1X,'CBARS',1X,'ALT',2X
     1,'ADF',2X,'HSI',2X,'IVSI',1X,'ENG',2X,'NON',2X,'OUT',
     22X,'SUM')
      DO 4 I=1,10
      WRITE(22,85)(NT(I,J),J=1,10),NC(I)
   85 FORMAT(11(1X,I4))
    4 CONTINUE
      WRITE(22,85)(NR(I),I=1,10),NTT
      CALL PTRANS(NT,PT,SCP,SRP,TP,T)
      WRITE(22,86)NN
   86 FORMAT(//,'TRANSITION PROBABILITY MATRIX FOR SUBJECT ',1A5)
      WRITE(22,888)
  888 FORMAT(/,4X,'AS',4X,'ROLL',2X,'CBARS',3X,'ALT',4X,'ADF'
     1,4X,'HSI',3X,'IVSI',4X,'ENG',4X,'NON',4X,'OUT',4X,'SUM')
      DO 5 I=1,10
      WRITE(22,87)(PT(I,J),J=1,10),SCP(I)
   87 FORMAT(10(1X,F6.4),1X,F7.4)
    5 CONTINUE
      WRITE(22,87)(SRP(I),I=1,10),TP
      WRITE(22,88)NN
   88 FORMAT(//,10X,' DWELL MATRIX FOR SUBJECT ',1A5)
      WRITE(22,84)
      DO 6 I=1,10
      WRITE(22,85)(ND(I,J),J=1,10),NCD(I)
    6 CONTINUE
      WRITE(22,85)(NRD(I),I=1,10),NTD
      CALL PDWELL(ND,T,PD,SRPD,SCPD,TPD)
      WRITE(22,89)NN
   89 FORMAT(//,' DWELL TIME MATRIX FOR SUBJECT ',1A5)
      WRITE(22,888)
      DO 7 I=1,10
      WRITE(22,87)(PD(I,J),J=1,10),SCPD(I)
    7 CONTINUE
      WRITE(22,87)(SRPD(I),I=1,10),TPD
      CALL LENTR(PT,PD,ENT)
      WRITE(22,90)NN,ENT
   90 FORMAT(//,' THE ENTROPY RATE FOR SUBJECT ',1A5,'IS ',F7.5)
      WRITE(23,555)NN,ENT
  555 FORMAT(10X,1A5,10X,F7.5)
      STOP
      END
      SUBROUTINE NTRANS(LP,NT,NR,NC,NTT,ND,NRD,NCD,NTD)
      COMMON NCT,TP,TPD,SUM,ENT
      DIMENSION LP(1600),NT(10,10),NR(10),NC(10),ND(10,10)
     1,NRD(10),NCD(10)
      I=0
      LCNT=0
      MCNT=0
  100 I=I+1
      IF(LP(I+1).EQ.LP(I))101,102
  101 LCNT=LCNT+1
      GO TO 100
  102 IF(LCNT.LT.3)103,104
  103 LCNT=0
```

```
      GO TO 100
  104 L=LP(I)
      I=I+1
      DO 1 J=I,NCT-1
      IF(LP(J+1).EQ.LP(J))105,106
  105 MCNT=MCNT+1
      GO TO 1
  106 IF(MCNT.LT.3)107,108
  107 MCNT=0
      GO TO 1
  108 M=LP(J)
      IF(L.EQ.M)LCNT=LCNT+MCNT
      IF(L.EQ.M)MCNT=0
      IF(L.EQ.M)GO TO 1
      NT(L,M)=NT(L,M)+1
      ND(L,M)=ND(L,M)+LCNT+MCNT
      L=M
      LCNT=MCNT
      MCNT=0
    1 CONTINUE
      DO 2 I=1,10
      DO 2 J=1,10
      NR(J)=NR(J)+NT(I,J)
      NRD(J)=NRD(J)+ND(I,J)
      NC(I)=NC(I)+NT(I,J)
      NCD(I)=NCD(I)+ND(I,J)
      NTT=NTT+NT(I,J)
      NTD=NTD+ND(I,J)
    2 CONTINUE
      RETURN
      END
      SUBROUTINE PTRANS(NT,PT,SCP,SRP,TP,T)
      DIMENSION NT(10,10),PT(10,10),SCP(10),SRP(10),T(10,10)
      COMMON NCT,NTT
      XTT=NTT
      DO 1 I=1,10
      DO 1 J=1,10
    1 T(I,J)=NT(I,J)
      DO 2 I=1,10
      DO 2 J=1,10
      IF(T(I,J).EQ.0.)GO TO 2
      PT(I,J)=T(I,J)/XTT
      SRP(J)=SRP(J)+PT(I,J)
      SCP(I)=SCP(I)+PT(I,J)
      TP=TP+PT(I,J)
    2 CONTINUE
      RETURN
      END
      SUBROUTINE PDWELL(ND,T,PD,SRPD,SCPD,TPD)
      DIMENSION ND(10,10),T(10,10),XND(10,10),PD(10,10),SRPD(10)
     1,SCPD(10)
      COMMON NCT,NTT
      DO 1 I=1,10
      DO 1 J=1,10
    1 XND(I,J)=ND(I,J)
      DO 2 I=1,10
      DO 2 J=1,10
      IF(T(I,J).EQ.0.)GO TO 2
      PD(I,J)=XND(I,J)/T(I,J)/30
    2 CONTINUE
```

```
      DO 3 I=1,10
      DO 3 J=1,10
      SRPD(J)=SRPD(J)+PD(I,J)
      SCPD(I)=SCPD(I)+PD(I,J)
      TPD=TPD+PD(I,J)
    3 CONTINUE
      RETURN
      END
      SUBROUTINE LENTR(PT,PD,ENT)
      DIMENSION PT(10,10),PD(10,10)
      DO 1 I=1,10
      DO 1 J=1,10
      IF(PD(I,J).EQ.0.)GO TO 1
      SUM=SUM+(PT(I,J)*(ALOG10(PT(I,J)/ALOG10(2.))))/PD(I,J)
    1 CONTINUE
      ENT=-SUM
      RETURN
      END
```

Program 6

Fortran Program to Predict Each Pilot's Scanning Behavior for the Right Segment of the Steep Turn Maneuver Using Each Pilot's Transitional Probabilities Computed in the Left Segment

```
C THIS PROGRAM IS DESIGNED TO READ IN THE CONDITIONAL PROBABILITIES
C FOR SEGMENT X AND THE FIRST 3 LPS FROM SEGMENT Y TO TO TEST HOW
C WELL THE SCANNING STRATEGY FOR SEGMENT X WILL PREDICT THE LPS     177
C IN SEGMENT Y.
      DIMENSION X(9,9,9,9)
      OPEN(ACCESS='SEQINOUT',UNIT=11,DEVICE='TTY')
      OPEN(ACCESS='SEQIN',UNIT=21,FILE='TC11L.PRB',DEVICE='DSK')
      OPEN(ACCESS='SEQOUT',UNIT=23,FILE='TC15L.3RE',DEVICE='DSK')
      CALL TIME(I,J)
      IM=(J/4096)
      CALL SETRAN(IM)
      DO 1 I=1,9
      DO 1 J=1,9
      DO 1 K=1,9
      DO 1 L=1,9
      READ(21,80)X(I,J,K,L)
   80 FORMAT(2X,F8.6)
    1 CONTINUE
      WRITE(11,500)
  500 FORMAT(10X,'LP1')
      READ(11,501)LP1
  501 FORMAT(I1)
      WRITE(11,502)
  502 FORMAT(10X,'LP2')
      READ(11,501)LP2
      WRITE(11,503)
  503 FORMAT(10X,'LP3')
      READ(11,501)LP3
      WRITE(11,504)
  504 FORMAT(10X,'LENGTH')
      READ(11,505)NCT
  505 FORMAT(I4)
      DO 9999 II=1,10
      DO 999 N=4,NCT
      IF(N.EQ.4)I=LP1
      IF(N.EQ.4)J=LP2
      IF(N.EQ.4)K=LP3
      IF(N.GT.4)I=J
      IF(N.GT.4)J=K
      IF(N.GT.4)K=IP
      P=RAN(XX)
      DO 6 L=1,9
      IF(P.LE.X(I,J,K,L))GO TO 7
    6 CONTINUE
    7 IP=L
      WRITE(23,82)IP
   82 FORMAT(1(I6))
  999 CONTINUE
 9999 CONTINUE
      STOP
      END
```

Program 7

Fortran Program to Predict Each Pilot's Lookpoint (LP) at Time, $\underline{t}$, Using 3 Previous Lookpoints and 1 Control Status (CS) Measure (LP_{t-3}, LP_{t-2}, LP_{t-1}), where $\underline{t}$ = 1/30 of a Second

```
C THIS PROGRAM USES 3 PREVIOUS LPS AND 1 PREVIOUS CONTROL STATUS
C TO PREDICT LP.
      DIMENSION LP(1600),NCS(1600),X(9,9,9,4,9),XN(9,9,9,4)
      OPEN(ACCESS='SEQINOUT',UNIT=11,DEVICE='DSK')
      OPEN(ACCESS='SEQOUT',UNIT=23,FILE='COATES.MAT',DEVICE='DSK')
      OPEN(ACCESS='SEQIN',UNIT=21,FILE='TC11L2.RED',DEVICE='DSK')
      OPEN(ACCESS='SEQOUT',UNIT=22,FILE='TC11L.2RE',DEVICE='DSK')
      CALL TIME(I,J)
      IM=(J/4096)
      CALL SETRAN(IM)
      DO 55 I=1,1600
      LP(I)=0
      NCS(I)=0
   55 CONTINUE
      DO 56 I=1,9
      DO 56 J=1,9
      DO 56 K=1,9
      DO 56 L=1,4
      XN(I,J,K,L)=0.
      DO 56 M=1,9
      X(I,J,K,L,M)=0.
   56 CONTINUE
      TN=0.
      NCT=0
      I=0
  100 I=I+1
      READ(21,80,END=200)LP(I),NCS(I)
   80 FORMAT(2(2X,I2))
      NCT=NCT+1
      GO TO 100
  200 CONTINUE
      DO 1 N=4,NCT
      M=LP(N)
      L=NCS(N-1)
      K=LP(N-1)
      J=LP(N-2)
      I=LP(N-3)
      X(I,J,K,L,M)=X(I,J,K,L,M)+1.
      XN(I,J,K,L)=XN(I,J,K,L)+1.
    1 TN=TN+1.
      DO 2 I=1,9
      DO 2 J=1,9
      DO 2 K=1,9
      DO 2 L=1,4
      IF(XN(I,J,K,L).EQ.0.)GO TO 2
      XN(I,J,K,L)=XN(I,J,K,L)/TN
    2 CONTINUE
      DO 222 L=1,4
      DO 222 I=1,9
      WRITE(23,777)L,I
  777 FORMAT(/,15X,'CONTROL STATUS # ',I2,/,15X,'LOCKPOINT # ',I2,/)
      DO 222 J=1,9
      WRITE(23,778)(XN(I,J,K,L),K=1,9)
  778 FORMAT(9(2X,F6.5))
  222 CONTINUE
      DO 3 I=1,9
      DO 3 J=1,9
      DO 3 K=1,9
      DO 3 L=1,4
```

```
      DO 3 M=1,9
      IF(X(I,J,K,L,M).EQ.0.)GO TO 3
      X(I,J,K,L,M)=X(I,J,K,L,M)/TN
      X(I,J,K,L,M)=X(I,J,K,L,M)/XN(I,J,K,L)
    3 CONTINUE
      DO 5 I=1,9
      DO 5 J=1,9
      DO 5 K=1,9
      DO 5 L=1,4
      DO 5 M=2,9
    5 X(I,J,K,L,M)=X(I,J,K,L,M)+X(I,J,K,L,M-1)
      DO 9999 II=1,10
      DO 999 N=4,NCT
      IF(N.EQ.4)I=LP(N-3)
      IF(N.EQ.4)J=LP(N-2)
      IF(N.EQ.4)K=LP(N-1)
      IF(N.GT.4)I=J
      IF(N.GT.4)J=K
      IF(N.GT.4)K=IP
      L=NCS(N-1)
      P=RAN(XX)
      DO 6 M=1,9
      IF(P.LE.X(I,J,K,L,M))GO TO 7
    6 CONTINUE
    7 IP=M
      WRITE(22,81)IP,NCS(N)
   81 FORMAT(2(I6))
  999 CONTINUE
 9999 CONTINUE
      STOP
      END
```

VITA

Dennis H. Jones
May 1983

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May 1976 - Aug. 1976	Summer Coordinator Neighborhood Youth Corps Job Placement Supervisor for Underpriviledged Youth Charleston, South Carolina
Aug. 1974 - April 1976	Research Assistant Department of Sociology Baptist College at Charleston Charleston, South Carolina
March 1968 - Aug. 1974	United States Air Force Director, Drug/Alcohol Education and Rehabilitation Program Charleston, Air Force Base, South Carolina

Professional Experience - Teaching

Jan. 1981	Instructor Statistics in Behavioral Sciences Old Dominion University Norfolk, Virginia
Aug. 1980	Instructor Statistics in Behavioral Sciences Old Dominion University Norfolk, Virginia
Jan. 1980	Instructor Physiological Psychology Lab Old Dominion University Norfolk, Virginia
Aug. 1979	Instructor Experimental Psychology Lab Old Dominion University Norfolk, Virginia
Jan. 1979	Instructor Experimental Psychology Lab Old Dominion University Norfolk, Virginia
Sept. 1977	Guest Lecturer Trident Technical College Substance Abuse in Adolescence Charleston, South Carolina
May 1977	Instructor Psychiatry In-Patient Staff Seminars in Transactional Analysis Medical University of Sourth Carolina Charleston, South Carolina
1973 - 1974	Instructor Rehabilitation Management and Counselor Training Department of the Air Base Lackland Air Force Base San Antonio, Texas
1972 - 1974	Instructor Drug/Alcohol Education Seminars Charleston Air Force Base, South Carolina
1971 - 1974	Community Presentations Department of the Air Force (Guest lecturer for various social, civic, and governmental agencies including Charleston County Commission on Drug Abuse and Alcoholism and the University of South Carolina Drug/Alcohol Education Committee)

Research Publications

Jones, D. H. An error-dependent model of instrument scanning in commercial airline pilots. Ph.D. Dissertation, Old Dominion University, May 1983.

Jones, D. H., Coates, G. D., Kirby, R. H., & Jones, R. The effectiveness of incorporating a real-time oculometer system in a commercial flight training program. NASA CR-3667, 1983.

Jones, D. H., Coates, G. D., & Kirby, R. H. The effectiveness of an oculometer training tape on pilot and copilot trainees in a commercial flight training program. NASA CR-3666, 1983.

Jones, D. H. The effects of practice on the rate of gain of information in a pencil and paper task. Masters Thesis, 1980.

Research Presentations

Jones, D. H., Coates, G. D., Kirby, R. H. The third day phenomenon: An investigation into performance decrements in a commercial flight training program. Paper presented at the annual meeting of the Southeastern Psychological Association (SEPA), March 1983.

Jones, D. H. On being taught to teach: A retrospective. Paper presented at the annual meeting of the Southeastern Psychological Association (SEPA), March 1983.

Coates, G. D., Jones, D. H., Kirby, R. H. An investigation into the usefulness of incorporating a real-time oculometer system in a commercial flight training program. Paper presented at the annual meeting of the Southeastern Psychological Association (SEPA), March 1983.

Spady, A. A., Jr., Jones, D. H., Coates, G. D., & Kirby, R. H. The effectiveness of using real-time eye scanning information for pilot training. Paper presented at the annual meeting of the Human Factors Society, October 1982.

Jones, D. H., Coates, G. D., & Kirby, R. H. The effectiveness of an oculometer training tape on pilot and copilot trainees in a commercial flight training program. Paper presented at the annual meeting of the Southeastern Psychological Association (SEPA), March 1982.

Jones, D. H. The effects of practice on the rate of gain of information in a paper and pencil task. Paper presented at the annual meeting of the Southeastern Psychological Association (SEPA), March 1981.

Honors and Awards

Aug. 1982	NASA Doctoral Fellowship Award NASA Washington, D.C.
Aug. 1981	University Fellowship Award Old Dominion University Norfolk, Virginia
Aug. 1979	Vice-President Psychology Graduate Students Association Old Dominion University Norfolk, Virginia
June 1976	Valedictorian, Class of 1976 Baptist College Charleston, South Carolina
May 1976	Graduated Summa Cum Laude Cumulative GPA equalled 4.0 Baptist College Charleston, South Carolina
May 1976	Elected to inclusion in Who's Who in American Colleges and Universities Baptist College Charleston, South Carolina
May 1976	Recipient, Outstanding Sociology Student Award Baptist College Charleston, South Carolina

Professional Organizations

American Psychological Association
Virginia Psychological Association
Southeastern Psychological Association
Human Factors Society
Tidewater Human Factors Society

Professional Interests

Industrial/Organizational	-	Personnel: Selection/Performance Appraisal/Training Human Resource Development Communication Skills Training
Human Factors	-	Systems Design and Development Computer Simulation Aviation Psychology

References

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